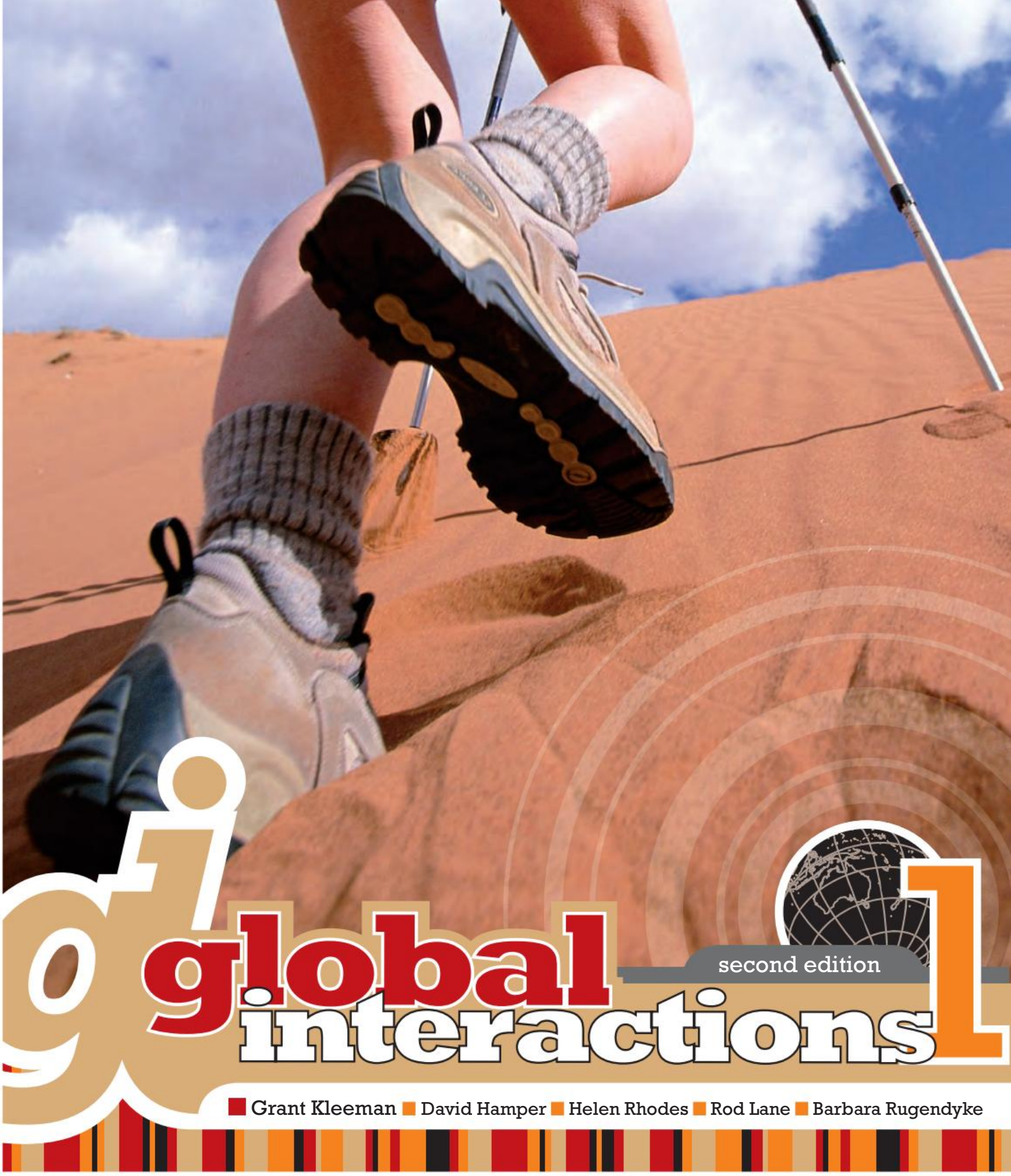


global interactions 1

second edition

Grant Kleeman ■ David Hamper ■ Helen Rhodes ■ Rod Lane ■ Barbara Rugendyke

Preliminary course

PEARSON
Heinemann

contents


















Introduction

Using *Global Interactions 1: Second Edition*

Global Interactions 1: Second Edition has been written by a team of experienced geography educators for the Preliminary course of the New South Wales Stage 6 Geography Syllabus. The text aims to help develop students' knowledge, understanding, skills, attitudes and values in relation to the biophysical and human environments. Students using *Global Interactions 1: Second Edition* will gain a solid foundation for the study of geography in Year 12.

Structure

This text is divided into two sections corresponding with the Stage 6 syllabus:

1 **Biophysical interactions.** This section investigates the nature and functioning of the four components of the biophysical environment, including the interactions between the components and the human impacts on them. It also focuses on how an understanding of these processes contributes to sustainable management. Students develop this knowledge and understanding by studying a specific environment and a related environmental issue. Students are provided with two case studies:
   - coastal environments and the management of coastal sediments
   - catchments and river regulation.

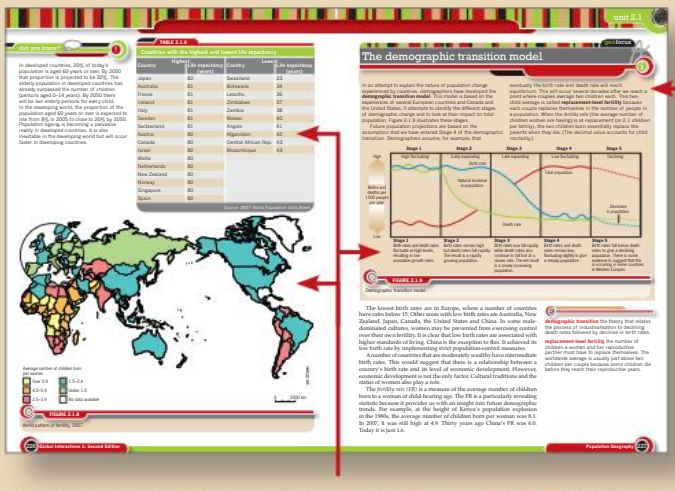
2 **Global challenges**. The focus of this section is the social, cultural, political and environmental challenges occurring at a global scale. These challenges are investigated under the following headings:
   - population geography
   - natural resource use
   - cultural integration
   - political geography
   - geographies of development: towards global equity?



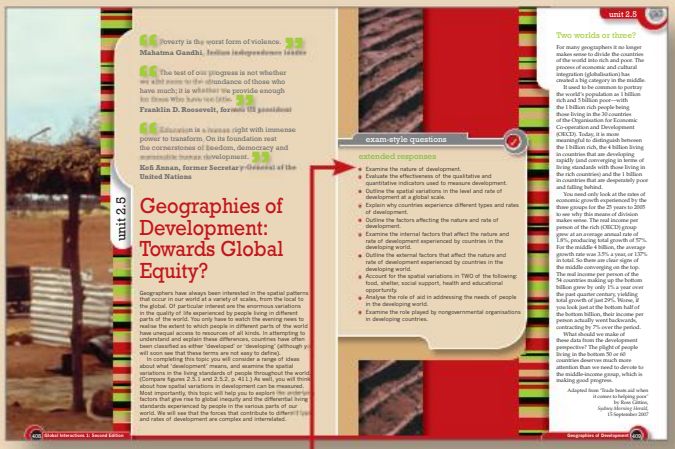
Key features

Global Interactions 1: Second Edition presents Stage 6 Geography using stimulus material and case studies that will demonstrate the relevance and importance of geography to students and their society. The new edition also boasts a totally new layout and design incorporating some outstanding new features.

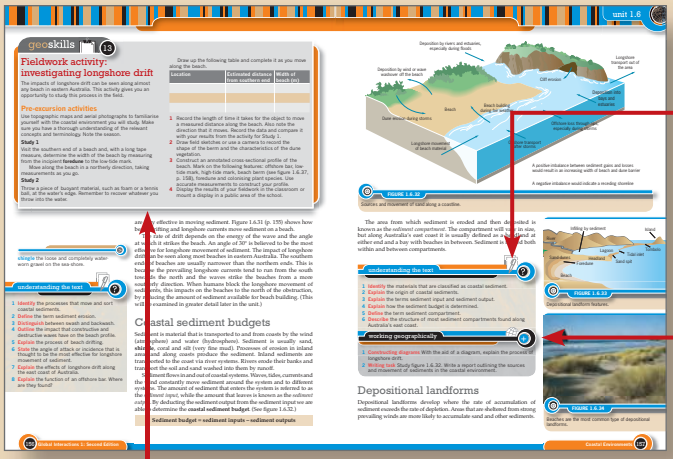
Geofocus boxes are designed to develop students' knowledge and understanding of the concepts and processes that are central to the study of geography at this stage of learning.



The book contains a wealth of **stimulus material**, including photographs, diagrams, maps, cartoons, newspaper extracts and up-to-date statistical information.



Each unit of the text includes a variety of extended-response **exam-style questions**. These enable students to practise and develop their skills in answering examination-style questions.



Geoskills boxes assist students to communicate their geographical knowledge. To enhance their appreciation of the subject's inquiry-based methodology, the text includes material that is relevant to the skill-related outcomes targeted in the syllabus.

The text contains the following Geoskills boxes: synoptic charts (p. 23); studying microclimates in your local community (p. 35); choropleth maps (p. 41); proportional graphs (p. 45); writing extended responses (pp. 48–51); proportional circles (p. 55); writing stimulus-based responses (p. 74); the Senior Geography Project (pp. 75–9); investigating soils (p. 104); presenting an oral report (p. 106); multimedia presentations (p. 107); wave experiment: the effect of wind on waves (p. 145); investigating longshore drift (p. 156); photographic images (p. 175); topographic maps (p. 181); measuring the discharge of a river (p. 184); investigating river sediment load (p. 184); investigating the relative proportions of sand, silt and clay found in a soil (p. 185); investigating river beds (p. 189); investigating river banks (p. 190); log-log and semi-logarithmic graphs (p. 220); population pyramids (p. 238); proportional circles and shapes (p. 243); flowline maps (p. 246); mindmaps (p. 259); and interpreting cartoons (pp. 306–7).

Geojobs boxes throughout the text provide information about relevant careers so that students develop an awareness of the range of occupations available.

Understanding the text questions guide students towards an understanding of the content (knowledge and understandings) specified by the syllabus.

Working geographically activities (including **ICT-related research tasks**) extend students beyond the text and involve them in a variety of learning experiences. The activities have been carefully selected to cater for the full range of student abilities. Many activities are based on the stimulus material presented. This will facilitate the development of the skills used by geographers. Directive terms and activity types are clearly labelled for each activity or question to aid learning and assessment.

Geolink boxes and **hi.com.au** icons indicate where website URLs are listed at a dedicated site: www.hi.com.au/gi1. Researching these websites will extend and enhance the information available to students.

About the authors

Dr Grant Kleeman (series editor) is a Senior Lecturer in Education at Sydney's Macquarie University. He is an experienced teacher educator, geography teacher, author, curriculum consultant and examiner. Grant has been closely involved in the development of the geography curriculum in New South Wales. He is the coordinating author of a range of texts, including the successful *Global Explorations* and *Australian Explorations*.

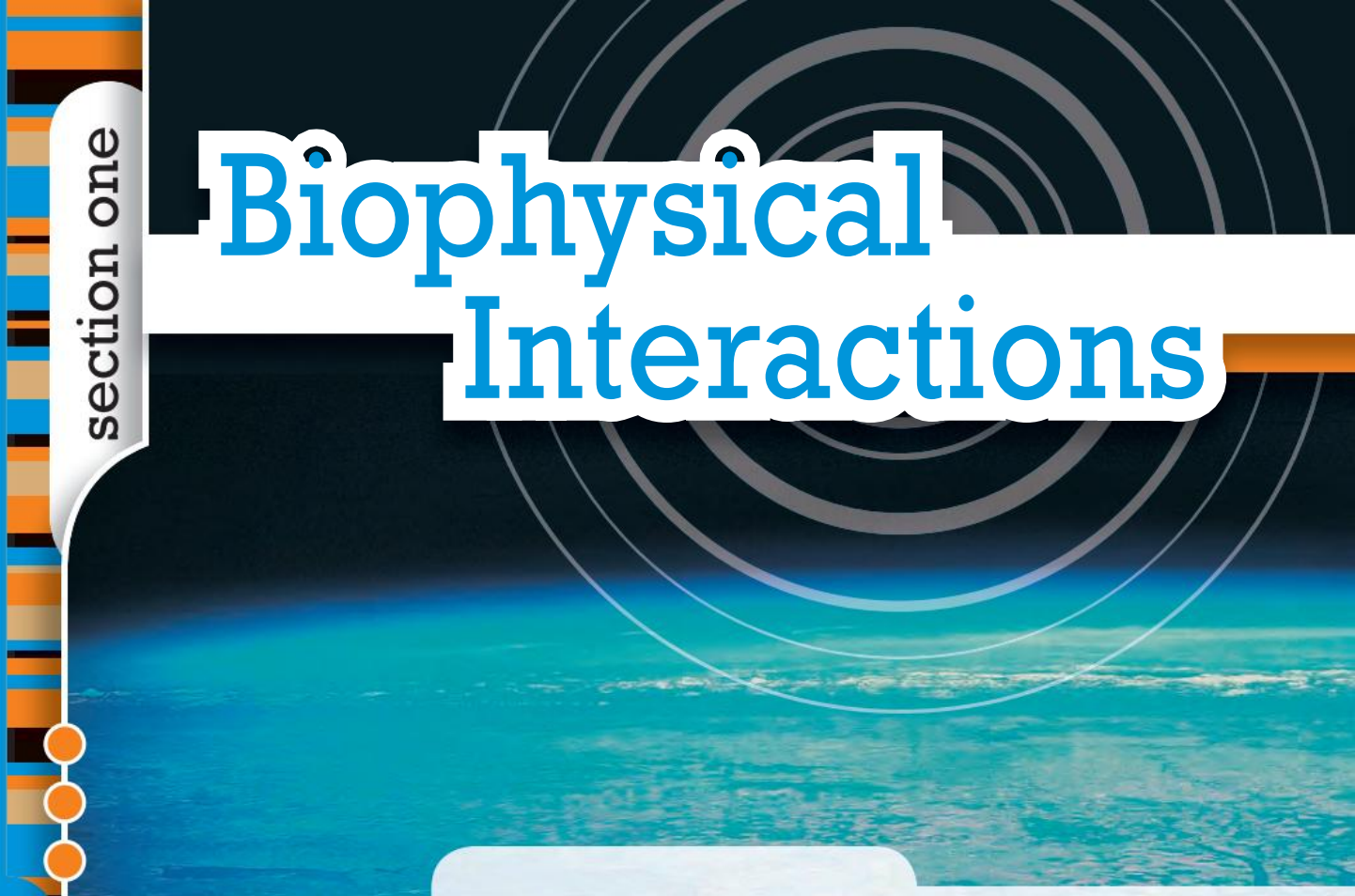
David Hamper, **Helen Rhodes**, **Rod Lane** and **Assoc. Prof. Barbara Rugendyke** are experienced geography educators. David is Head of Staff Development at International Grammar School, Sydney. Helen is Master Assisting in Geography at Shore, North Sydney. Rod is a Lecturer in Education at Macquarie University. Barbara, who wrote Unit 2.5, is a Senior Lecturer in Geography at the University of New England. David, Helen and Rod have also contributed to several texts, including the *Explorations* series.

Preliminary course outcomes matrix

Section of text	Syllabus outcomes											
	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
Section 1: Biophysical Interactions	✓	✓	✓			✓	✓	✓	✓	✓	✓	✓
Section 2: Global Challenges	✓			✓	✓	✓	✓	✓	✓	✓	✓	✓

section one

Biophysical Interactions



Geography is the study of earth's surface features and related human activity. It helps us to make sense of our place in a rapidly changing world and engage with issues such as climate change, the management of scarce water resources, the challenges facing our great cities, global inequalities and the 'war on terror'.

Geography provides us with fascinating insights into the way human and biophysical processes interact. Every day we hear about the ways in which humans are placing ever-greater demands on the earth and its systems. But is drought a human or a biophysical phenomenon? What about coral bleaching? Or rising sea levels? Geography gives us the knowledge and understandings as well as the language, skills and techniques to engage with these questions with confidence.

Geography gives us a unique understanding of people and places. Human societies create living spaces and systems of production, distribution and consumption. People have many common interests, concerns and aspirations. Yet no two places are alike. We can all see the differences and may wonder about the reasons for them.

Geography studies real people in real places, and in doing so it shows how daily lives are shaped by local circumstances. These circumstances are not only the physical characteristics of place, but also the social, cultural, economic and political opportunities and constraints that exist. Geography shows how each local place exists in a regional, national, international and global context.

And there is a bonus: geography is a practical subject. It teaches young people the skills they need across the school curriculum, at home and in the workplace. Through geography, students learn about map use (including GIS), data analysis, problem solving and ICT. They find out how to work alone and in a team. They work directly in the real world by undertaking fieldwork. They also gain an appreciation of social and environmental responsibility.

outcomes

students:

- **P1** differentiate between spatial and ecological dimensions in the study of geography
- **P2** describe the interactions between the four components which define the biophysical environment
- **P3** explain how a specific environment functions in terms of biophysical factors
- **P6** identify the vocational relevance of a geographical perspective
- **P7** formulate a plan for active geographical inquiry
- **P8** select, organise and analyse relevant geographical information from a variety of sources
- **P9** use maps, graphs and statistics, photographs and fieldwork to conduct geographical inquiries
- **P10** apply mathematical ideas and techniques to analyse geographical data
- **P12** communicate geographical information, ideas and issues using appropriate written and/or oral, cartographic and graphic forms

overview

In this section of the text we focus on a geographical investigation of biophysical processes and how an understanding of these processes contributes to sustainable management.

unit 1.1

> Live as if you were to die tomorrow. Learn as if you were to live forever.
> **Mahatma Gandhi, Indian independence leader**

> Economic advance is not the same as human progress.
> **John Clapman, English economist**

> We shall require a substantially new manner of thinking if mankind is to survive.
> **Albert Einstein, German-born physicist**

> We cannot command Nature except by obeying her.
> **Francis Bacon, English philosopher, statesman and essayist**

Biophysical Interactions: An Introduction

Throughout the relatively short period of time that humans have occupied the planet, they have often admired, yet largely taken for granted, the natural wonders that surround them. For tens of thousands of years, the physical world has provided inspiration to painters, writers and musicians. Others with a more scientific outlook have been prompted to undertake penetrating research to seek an understanding of the biophysical world. It seems that the more knowledge we gain of the planet, the more we realise we have even more to learn. Thirty years ago it was thought that there were only about 3 million species of living things on earth; recent sampling has pushed this estimate up to 30 million, a figure that may yet prove to be too conservative. This uncertainty demonstrates just how poorly we understand the complexity of the earth's biophysical systems.

Geographers have a special role to play in investigations of the planet. They study all the phenomena that make up the biophysical environment not as poets or artists but as scientists. Yet, where science fundamentally specialises, geography attempts to study the earth as a whole and to see the connections and interrelationships that exist.

glossary

- **atmosphere** the blanket of air surrounding earth.
- **biosphere** the living part of the planet that consists of a thin layer extending from just above the earth's surface to just below it; the combined ecosystems of the earth.
- **hydrosphere** the part of the earth that is composed of water, including clouds, oceans, seas, ice caps, glaciers, lakes, rivers, underground water supplies and atmospheric water vapour.
- **lithosphere** the upper zone of the earth's mantle and its inorganic mixture of rocks and mineral matter (including soil) in the earth's crust.
- **sustainable development** development that meets the needs and aspirations of the present generation without compromising the capacity of future generations to satisfy their needs and aspirations.

The polar bear: an early victim of climate change?

The Arctic region is far from being a frozen, barren open space. It is, in fact, the largest unfragmented wilderness in the Northern Hemisphere. The waters on which the Arctic ice mass forms are among the most biologically productive on earth. This is the land of the polar bear.

The polar bear is the world's largest terrestrial carnivore. The bear's thick layer of fat serves both as insulation against the cold and as an energy reserve. Polar bears typically build up their store of body fat from late April to mid-July, when ringed seal pups (their preferred food) are abundant. They then fast during the ice-free season when food is not readily available. There are an estimated 22 000 polar bears worldwide.

Large carnivores such as the polar bear are sensitive indicators of an ecosystem's health. In recent decades, the area covered by Arctic sea ice has been melting at an unprecedented rate. Polar bears use the sea ice to access their food, and to move from the hunting grounds to their summer resting areas. Other threats to the polar bear include the toxic chemicals that are transported to the Arctic by ocean currents from the south. These chemicals have long-term effects on polar bear health and longevity. Oil exploration poses an additional threat. It fragments and disturbs the bear's habitat, and introduces oil and other toxic substances to their environment.

The polar bear may be an early victim of climate change.

FIGURE 1.1.1

The earth viewed from space.

The most beautiful object I have ever seen in a photograph, in all my life, is the planet earth seen from the distance of the moon, hanging there in space, obviously alive. Although it seems at first glance to be made up of innumerable separate species of living things, on closer examination every one of its working parts, including us, is independently connected to all other working parts. It is, to put it another way, an organism. It came alive, I shall guess, 3.8 million years ago today, and I wish it a happy birthday and a long life ahead, for our children and their grandchildren and theirs and theirs.

Robert Lewis, quoted in Norman Myers, *The Gaia Atlas of Planet Management*, Doubleday

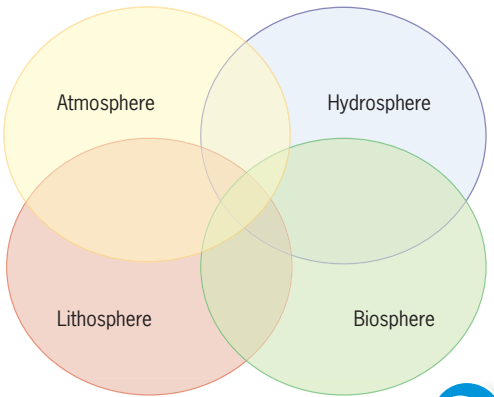


FIGURE 1.1.2

The four spheres.

The four components of the biophysical environment

The biophysical environment of the earth consists of four overlapping spheres:

- the **atmosphere**—the combination of gases and particles enveloping the globe
- the **lithosphere**—the earth's solid outer shell
- the **hydrosphere**—the interconnecting system of water storage in the atmosphere and lithosphere
- the **biosphere**—the earth's surface zone and its adjacent atmosphere in which all organic life exists.

Each of these spheres plays a vital role in sustaining life on earth. Most of the life on this planet exists in a thin film of air, water and rocks in a zone extending from about 61 m below the earth's surface to about 61 000 m above sea level.

Not all planets in the solar system have these four constituent parts. Some have no atmosphere, or are too hot or too cold to support life.

Planet earth is indeed fortunate to have all the elements necessary to support life as we know it. This life, mysterious in origin, is amazingly diverse. Any geographical investigation of this life reinforces the importance of the interaction between the spheres that constitute the biophysical environment. Such interactions are apparent at a very localised site or on a global level.

Geographers are, by nature, keen observers. When confronted with problems concerning the biophysical environment, they find it valuable to assess the relative importance of the processes involved. This inevitably leads to an appreciation of the interaction between the spheres.

Problems such as those at the quarry site shown in figure 1.1.4 do not occur in isolation. Change over time can have far-reaching consequences on many aspects of the biophysical environment. Figure 1.1.3 illustrates the place of the tree within the biosphere and its interdependence with the other spheres.

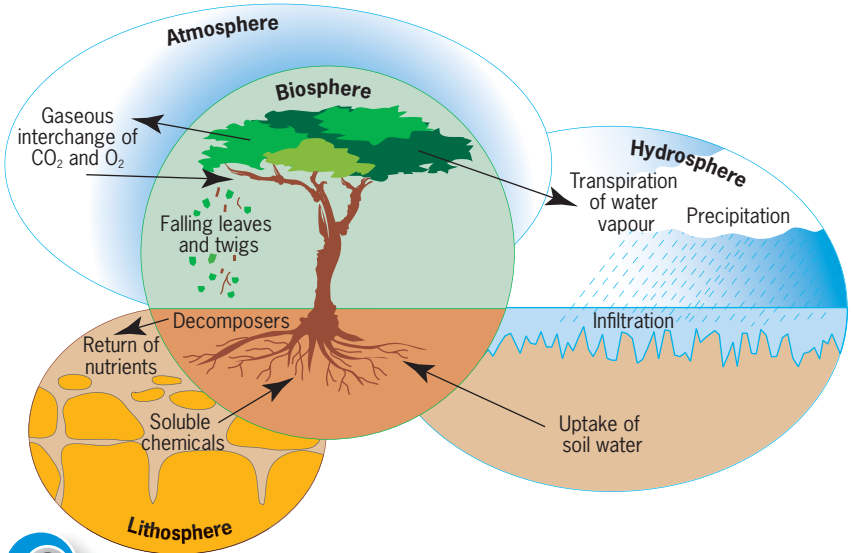


FIGURE 1.1.3

The interdependence of the spheres.

Land degradation, such as shown in figure 1.1.4, arises because some humans perceive that the resources of the biophysical environment can be readily exploited. They give little consideration to the environmental impact of such activities. The original inhabitants of Australia perceived their environment very differently. They managed to use the land carefully for thousands of years so that it could continue to sustain life for them. Aboriginal Australians would have appreciated the richness of life offered to them by the area where the former quarry is located.

Today, with the end of quarrying at the site, efforts are being made by officers of the Department of Natural Resources to rehabilitate the area by damming it and creating an artificial wetland. Local Landcare groups are involved in a revegetation program to create a native habitat.

The dying tree is symbolic of how modern Australians have misused the resources available to them. We are now confronted with the task of trying, in some human-modified environments, to recreate nature, because what we have created in its place is unsustainable.

The human element is only one part of the biosphere. Our studies will extend beyond the fate of an individual tree to, for example, the loss of such flora on a global scale. It will be quite apparent that the impact of humans on the biophysical environment must be recognised. The magnitude of this impact is increasing in proportion to technological development and population size.

A study of the different aspects of the biophysical environment leads to an appreciation of the many factors involved and how they interact to produce recognisable patterns and features. Furthermore, such a study helps in our endeavours to improve our coexistence with nature, which is so important to our continued occupation of this planet.

Human impacts, global dimensions

We can no longer conceptualise the earth as consisting of isolated environments. Rather, we must appreciate that each of these environments is part of an interacting global environment, on which humans are having an increasing impact.

It should not be assumed, however, that human impacts on the biophysical environment are in some way relatively recent events. For tens of thousands of years groups of indigenous people behaved in ways that often transformed ecosystems and led to the extinction of many species. Such impacts, however, were usually followed by long periods of environmental and ecological stability. During these times the elements of the biophysical environment adjusted to the human impacts. Many societies ultimately managed to live in harmony with nature. They utilised the land, marine environments and plants and animals in ways that did not greatly disturb the fragile ecological balance.

More recently, contemporary industrial societies have exploited the biophysical environment with little regard for its ecological limits. They have done so motivated by the pursuit of material wealth, consumption and economic development. The Industrial Revolution and the related technological advances have greatly intensified human impacts on the environment.

However, we humans have the ability to overcome the problems caused by our exploitation of the environment. We have the capacity to better manage and protect the global ecosystem and bring about a more prosperous future for all. This can be achieved not as individual countries working on their own but together, in a global partnership for **sustainable development**.

geofocus

Interactions on a local scale

The imminent death of the tree in the foreground of figure 1.1.4 can be attributed to the loss of the soil from around its root area. Soil contains the nutrients that are basic to the tree's survival. Further investigation at this site reveals that soil loss is due to the overexploitation of the land for the purpose of quarrying. A local brickworks has removed the clay-rich soil and the associated earthworks have exposed the land surface to accelerated rates of erosion.

Ongoing decline in the health of trees at the site will result in associated changes in all the spheres, including the following:

- lithosphere
  - lower organic content within the soil
  - exposed soil that is subject to removal by wind and water erosion
- hydrosphere
  - reduced infilitration of water into the soil
  - increased surface runoff
- atmosphere
  - less water vapour gained from transpiration
  - altered microclimate—less shade, higher temperatures and higher rates of evaporation
- biosphere
  - loss of habitat for native animals.

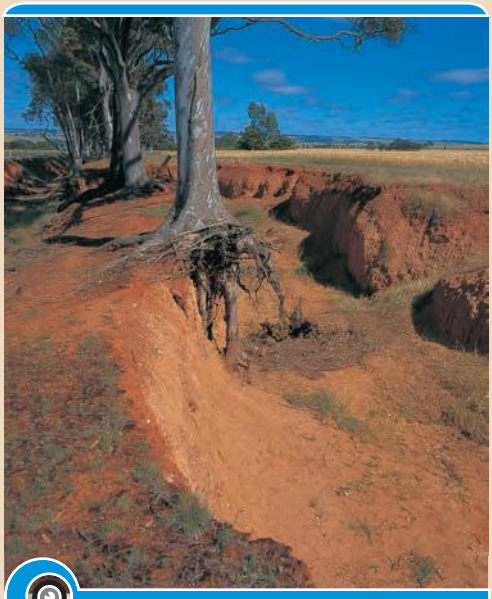


FIGURE 1.1.4

The tree in the foreground will soon die because of the soil erosion around its roots.

did you know?

Note to teachers and students

This section of the text provides a systematic study of the four components of the biophysical environment followed by TWO case studies that investigate the interaction of the components within the context of a specific biophysical environment and a related issue. The approach allows for greater programming flexibility.

Students can:

- focus on ONE of the case studies and refer back to Units 1.1 to 1.5 when they need to enhance their knowledge and understanding of a specific biophysical process
  or
- undertake a systematic study of the four components of the biophysical environment followed by ONE of the integrated case studies.

What is sustainable development?

Sustainable development is achieved by maximising people's economic and social well-being (their quality of life) while maintaining and protecting the quality of the biophysical environment.

The principles that guide sustainable development include a recognition that:

- Improvements in health care, education and social well-being are necessary to reduce birth rates in developing countries and stabilise world population.
- The earth's renewable resources should only be used in a way that does not reduce their usefulness for future generations.
- Decisions made today should not damage the prospects for maintaining or improving future living standards.
- People should be involved in decisions that affect their lives.
- Priority should be given to the development of new technologies that are cleaner, more energy-efficient and use fewer natural resources.
- Steps should be taken to prevent further degradation of the land and biophysical resources.
- The benefits of economic growth should be more evenly distributed.

Sustainable development and good environmental management go hand in hand.

FIGURE 1.1.5

The many varied landscapes of the earth. **A** African savanna. **B** Antarctica. **C** Glacial valley in Yosemite National Park. **D** The rainforest of Hawaii. **E** Coastal landscape. **F** Desert landscape.

In the relentless human colonisation of every corner of this planet, from the Arctic to the Antarctic, we are witnessing the end, indeed the death, of natural environments. The water we drink, the air we breathe, the food we eat, are all modified by human activity. Our activities, and the seemingly inevitable degradations of the earth, have meant, in effect, the death of the natural world. We are seeing a transformation from a naturally 'managed' world to a managed 'natural' world.

B.W. Boer, 'Living sustainably', *The Architecture Show*

understanding the text

1 **Explain** how the role of geographers differs from that of scientists.
2 **Identify** the four components of the biophysical environment. Give a brief description of each.
3 **Explain** where most life on earth occurs.
4 **State** two factors that have increased the magnitude of human impact on the biophysical environment.
5 **Outline**, in brief, the nature of the relationship that indigenous people have with the biophysical environment.
6 **Explain** what has motivated contemporary industrial societies to exploit the biophysical environment.
7 **Define** the term sustainable development. What are its guiding principles?

working geographically

Group work Divide the class into four groups. Each group is to select one of the four components of the biophysical environment and then brainstorm the following:

a the ways in which the selected component affects the activities of people
b the ways in which the activities of people have affected the selected component.

Record the main points raised in your group's discussion on a large sheet of paper. Share your group's findings with the rest of the class.

geofocus

The Wollemi Pine

The recent discovery of a small stand of Wollemi Pine trees, previously known only in the fossil record, has captured the world's imagination. Scientists have likened the discovery to that of finding a small dinosaur still alive. The ancestors of the remaining trees have survived millions of years of climatic and environmental change.

The small remnant stand of pine trees lies hidden within the Wollemi National Park, just 150 km from Sydney. The location of the stand is a closely guarded secret. Authorities have developed a strategy to ensure the survival of the species. Access to the site is restricted and the species will be grown for commercial sale through plant nurseries. The widespread availability of the Wollemi Pine should safeguard the future of this priceless botanical heritage.

This discovery demonstrates just how little we know about the diversity of life on earth.

FIGURE 1.1.4

The ancient Wollemi Pine (*Wollemi nobilis*), which was discovered in 1994.

unit 1.2

> Water and air, the two essential fluids on which all life depends, have become global garbage cans.
> **Jacques Cousteau, conservationist, scientist and film maker**

> Don't knock the weather; nine-tenths of the people couldn't start a conversation if it didn't change once in a while.
> **Kin Hubbard, journalist**

> Thatch your roof before rainy weather, dig your well before you become parched with thirst.
> **Chinese proverb**

The Atmosphere

The atmosphere is the gasesous layer that surrounds earth. It constitutes the transition between the planet's surface and the vacuum of space. The atmosphere consists of a mixture of gases: principally nitrogen, oxygen, carbon dioxide and water vapour. It extends some 500 km above the surface of the earth. The atmosphere's lower level is called the troposphere. It houses the climate system that maintains the conditions required to sustain life on the planet's surface. The next atmospheric level, the stratosphere, exists 12 to 48 km above earth. It contains the ozone layer that protects life on the planet by filtering harmful ultraviolet radiation emitted by the sun.

Since the Industrial Revolution, humans have been altering the composition of the atmosphere by burning fossil fuels. Concern has been growing about rising concentrations of carbon dioxide, methane, nitrous oxide and chlorofluorocarbons in the atmosphere because these greenhouse gases trap the heat energy emitted from the earth's surface and increase global temperatures. In addition, chlorofluorocarbons are effective at depleting the earth's protective ozone shield.

By developing our knowledge and understanding of atmospheric processes we are better placed to engage with the issue of global climate change.

exam-style questions

extended responses

- Analyse the factors that determine the world pattern of climate.
- Account for local variations in climate.
- Explain the impact that large cities have on climate at a local scale.
- Outline the consequences of people's interactions with the atmosphere.
- Write an extended response on global warming. In your response:
  - Outline the causes of global warming.
  - Speculate on the possible impacts of global warming.
  - Explain how the rate of warming might be slowed.

An Inconvenient Truth

Humanity is sitting on a ticking time bomb. If the vast majority of the world's scientists are right, we have just 10 years to avert a major catastrophe that could send our entire planet into a tail-spin of epic destruction involving extreme weather, floods, droughts, epidemics and killer heat waves beyond anything we have ever experienced. This is the central message that former US vice-president Al Gore seeks to communicate in *An Inconvenient Truth:* the Academy Award winning documentary on the causes and likely impacts of global climate change.

In the wake of his defeat by George W. Bush in the 2000 US presidential election, Gore decided to devote himself to a last-ditch, all-out effort to help save the planet from irrevocable change. The film highlights one man's fervent crusade to halt in its tracks the deadly progress of global warming by exposing the myths and misconceptions that surround it.

At the heart of Al Gore's persuasive argument is the view that we can no longer afford to regard global climate change as a political issue. Instead, it must be treated as the biggest moral challenge facing our global civilisation.

glossary

- **acid rain** precipitation containing excessive amounts of acid that is formed when oxides of sulfur and nitrogen, released by the combustion of fossil fuels, mix in the atmosphere.
- **atmosphere** the transparent, odourless mass of air surrounding the earth.
- **atmospheric pollution** a change in the chemical composition of the atmosphere that affects the well-being and activities of all living things; also known as air pollution.
- **atmospheric pressure systems** areas of the atmosphere with relatively high or low barometric pressure; often referred to as highs and lows.
- **fossil fuels** energy sources formed in past geological times from organic materials. Examples include coal, petroleum and natural gas.
- **greenhouse effect** the trapping and buildup of heat in the troposphere, near the earth's surface. Some of the heat that is radiated towards space from the earth's surface is absorbed by water vapour, carbon dioxide, ozone and several other gases and radiated back towards the earth's surface.
- **greenhouse gases** gases in the earth's atmosphere that contribute to the greenhouse effect; for example, carbon dioxide, ozone, methane and nitrous oxide.
- **lapse rate** the decline in temperature that occurs with increasing altitude throughout the troposphere.
- **microclimate** a small, localised area within a larger climatic region in which the atmospheric characteristics differ significantly from those of the major climate.
- **ozone** a colourless gas that is the product of the reaction between oxygen and the sun's ultraviolet radiation.
- **ozone layer** the layer of gaseous ozone in the stratosphere that protects life on earth by filtering out harmful ultraviolet radiation from the sun.
- **photochemical smog** a complex mixture of air pollutants produced in the atmosphere by the reaction of hydrocarbons and nitrogen oxides under the influence of sunlight.
- **solar radiation** energy received from the sun and on which all life depends.
- **temperature inversion** results when a layer of dense, cool air is trapped under a layer of less dense warm air. If prolonged, air pollution in the trapped layer may build up to harmful levels.
- **troposphere** the innermost layer of the atmosphere in which most of the earth's weather occurs.
- **urban heat island** a phenomenon of urban settlements where relatively warm atmospheric temperatures prevail in the most heavily built-up areas and decrease outward towards the fringes.
- **wind** a movement of air from areas of relatively high atmospheric pressure to areas of relatively low atmospheric pressure. Winds are named after the direction from which they are blowing.

The **atmosphere** comprises the transparent, odourless gases that surround the earth and are held in place by the gravitational attraction of the planet. It is part of the shared resources to which all species have rights. These resources are often referred to as the global commons. The atmosphere has no territorial boundaries and cannot be exploited under the sovereign rights of individual nation-states. In other words, the atmosphere can be said to belong to no-one as it belongs collectively to everyone.

When the earth was formed, around 5 billion years ago, it did not have an atmosphere. Massive volcanic eruptions released gases and as the gases cooled the atmosphere developed. The composition of the atmosphere at that time was thought to have been 80% water vapour, 12% carbon dioxide, 7% sulfur dioxide and 1% nitrogen and other trace gases. Missing was the oxygen necessary for life to flourish on the planet. The intensity of incoming **ultraviolet (UV) radiation** also acted to prevent the development of life forms. Eventually, however, the levels of UV radiation began to decline. This triggered the types of chemical reactions that are believed to have led to the evolution of life on earth.

ultraviolet (UV) radiation a form of radiant energy that comes from the sun and can cause skin damage, such as melanoma and other types of skin cancer.

Oxygen was introduced into the atmosphere when small organisms broke down carbon dioxide (CO_2) to use the carbon. Oxygen was emitted as a waste product of this process. The increasing concentrations of oxygen within the atmosphere absorbed greater amounts of UV radiation. This led to the earth's surface becoming warm and rich enough for life forms to flourish. (See figure 1.2.1.)

Human impact on the atmosphere

Human activities have had a dramatic impact on the operation of the atmosphere. On a global scale, global warming and **ozone** depletion are now the focus of international attention. In cities, government authorities are attempting to identify and control the sources of those atmospheric pollutants that threaten the physical well-being of inhabitants. (See figure 1.2.2.)

Certain environmental issues highlight the interaction between the different components of the biophysical environment. One such set of interactions involves those atmospheric and hydrological processes that contribute to land degradation. Soil erosion, for example, is directly related to the pattern of surface **winds** at a continental scale. Water erosion is directly related to both the atmospheric and hydrological processes of runoff and floods. The wind erosion rate is increased substantially by drought, and the balance between rainfall and evaporation can significantly affect levels of soil salinity.

FIGURE 1.2.1

The development of the atmosphere was essential to the creation of life on earth.

The structure and composition of the atmosphere

The structure of the atmosphere

Earth's atmosphere has a layered structure. The layers shown in figure 1.2.4 (p. 18) are based primarily on temperature characteristics.

The troposphere

Almost all the weather and related processes take place in the **troposphere**. (See figure 1.2.3, p. 18.) It contains all the weather systems that produce precipitation, surface winds and the other climatic variables that impact on the way humans utilise the land.

The troposphere extends upwards from ground level to about 8 to 10 km above the poles and 15 to 17 km above the Equator. The top of the troposphere is called the tropopause. It forms the boundary between the troposphere and the stratosphere. Temperatures at the tropopause are very low; from –40°C to –80°C. The air within the troposphere is warmed by heat radiated from the earth's surface.

The stratosphere

The *stratosphere* extends from about 10 km to 50 km above the earth's surface. It is relatively calm compared with the troposphere. In the lower stratosphere, temperatures are relatively constant; they don't change much with altitude. In the upper stratosphere, temperatures increase with altitude. They reach about 0°C at the top of the stratosphere. This warming is caused by the absorption of **solar radiation**.

The mesosphere

The *mesosphere* extends about 80 km above the earth's surface. Temperatures fall rapidly with elevation because there is no water vapour, cloud or dust to absorb incoming radiation. Temperatures are as low as –90°C and wind velocities (speeds) are as high as 3000 km/h, the strongest in the atmosphere.

The thermosphere

Within the *thermosphere*, the atmosphere becomes more tenuous or thinner with elevation. Temperatures rise rapidly, reaching as high as 1500°C. This is due to increasing concentrations of **atomic oxygen** in the atmosphere, which, like ozone, absorbs incoming UV radiation.

FIGURE 1.2.2

Human activities have dramatically altered the operation of the atmosphere.

atomic oxygen single oxygen atoms compared to oxygen molecules (two oxygen atoms) found in air.

FIGURE 1.2.3

Earth's weather processes occur within the troposphere.

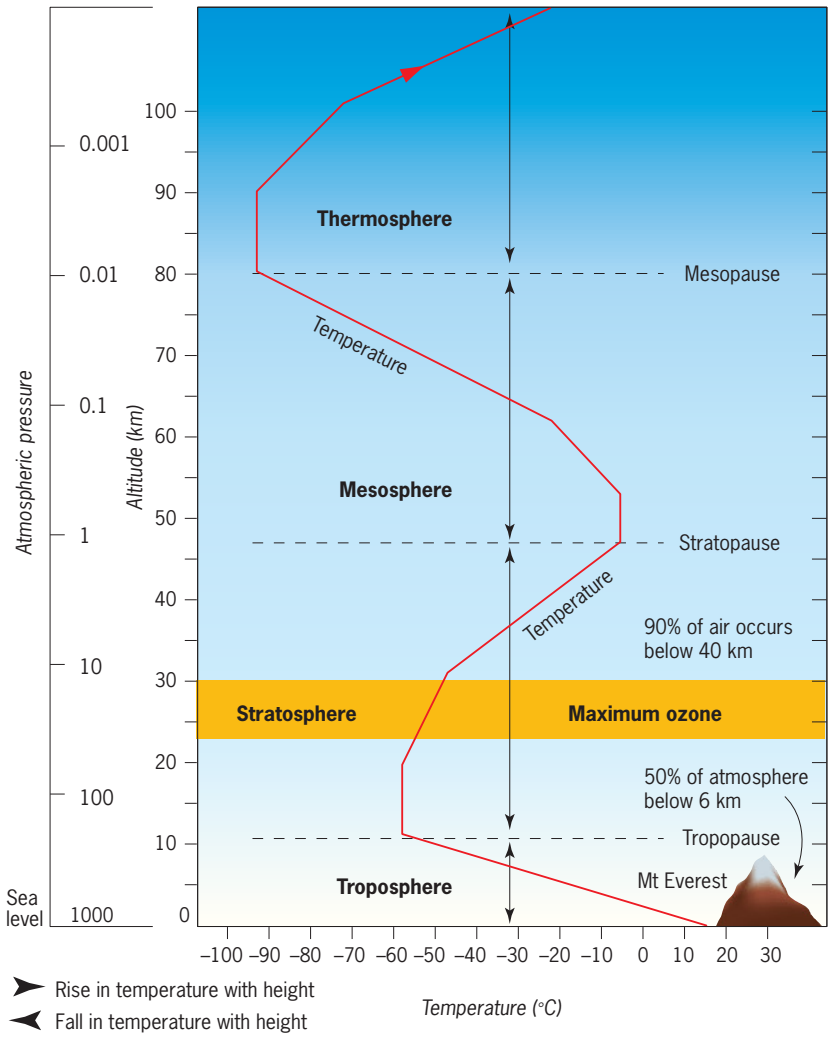


FIGURE 1.2.4

The layers of the atmosphere.

The composition of the atmosphere

Oxygen and nitrogen together make up 90% of the atmosphere's volume. The remainder comprises other gases (such as ozone and CO_2) as well as pollutants and particulates. The composition of the atmosphere is shown in table 1.2.1.

The majority of scientists are alarmed by the likely impacts of human-induced changes to the earth's atmosphere. Increases in atmospheric concentrations of ozone-destroying gases and CO_2 are now a major focus of scientific research.

did you know?

Weather and climate

Care needs to be taken when we use the terms 'weather' and 'climate'. *Weather* refers to the day-to-day condition of the atmosphere at a particular place. It includes all the daily changes in temperature, precipitation, wind, sunshine, humidity (the amount of moisture in the air) and atmospheric pressure. *Climate*, on the other hand, is the long-term weather pattern for a place or region. The factors that determine what type of climate a place will have include latitude, season, aspect, closeness to the sea, ocean currents and height above sea level (elevation).

Atmospheric processes

Energy in the atmosphere

The sun is the earth's main source of energy. This energy is received as incoming short-wave solar radiation (*insolation*), which controls the planet's climate, weather and water cycle. Through its conversion into chemical energy via the process of photosynthesis in green plants, it supports all life on earth.

TABLE 1.2.1

Composition of the atmosphere

Component	Composition by volume (%)	Importance
Permanent gases:		
■ nitrogen	78.09	■ Plays an important role in the growth of plants
■ oxygen	20.95	■ A product of photosynthesis, it is reduced when the world's forests are destroyed
Variable gases:		
■ water vapour	0.2–4.0	■ Reflects and absorbs incoming radiation and provides the moisture for cloud formation and precipitation
■ carbon dioxide	0.03	■ Absorbs heat radiated from the earth's surface
■ ozone	0.00006	■ Absorbs harmful incoming UV radiation
Other gases:		
■ argon	0.93	
■ helium	traces	
■ krypton	traces	
■ neon	traces	
Particulates:		
■ dust	traces	■ Absorbs/reflects incoming solar radiation and provides the condensation nuclei on which cloud formation depends; added to the atmosphere by volcanic eruptions and wind erosion
Pollutants:		
■ methane	traces	■ Contributes to global warming
■ nitrogen dioxide	traces	
■ sulfur dioxide	traces	■ Mixes with atmospheric moisture to form **acid rain**; added to the atmosphere by industrial processes, power generation and car exhausts

The amount of incoming solar radiation received at a particular location on the earth's surface is determined by the following:

- *Distance from the sun*. The elliptical orbit of the earth around the sun can result in 6% variation in the amount of insolation received by the earth at different places and times.
- *Latitude*. As demonstrated in figure 1.2.5, incoming solar radiation has twice the area to heat at 60° north and south as it does at the Equator. Therefore, average temperatures are lower at higher latitudes.
- *Length of day and night*. Because the earth's axis is tilted at an angle of 23.5°, there are seasonal variations in the length of day and night. The shorter the day the less opportunity there is for the absorption of incoming solar radiation.

Not all incoming solar radiation reaches the ground; most is absorbed, reflected and scattered as it passes through the atmosphere. Some is absorbed by ozone, water vapour, CO_2 and particles of dust and ice present in the atmosphere; some is also reflected back into space from clouds and, to a lesser extent, from the earth's surface.

The ratio between incoming radiation and the amount reflected back into space, expressed as a percentage, is known as the *albedo*. The albedo varies from less than 10% over oceans and dark soil to 25% over grasslands, 40% over desert sands and 85% over snow. The albedo increases where human landuse activities have resulted in the removal of vegetation by land clearance and overgrazing. This may reduce the likelihood of cloud formation and precipitation and increase the risk of desertification.

Scattering of the sun's energy occurs when incoming solar radiation is diverted by molecules of gas in the atmosphere. It takes place in all directions, with some radiation reaching the earth's surface as diffuse radiation.

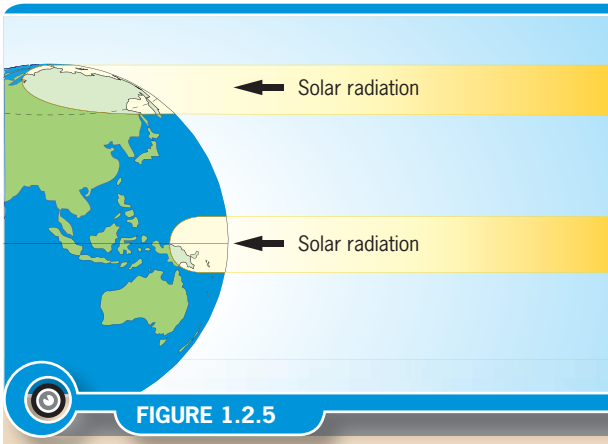


FIGURE 1.2.5

Latitude plays a crucial role in the heating of the earth's surface.

did you know?

The lowest temperature ever recorded was –89.2°C. This was recorded at Vostok in Antarctica. The hottest recorded temperature is 56.7°C, which was recorded in Death Valley in the United States.

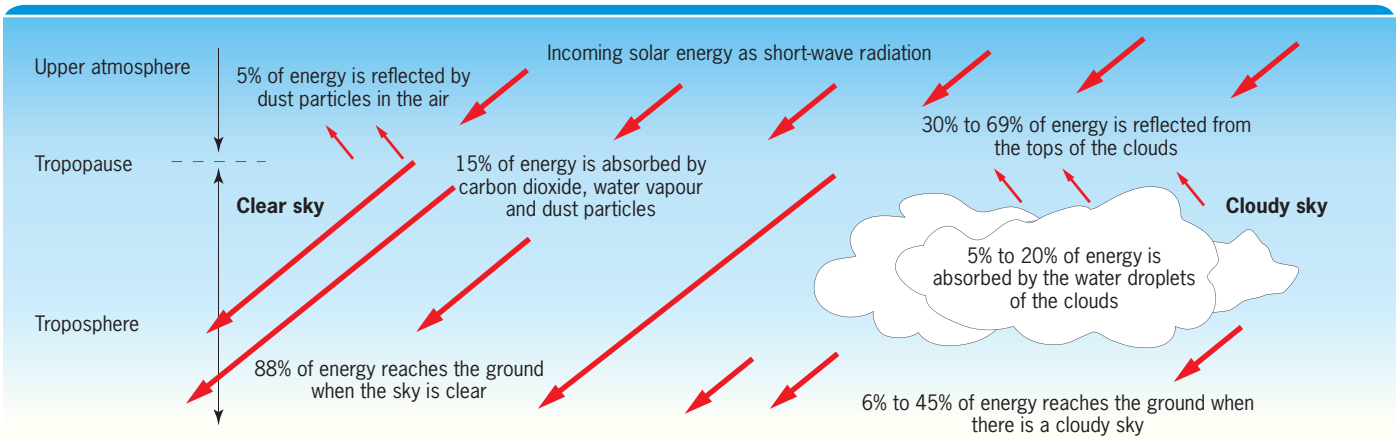


FIGURE 1.2.6

The absorption and scattering of insolation.

understanding the text

1 **Define**, in your own words, the atmosphere.
2 **Explain** how the atmosphere was formed.
3 **Outline** how oxygen began to accumulate in the atmosphere.
4 **Explain** the difference between weather and climate.
5 **Describe** the troposphere. Why is it so important to humans?
6 **Outline** the composition of the atmosphere.
7 **Discuss** the factors that determine the amount of incoming solar radiation at particular locations on the earth's surface.

working geographically

1 **Interpreting diagrams** Study figure 1.2.4 (p. 18). Write a report outlining what happens to temperature in each layer of the atmosphere.
2 **Interpreting diagrams** Study figure 1.2.5 (p. 19). Write a short-answer response explaining why temperatures decrease with increasing latitude.
3 **Writing task** Study the 'Did you know?' box on page 18. Write a paragraph distinguishing between weather and climate.

terrestrial radiation stored heat emitted as longwave radiation by the earth, including its land, oceans and atmosphere.

conduction energy transfer from one material to another by direct contact.

convection currents movements within a medium caused by a difference in temperature.

Only 24% of incoming solar radiation reaches the earth's surface directly; an additional 21% reaches the surface as diffuse radiation. Incoming radiation is transformed into heat energy when it reaches the earth's surface. As it heats the ground, it radiates long-wave or infra-red energy back into the atmosphere. In the atmosphere, 94% of this energy is absorbed by water vapour and CO_2, creating a natural **greenhouse effect**. (See figure 1.2.6.)

The global heat budget

Generally speaking, the temperature of the earth remains relatively constant from year to year. This means that there is a balance between incoming insolation and outgoing terrestrial radiation. Features of this *global heat budget* include:

- a net gain in radiation everywhere on the earth's surface except at the poles, which have a high surface albedo
- a net loss in radiation throughout the atmosphere.

After taking incoming and outgoing radiation into account, there remains a net surplus of heat between 35°S and 40°N and a net deficit to the poleward side of these latitudes. This difference according to latitude is due to the larger size of the land masses in the Northern Hemisphere.

Overall, therefore, there is a positive heat balance within the tropics and a negative heat balance in the polar regions and at high altitudes. One outcome of this imbalance is the transfer of heat from the tropics towards the poles and to higher altitudes. If this transfer did not take place, the tropics would 'overheat'.

Two types of transfer take place:

- *Horizontal transfers*. Wind and ocean currents transfer heat from the tropics towards the poles. Winds account for 80% of the heat transfer, and ocean currents for the remaining 20%.
- *Vertical transfers*. Heat is transferred to the atmosphere from the earth's surface by **terrestrial radiation**, **conduction**, **convection currents** and the transfer of **latent heat** via **condensation**. If this transfer did not occur, the earth's surface would get hotter and the atmosphere colder.

Lapse rates

As altitude increases throughout the troposphere there is a decline in temperature. This temperature decline is called the **lapse rate**. On average, air temperature decreases by approximately 6.5°C for every

1000 m of elevation. This concept is best demonstrated by way of example. At 8848 m above sea level, the peak of Mt Everest would be 57.5°C colder than the average sea level temperature, if the average lapse rate were applied.

The actual lapse rate varies from place to place, depending on air **humidity**. The rate that applies at any given place and time is known as the *environmental lapse rate*.

What causes the air to move?

The air within the troposphere is never at rest. The sun heats the equatorial regions more quickly than the polar regions, causing movements of air within the troposphere at a global scale. These movements produce the distinctive climatic features experienced on the surface of the earth. The global pattern of atmospheric circulation is shown in figure 1.2.7.

At the Equator, heated air rises. When it reaches the tropopause it moves towards the poles. At 30° north and south of the Equator, a body of descending air creates the subtropical high pressure belt, with its clear skies and dry, stable conditions. On the surface of the earth, some of the descending air moves back towards the Equator. The cells created by this pattern of circulation are known as *Hadley cells*.

On the polar side of the Hadley cells the remaining air moves towards the poles. When this relatively warm air meets the cold polar air at the polar front, it pushes under and uplifts the warmer air. This forms an area of low pressure known as a polar cell. The polar front, therefore, marks the boundary between the warm tropical air masses and the cold polar air masses. The frontal zone is quite distinct and moves as a non-continuous band right around the planet.

In the upper troposphere very strong winds reach speeds in excess of 200 km/h. (Military and commercial aircraft take advantage of these winds; eastward flights are much faster than westward flights.) Within these wind systems are narrow bands of extremely fast-moving air known as jet streams. Jet streams assist in the rapid transfer of energy and can exceed speeds of 230 km/h.

Surface winds

Surface winds are caused by the movement of air from areas of high pressure to areas of low pressure. These winds are highly variable, both in terms of speed and direction, but have an overall global pattern.

The Hadley cells, shown in figure 1.2.7, produce descending air in the mid-latitudes on either side of the Equator. This air moves back towards the Equator as a surface wind. Air moving towards the Equator is deflected to the left in the Southern Hemisphere and to the right in the Northern Hemisphere by the Coriolis effect. The result of these deflections is to give the winds a direction from south-east to north-east in the Southern Hemisphere, and from north-east to south-west in the Northern Hemisphere. These surface winds are referred to as the south-east trade winds and the north-east trade winds, respectively.

Air moving away from the Equator towards the poles is also deflected to the left in the Southern Hemisphere and to the right in the Northern Hemisphere. On the polar side of the Hadley cells, descending air moves towards the poles and is deflected. This results in a band of strong winds in each hemisphere. In the Southern Hemisphere such winds are known as the 'Roaring Forties' because of their persistence within the 40°–49° band of latitude.

In the equatorial region, air rises and there are no strong horizontal surface winds. This results in a phenomenon known as the 'equatorial doldrums'. Another region of relatively calm weather is that below the descending air of the polar ends of the Hadley cells. Early mariners

latent heat the amount of heat that is lost or gained when a substance undergoes a phase change, such as condensation, evaporation or sublimation.

condensation the process by which water vapour becomes a liquid.

humidity the water vapour content of the air.

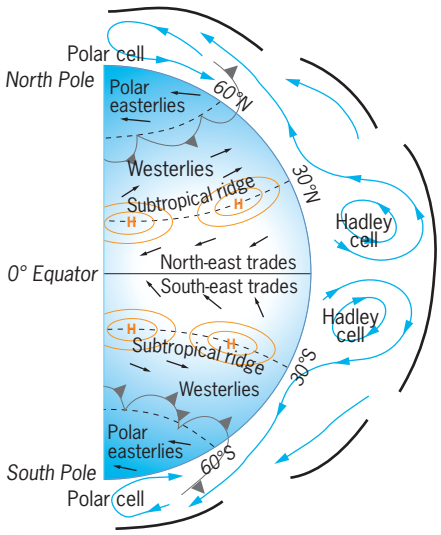


FIGURE 1.2.7

A diagrammatic representation of the earth showing the movement of air around the globe.

understanding the text

1 **Outline** the main features of the global heat budget.
2 **Explain** how the imbalances in incoming and outgoing radiation that occur with latitude and longitude are rectified.
3 **Define** the term lapse rate.
4 **Define** the term environmental lapse rate.

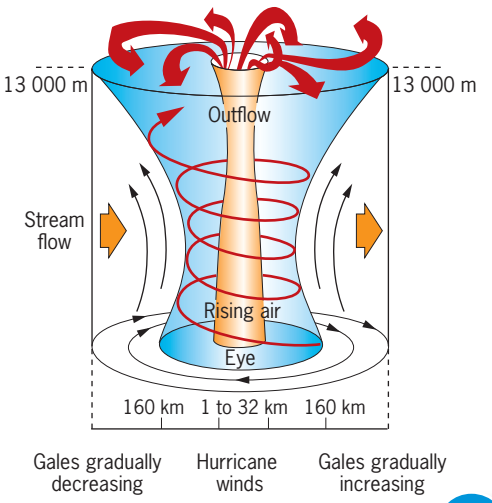


FIGURE 1.2.8

The formation of a cyclone.

did you know?

Pressure systems (highs and lows) are associated with their own distinctive weather patterns. Areas under the influence of *high* pressure systems (anticyclones) experience stable atmospheric conditions: clear skies and gentle winds. Areas under the influence of *low* pressure systems (cyclones) experience unstable atmospheric conditions: cloudy skies, strong winds and the likelihood of rain.

applied the term 'horse latitudes' to these zones. They were so named because their ships were often becalmed, so their animals died of starvation and had to be thrown overboard.

Pressure systems

Atmospheric pressure systems are areas of the atmosphere with relatively high or low barometric (air) pressure. They are often referred to simply as 'highs' and 'lows'. Large areas of permanent high and low pressure exist in bands around the earth, and these influence world climate patterns and ocean currents.

High pressure systems are sometimes referred to as *anticyclones*. An anticyclone is a large body of sinking air that produces an area of high pressure on the earth's surface. The source of the air is the upper atmosphere where there is very little moisture. Because descending air warms, weather conditions remain dry. When the pressure gradients remain gentle, wind velocities are low. (Pressure gradients are shown by the isobars on a synoptic chart.)

The weather in regions dominated by high pressure systems is characterised by stable atmospheric conditions, clear skies and gentle winds.

Low pressure systems are often referred to as *cyclones*. A cyclone is a large body of rising air that produces an area of relatively low atmospheric pressure. As the source of the air is close to the earth's surface, there may be considerable amounts of moisture. As moist air rises it cools rapidly, condensation takes place and the potential for precipitation increases. Wind velocities are relatively high because the pressure gradients are relatively steep. (This is indicated on synoptic charts by isobars that are close together.)

The weather in areas dominated by low pressure systems is characterised by unstable atmospheric conditions, cloudy skies, rain and strong winds.

Tropical cyclones are intense low pressure systems. They develop over warm tropical oceans and their behaviour is often erratic and unpredictable. Once they cross a coastline they turn towards the pole, their intensity is reduced and they develop into what is known as a rain depression.

For tropical cyclones to form and move there must be a continuous supply of heat and moisture to maintain the rising thermal currents. There must also be a large supply of moisture to provide the latent heat (released by the process of condensation) that drives the cyclone and facilitates the associated heavy rainfall. At the centre of the cyclone is the

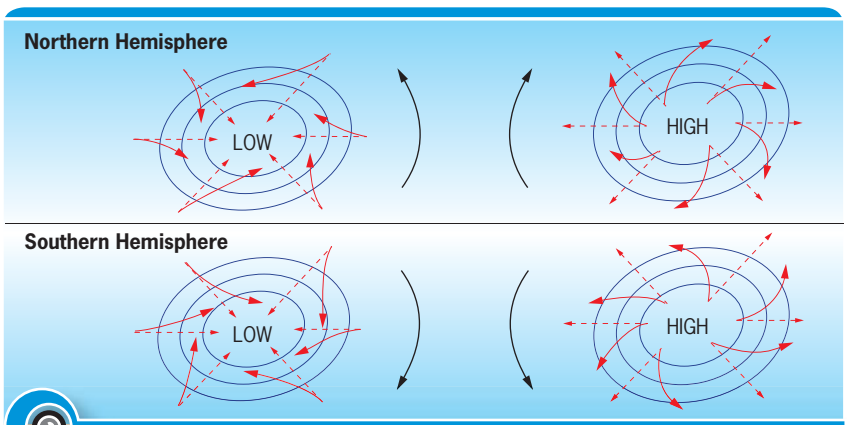


FIGURE 1.2.9

The patterns of air movement within pressure cells.

geoskills 1

Synoptic charts

A synoptic chart or weather map is a record of the atmospheric conditions experienced at a particular time in a particular place. (See figure 1.2.13, p. 24.) They provide information related to air pressure; the location of air masses and frontal activity (see below); the extent of cloud cover, wind speed and direction; and the distribution of rainfall. Using this information, it is possible to make predictions relating to temperature, humidity, ocean conditions and the likely sequence of weather over the next few days.

Features of a synoptic chart

Synoptic charts display a number of features:

- *Isobars*. These are lines joining places of equal barometric pressure. Barometric pressure is measured in units called *hectopascals* (hPa). Finding the atmospheric (or barometric) pressure of a particular location requires you to refer to the value of adjacent isobars. The process is the same as that for estimating height above sea level using contour lines.
- *Pressure systems*. These are defined by the patterns formed by the isobars. High pressure systems are indicated where barometric pressure increases towards the centre of a set of enclosed isobars. Low pressure systems are indicated where the barometric pressure decreases towards the centre.
- *Cold fronts*. These are formed when a mass of cold air moves in and displaces warmer air. The resulting uplift of warm moist air means that the passing of a cold front is often associated with rainfall.
- *Warm fronts*. These occur when a mass of warm air moves in and displaces cold air.
- *Wind speed*. The closer the isobars, the greater the wind speed. Some synoptic charts include wind speed and direction indicators.
- *Wind direction*. Winds are named after the direction from which they come. For example, a wind coming from the south is called a southerly. Wind direction is determined largely by the location of pressure systems. In the Southern Hemisphere, winds blow in an anticlockwise direction from areas of high pressure. The winds associated with low pressure systems blow in a clockwise direction towards the centre.
- *Rainfall*. Areas in which rainfall has occurred in the previous 24 hours are highlighted by shading.

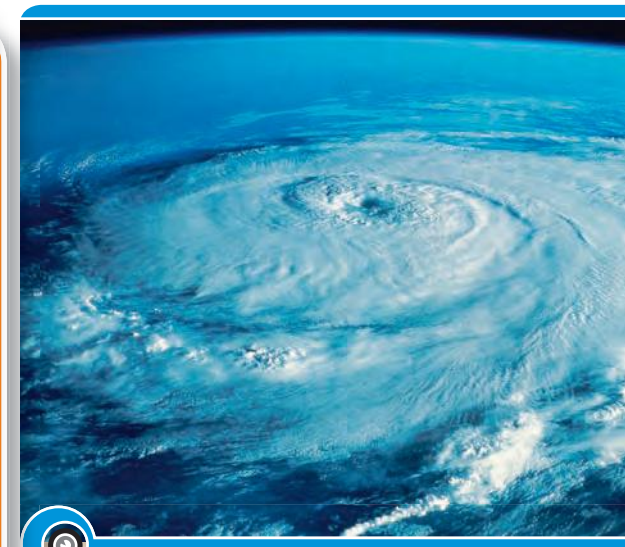


FIGURE 1.2.10

Tropical cyclones are intense storms with very low air pressure.

'eye'. This is an area that is 30–50 km in diameter and is characterised by subsiding air, light winds, clear skies and relatively high temperatures. The descending air warms quickly, increasing the cyclone's intensity.

Pressure systems are featured on synoptic charts. Being able to interpret these charts is an important geographical skill. (See the Geoskills 1 box.)

Air masses

Air is affected by the nature of the earth's surface over which it passes. A body of air that has been affected by a large area of the earth's surface, such as an ocean or a continent, is known as an **air mass**.

Air masses over large continental areas and oceans are affected by temperature and humidity. Air masses above oceans contain more moisture than those that form over continental areas. High pressure areas where air sinks towards the earth's surface near the tropics form warm air masses. High pressure areas near the poles form cold air masses.

Air masses that form over oceans are usually referred to as maritime air masses and those formed over land masses are called continental air masses. Air masses that form over the Arctic and Antarctic ice fields are very cold and dry. They are referred to as the Arctic air mass (Ac) and the Antarctic air mass (Aac).

did you know?

Tropical cyclones are known as hurricanes in the Atlantic Ocean and typhoons in the western Pacific Ocean.

did you know?

Sixty-five people were killed as a result of Cyclone Tracy, which struck Darwin on Christmas Eve 1974.

geofocus

Cyclone Larry

Cyclone Larry struck the far north coast of Queensland on 20 March 2006. The cyclone was one of the most damaging to strike Australia since 1974 when Cyclone Tracy caused widespread damage to Darwin. Cyclone Larry crossed the coast near Innisfail, south of Cairns. During the height of the storms, wind speeds reached more than 150 km/h and the damage done by the storm was immense.

The area around Innisfail is Australia's major banana-growing region. The cyclone saw more than 80% of the Australian banana crop destroyed. Many farmers were left with no banana trees at all. In the town of Babinda, north of Innisfail, more than 80% of buildings were damaged and in the neighbouring town of Silkwood 99% of homes lost their roofs.

FIGURE 1.2.11

The path of Cyclone Larry.

FIGURE 1.2.12

Radar image of the rainfall intensity associated with Cyclone Larry.

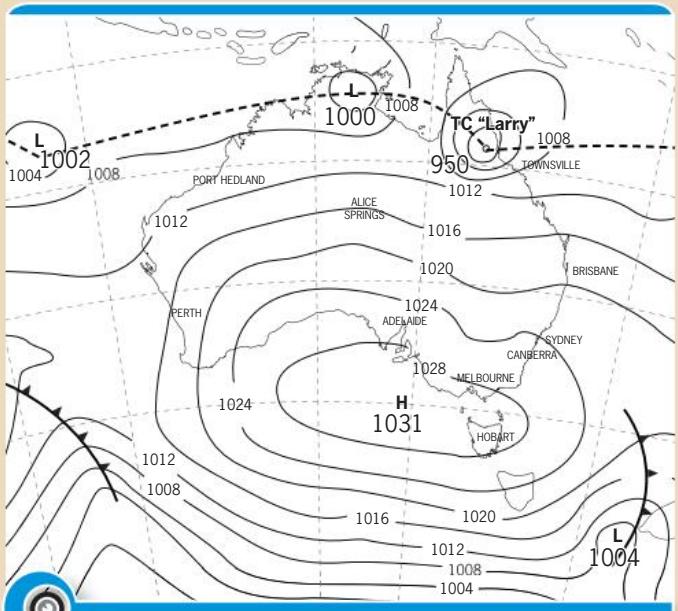


FIGURE 1.2.13

Synoptic chart featuring Cyclone Larry.

FIGURE 1.2.14

A banana plantation after the cyclone.

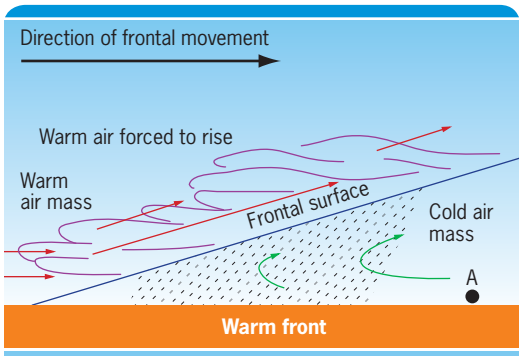
The areas where air masses form are known as source regions. There are five main source regions. They are tropical maritime (Tm), polar maritime (Pm), tropical continental (Tc), polar continental (Pc) and equatorial (E).

Air drawn from these five source regions by the pattern of air movement associated with high and low pressure systems plays a major role in determining the weather and longer-term climatic conditions experienced at a particular location. The air masses that influence the climates of North America and Australia are shown in figure 1.2.16.

When two air masses from different source regions meet, the air from each does not mix straight away. This is because they have different temperatures and densities. The point where two air masses meet is known as a *front*. (See figures 1.2.15 and 1.2.17.) A warm front develops when warmer or moister air is forced to rise over colder or drier air. A cold front develops when advancing cold air undercuts a body of warm air. In both cases the rising air is cooled and condensation results in the formation of clouds. Precipitation often accompanies the passing of a front.

FIGURE 1.2.15

The point at which two air masses meet is known as a front.



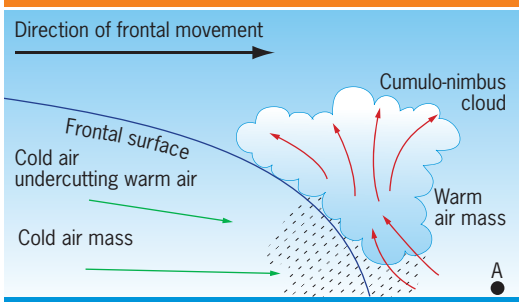


FIGURE 1.2.17

Warm and cold fronts.

did you know?

Warm fronts rarely occur in Australia but play a major role in the weather experienced in North America, Europe and Northern Asia.

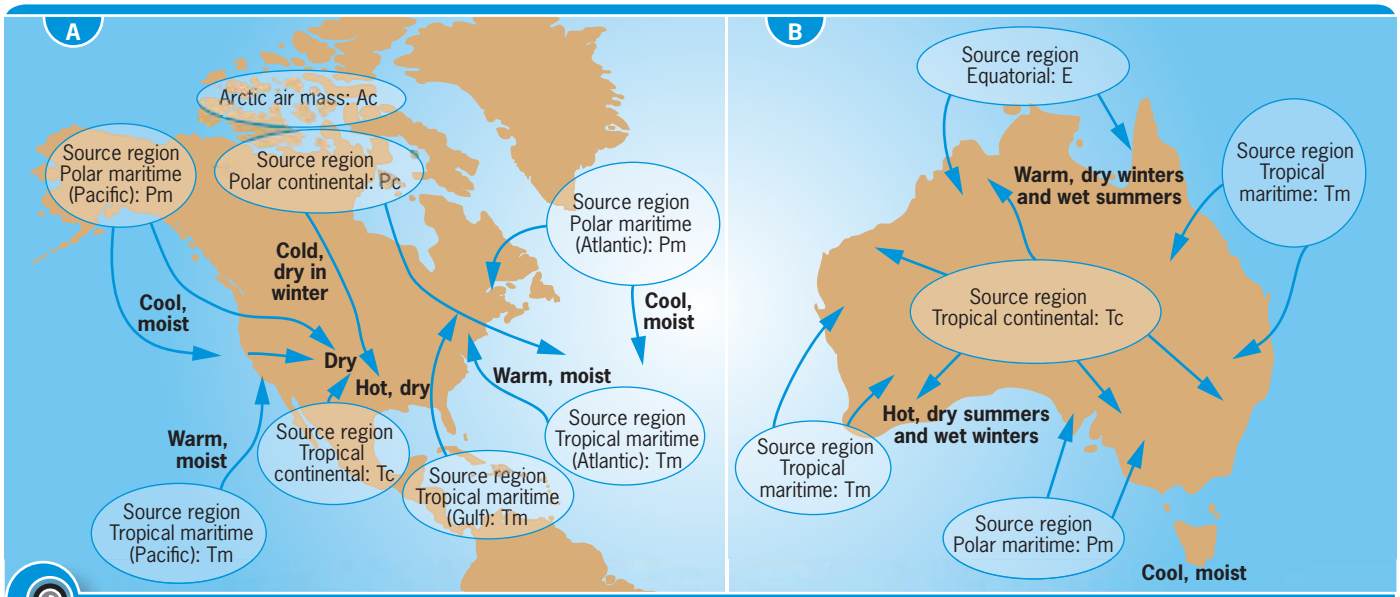


FIGURE 1.2.16

The source regions of the air masses that affect the climates of **A** North America and **B** Australia.

understanding the text

1 **Explain** what causes the global-scale movement of air within the troposphere.
2 **Describe** the relationship between atmospheric pressure and the movement of air across the earth's surface.
3 **Describe** the processes that lead to the development of a Hadley cell.
4 **Describe** the impact that the Coriolis effect has on air circulation in both the Southern and Northern Hemispheres.
5 **Describe** both high and low pressure systems and the weather conditions normally associated with them.
6 **Distinguish** between a cyclone and an anticyclone.
7 **Outline** the nature of tropical cyclones.
8 **Define** the term air mass. Name two types of air masses.
9 **Explain** the difference between a warm front and a cold front.

working geographically

1 **Writing task** Write an explanation outlining why the temperature of the atmosphere declines with increasing altitude.
2 **Interpreting diagrams** Study figure 1.2.9 (p. 22). Write a paragraph describing the pattern of air movement associated with high and low air pressure systems in the Northern and Southern Hemispheres.
3 **Interpreting text and diagrams** Study the Geofocus box 'Cyclone Larry' (p. 24).
   a Outline the impact of Cyclone Larry on the communities of North Queensland.
   b Examine figure 1.2.11. Write a short report describing the route taken by the cyclone.
4 **Writing task** Using the information in figure 1.2.16 (p. 25), write an explanation outlining how air masses can affect weather conditions in different parts of North America and Australia.
5 **Research task** Collect a series of Australian synoptic charts covering at least five consecutive days. Trace the passage of high and low pressure systems across the continent. Note the weather conditions associated with the passage of these pressure systems and write two or three paragraphs explaining what has occurred.

geofocus

Storms

Each year thousands of thunderstorms occur in New South Wales. Of these, about 100 are classified as 'severe' or likely to cause damage. Severe thunderstorms are those that produce any of the following:

- hailstones with a diameter equal to or greater than 2 cm
- wind gusts of 90 km/h or more
- flash flooding.

While severe thunderstorms can occur at any time during the year, they are more likely to occur during the months of September through to March. (See figure 1.2.18.) The incidence of severe storms during this period is primarily due to the increase in energy provided by the sun during the warmer spring and summer months, together with weather patterns that are favourable for storm development.

In addition to these seasonal variations there is a marked pattern of storm activity on a daily basis. Storm activity peaks between 2 p.m. and 6 p.m. (See figure 1.2.19.)

Conditions under which storms develop

The three conditions required for the development of thunderstorms are a source of moist air, an unstable atmosphere and a mechanism to initiate their development. Moist air is important because it condenses to form cloud. As condensation takes place, heat energy is released.

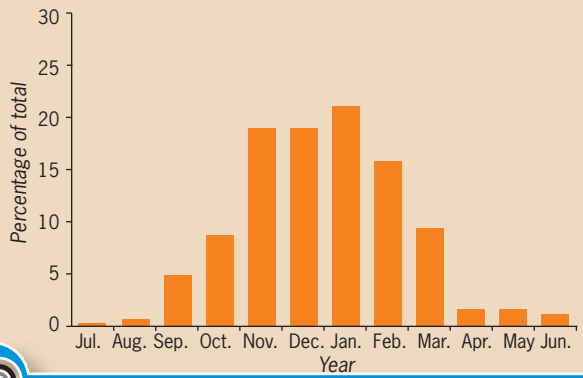


FIGURE 1.2.18
Monthly distribution of storm events in Sydney, 10-year average.

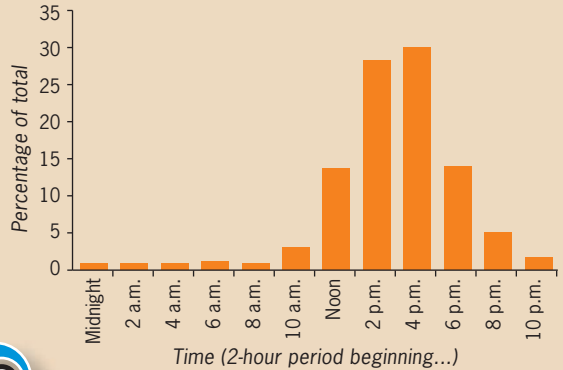


FIGURE 1.2.19
Time distribution of storm events in Sydney.

This makes the rising air more buoyant and promotes further cloud growth. Unstable atmospheric conditions allow developing clouds to rise to great heights in the atmosphere. The mechanisms that initiate thunderstorms are fronts, troughs and regions of low pressure. Landform features, such as mountain ranges, may also promote storm development.

The severity of a storm depends largely on the rate at which air rises. Severe storms occur when the atmosphere is very unstable and the upward movement of air is very rapid. Sometimes several storm cells, at different stages of their life cycle, are found within the same storm system. These 'multicellular' storms produce hail, strong winds and the possibility of flash flooding. In some cases, severe storms develop into long-lived thunderstorms called supercells. A supercell is a rare but unusually severe type of thunderstorm whose structure, behaviour, intensity and longevity are quite different from those of ordinary thunderstorms. These storms are associated with very large hail, extraordinary wind gusts and heavy rainfall. Figure 1.2.20 shows how hail develops within a storm.

Lightning and thunder

Lightning occurs when electrical energy is discharged during thunderstorms. Sometimes the lightning flash is between the cloud and earth. This is called *forked lightning*. At other times it occurs within the cloud and is known as *sheet lightning*. Thunder is the sound caused by the electrical discharge. Usually we hear the thunder after we see the flash of light. This is because sound travels more slowly than light.

Within thunderstorms there is a fast upward movement of air and moisture. This separates the positively and negatively charged particles. The top of the storm clouds usually has a positive charge, while the middle and bottom layers may have a negative charge. The ground below usually has a positive charge. When the difference is great enough, an enormous electrical spark jumps between the two charges; this is the flash of lightning. Some lightning flashes contain up to 30 million volts.

Hailstorms

One of the most damaging types of storms is a hailstorm. Hail is nothing more than frozen water that forms into chunks of ice due to very cold conditions in the upper atmosphere. Most hail melts before it reaches the ground. However, in hailstorms the hail reaches the ground while still in large chunks.

Hail has the potential to do great damage to buildings and cars and can even cause serious injury to people caught out in the storm. One of the most damaging hailstorms to ever strike Australia took place in April 1999. A massive hailstorm struck the Eastern Suburbs of Sydney on 14 April and caused more than $1 billion worth of damage, making it one of the most costly natural disasters in Australian history. More than 20 000 properties sustained roof and window damage in the storm and around 60 000 cars were also damaged, some so badly they were wrecked. (See figure 1.2.22, p. 28.)

On 21 December 2006 another massive hailstorm hit New South Wales. This one struck the town of Armidale in the New England region of the state. The storm left ice some 50 cm thick across much of the town and the short but violent storm led to flash flooding as gutters overflowed. More than 170 homes were damaged in the storm and the State Government created a natural disaster zone around Armidale. One of the most dramatic storm-related events occurred at the Armidale Exhibition Centre. The large roof area of the centre captured so much hail that the weight of the ice on the roof caused it to collapse. This left the whole building a wreck and caused more than $500 000 damage. It is common for people to take shelter in the centre during large storms, but fortunately the building was empty when it collapsed and so no-one was hurt.

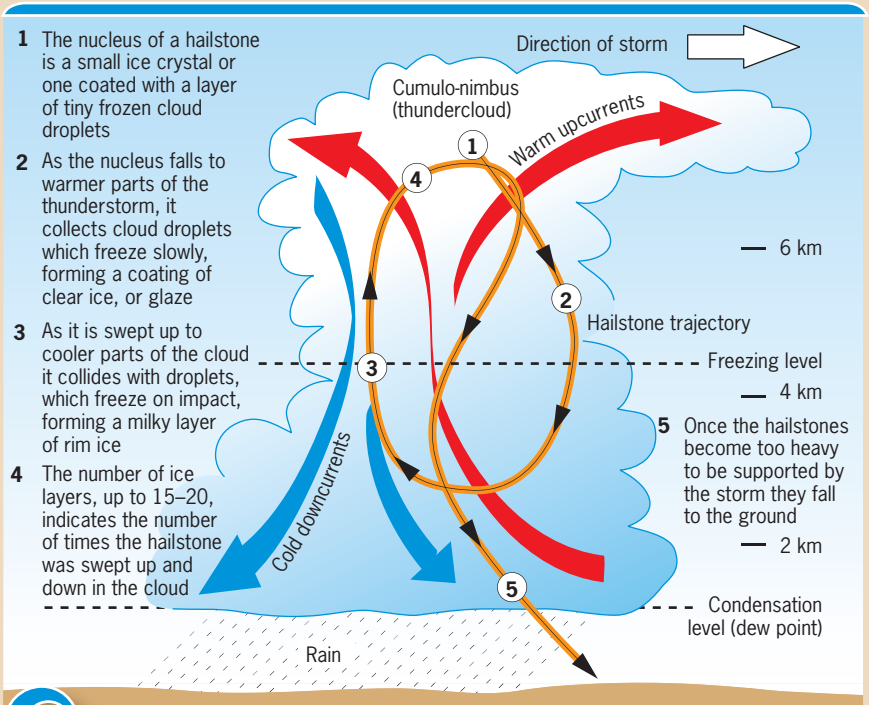


FIGURE 1.2.20

The formation of hail within a storm.

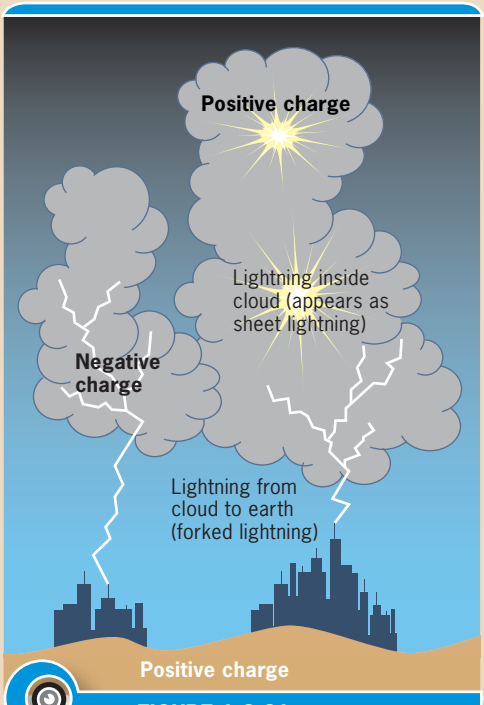


FIGURE 1.2.21

The differences in electrical charge between the top and bottom of storm clouds creates lightning.

understanding the text

1 **Distinguish** between a 'severe' thunderstorm and other storms.
2 **Outline** the conditions under which thunderstorms develop.
3 **Describe** the conditions under which severe thunderstorms develop.
4 **Distinguish** between 'multicellular storms' and 'supercells'.

working geographically

1 **Interpreting diagrams, writing task and using ICT** Study the Geofocus box 'Storms' (pp. 26–7).
   a Study figures 1.2.18 and 1.2.19. Write a paragraph describing the monthly and daily occurrence of thunderstorms in Sydney.
   b Study figure 1.2.20. Write an explanation outlining how hail develops within a storm system.
   c With the aid of an annotated sketch, write an explanation of how lightning and thunder occur.
   d Write a report detailing the impact of recent hailstorms in Sydney and Armidale.
   e Using digital newspaper databases and the Internet, research a recent severe storm. Outline the effects of the storm on the affected community and environment.

FIGURE 1.2.22
Hail-damaged roofs in Sydney.

The world pattern of climate

Major factors affecting the world pattern of climate

Five main factors determine the world pattern of climate (shown in figure 1.2.23). These are:

- variations in the amount of incoming solar radiation (insolation) reaching different parts of the earth's surface
- the revolution of the earth around the sun and its daily rotation on its axis
- the composition of the atmosphere
- the distribution of the continents and oceans
- topography.

Insolation variations

The amount of incoming solar radiation reaching the earth's surface varies with latitude. (See table 1.2.2.) Near the Equator the sun's rays are almost vertical and are concentrated on a small area of the earth's surface. Closer to the poles the sun's rays strike the earth's surface at an angle. This spreads the sun's rays over a larger area and results in less solar energy per unit area. (See figure 1.2.5, p. 19.)

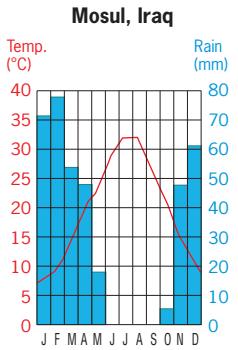
The relatively large input of heat near the Equator warms the air, which then rises due to heated air having a lower density than cold air. As the warmer air rises, it moves northwards and southwards, carrying heat away from the Equator towards the poles. As it does, it cools and begins to descend. These cool masses of air then flow back towards the Equator as surface winds, to fill the void left by the rising air. This pattern of air movement moderates global air temperatures.

The earth's revolution and rotation

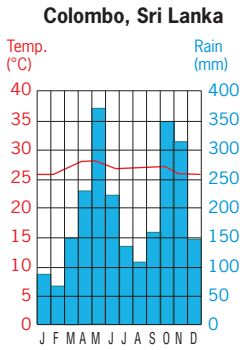
Other than at the Equator, where temperatures remain fairly constant throughout the year, average temperature patterns vary with the seasons. Seasonal variations occur because of the earth's annual revolution around the sun on an axis tilted at 23.5°. When the earth's South Pole tilts towards the sun, the sun's rays strike the Southern Hemisphere more directly and intensely than in winter when the South Pole is tilted away from the sun. This means that the Southern Hemisphere experiences summer while winter conditions prevail in the Northern Hemisphere. (See figure 1.2.25, p. 30.)

TABLE 1.2.2
Variations in solar insolation resulting from latitude

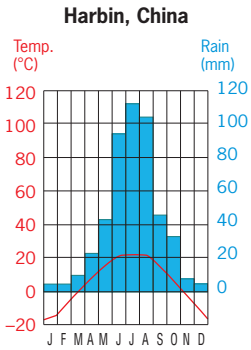
Latitude	Insolation percentage
0°	100.0
10°	98.6
20°	94.5
30°	88.0
40°	79.2
50°	68.5
60°	57.0
70°	47.4
80°	43.0
90°	41.6



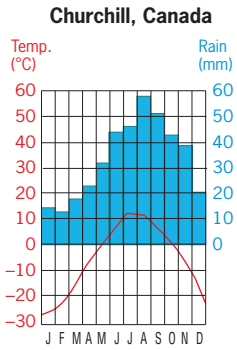
Annual average:
temperature 19.6°C
rainfall 384 mm



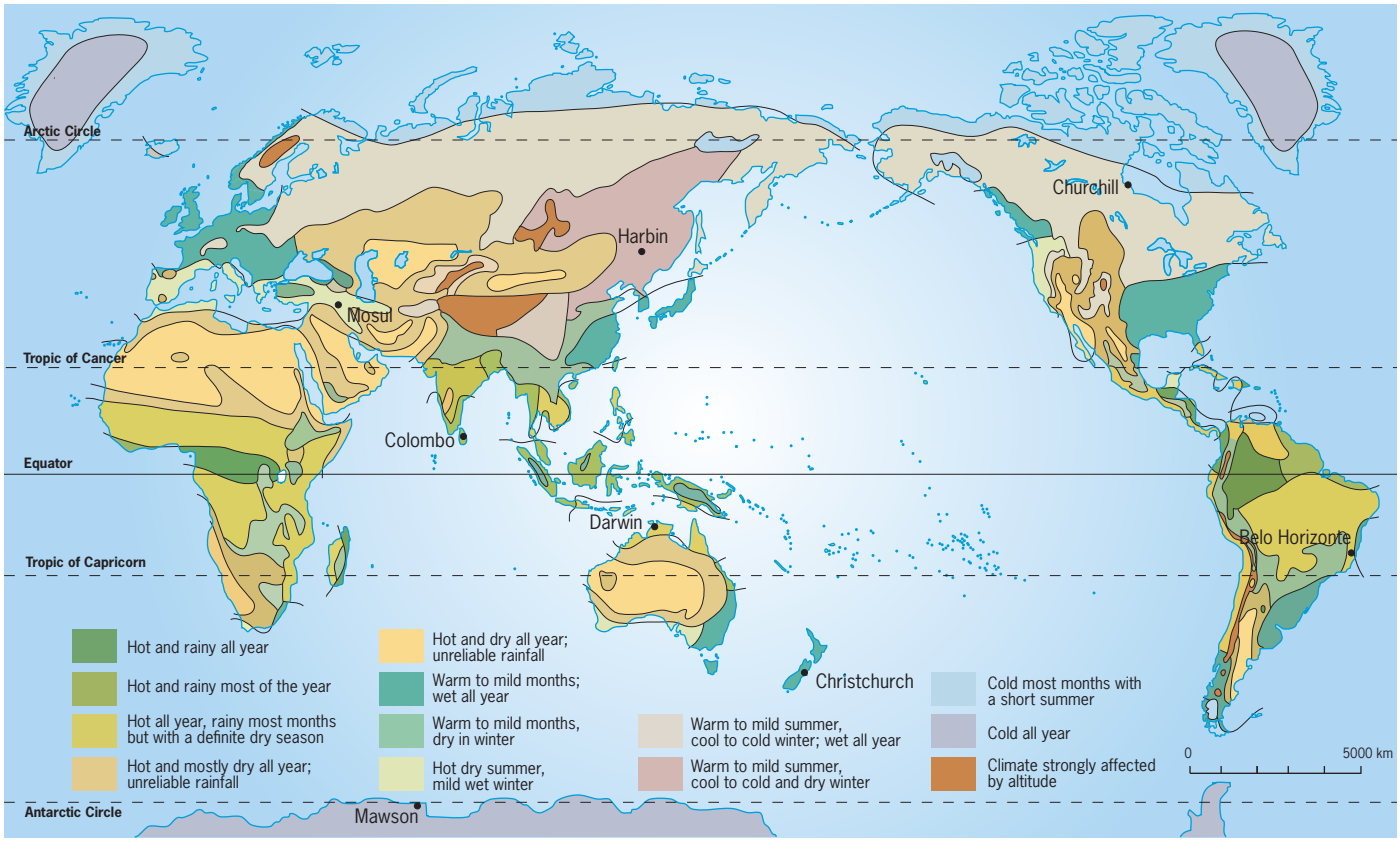
Annual average:
temperature 27°C
rainfall 2365 mm

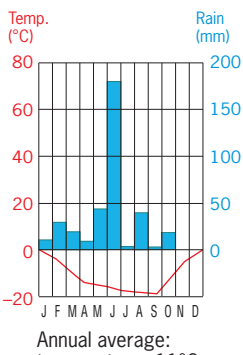


Annual average:
temperature 3°C
rainfall 488 mm

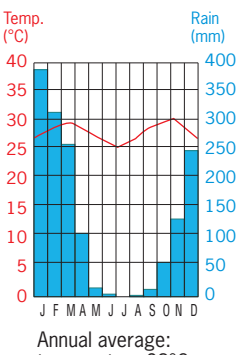


Annual average:
temperature –7°C
rainfall 402 mm

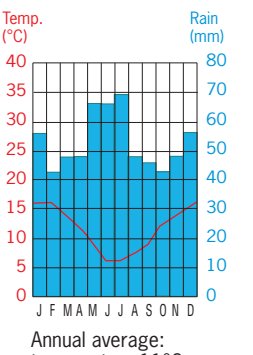




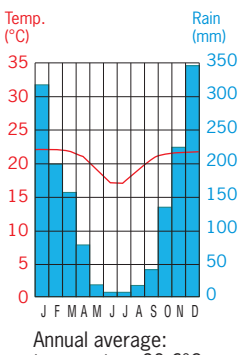
Annual average:
temperature –11°C
rainfall 362 mm



Annual average:
temperature 28°C
rainfall 1491 mm



Annual average:
temperature 11°C
rainfall 638 mm



Annual average:
temperature 20.6°C
rainfall 1561.5 mm

FIGURE 1.2.23

The world's major climatic zones and climate graphs for selected locations.

FIGURE 1.2.24

Solar energy is essential for plant growth.

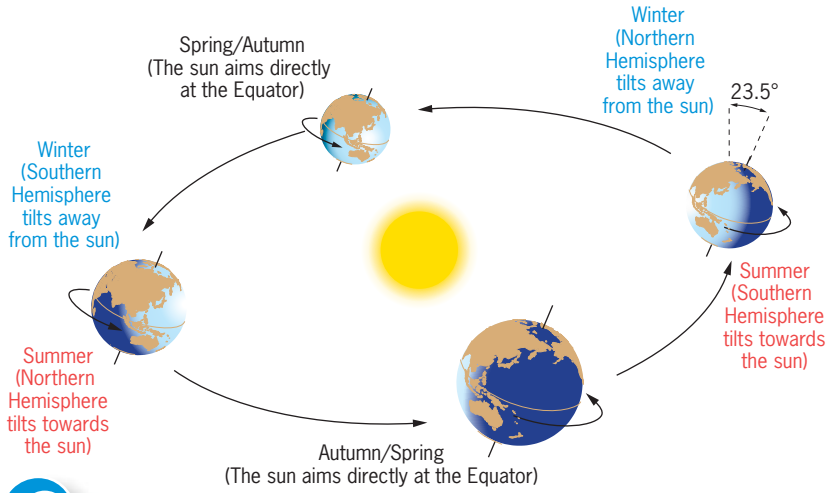


FIGURE 1.2.25

The revolution of the earth around the sun and its impact on climate.

The forces generated by the earth's rotation on its axis break up the general pattern of air circulation from the Equator to the poles. This creates six separate belts of moving air: three to the north of the Equator and three to the south of the Equator.

The revolution of the earth around the sun and the angle of the earth's axis also result in a variation in the length of night and day. The longer the day, the greater the amount of incoming solar radiation that can reach the earth's surface and therefore the more solar energy there is available for plant production.

The composition of the atmosphere

The composition of the atmosphere plays a major role in determining the earth's temperature and, therefore, its climate. In the troposphere, for example, CO_2 and water vapour are important in regulating temperatures. They let in the radiant energy of the sun but prevent some of it from escaping back into space. This creates what is often referred to as a 'natural greenhouse effect'.

If this natural greenhouse effect did not exist, the earth would be a cold and lifeless planet, with an average atmospheric temperature of just –18°C.

The distribution of the continents and oceans

Ocean currents also influence climate, especially in coastal areas. As warm ocean currents experience relatively high rates of evaporation, the coastal areas adjacent to them are likely to experience relatively high levels of precipitation, especially where the prevailing wind blows onshore.

Cold ocean currents are accompanied by relatively low levels of evaporation, and the air above them tends to contain little moisture. The earth's largest deserts adjoin coastal areas that are influenced by cold ocean currents.

Topography

Because of their altitude, mountainous areas tend to be cooler than adjacent areas at lower altitudes. The summit of Mt Kilimanjaro, Africa's highest mountain, is permanently covered with snow, even though it is located just to the south of the Equator.

did you know?

The snows that have covered the peak of Mt Kilimanjaro for centuries are beginning to melt as climate changes associated with human activity begin to take place.

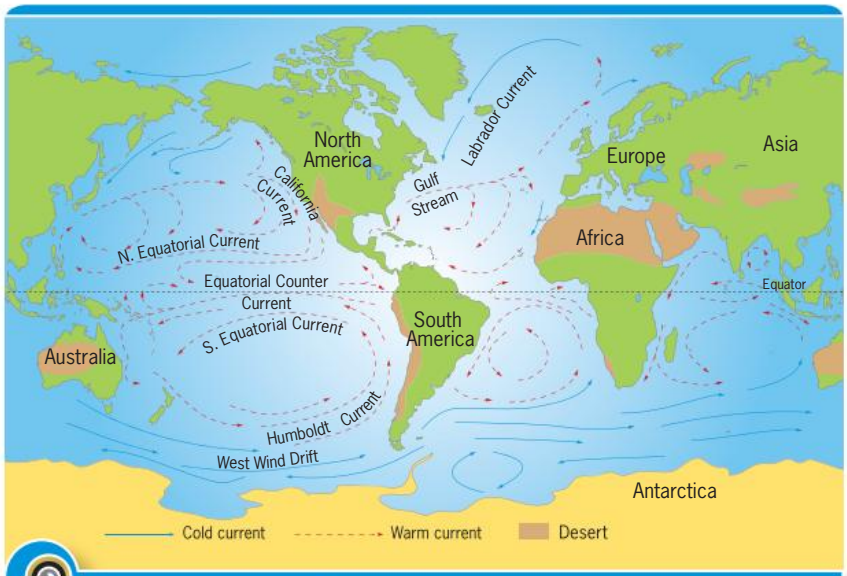


FIGURE 1.2.26

Location of the world's deserts and the role played by ocean currents in their formation.

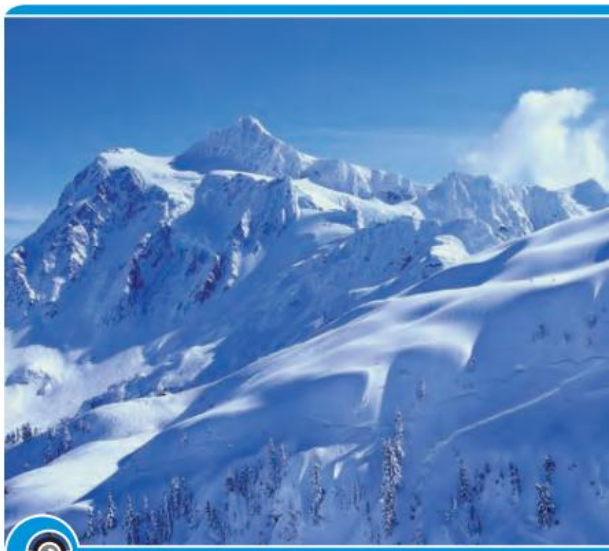


FIGURE 1.2.28

Mountain ranges interrupt air currents, causing variations in climate.

Mountain ranges, such as those in figure 1.2.28, also interrupt the movement of prevailing winds and the movement of moisture-laden air. When moist air is forced to rise it cools and expands. This causes it to lose most of its moisture as either rain or snow on the mountain range's windward side (the side exposed to the wind). This process produces what is known as the *rain-shadow effect or orographic rainfall*. (See figure 1.2.27.)

As the drier air flows down the leeward slope (the side sheltered from the wind) it is compressed and becomes warmer. Thus, deserts and semi-arid areas are often found on the leeward side of large mountain ranges. Products of the rain-shadow effect include the Mojave Desert, to the east of the Sierra Nevada Mountains in the United States, and the semi-arid regions adjacent to the Himalayas in Asia and the Andes in South America.

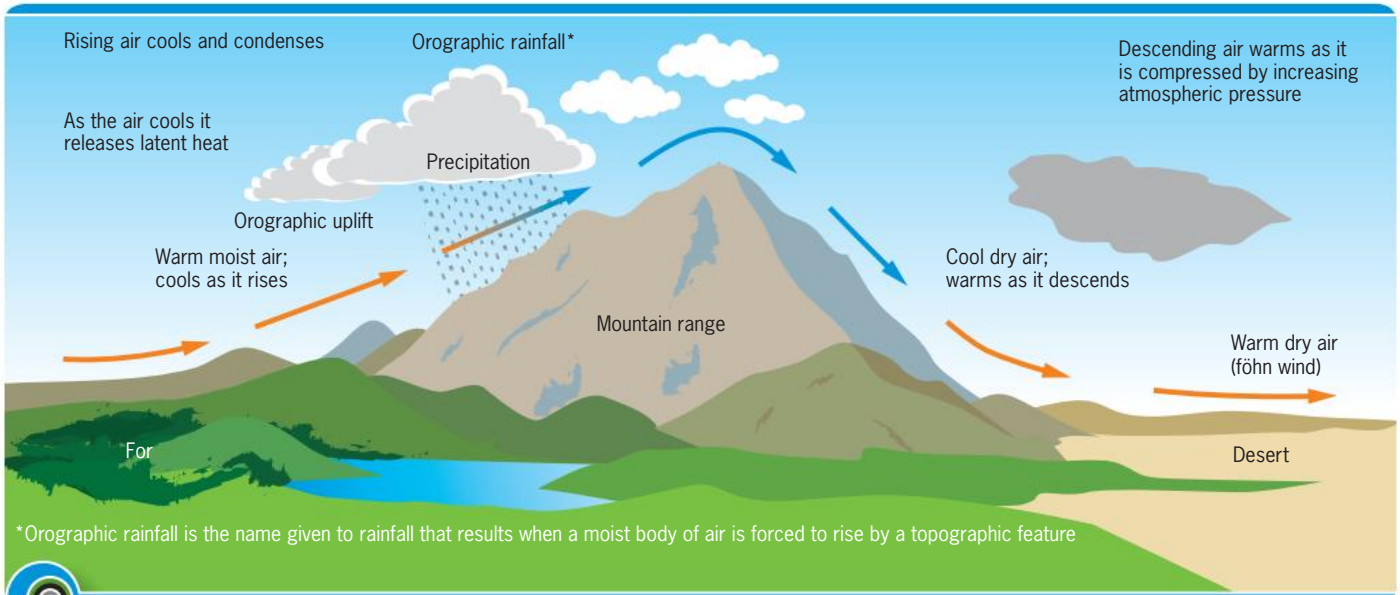


FIGURE 1.2.27

The impact of topography on climate.

did you know?

Up-valley and upslope winds create ideal conditions for hang-gliding.

Local climatic variations

Local conditions affect the climatic conditions prevailing in an area. Here are some examples.

Land and sea breezes

Land and sea breezes result from the differential heating of the sea and the adjacent land surface. The resulting differences in atmospheric pressure, although small, are significant enough to initiate a movement of air. As illustrated in figure 1.2.30, the sea breeze builds up in the late morning and dies off in the evening. At night, the sea retains heat longer than the adjacent land surface. Therefore, the atmospheric pressure over the sea drops slightly as thermal currents create uplift. The land breeze begins soon after sunset and dies off at sunrise.

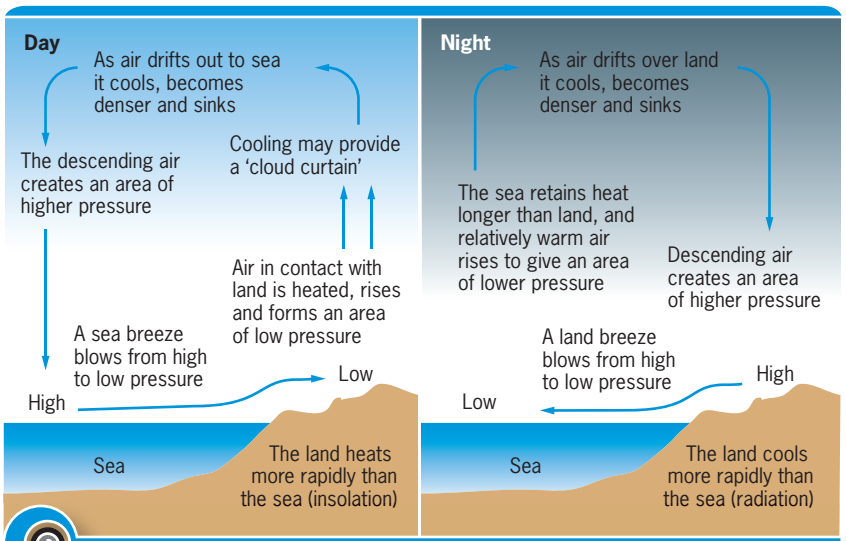


FIGURE 1.2.30

Formation of land and sea breezes.

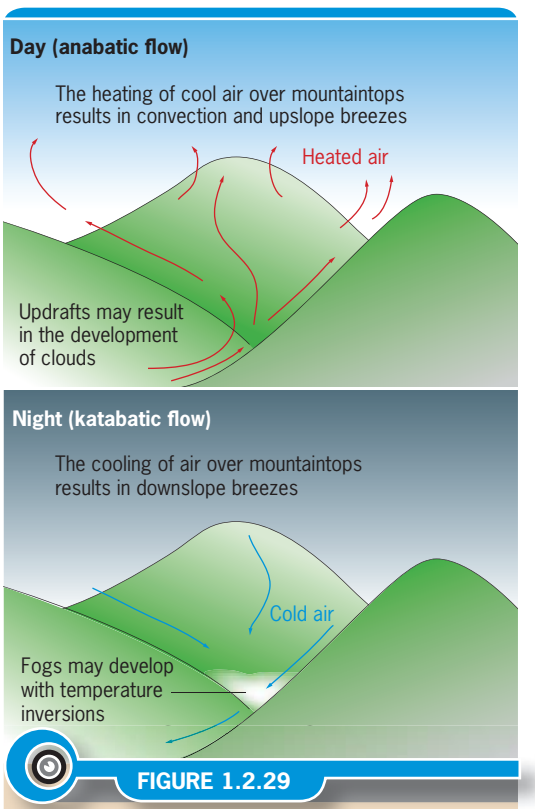


FIGURE 1.2.29

Formation of anabatic and katabatic winds.

Anabatic and katabatic winds

When valley sides are heated by the sun, the surrounding air is heated and expands. As the air rises, it creates a zone of relatively low atmospheric pressure. By mid-afternoon a strong uphill, or *anabatic*, wind develops. (See figure 1.2.29.)

At night, the valley sides and floor lose heat through radiation. The surrounding air becomes cooler and increases in density. As it does so, it begins to flow down the valley sides as a mountain, or *katabatic*, wind. This process often gives rise to **temperature inversion**. If the air contains enough moisture, a fog may develop in the valley.

understanding the text

1 **Explain** how variations in the amount of incoming solar radiation reaching the earth's surface affect climate.
2 **Outline** how the revolution of the earth around the sun and its daily rotation on its axis affect climate.
3 **Describe** the natural greenhouse effect.
4 **Explain** the relationship between the temperature of ocean currents and the climate experienced by nearby land surfaces.
5 **Outline** how topography affects climate.
6 **Explain** the cause of land and sea breezes.
7 **Describe** the differences between anabatic and katabatic winds.

working geographically

1 **Interpreting diagrams** Study the climate graphs in figure 1.2.23 (p. 29).
   - a Locate each of the climatic stations on the world map and name the climate type experienced by each.
   - b Name the station that has the:
     - i lowest annual rainfall
     - ii highest annual rainfall
     - iii highest average monthly rainfall recording
     - iv highest average monthly temperature
     - v lowest average monthly temperature
     - vi greatest seasonal variation in temperature
     - vii smallest seasonal variation in temperature
     - viii greatest seasonal variation in rainfall
     - ix smallest seasonal variation in rainfall.
   - c List those stations that experience a climate characterised by summer rainfall and winter drought.
   - d List those stations that experience high rainfall throughout the year.

2 **Interpreting diagrams** Study the map in figure 1.2.23 (p. 29).
   - a Comment on the longitudinal spread of those climates that are hot and wet for most of the year.
   - b Describe the distribution of hot and dry climates.
   - c Describe the distribution of those places that experience hot dry summers and mild wet winters.
   - d State the climate experienced by the following geographical locations:
     - Northern Australia
     - Sub-Saharan Africa
     - Tasmania
     - Alaska
     - Northern India
     - United Kingdom
     - Papua New Guinea
     - Northern Russia.

3 **Interpreting diagrams** Study figure 1.2.26 (p. 31). Write a report describing the pattern of the earth's ocean currents and the relationship between cold currents and the earth's deserts.

4 **Interpreting diagrams** Study figure 1.2.27 (p. 31). Explain the:
   - a formation of orographic rainfall and the föhn wind
   - b existence of deserts and semi-arid environments on the leeward side of large mountain ranges.

5 **Interpreting diagrams** Study figure 1.2.29. Write an explanation outlining the processes associated with the formation of anabatic and katabatic winds.

6 **Interpreting diagrams** Study figure 1.2.30. Write an explanation outlining the occurrence of land and sea breezes.

The development of microclimates

Significant climatic differences often occur over relatively small areas. The study of these climatic differences is known as microclimatology. The most widely studied **microclimates** are those associated with large urban centres. Other microclimates occur naturally and result from differences in factors such as aspect and type of land surface.

Urban microclimates

Large urban centres experience climatic conditions that are significantly different from those of surrounding rural areas. Cities generate more dust and other particles on which droplets of moisture form. Cities also create heat, alter the pattern of radiation, change the composition and moisture content of the air, and affect the pattern of air flow.

Sunlight

Despite having higher average temperatures, large urban centres often receive less sunshine and have more cloud cover than surrounding rural areas. Atmospheric particulates may absorb and reflect as much as 50% of insolation, especially in winter when the sun is lower in the sky.

Humidity

The relative humidity of urban air is often lower than that of the surrounding areas because warmer air can hold more moisture. The lack of vegetation limits **evapotranspiration**.

evapotranspiration the transfer of moisture from the earth to the atmosphere by evaporation of water and transpiration from plants.

Cloud formation and precipitation

Large urban centres experience an increased rate of cloud formation and higher precipitation. This is a result of the larger number of condensation nuclei present in the atmosphere, combined with the convection currents generated by higher urban temperatures. Cloud cover may be as much as 10% heavier over large urban areas, and strong thermal currents can increase the likelihood of thunder by 25% and hail by as much as 400%.

geofocus

Urban heat islands

Large urban centres alter the local (and sometimes regional) climate. They are generally warmer, rainier, foggier and cloudier than surrounding rural areas. Urban building materials and roads tend to be non-reflective and have a high capacity to absorb and retain heat. They absorb and store heat during the day and release it slowly at night. Additional heat is generated by factories, power stations, motor vehicles and people themselves. Rainfall runs off surfaces so fast that little surface water is available to cool the air through evaporation. This combination of effects creates an **urban heat island**. (See figure 1.2.31.)

In summer, cities can be up to 5°C warmer than surrounding suburbs and rural areas. In winter, urban temperaratures can be up to 1°–2°C higher. One indicator of warmer urban temperatures is the lower incidence of winter frosts experienced by urban centres compared with surrounding rural areas.

Under calm conditions, temperatures are highest in the centre of the urban area and decrease towards the outer suburbs and rural areas. The added heat can destabilise the atmosphere and change the way air circulates around cities. Mostly during the warmer months, the added heat creates wind circulations and rising air that can produce or enhance existing clouds. Under the right conditions, these clouds can evolve into rain-producers or storms.

The dome of heat traps atmospheric pollutants (especially tiny solid particles). This contributes to higher urban temperatures. Dust and other particulates act like a blanket, reducing the amount of radiation, and creating a *dust dome* above urban areas. If wind speeds increase, the dust dome spreads out to form a *dust plume*, which can spread the city's pollutants for hundreds of kilometres.

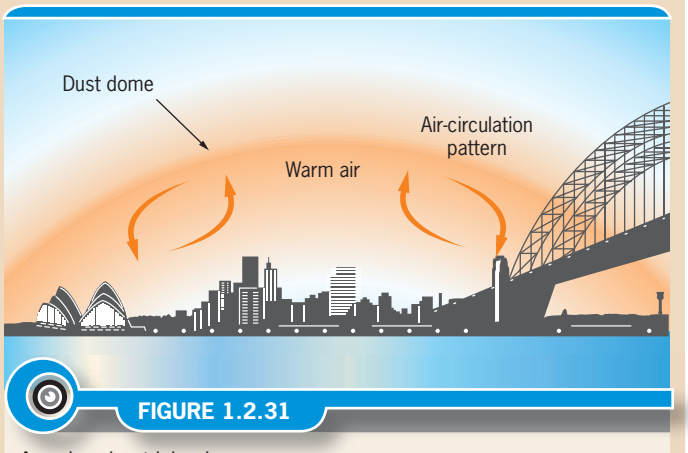


FIGURE 1.2.31

An urban heat island.

FIGURE 1.2.32

The tall buildings of large cities create artificial wind tunnels.

Wind

Wind velocities within urban areas are generally lower than those experienced in surrounding districts; on average, as much as 30% lower. Buildings and other urban structures create surface friction and form windbreaks.

Large buildings also form 'canyons' through which winds are channelled at higher velocities. Buildings also cause small-scale disturbances, such as eddies.

Aspect-induced microclimates

Aspect refers to the direction in which a slope faces. Slopes that face the Equator have a northerly aspect in the Southern Hemisphere and a southerly aspect in the Northern Hemisphere. These slopes receive more direct sunlight than slopes that face towards the poles. Slopes with an easterly aspect receive their direct sunlight during the morning when temperatures are usually lower. Western-facing slopes receive their direct sunlight during the hottest part of the day. Slopes not exposed to direct sunlight have a cooler, moister microclimate than those exposed to longer periods of direct sunlight. (See figure 1.2.33.)

In mountainous regions, agricultural landuses and settlements are usually found on the sides of the valleys that receive most direct sunlight. Vegetation patterns also respond to the differences in exposure to sunlight. Along Australia's eastern seaboard, for example, it is not unusual to find pockets of rainforest or wet sclerophyll forest on slopes that have a southerly or easterly aspect. In Australia's Snowy Mountains, ski slopes are those that face either east or south. On these slopes, snow conditions are better for longer periods of time.

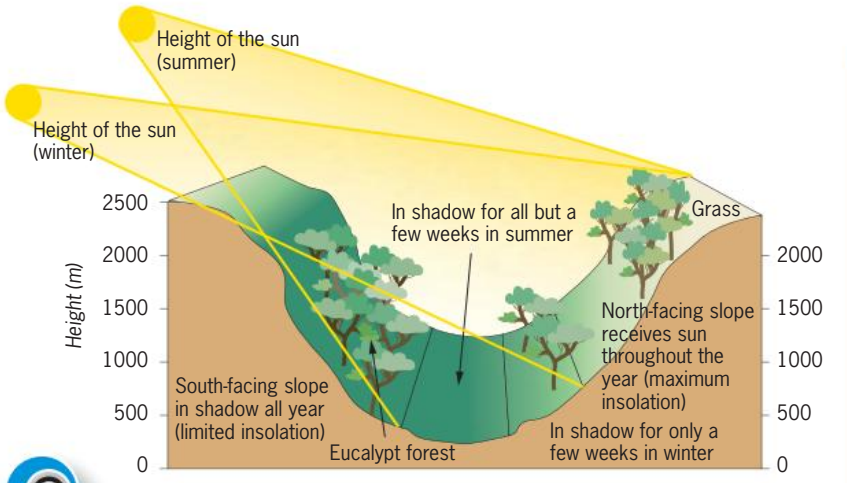


FIGURE 1.2.33

Impact of aspect on climate.

Microclimates resulting from differences in land surfaces

Different land surfaces often produce quite distinctive microclimates. Forested areas, for example, absorb and trap larger amounts of incoming radiation compared with more exposed surfaces. The canopy of leaves acts as a blanket. As a result, forests have a small **diurnal range** of temperature (the difference between the daily maximum and minimum). Forests have a higher level of relative humidity due to evapotranspiration. Precipitation is also higher due to the moisture pumped into the air by trees. Wind velocities are reduced in forests because trees act as a windbreak.

FIGURE 1.2.34

Vegetation impacts on local climate by increasing humidity levels and absorbing greater solar radiation.

geoskills 2

Studying microclimates in your local community

1. Using thermometers, measure and record the air temperature at various locations within the school grounds. Examine the nature of the areas in which your individual recordings were made and then try to account for the different temperatures recorded. Compare your results, and plot the locations of the recording sites on a map of the school.
2. Investigate the impact of large buildings in the school on wind flow by using light strips of cloth pinned to the top of sticks hammered into the ground.
3. As a class, measure and record variations in temperature and rainfall within your local community. All take thermometers home with you and at a prearranged time measure the temperature of the air in your backyards. All construct simple rain gauges to record the amount of rainfall experienced in your backyards within a predetermined period of time. Record your findings on a map of the local community. Examine the findings and note any variation in the temperature and rainfall patterns.
4. Locate a small valley with slopes that have a southerly and northerly aspect. Measure the air temperature on each slope and compare your results. Note any differences in the vegetation types found on each slope.
5. If you live in a rural-based urban centre compare the number of frosts experienced in the town with the number experienced in the surrounding district. You may have classmates who live in the surrounding district who could provide you with this information. If you live in a city, contact the Bureau of Meteorology to find out how many days of frost were experienced in the previous 12 months.

understanding the text

1 **Define** the term microclimatology.
2 **Explain** how urban areas create their own microclimates. In your answer make specific reference to temperature, sunlight, humidity, precipitation and wind velocity.
3 **Explain** how aspect can produce a microclimate.
4 **Explain** how a specific type of land surface can produce its own distinctive microclimate.

FIGURE 1.2.35

Industry is one of the major sources of air pollution. Many industrial processes create sulfur and nitrogen oxides, which pose risks to both humans and plant life.

acid rain precipitation that has been made acidic by airborne pollutants.

geojobs

Meteorologist

Meteorologists forecast the weather and study the atmosphere to improve our understanding of weather and climate. They use their knowledge and skills to:

- prepare forecasts for the public and for specific user groups, such as farmers
- issue warnings for cyclones, storms, floods and frosts
- study climate and climatic changes
- analyse and interpret satellite images and other remote sensing data about atmospheric conditions.

Sydney's Macquarie University offers a Bachelor of Science (Atmospheric Science).

Consequences of human interactions with the atmosphere

The earth's atmosphere exists in a state of dynamic equilibrium. Any disturbance to this equilibrium impacts on the atmospheric balance and the balance of the biosphere as a whole. In relatively recent times the atmosphere has been adversely affected by the activities of the human population. The release of gases into the atmosphere disturbs the existing atmospheric balance either directly, as in the case of CO_2 emissions, or indirectly, as in the case of manufactured gases, such as chlorofluorocarbons (CFCs).

There have been decades of warnings and efforts to control atmospheric pollutants and their effects. Despite this, urban dwellers are still exposed to unacceptably high levels of toxic pollutants, forests and waterways continue to be degraded by acid deposition, the earth's protective **ozone layer** has been damaged by human-produced chemical gases, and global warming is set to induce global climatic change.

Issues that transcend international boundaries

One of the major issues associated with **atmospheric pollution** is the disparity between the source of pollutants and their atmospheric and terrestrial impacts. Once a pollutant is released into the atmosphere its distribution is a function of the prevailing winds and weather patterns. Pollutants are thereby dispersed over thousands of kilometres, making their emission relevant to countries throughout a region. **Acid rain** is one example of a 'transboundary' pollutant.

The explosion in one of the four reactors of the Chernobyl nuclear power plant in the Ukraine is another example. The disaster resulted in nuclear fallout throughout Europe and even in parts of the United States and Japan, increasing the risk of cancer and damaging plant and animal life.

The effects of CFCs also extend well beyond the points of production and consumption. CFCs used in North America and Europe may damage the atmosphere over Antarctica. Use of aerosol sprays in Italy may cause a reduction in crop yields and an increase in the incidence of skin cancer in Australia and New Zealand.

Air pollution

Air pollution can cause breathing difficulties and other health problems in humans, aggravating diseases such as asthma and pneumonia and contributing to the development of cancer and emphysema. Air pollution also harms plants and animals.

Two of the most serious causes of air pollution are the oxides of sulfur and nitrogen. A major source of these compounds is the burning of **fossil fuels** (coal, oil and natural gas) in industry and transportation. These pollutants are often associated with high levels of toxins (such as lead, zinc and ground-level ozone, a component of smog).

Urban air quality

Smog

Photochemical smog is a complex mixture of air pollutants that are produced in the atmosphere by the reaction of hydrocarbons and nitrogen oxides under the influence of sunlight. Car exhaust fumes are the main source of smog in urban areas. The action of sunlight on the mixture of hydrocarbons and nitrogen oxides results in a range of secondary pollutants, the main one being ozone. Ozone is a colourless gas, which in high concentrations causes eye irritation and can induce allergic reactions (such as asthma and hay fever) or chronic disorders (such as bronchitis and cardiac conditions). Smog can also cause extensive damage to urban trees, and to forests adjacent to urban centres.

Smog is a major environmental issue in most large urban centres. It is particularly severe in those cities where prevailing meteorological conditions and topography restrict the movement of air. Those cities include Athens, Bangkok, Los Angeles, Mexico City and Tokyo. Atmospheric pollution, including smog, is a major problem in those cities. In many cities, government authorities have been forced to institute measures to address the problem. Vehicle-free days and strict emission controls are among the strategies used.

Smog becomes a critical issue in areas that are subject to frequent temperature inversions. In the city of London, a special tax known as the congestion tax has dramatically reduced the number of cars in the city. This has had the added benefit of significantly improving air quality.

Temperature inversions occur when weather conditions trap a layer of dense, cool air beneath a layer of less dense, warm air in an urban basin or valley. In figure 1.2.36, a layer of warm air covers the region, preventing pollutants from escaping in upward-flowing air currents. If the temperature inversion were to last for several days, the amount of ground-level pollution could build up to harmful, and even lethal, levels.

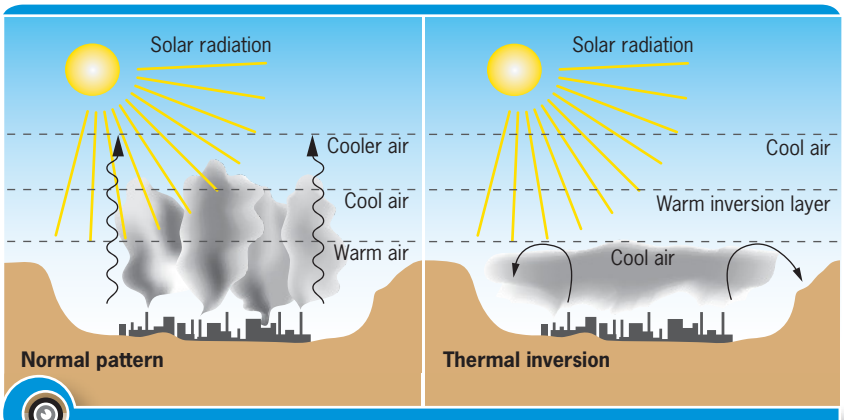


FIGURE 1.2.36

Temperature inversions trap pollutants below a layer of warm air.

Los Angeles is another city that is notorious for its smog. The city's geographical features create conditions that are ideal for the formation of a temperature inversion. These features are its prevailing wind pattern and surrounding mountains. Controls on vehicle emissions have achieved some success in reducing the level of air pollution.

Sydney's relatively high levels of atmospheric pollution are closely linked to its high traffic density, meteorological conditions and

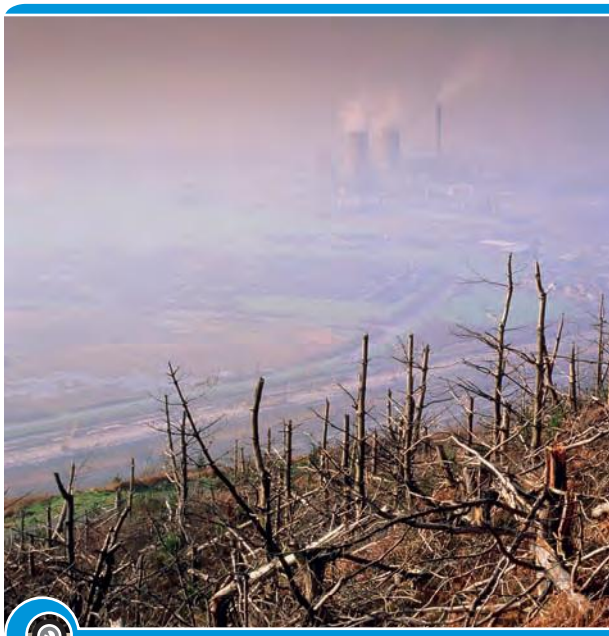


FIGURE 1.2.37

Acid rain has killed vast areas of forest in North America and Europe.

topography. Peak levels of ozone are recorded in the calmer weather conditions that prevail in summer and autumn. Sydney's topographical features exacerbate the problem. The elevated topography to the west and north often acts as a barrier to the dispersal of pollutants. Figure 1.2.38 shows the daily inputs and outputs of matter and energy of a city of 1 million people.

Acid rain

One of the most serious outcomes of air pollution is *acid rain*. Industrial and vehicle-exhaust emissions of sulfur and nitrogen oxides combine with moisture in the atmosphere to form sulfuric and nitric acids. Pollutants are distributed into the atmosphere according to the prevailing weather patterns and can be dispersed thousands of kilometres from their original source. Eventually the acidic compounds fall back to earth as 'acid' rain or snow. Figure 1.2.39 shows how acid rain is formed. Figure 1.2.40 shows the areas of the world affected by acid rain.

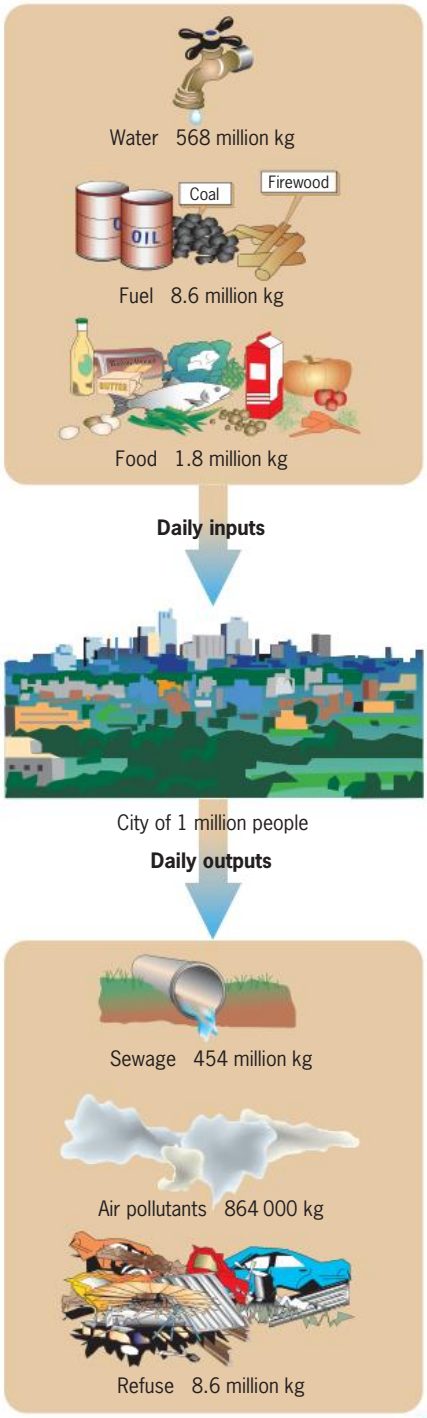


FIGURE 1.2.38

Daily inputs and outputs of matter and energy of a city of 1 million people.

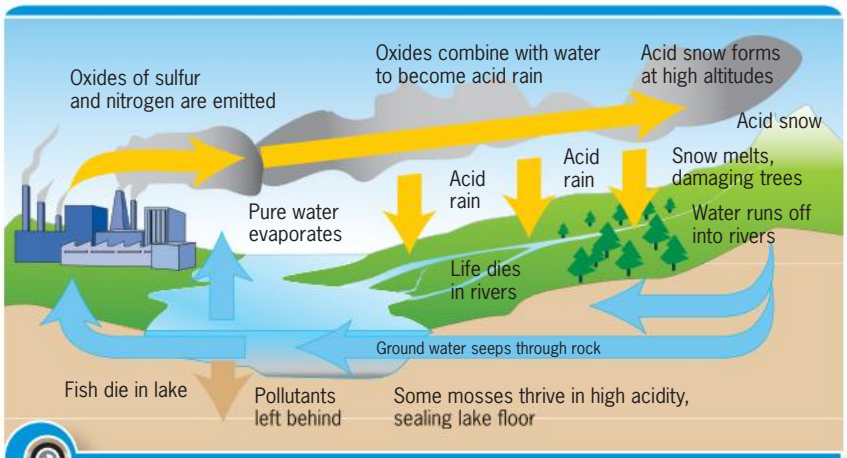


FIGURE 1.2.39

The creation and effects of acid rain.

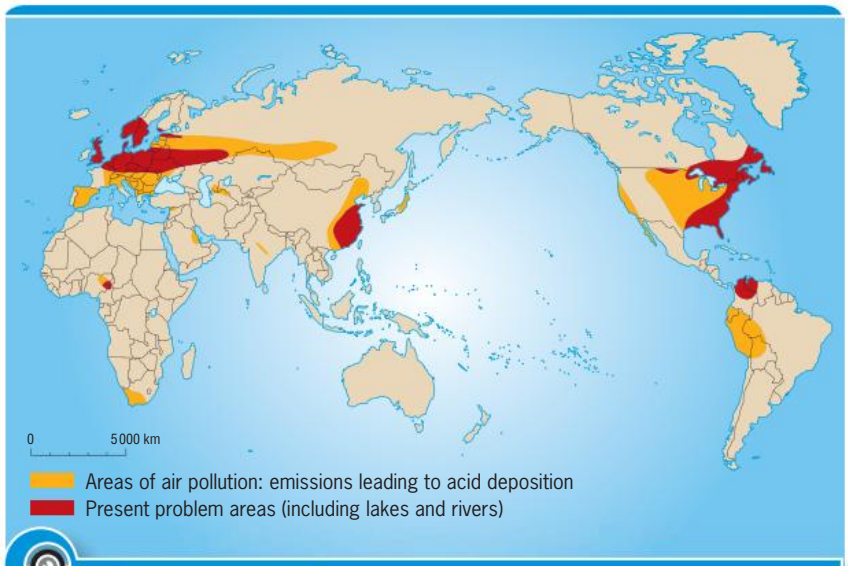


FIGURE 1.2.40

Areas affected by acid rain.

did you know?

In Sweden it is estimated that up to 18000 lakes have been poisoned by acid rain.

understanding the text

1 a **List** the main environmental issues associated with human interactions with the atmosphere.
  b **Explain** why these issues 'transcend international boundaries'.
2 **Outline** the main sources of atmospheric pollutants.
3 **Describe** the nature of photochemical smog and how it impacts on the well-being of humans.
4 **Define** the term temperature inversion.
5 **Explain** the link between temperature inversions and high levels of atmospheric pollution.
6 **Describe** the processes that lead to the formation of acid rain.
7 **Describe** the effects of acid rain.

working geographically

1 **Writing task and Internet research** Study the Geofocus box 'Urban heat islands' (p. 34).
  a Write an explanation outlining how the phenomenon of the urban heat island occurs. Explain how it affects air quality in large urban centres.
  b Undertake Internet research. Find more information about urban heat islands and their effects. Use it to supplement your explanation in activity 1a.
2 **Writing task** Study figure 1.2.36 (p. 37) and the text. Write an explanation outlining the formation of a temperature inversion and its relationship to atmospheric pollution.
3 **Writing task** Study figures 1.2.39 and 1.2.40. Write an explanation outlining the processes culminating in acid precipitation. Identify the areas affected by acid rain.

geofocus

Global climate change

Rising global temperatures and sea levels, melting glaciers and shrinking areas of sea ice are part of the mounting evidence that the earth's climate is changing. The vast majority of scientists are convinced that people are to blame for these changes. Burning fossil fuels and farming are just two of the various activities that release heat-trapping gases into the atmosphere. In the atmosphere, these greenhouse gases absorb the heat that comes from the earth and radiate it back to the planet's surface. This enhances earth's natural greenhouse effect. (See figure 1.2.41.)

Between 1906 and 2006, the average surface temperature of the earth rose by 0.6–0.9°C. By 2006, greenhouse gas concentrations had reached their highest levels in at least the past 650 000 years. (See figures 1.2.42 and 1.2.43, p. 40.) Scientists believe that if these trends continue, temperatures are likely to rise by 2–6°C by the end of the twenty-first century. This change may seem small, but it will probably lead to major environmental changes.

Scientists argue that global climate change will lead to more frequent heat waves, bigger storms (including more intense tropical cyclones, or hurricanes) and more widespread drought. Even minor increases in average temperatures can threaten entire ecosystems. The world's coral reefs and animal species such as the polar bear are... (cont. on p. 41)

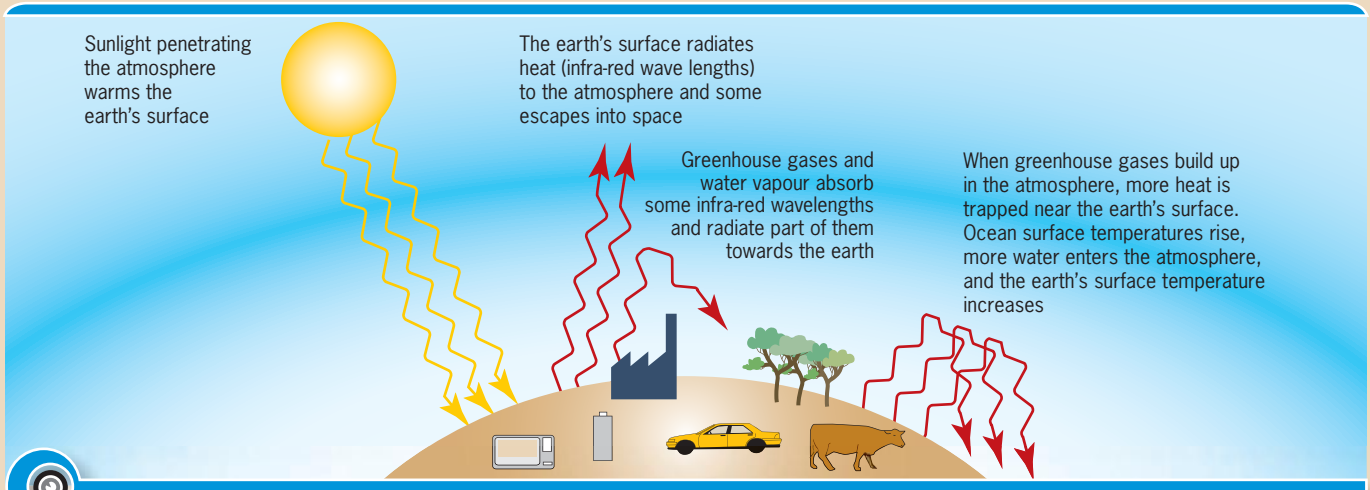


FIGURE 1.2.41

The greenhouse effect.

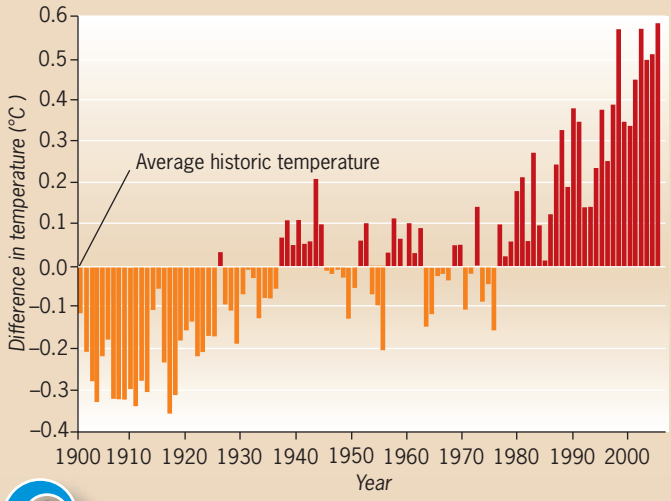


FIGURE 1.2.42

Trends in global temperature. This graph shows differences in global land-sea temperature (that is, how much warmer or colder it was each year compared with the average temperature between 1951 and 1980) from 1900 to 2005.

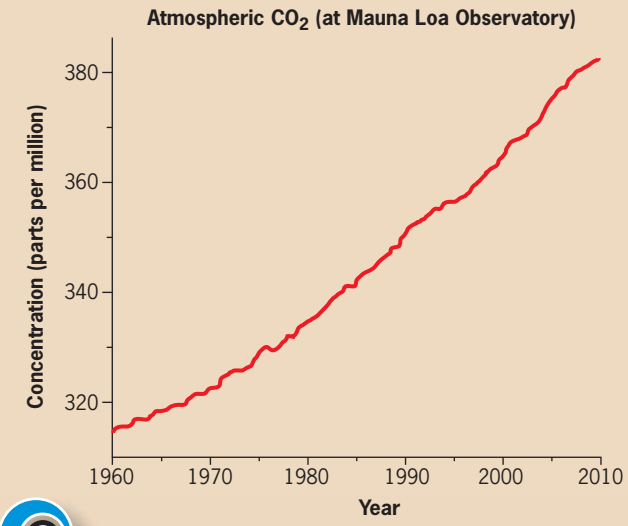


FIGURE 1.2.43

Trends in atmospheric CO_2 concentrations. In 1850, about 280 out of every million air molecules were CO_2. By 2007, the concentration exceeded 380 parts per million and, if no steps are taken to slow this trend, scientists predict it will increase to 700 parts per million by 2100.

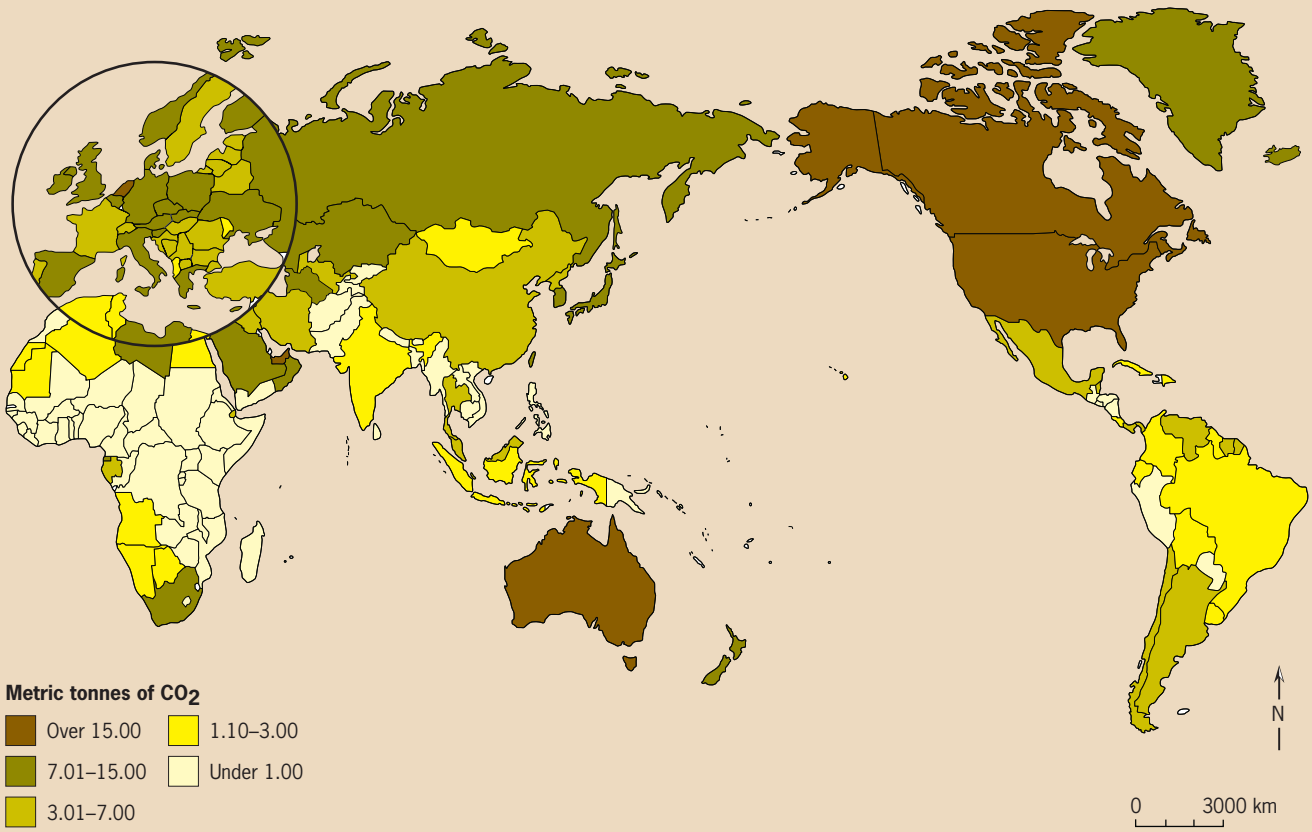


FIGURE 1.2.44

CO_2 emissions per capita, 2006.

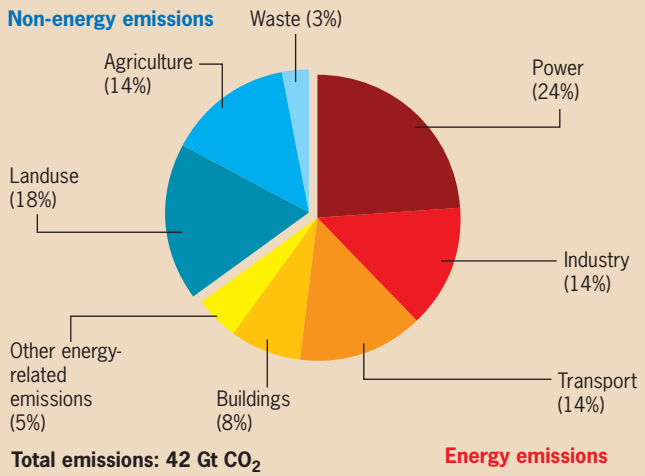


FIGURE 1.2.45

Sources of greenhouse gas emissions, 2000.

TABLE 1.2.3

Top 10 CO_2 emitting countries and Australia

Rank	Country	CO_2 emissions ('000 metric tonnes)
1	United States	6049435
2	China	5010170
3	Russia	1524993
4	India	1342962
5	Japan	1257963
6	Germany	808767
7	Canada	639403
8	United Kingdom	587261
9	South Korea	465643
10	Italy	449948
19	Australia	326757

World total CO_2 emissions: 27245758 thousand metric tonnes

Source: Data collected in 2004 by the CDIAC for the United Nations (CDIAC is the Carbon Dioxide Information Analysis Center, an organisation within the US Department of Energy)

(cont. from p. 39) ...threatened with extinction. Higher sea levels will result from melting of glaciers and the polar ice caps and will increase coastal erosion. Up to 10% of the world's population lives in coastal regions that have an elevation less than 10 m above sea level, making them vulnerable to a rise in sea level.

The greenhouse effect

As we have already discovered, the earth is protected by radiation-absorbing gases, such as CO_2 and water vapour. These retain some of the earth's warmth in what is often referred to as the *greenhouse effect*. (See figure 1.2.41, p 39.) Without these gases the surface temperature of the earth would be too cold to support life.

Atmospheric concentrations of CO_2 began to increase with the onset of the Industrial Revolution. In 1750, CO_2 concentrations were about 280 parts per million by volume (ppmv). Today, they exceed 360 ppmv, and are expected to grow to 450 ppmv by 2025. Experts now predict a global increase in average temperatures of 1.5°C to 4.5°C, with a 'best guess' mean increase of about 3°C (1°C at the Equator and up to 7°C at the poles) by 2100. Between 1940 and 2005, global temperatures increased by 0.6°C. Until recent times, global temperatures did not vary by more than 2°C over 100000 years.

The consumption of fossil fuels in the industrialised developed countries has contributed disproportionately to the threat of global climatic change. The main CO_2 producers are the developed countries that are dependent on fossil fuels. The United States alone accounts for 25% of greenhouse gas emissions, followed by Western Europe and the countries of Eastern Europe and Russia. While the earth does have a capacity to absorb greenhouse gases, many of the developing countries are questioning how this capacity can be shared in a more equitable way. The sources of CO_2 emissions are shown in figure 1.2.45.

Other human-influenced greenhouse gases include methane, which accounts for 15% of global warming, CFCs (22%) and nitrous oxides (6%). Methane emissions are difficult to control because they come from cattle, rice paddies and other wetlands, and leaks associated with the gas and coal industries. CFCs are manufactured by humans and are used in refrigeration equipment and fire-retardant products and as aerosol propellants. Nitrous oxides, as we have seen, are produced by the chemical reaction of sunlight with aerial pollutants produced by car exhausts and industry.

geoskills 3

Choropleth maps

Choropleth maps use shading and colour to show the quantity or density of features, such as population, rainfall and temperature. Different ranges of values are selected for the feature and a colour or shade allocated to each range of values. When drawing choropleth maps, each area that falls within a particular range is allocated the appropriate colour or shade until the overall pattern is revealed. Shadings should grade from the deepest colour/highest density downwards.

When interpreting choropleth maps it is important to remember that considerable differences can exist within an area, even though areas may have the same colour or type of shading. World maps, for example, usually present data for particular nation-states. National borders often become the boundaries between different ranges of values, resulting in generalisations and the neglect of localised variations in the feature being mapped.

Possible impacts of human-induced climate change

Scientists fear that global climate change will result in widespread environmental, social and economic dislocation. Many argue that it has the potential to cause large-scale disruption to the planet's **biota**, agriculture and sea levels.

The following are among the anticipated results of global climate change:

- Sea levels are expected to rise by as much as 1 m by 2100 as a result of the partial melting of the polar ice caps and the thermal expansion of water. Warm water expands and hence sea levels rise. This will affect densely settled, low-lying coastal areas and may, in time, result in the inundation of some low-lying island countries, such as those in the South Pacific Ocean.
- Climatic zones could shift several hundred kilometres towards the poles.
- A larger global expanse of water will result in higher levels of evaporation and increases in global rainfall.
- Patterns of agricultural production will undergo change. Because average temperatures are expected to increase at higher latitudes than those near the Equator, the more northerly and southerly agricultural land is likely to become more productive.
- Fragile ecosystems that are sensitive to climatic changes, such as coral reefs, are likely to collapse.
- Changes in temperature and humidity could affect the global distribution of disease-carrying insects and parasites.
- More people are likely to become vulnerable to the effects of drought, flooding and famine. This could increase the number of refugees.
- The occurrence of extreme weather conditions is likely to increase. (See figure 1.2.52, p. 45.)

The science is in. The facts are there that we have created… a self-inflicted wound… through global warming.

Arnold Schwarzenegger, Governor of California

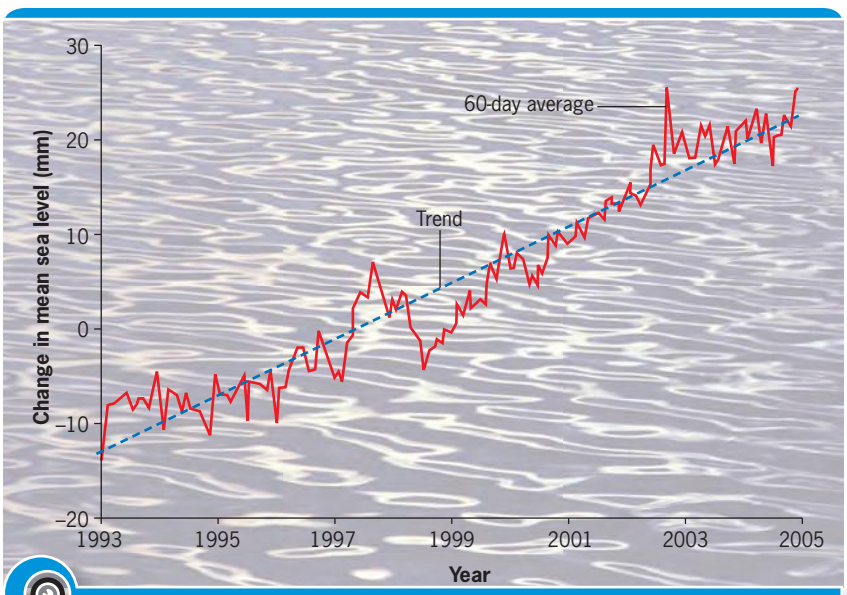


FIGURE 1.2.46

Sea level change, 1993–2005.

biota the animal and plant life of a given area.

working geographically

1 **Writing task** Study figure 1.2.41 (p. 39). Write an explanation outlining the process of global warming.

2 **Interpreting diagrams** Study figure 1.2.42 (p. 40).
- a Describe the trend in global temperatures.
- b In 2005, how much hotter was it than the average temperature between 1951 and 1980?
- c In what year did the sustained upwards trend in global temperatures become established?

3 **Interpreting diagrams** Study figure 1.2.43 (p. 40).
- a By how much did atmospheric CO_2 concentrations increase between 1960 and 2005?
- b In what year did atmospheric concentrations of CO_2 first exceed 360 parts per million?

4 **Interpreting diagrams** Study figure 1.2.44 (p. 40).
- a With the aid of an atlas, identify five countries with CO_2 emissions per capita greater than 15 metric tonnes.
- b Describe the distribution of countries with levels of CO_2 emissions per capita less than 3 metric tonnes.

5 **Interpreting diagrams** Study figure 1.2.45 (p. 41).
- a What is the largest single source of CO_2 emissions?
- b What percentage of total emissions is energy related?
- c What percentage of CO_2 emissions came from industry?
- d What is the total amount of CO_2 produced by agriculture?
- e What is the total amount of CO_2 emitted by power generation?

6 **Constructing diagrams** Study table 1.2.3 (p. 41). Construct a column graph showing the 10 largest CO_2 emitting countries. Add Australia to this graph.

geofocus

Glaciers slowly disappearing

There are an estimated 160 000 glaciers across the earth's polar regions and high mountain environments. Appearing to be huge rivers of ice, these glaciers have carved out great valleys and shaped mountains. Since 1980, the rate of glacial retreat has become more rapid and widespread. (See figure 1.2.47.) This process has increased markedly since 1995. In the last 30 years, the surface area of Peru's glaciers, for example, has diminished by almost 25%.

In Glacier National Park in the United States, over 110 glaciers have disappeared over the past 150 years. Only 37 glaciers remain in the park, and scientists estimate that these may be gone in another 25 years. In the European Alps, glaciers are also retreating and disappearing every year. (See figure 1.2.48.) Mountain climbers, tourist agencies and environmental researchers are alarmed by these changes.

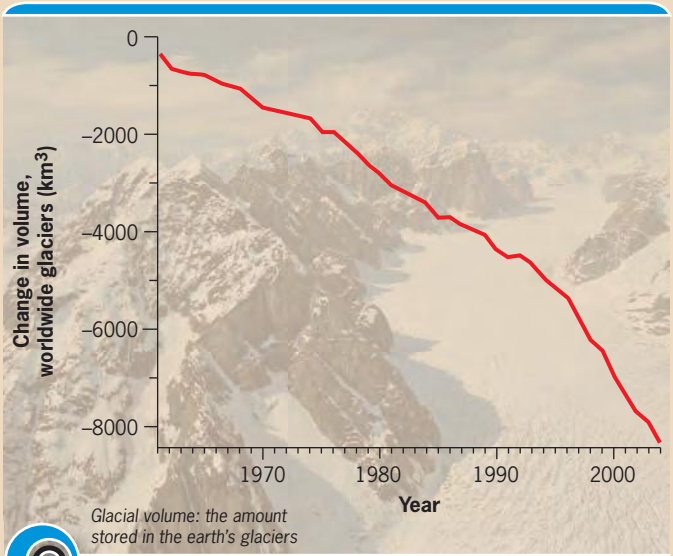


FIGURE 1.2.47

Change in glacial volume (km^3), 1960 to 2005.

The melting of glaciers and ice caps, combined with the thermal expansion of ocean water, has caused the sea level to rise by 10 to 25 cm over the past century.

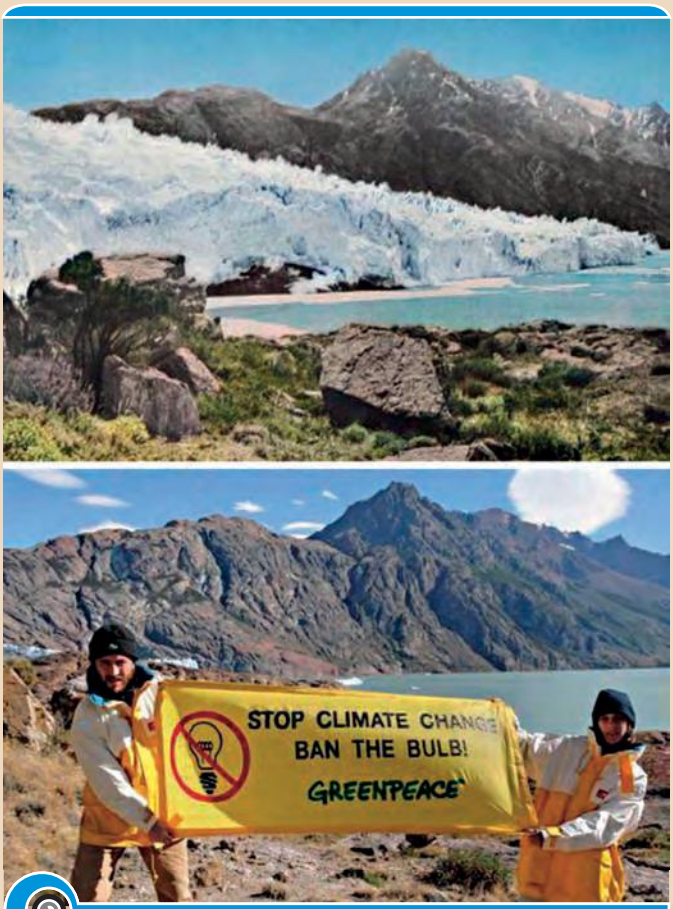


FIGURE 1.2.48

The retreat of the Viedma Glacier, Argentina: 1930 (top) and 2006 (bottom).

geofocus

The *Stern Review*

Sir Nicholas Stern, a highly respected British economist, examined the economic impact of climate change on the global economy and drew some interesting findings. His research was carried out at the request of the British Government. The findings, known as the *Stern Review*, were published in October 2006.

Stern found that the economic cost of taking no action to deal with climate change would be greater than the economic cost of taking steps to reduce climate change. This was an important finding because one of the main barriers to successfully dealing with the impacts of climate change is the perceived costs to the community.

The *Stern Review* found that if left unaddressed climate change could result in the global economy shrinking by as much as 20%. Stern estimates that the cost of dealing with climate change would be around 1% of the total production of the global economy.

The shrinking Arctic ice sheet

Average temperatures in the Arctic region are rising twice as quickly as anywhere else on earth. This is causing the Arctic ice sheet to shrink and become thinner. NASA satellite images reveal that the area of permanent ice cover at the Arctic is contracting by 9% each decade. If this trend continues, by the end of the century there may be no ice in the Arctic during summer. (See figures 1.2.49 to 1.2.51.) Such a dramatic change will impact on sea levels and global climate.

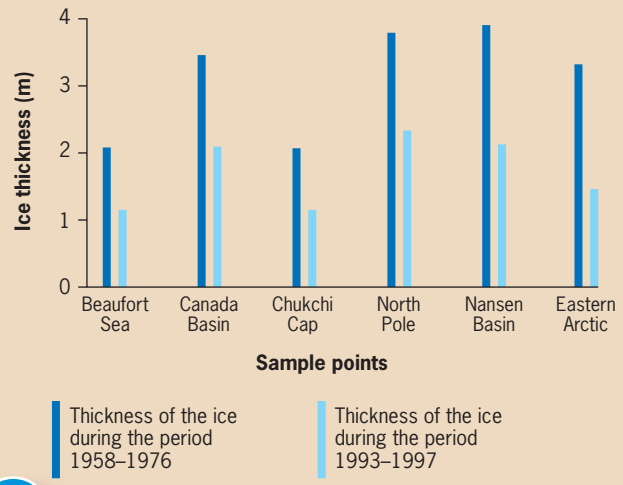


FIGURE 1.2.49

The thinning of the Arctic sea-ice, 1958–76 and 1993–97. The sampling points are centred on the North Pole.

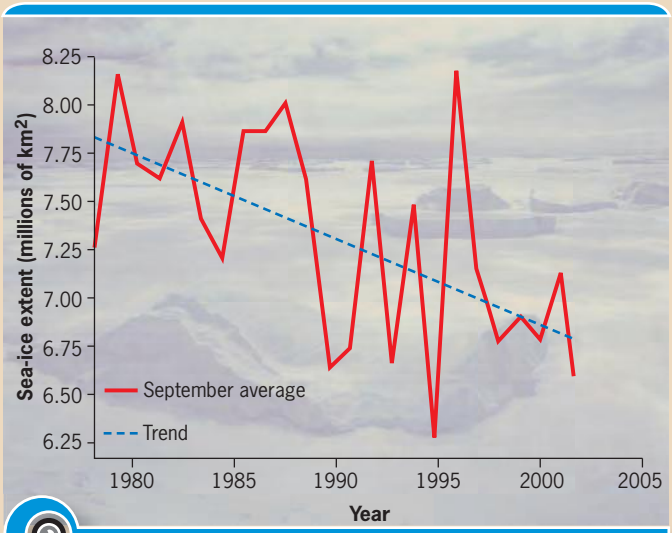


FIGURE 1.2.50

The extent of the Arctic sea-ice.

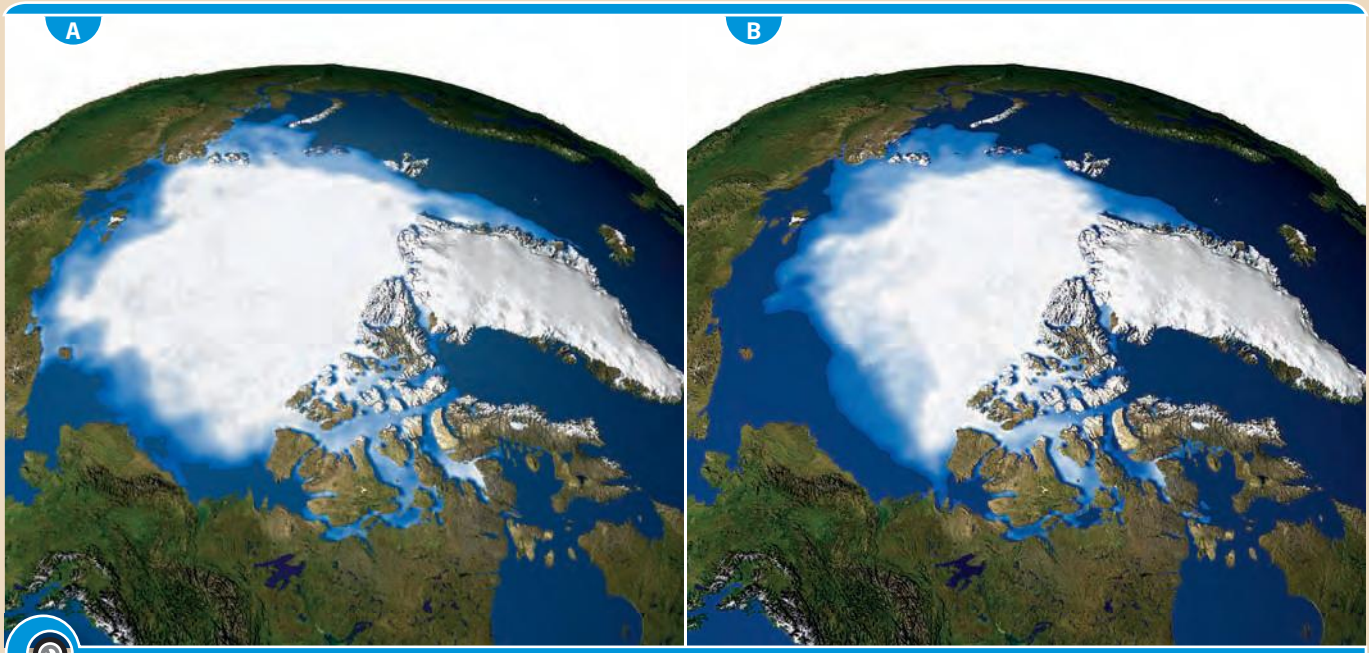


FIGURE 1.2.51

Arctic sea-ice extent. **A** 1979. **B** 2005. Taken during summer, the images show the minimum sea-ice concentration at the North Pole. Successive images enable scientists to monitor the rate and extent of sea-ice retreat.

geofocus

The Intergovernmental Panel on Climate Change

The Intergovernmental Panel on Climate Change (IPCC) was established in 1988 by the World Meteorological Organisation (WMO) and the United Nations Environmental Programme (UNEP), both of which are United Nations organisations. The IPCC is made up of around 1000 scientists drawn from more than 100 countries. The IPCC has the task of collecting and analysing data relating to climate change and its social, economic and political impacts. The IPCC does not conduct its own research but examines the research of other scientists.

The IPCC came to worldwide attention in February 2007 when it released a report called *Climate Change 2007: Fourth Assessment Report*. In this report the IPCC stated that climate change was actually occurring and that there was no doubt that these changes were due to human activity. This was an important development because until that time the IPCC had said that it could not be 100% certain that climate change was human induced. The 2007 report placed added pressure on the world's governments to take immediate action to address the devastating impacts associated with climate change.

geoskills 4

Proportional graphs

Proportional graphs are an effective way of presenting data. They provide the observer with a quick and visual impression of the information and can be analysed to obtain a more detailed understanding.

A pie graph is a circle divided into segments by lines radiating out from its centre. Each segment of the graph is proportional to the value the segment represents. Pie graphs are sometimes referred to as sector graphs.

A complete pie graph (360°) represents 100%. Therefore, each percentage point equals 3.6°. Knowing this statistic will enable you to construct and interpret pie graphs.

Constructing pie graphs

1. Draw a circle and then rule a line from its centre to the 12 o'clock mark.
2. Convert the percentage value of each component to degrees by multiplying it by 3.6. Example: If the percentage was 25%, this would represent 90° on the pie graph, 25% x 3.6 = 90°.
3. List your converted values from the largest to the smallest. Place categories such as 'others' at the end of your list.
4. Starting at 12 o'clock, mark in each segment using a protractor. Work in a clockwise direction, starting with the largest segment.
5. Shade in and label each segment. It may be necessary to provide a key.

Strategies to contain human-induced climate change

Attempts to address the issue of global warming have generally focused on the need to institute a staged reduction in the production and consumption of greenhouse gases. By reducing the emissions of these gases it is expected that we will not only delay the onset of significant global warming, but also slow its advance and reduce its ultimate impact. Attempts to curb the production and consumption of greenhouse gases to date, however, have met with only limited success. If real advances are to be made, there will need to be a degree of international cooperation never before achieved.

Any policy designed to achieve a sustained reduction in greenhouse gas emissions would need to incorporate five key elements:

- an increase in the efficiency of energy production and use
- a change from carbon-intensive fuels, such as coal, to nitrogen-intensive fuels, such as natural gas, wherever possible
- encouragement of the development and use of solar energy and other carbon-free sources of energy
- elimination of CFC production, and the development of the technology required to 'recapture' those CFCs now in use
- reduction in the rate of deforestation.

Ozone depletion

One of the most alarming outcomes of the interaction between humans and the atmosphere is the damage being caused to the earth's protective

did you know?

There are two reasons why sea levels are rising. First, water that had previously been held in glaciers and ice sheets enters the oceans when it melts. Scientists predict that an increase in global temperatures of 1.5–4.5°C will result in a sea level rise of 15–95 cm by the end of the century. Second, as average global temperatures increase, the volume of water in the earth's oceans expands. This occurs because the molecules that make up the body of water move more rapidly and collide more frequently.

did you know?

Low-lying island countries are already suffering the consequences of sea level rise. Two of these, Kiribati and Tuvalu, have requested that Australia and New Zealand consider assisting in the relocation of the entire populations of these islands.

FIGURE 1.2.52

Hurricane Katrina caused billions of dollars worth of damage in the southern United States in 2005. Such massive storms are likely to become more frequent as a result of global warming.

FIGURE 1.2.53

Use of renewable energy sources, such as solar power, is one strategy that can be employed to reduce global warming.

geofocus

Carbon trading

Carbon (or emissions) trading is an administrative process used to control and, over time, reduce carbon emissions by providing an economic incentive to do so. The cap, or limit, on emissions is usually lowered over time, with the aim being to reach a national emissions reduction target. In other systems a portion of all traded credits must be retired, or surrendered, with each transaction, resulting in a net reduction in emissions over time.

In a carbon trading regime, a central authority (usually a government agency) determines a cap on the amount of a specific pollutant that can be emitted. Corporations or utilities (such as power stations) emitting the pollutant are given credits, which represent a right to emit a specific amount. The total amount of credits cannot exceed the cap, which limits total emissions to that level. Corporations that pollute beyond their cap must buy credits from those who pollute less than their capped allowance. If they do not, they will incur substantial penalties. This transfer is referred to as a trade. In practice, the buyer is being fined for polluting, while the seller is being rewarded for having reduced emissions. Thus, corporations that can readily reduce their emissions will do so and those that find this harder will buy credits. This process reduces greenhouse gases at the lowest possible cost to society.

layer of ozone. Located in the stratosphere, approximately 30 km above the earth's surface, the ozone layer acts as a shield, protecting the earth from the harmful effects of the sun's radiation. It does this by partially filtering UV radiation, particularly the harmful UV-B radiation, before it is able to reach the earth's surface. Only 10–30% of incoming UV-B radiation reaches the earth's surface.

Ozone is the product of the reaction between oxygen and the sun's UV radiation; three atoms of oxygen combine chemically to form a molecule of ozone. The thickness of the ozone layer varies with latitude and the season of the year.

While ground-level ozone is regarded as a harmful pollutant, ozone in the stratosphere is seen as critical to life on earth because it protects living things from a biologically damaging form of energy. UV radiation causes skin cancer and other health problems; increases the risk of cataracts, which cloud the lens of the eye and can result in blindness; and may also weaken the human body's disease-fighting immune system.

> *If a qualitative climate change were to occur suddenly in the coming century—within less than 10 years—as has happened many times before in geological history, we may already have written our epitaph.*
>
> Jeremy Rifkin, *The Guardian*, 1 March 2002

> *The ultimate concern is that if runaway global warming occurred, temperatures could spiral out of control and make our planet uninhabitable... this is the first time that a species has been at risk of generating its own demise... The dinosaurs dominated the earth for 160 million years. We are in danger of putting our future at risk after a mere quarter of a million years.*
>
> Michael Meacher, UK Minister for the Environment, 1997–2003, *The Guardian*, 14 February 2003

Increased levels of UV radiation may also interfere with plant photosynthesis, causing ecological damage and reduced agricultural production. In the world's oceans, increased levels of UV radiation could damage marine life by killing phytoplankton, the unicellular plants that form the basis of the ocean's food chain. The krill, which feed on phytoplankton, are, in turn, a major source of food for a range of sea animals, including penguins, seals and whales. As phytoplankton also play an important role in absorbing excess CO_2, their loss would add to global warming.

Global warming, ozone depletion and global climatic change are chemically connected. All are truly global in extent. The main cause of ozone depletion is the use of chlorofluorocarbons (CFCs). CFCs were once widely used in refrigeration and as propellants in aerosol cans. In the upper atmosphere the CFCs react with ozone and destroy it.

Protecting the ozone layer

In 1987, 24 countries signed the Montreal Protocol, agreeing to cut the production of CFCs by 50% by 1999. Since then some countries have gone further; most European countries and the United States stopped producing CFCs in 1995.

CFCs can remain in the atmosphere for at least 75 years before natural processes break them down. Thus, even if all CFC production ceased today, a depleted ozone layer will continue for almost a century. CFCs used in industry are not easily replaced; there is, however, a growing list of substitutes for most CFC uses, including refrigeration.

did you know?

A 1% decrease in ozone concentration would result in a 4% increase in the cases of skin cancer worldwide.

understanding the text

1 **List** the key indicators of global climate change.
2 **Explain** the impact of CO_2 emissions on the atmosphere.
3 **Outline** the anticipated impacts of global climate change.
4 **List** the strategies that need to be implemented to slow the rate of human-induced climate change.
5 **Describe** the function of the ozone layer.
6 **Outline** the likely impacts of any reduction in the level of atmospheric ozone.
7 **Describe** what actions have been taken to protect the ozone layer.

working geographically

1 **Interpreting diagrams** Study figure 1.2.47 (p. 43).
   a By how much has the volume of glacial ice changed between 1960 and 2005?
   b Has the decline in glacial volume accelerated or slowed since 1992? Explain how you arrived at this answer.
2 **Interpreting photographs** Study figure 1.2.48 (p. 43).
   a Construct two photosketches comparing the Viedma Glacier in 1930 and 2006.
   b Working in groups, suggest the possible causes of the changes shown in the photographs. Share your suggestions with the rest of the class.
3 **Internet research** Undertake Internet-based research. Investigate what is happening to glaciers in different parts of the world. What explanations are given for the changes taking place?
4 **Interpreting diagrams** Study figure 1.2.49 (p. 44).
   a By how much did the thickness of sea-ice at the North Pole change between 1958–76 and 1993–97?
   b Which sampling point experienced the greatest reduction in sea-ice between 1958–76 and 1993–97?
5 **Interpreting diagrams** Study figure 1.2.50 (p. 44).
   a By how much did the trend extent of sea-ice change between 1980 and 2000?
   b In what year did sea-ice extent reach its lowest extent?
   c In what year did sea-ice extent last exceed 8 million km^2?
6 **Interpreting satellite images** Study figure 1.2.51 (p. 44). Describe the change evident in the extent of the Arctic ice-sheet between 1979 and 2005.
7 **Interpreting diagrams** Study figure 1.2.46 (p. 42). By how much did mean sea level change between 1993 and 2005?
8 **Internet research** Use the Internet to conduct research into the *Stern Review*. Outline some of the strategies that Stern put forward for dealing with the problems of climate change.
9 **Interpreting text** Study the Geofocus box 'The Intergovernmental Panel on Climate Change' (p. 45).
   a Describe the role and structure of the IPCC.
   b Explain why the work of the IPCC is so important.
10 **Writing task** Study the Geofocus box 'Carbon trading'. Write an explanation of this initiative using your own words.
11 **Internet research** Using the Internet, source the data required to construct a pie chart showing the proportion that each greenhouse gas contributes to the greenhouse effect.

Writing extended responses

The skills of writing and speaking are essential to the acquisition and communication of geographical knowledge. Developing these skills is just as important as learning the subject matter of geography. Language is much more than the means by which we communicate our geographical knowledge and understanding. We also use language to construct knowledge; for example, write up our Senior Geography Project. For this reason it is important that we don't view the development of these skills as being separate from the subject matter of geography.

In this text we focus on:

- writing extended responses and using text types
- writing stimulus-based responses (Unit 1.3, p. 74)
- presenting an oral report (Unit 1.4, p. 106)
- constructing mindmaps (Unit 2.1, p. 259).

Writing extended responses

Listen to any group of teachers and you will often hear them say, 'These students can't write essays' or 'They haven't answered the question.' Many students will also admit that writing an extended response or essay is a skill that they have never mastered.

Being able to write a good extended response is not only an important examination technique but also a skill of broader educational importance. It is one of the most common ways in which we are required to communicate our knowledge and understanding of what we have learnt. Writing an effective extended response requires clear thinking and careful expression, which are in themselves valuable attributes.

Successful writing depends on:

- an understanding of the question being asked
- an understanding of the information on which the question is based
- a knowledge of how to structure an effective extended response.

TABLE 1.2.4

Do's and don'ts when writing an extended response

1	Always plan your extended response.
2	Always stick to the question. Be selective; don't just write down everything you know about the topic. Irrelevant information only detracts from your response.
3	Answer all parts of the question. The failure to answer even one part of a structured question could affect the quality of your response and lose you marks.
4	Use diagrams, models and sketch maps where appropriate.
5	Don't include references to yourself in your written responses; for example, 'I will now answer the question', 'As I have shown…' or 'I think…'.
6	Don't ask rhetorical questions in your response; for example, 'So! What is eutrophication?'
7	Avoid value judgements (for example, 'All conservationists are hippies') or make sure you support such judgements with evidence or argument.
8	Use only commonly accepted abbreviations for names of organisations, for example. The first time the name or term is used, write it out in full and place the abbreviation in brackets after it.
9	Always read over your completed response to check for errors in punctuation, spelling, syntax and the labelling of diagrams, for example.

Getting started

Read and dissect the rubric and question carefully; that is, make sure you understand what you are required to do. All extended response questions include directive terms that indicate how you should go about answering the question. They also include key words that give an indication of the subject matter you are required to address in your response. It is always useful to underline the key words and directive terms in the question. (See table 1.2.5.)

Some questions have a number of parts. These types of questions are usually referred to as structured questions. To achieve the best result you must answer each part of the question.

Warning! Some students believe that if they write all they know on a topic they will cover the question. Others use prepared answers that may not relate to the question being asked. These students rarely gain good marks. The best essays are written by those students who adapt their knowledge and understanding of the subject matter to answer a particular question. They are able to select and develop appropriate arguments and use them to address the particular focus of the question.

Doing the research

The information on which your written response is to be based can be obtained from a number of sources. These could include texts and reference books, the Internet, videos, computer databases, DVDs and your own notes.

To ensure that your information is up to date, it is often useful to refer to recent events or examples. Sources of up-to-date information include the Internet, newspapers, magazines, journals and government publications.

Skim read the resources you have collected to ensure the material is relevant to the topic. Then make your own summary notes as you reread the material you have identified as being relevant. Your notes could be organised under a series of subheadings derived from the extended-response question.

Once you have collected your information it will need to be organised. Decide what should be included, what should be left out and in what order the information should be presented. You may find it useful to write each of the main points to be made in the body of the response on individual strips of paper. These strips can be moved around and grouped, with the groups forming the basis of paragraphs. The groups can then be reordered to give the essay a logical sequence and structure.

Planning the extended response

Taking just a few minutes to plan your extended response, even under exam conditions, is never wasted. In fact, it will actually save you time during the writing of the response. A plan, which may be no more than a list of key words or pieces of information, helps you to recall information and avoid repetition. It also assists you by giving your written response structure, and by ensuring that your arguments are logically sequenced and well written.

Your plan should also include a list of the points you wish to discuss in your response. These can then be developed into paragraphs.

Your plan should reflect your interpretation of the question and take account of the directive terms. These terms often give you an indication of the amount of detail required. Terms such as briefly, list and outline, for example, imply conciseness. Your plan will also help you to avoid aspects of the topic that are not relevant.

As you write your extended response, constantly refer back to the plan and cross off each of the points as you proceed. This process can often stimulate the recall of ideas that you may have forgotten. These can now be included if appropriate.

As you complete each paragraph, quickly read over it before proceeding onto the next point in your plan. This may seem time-consuming, but it will ensure that you only include relevant information and that you answer the set question. While writing you should be constantly asking yourself 'Am I answering the question?' Reading over the paragraph will also enable you to quickly correct any obvious errors that might otherwise detract from the quality of your response.

TABLE 1.2.5

Common directive terms* used in questions

Term	Meaning
Account	Account for: state reasons for; report on Give an account of: narrate a series of events or transactions
Analyse	Identify components and the relationship between them; draw out and relate implications
Apply	Use; utilise; employ in a particular situation
Appreciate	Make a judgement about the value of
Assess	Make a judgement of value, quantity, outcomes, results or size
Calculate	Ascertain/determine from given facts, figures or information
Clarify	Make clear or plain
Classify	Arrange or include in classes/categories
Compare	Show how things are similar or different
Construct	Make; build; put together items or arguments
Contrast	Show how things are different or opposite
Critically (analyse/ evaluate)	Add a level of accuracy, depth, knowledge and understanding, logic, questioning, reflection and quality
Deduce	Draw conclusions
Define	State meaning and identify essential qualities
Demonstrate	Show by example
Describe	Provide characteristics and features
Discuss	Identify issues and provide points for and/or against

Term	Meaning
Distinguish	Recognise or indicate as being distinct or different from; note differences between
Evaluate	Make a judgement based on criteria; determine the value of
Examine	Inquire into
Explain	Relate cause and effect; make the relationships between things evident; provide the why and/or how
Extract	Choose relevant and/or appropriate details
Extrapolate	Infer from what is known
Identify	Recognise and name
Interpret	Draw meaning from
Investigate	Plan, inquire into and draw conclusions about
Justify	Support an argument or conclusion
Outline	Sketch in general terms; indicate the main features of
Predict	Suggest what may happen based on available information
Propose	Put forward (for example, a point of view, idea, argument or suggestion) for consideration or action
Recall	Present remembered ideas, facts or experiences
Recommend	Provide reasons in favour
Recount	Retell a series of events
Summarise	Express, concisely, the relevant details
Synthesise	Put together various elements to make a whole

*As defined by the NSW Board of Studies.

Writing the extended response

An extended response has three parts: an introduction, a body, and a conclusion.

Introduction

The introduction should 'set the scene' for the reader by introducing the main ideas and significant points on which your arguments are to be developed. It is often useful to include in the introduction the key words used in the question. It is also important to clearly and concisely define the key geographical terms and concepts being addressed by the question.

Warning! In exams it is very important to write a good introduction. The examiner will very quickly determine whether or not you are on the right track. Your introduction should not be too long; it should merely repeat the question and it should avoid narrative, such as 'In this essay I will…'.

TABLE 1.2.6

Text types

Text type	Purpose	Structure	Language features
Report	A report is used to classify and describe a geographical feature or process. It usually contains facts about the feature or process.	The three parts of a report are: 1 A general *introductory statement* introducing the subject of the report. It can be a short description or a definition. 2 A *series of paragraphs* about the feature or process. Each new paragraph usually describes just one aspect of the feature or process and begins with a topic (or preview) sentence. 3 A *conclusion* that summarises the information presented.	■ Technical language related to the geographical feature or process; for example, 'annual rainfall' instead of 'the amount of rain received each year' ■ Generalised terms ■ Use of the timeless present tense ■ Linking verbs, especially when defining the topic ■ Words or phrases that allow for comparisons (see table 1.2.7).
Explanation	An explanation is used to explain how or why something occurs.	The three parts of an explanation are: 1 A *general statement* about the geographical feature or process being written about. The general statement serves as an introduction. 2 A *series of paragraphs* that tell us how or why. These should be in sequence so that the reader builds up an understanding of the feature or process. 3 A *concluding paragraph*. This signals to the audience that the explanation is finished.	■ Technical language (geographical terms) ■ Words that show cause and effect (see table 1.2.7) ■ Use of the timeless present tense.
Discussion	A discussion is used to present the different opinions on a particular issue or topic; that is, the arguments for and against.	The three parts of a discussion are: 1 An *introductory paragraph* that introduces the issue or topic being discussed. It can contain a question or it can state the view of the writer. 2 A *series of paragraphs* that outline the arguments for and against the issue or topic. 3 A *conclusion* that sums up the issue and outlines the writer's own point of view or recommendation.	■ Generic terms related to the topic ■ Words that show a comparison or contrast (see table 1.2.7) ■ Words that link arguments (see table 1.2.7) ■ Words that qualify, such as 'usually' and 'probably' ■ Words that show the writer's opinions ■ Use of the timeless present tense
Exposition	An exposition argues only one side of an issue. It is used to persuade the reader by presenting a particular point of view.	The three parts of an exposition are: 1 An *introductory statement* that gives the writer's point of view and previews the arguments that will be presented to support their position. A question or emotive statement is sometimes used to gain the reader's attention. 2 A *series of arguments* that aim to persuade the reader. A new paragraph is used for each new argument, and each new paragraph begins with a topic sentence that introduces a new argument. 3 A *conclusion* that sums up the arguments presented and reinforces the writer's point of view.	■ Generalised noun or noun groups; that is, classes of things rather than specific individuals ■ Words that show the writer's attitude and point of view ■ Words that express feelings (emotive words) ■ Use of the timeless present tense ■ Conjunctions/connectives that structure the argument (see table 1.2.7) ■ Words that qualify or express tentativeness, such as 'usually' and 'probably'.

Body

The body provides the detail of your argument or information. Each paragraph should include one main point or idea that contributes to the development of your argument. This main point or idea is usually summarised in the opening sentence. The rest of the paragraph should expand on the main point by way of explanation or example. Each paragraph should be placed in an order that best develops your answer.

In geography it is acceptable to use subheadings and list points where appropriate. Each set of points must be introduced by a formal sentence. Each individual point should stand as a formal sentence where required. For example:

A range of strategies can be used to better manage water resources. These include:

- *the introduction of the 'user pays' system*
- *restricting and regulating consumption*
- *the construction of more storage facilities.*

Including maps, diagrams and models can be a very effective means of developing your argument and demonstrating your knowledge and understanding of the topic. If a map is included it should have some indication of scale and include a north arrow. This illustrative material should be clear, of a reasonable size and neatly presented. It should be included within the extended response, not at the end, and reference to it made in the text of the response.

References to fieldwork and case studies should be included where appropriate. These enable you to apply your experiences and knowledge to the explanation of geographical phenomena.

Conclusion

The conclusion draws together your arguments and ideas. It should focus on the point of view that is expressed in the introduction to the response. Be careful to avoid contradicting what was written earlier.

Extended-response checklist

If you have written your extended response at home and are about to submit it for marking, go through the following steps to ensure that you gain the best possible result for your efforts:

1. Read through your draft to ensure it is coherent.
2. Cross out those parts that seem irrelevant or repetitive.
3. Read your essay out aloud and ensure the sentence structure and punctuation are correct.
4. Check the spelling and take out words and phrases that are not needed. Simplify and clarify by breaking lengthy sentences into shorter, better focused ones.
5. Ask these final questions about your draft
   - Are the ideas linked?
   - Is there any waffle?
   - Have I been repetitive?
   - Have I answered all parts of the question?
   - Have I defined the major terms?
6. Rewrite the essay in neat, legible handwriting if presenting it in a handwritten form.
7. Consider using word-processing because it facilitates the editing process and makes it easier to correct spelling and grammatical errors.

Using text types

Increasingly, students are being examined on their ability to construct particular types of text. The text types most commonly used in geography include reports, explanations, expositions and discussions. Each text type has its own grammatical and structural features.

The word lists in table 1.2.7 will help you improve your writing.

TABLE 1.2.7

Writers' word bank

Words that compare	also similar to	as	as do	like	the same as
Words that contrast	alternatively however rather	although instead whereas	but nevertheless yet	by contrast on the contrary	differs from on the other hand
Words that show cause and effect	an effect of brings about creates gives rise to results in	an outcome of brought about culminated in hence so	as a consequence of caused by despite this leads to stems from	as a result of consequently due to otherwise therefore	because contributed to even though produced by
Words that show time and sequence	after a while first (second, third, etc.) meanwhile shortly	afterwards next soon	at this point here next time then	before in the end now when	finally lastly previously
Words for presenting another argument	also likewise	as well as moreover	besides not only	furthermore	in addition to
Words for introducing examples	as shown by these include	for example	for instance	including	such as

unit 1.3

"We never know the worth of water till the well is dry."
Thomas Fuller, eighteenth-century British author

"Water is life's mater and matrix, mother and medium. There is no life without water."
Albert Szent-Gyorgyi, Nobel Prize winning biochemist

"Don't throw your old bucket away till you know whether the new one holds water."
Swedish proverb

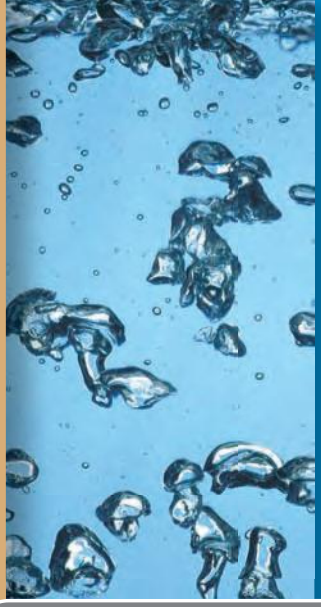
The Hydrosphere

Although water covers almost 70% of the earth's surface, it is not a limitless resource. Every drop of water that exists on the planet today was here in one form or another on the day our planet came into being.

Water comes in many forms. The salty oceans contain more than 97% of all the water on earth and play an important role in diluting and degrading the pollutants that may flow into them. Polar ice caps and ice floes are the next largest component of the earth's surface water (2.7%). They are an important influence on the world's climate and provide essential habitat to many unique life forms.

The rest of the fresh water on earth (0.3%) is what we see every day. Rivers, streams and creeks transport the runoff flowing from snow and ice melt, storms or floods. This runoff, together with groundwater, also provides an important source of water for fresh water for domestic, industrial and agricultural purposes. Wetlands and marshes are of exceptional ecological value, from cleansing the water we drink (removing sediments and contaminants), to long-term storage for slow uptake of groundwater (recharge), to protecting us from floods and droughts.

In this section of the text we examine the nature and functioning of the hydrosphere, with a special focus on the water cycle and the ways people interact with it.



exam-style questions

extended responses

- Explain the operation of the water cycle and assess its importance to global ecosystem functioning.
- Account for the spatial distribution of the global water budget.
- Assess the impact of human activities on the hydrosphere.
- Analyse the effect of human activity on the operation of river systems.
- Explain the influences that the hydrosphere has on human activities around the world.

The plimsoll line

If you were to visit any port in the world and look at the ships tied up at the docks you would notice that they all have a series of markings on the side of the hull towards the bow (front) of the ship. These markings are known as the plimsoll line and are used to ensure that a ship does not become overloaded.

The plimsoll line was first introduced in Britain in 1876. The plimsoll line is shown by a circle with a horizontal line through it. The line represents the point at which it is still safe to load a ship: if the water rises beyond the line the ship is overloaded and may sink in heavy seas. However, not all sea water is equally buoyant. In some waters the ship will sit further out of the water than in other waters. As a general rule the more salty the water is the more buoyancy it has. The season is also important as in winter months rougher seas are more likely, meaning smaller loads should be carried.

To take into account this varying buoyancy and weather conditions additional marks are used in conjunction with the plimsoll line. These marks are:

- TF—tropical fresh water
- F—fresh water
- T—tropical sea water
- S—summer sea water
- W—winter sea water
- WNA—winter North Atlantic.

A plimsoll line is found on large sea-going ships.

glossary

- **aquifer** a water-bearing layer of the earth's crust.
- **catchment** an area from which a river system or lake derives its water.
- **condensation** the process by which water changes from a gaseous state to a liquid state.
- **drought** a prolonged period of below-average rainfall that inhibits plant growth.
- **evaporation** the process by which water changes from a liquid to a gaseous state.
- **evapotranspiration** the processes of evaporation and transpiration.
- **flood** the over-bank flow resulting from prolonged or heavy rainfall.
- **groundwater** water that has seeped into the ground and is contained within the soil or rock layer.
- **hydrosphere** the interconnected system of water storage in the atmosphere and lithosphere, including the oceans, ice caps, rivers and groundwater.
- **impervious** matter through which water cannot pass; also known as impermeable.
- **infiltration** the downward movement of water into the soil or rock.
- **irrigation** the supply of water to arable farming land by artificial means.
- **precipitation** the forms in which water passes from the atmosphere to the earth's surface. It includes rain, sleet, snow, hail, dew and fog.
- **riparian** relating to the river bank.
- **runoff** water that flows over the surface of the land.
- **transpiration** the discharge of water vapour from plants into the atmosphere.
- **turbidity** the muddiness of water.
- **water budget** the total amount of water available in an area; its inflows and outflows.
- **water table** the upper surface of the zone of saturation in permeable rock, sand or soil.

did you know?

Water is always moving. Its state and geographical location are always changing. This has been the case since its formation. Let's consider the 4.6-billion-year history of the earth as a 24-hour clock.

At 2.00 a.m. the planet was still being born. Heat from atomic decay in the planet's pressurised core, combined with the heat generated by continual meteorite impacts, fused the earth into a ball of magma, rich in iron. The heat in the interior of the planet drove oxygen and hydrogen atoms from the materials in which they were contained, and the newly formed molecules came to the surface in upwellings of magma. Steam rose from the crust as lava emerged through the fractures in the surface. The water vapour rose and cooled and soon clouds enveloped the planet. Violent electrical storms churned through the atmosphere.

When the surface had cooled sufficiently, the rains came. The first droplets fell at about 2.30 a.m. The storms continued until around 3.05 a.m., having lasted for about 112 million years. The result was a planet mostly covered by a shallow sea, muddy with sediment washed from the land—a land with no plants and no soil.

The water cycle

The same water has been circulating since the early days of the planet, driven by the energy of the sun. At a global level, the water (hydrological) cycle is a closed system. No water is added and none is taken away. What changes is the distribution of the water, its geographical location and sometimes its form. (See figure 1.3.2.)

Approximately 430 000 cubic kilometres (km^3) are evaporated annually from the surface of the oceans. Another 70 000 km^3 are evaporated from the land. This gives a total of approximately 500 000 km^3.

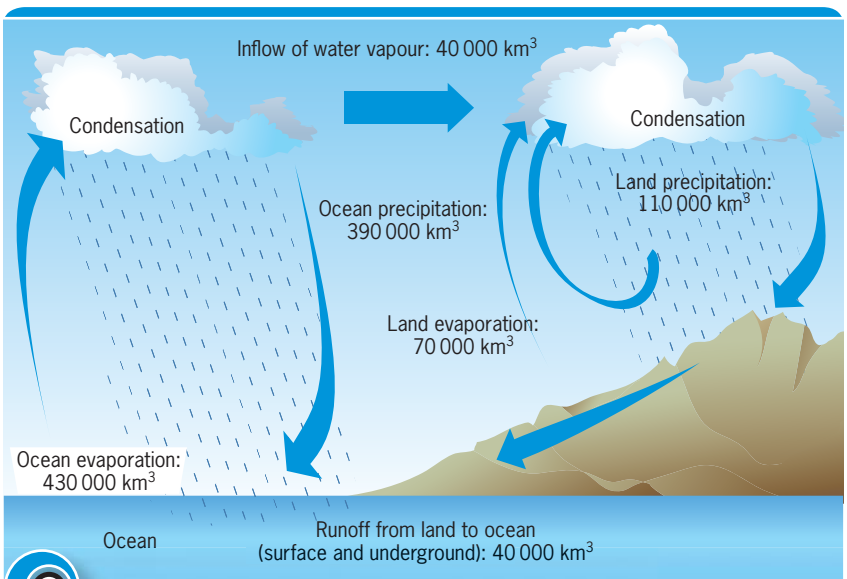


FIGURE 1.3.1

The quantities of water transferred within the hydrological cycle.

FIGURE 1.3.2

Water exists in various forms. **A** Dew (liquid). **B** Liquid. **C** Snow. **D** Ice.

Since the amount of water vapour in the atmosphere remains relatively constant, an equivalent amount is precipitated back to the earth's surface. However, its distribution varies. Precipitation over the oceans is approximately 390 000 km^3; precipitation over the land is approximately 110 000 km^3, compared with its **evaporation** of 70 000 km^3. This gives a net transfer from the oceans to the land of 40 000 km^3 a year. This transfer sustains all the terrestrial life within the biosphere.

However, far more water exists than is transferred annually. Water is stored in a number of forms and for varying periods of time. Just 2.65% of the earth's water is fresh water; that is, free of salt. Table 1.3.1 shows the sources of fresh water.

TABLE 1.3.1

The global distribution of water in its various states and storages

Storage	State	Volume (km^3)	Percentage of fresh water	Percentage of total
Ice caps and glaciers	Solid	28 200 000	76.5	2.14
Groundwater:				
■ 800 m deep	Liquid	3 740 000	10.1	0.27
■ 800–4000 m deep	Liquid	4 710 000	12.8	0.34
Lakes	Liquid	125 000	0.34	0.00091
Soil moisture	Liquid	69 000	0.19	0.005
Atmospheric vapour	Gas	13 500	0.037	0.01
Rivers and marshes	Liquid	1 500	0.004	0.0091
Total sources		*36 859 000*	*99.981*	*2.665*

geoskills 6

Proportional circles

Proportional circles, such as those in figure 1.3.3, show the relative size of the units being measured by the area of each circle. The size of each circle must be drawn in proportion to the total value it represents.

Proportional shapes are sometimes used instead of circles. They may be squares, rectangles, cubes, triangles, symbols or the shape of nation-states, for example.

did you know?

One cubic kilometre is equal to 1 billion cubic metres.

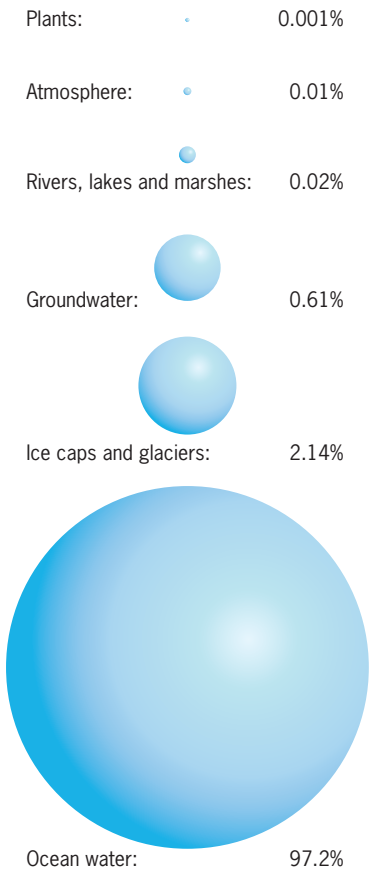


FIGURE 1.3.3

Where water is stored.

Condensation. Condensation is the process by which water changes from a gaseous state back into a liquid state. This process can only take place when there are solid objects on which moisture can be deposited. In the atmosphere, dust particles act as condensation nuclei; without them there would be no condensation. Condensed water may be visible as cloud, dew and mist.

The rate at which condensation takes place depends on the original air temperature (which influences the capacity of the air to hold water), the amount of moisture or humidity in the air and the rate of atmospheric cooling.

Condensation is a warming process because the latent heat absorbed during evaporation is returned to the atmosphere. Air, therefore, is capable of moving not only moisture from one place to another, but also heat. The larger the amount of moisture in the atmosphere, the greater the amount of energy it can store and transfer.

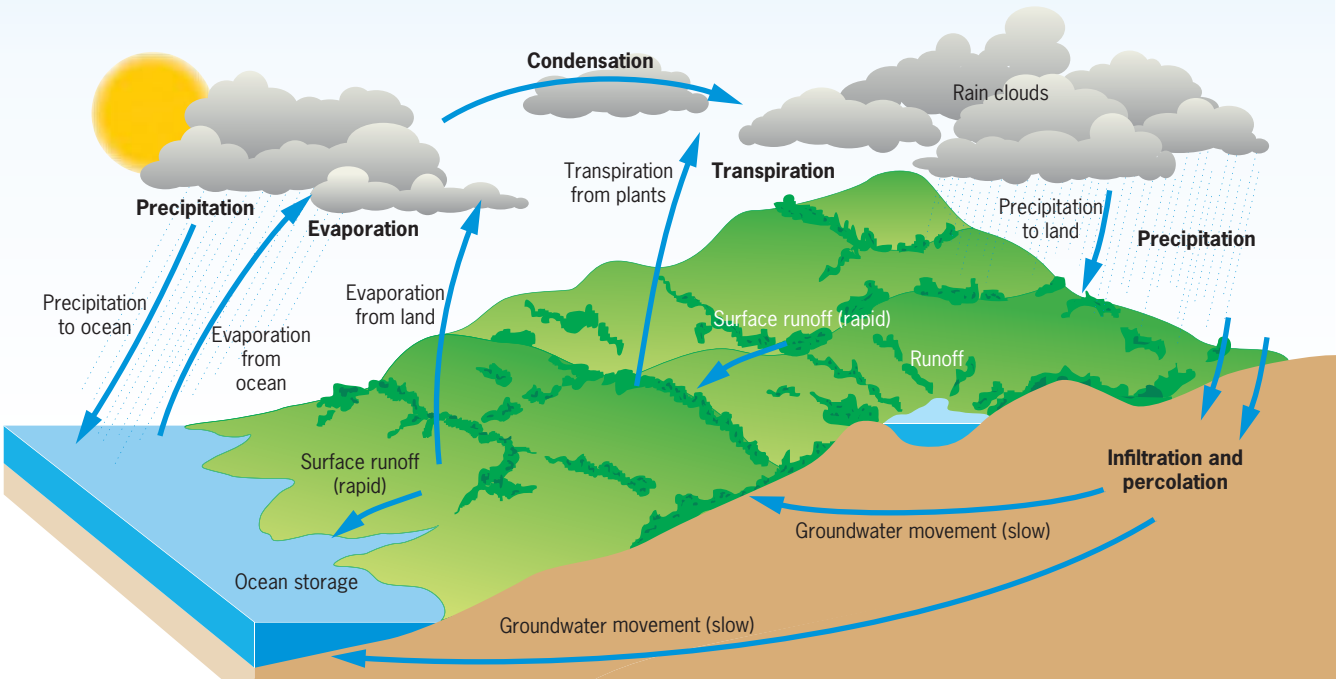
The temperature to which the air needs to be cooled before it becomes saturated (100% humidity) is known as its *dew point*. When the dew point is below freezing, water vapour changes directly to ice or frost. This process is known as *sublimation*.

Evapotranspiration. There are two components of evapotranspiration: evaporation and transpiration. Both involve the transformation of water from a liquid state to a gaseous state.

Evaporation. This is the physical process by which moisture is lost directly to the atmosphere from a body of water due to the sun's heat or the effects of air movements. The rate of evaporation depends on temperature, wind velocity, the level of humidity and hours of sunshine. Evaporation is a cooling process because it involves a transfer of heat energy from the body of water to the atmosphere.

Transpiration. This is a biological process in which water is lost from the pores of the leaves of plants. The rate of transpiration depends on the time of year, the type and amount of vegetation and the length of the growing season. The amount of water vapour in the air is known as *humidity*.

Precipitation. Precipitation results when large masses of moist air are cooled rapidly below dew point. With continued condensation, water droplets or ice crystals become larger and heavier. Eventually they become so heavy that the atmosphere can no longer support them and they precipitate. Types of precipitation include rain, sleet, snow and hail.



Infiltration. When precipitation occurs, the soil becomes moist and absorbent. Water enters the soil and passes through successive layers of the soil profile. The rate at which this occurs depends on the amount of water already in the soil. It is also determined by the soil's porosity and structure, and the amount and type of vegetation cover. The speed at which water passes through a soil is called its *infiltration capacity*. Infiltrating water eventually collects above an **impermeable** layer of rock or fills all pore spaces, forming a zone of saturation. The upper level of the saturated material is known as the **water table**. Water may gradually be transferred horizontally as groundwater flow or base flow.

FIGURE 1.3.4

Key processes in the hydrological cycle.

understanding the text

1 **Explain** what is meant by the statement 'Water is an integrating element in the biophysical environment.'
2 **Outline** the main states in which water can be found.
3 **Explain** what the water, or hydrological, cycle is.
4 **Explain** how water is moved around the hydrological cycle.

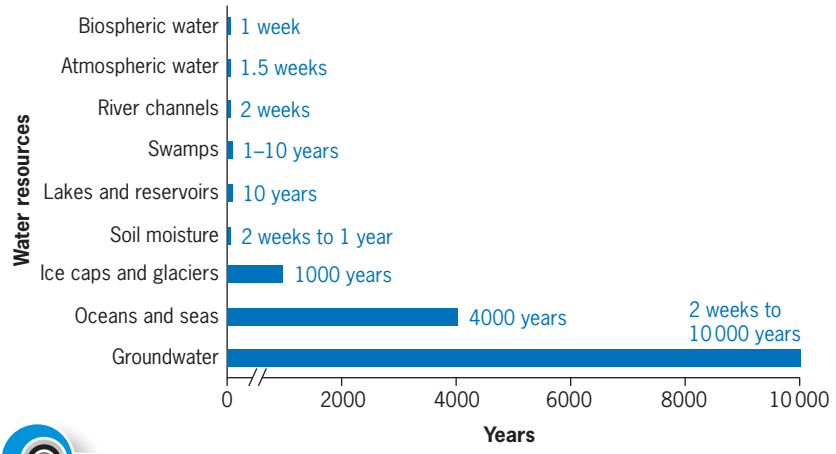


FIGURE 1.3.5

Estimated storage times of the world's water resources.

biospheric to do with or located in the biosphere.

did you know?

Several places claim to be the wettest city in the world. However, the *Guinness Book of Records* states that Cherrapunji, India, is the wettest.

The Atacama Desert in Chile is the driest place on earth.

The global water budget

The earth's **water budget** is the summation of the hydrosphere's inputs, outputs and net changes over a particular period of time. Figure 1.3.3 (p. 55) shows that the amount of water within the global water cycle is a staggering 1385 million km^3, of which less than 3% is fresh water. This may sound a small amount, but the total quantity of fresh water on earth is far greater than that required by the earth's human population.

The main sources of water used by humans make up less than 1% of the freshwater total. Yet this is still more than enough water for everybody. It is estimated that the annual renewable supply of water available for use is around 3000 m^3 per person. Compare this with a worldwide average water use of 750 m^3 per person.

The location, quantity and quality of water resources are largely determined by the relationship between climate (precipitation and evaporation) and biophysical features, such as geology.

Table 1.3.2 (p. 58) shows that a continent such as South America, which has high rainfall in equatorial areas, has high **runoff**. This accounts for the vast river systems and plentiful water supplies found in much of the continent, particularly on the eastern coast where the mighty Amazon Basin is found.

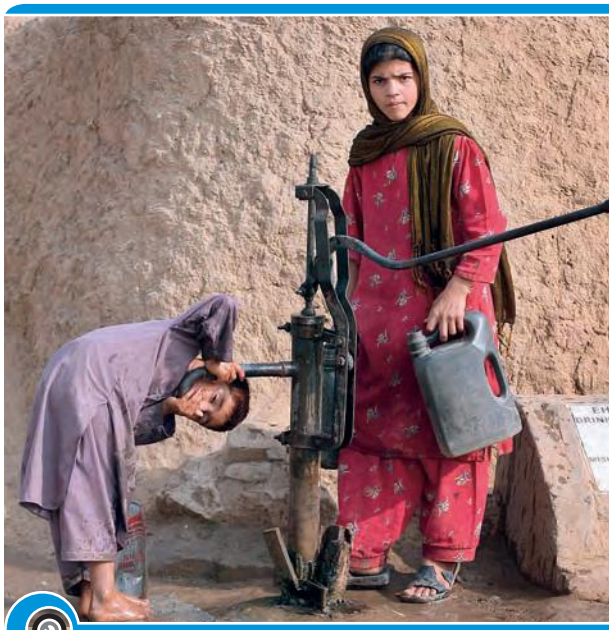


FIGURE 1.3.6

Although very little of the world's water is drinkable, there is more than enough fresh water for the world's population. However, the fresh water is not evenly distributed around the world, creating shortages in some places.

working geographically

1 **Writing task** Write a report outlining how water was originally formed on the earth.

2 **Interpreting diagrams** Study figures 1.3.1 (p. 54) and 1.3.4.
- a List all the storages that are part of the:
  - i atmosphere
  - ii lithosphere
  - iii biosphere.
- b Outline the processes by which water reaches the atmospheric store.
- c Explain why some parts of the lithosphere contain water while others do not.
- d Outline the ways in which water reaches the ocean from the lithosphere.
- e Explain how water reaches the biosphere.

3 **Writing task** Study figure 1.3.1 (p. 54). Explain how evaporation and condensation result in the transfer of heat energy.

4 **Writing task** Study figure 1.3.4. Write a report outlining the operation of the water cycle.

5 **Interpreting diagrams** Study figure 1.3.3 (p. 55) and table 1.3.1 (p. 55).
- a In which form is water most commonly found?
- b In which form is fresh water most commonly found?
- c Where is water found as a gas?

6 **Interpreting diagrams** Study figure 1.3.5. Write a report outlining the estimated time water is stored in various parts of the water cycle. What are the implications of this for the availability of water for human use?

geojobs

Oceanographer (marine scientist)

Oceanographers study the oceans: their movements, physical properties, and plant and animal life. They provide advice on the exploitation of fish and mineral resources, the protection of seas from pollution and the protection of coasts from damage by waves and tides.

Relevant degree courses are offered by Southern Cross University and the Universities of New England, New South Wales (Marine and Coastal Studies) and Sydney. The Australian National University offers a Bachelor of Global and Ocean Science and a Bachelor of Science (Marine Science).

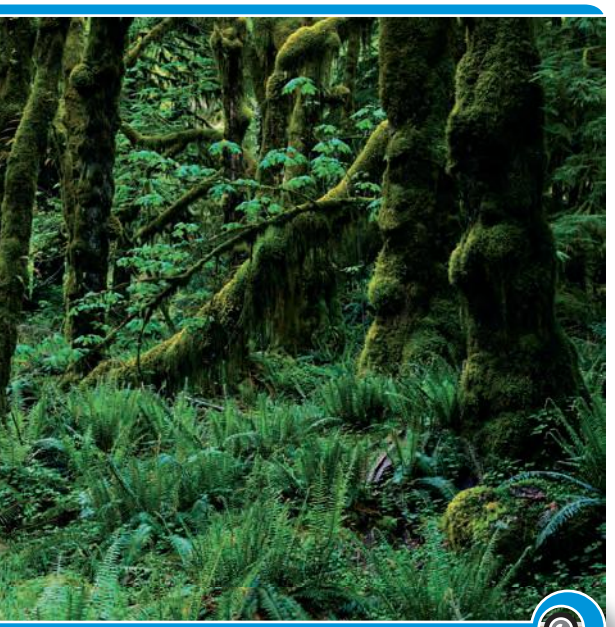


FIGURE 1.3.7

Global patterns of vegetation are strongly influenced by the availability of water.

With mid-latitude continents it is a different story. Australia not only has the lowest rainfall and runoff proportional to area of all the continents, but also has the lowest percentage of runoff proportional to rainfall incidence. In other words, in Australia evaporation and transpiration are so high that the amount of rain that ends up as streamflow is meagre. This leaves the continent with few major river systems and is one of the reasons why the centre of Australia is so dry and uninhabitable.

Global and continental variations in water budgets

The total amount of water within the water cycle is fixed. (See figure 1.3.1, p. 54, and table 1.3.1, p. 55.) Despite this, water is unevenly distributed both in terms of place and seasonal pattern. Continental water budgets vary as a result. (See table 1.3.2.) The size and location of the continents produce particular interactions between the lithosphere and the general atmospheric circulation. These specific interactions affect the climate of the world in general, and the climate at any particular continental location. Among the characteristics of climate are the amount of rainfall and its seasonal distribution. These characteristics influence the biosphere through the limits that water availability places on plant growth. The world patterns of climate and vegetation, therefore, are the result of specific interactions between the atmosphere, lithosphere and **hydrosphere**.

These interactions not only vary between locations, they also vary over time. Different patterns of continental crust produce different patterns of atmospheric circulation, and therefore different patterns of

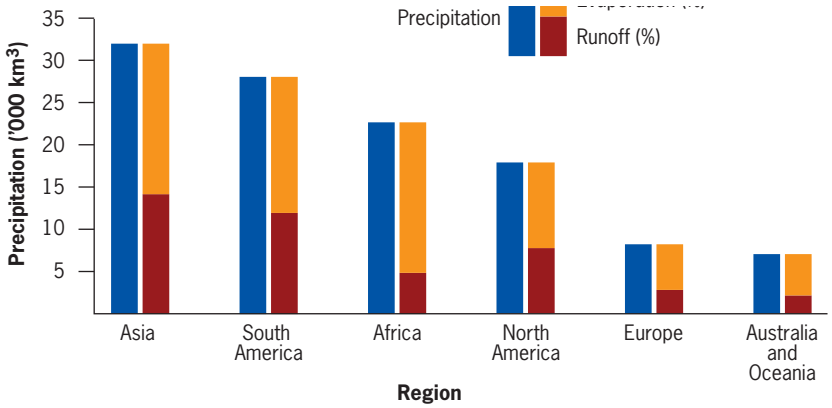


FIGURE 1.3.8

The world's surface water: precipitation, evaporation and runoff by region.

TABLE 1.3.2

Average rainfall and runoff of the continents

Continent	Area (km²)	Average rainfall (mm)	Average runoff (mm)	Average runoff (km³)	Per cent (runoff)
Africa	30 300 000	690	260	7 900	38
Asia	45 000 000	600	290	13 000	48
Australia	7 700 000	465	57	440	12
Europe	9 800 000	640	250	2 500	39
North America	20 700 000	660	340	6 900	52
South America	17 800 000	1630	930	16 700	57
Antarctica and Greenland	17 100 000	150–200*	160*	2 800*	*

* Data uncertain

Source: J. Brown, 'Australia's surface water resources, Water 2000', Consultant's Report No. 1, AGPS, Canberra

climate and vegetation on both the global and continental levels. These differences affect the distribution of water among the various stores within the water cycle.

Global and continental water budgets show spatial change over long periods of geological time. Around 330 million years ago, all the major land masses of the world began to gather on one side of the planet. Continental drift gradually united them into one huge land mass, Pangaea, stretching almost from pole to pole. (See Unit 1.4.)

The continental gathering of Pangaea disrupted global weather patterns. In the south, the Gondwana section of Pangaea was slowly carried across the South Pole, producing an Ice Age that lasted for 80 million years. The massive size of the continent produced extreme climates, with few areas of moderation. The northern and southern regions were colder than Siberia; the deserts were hotter than the Sahara; and in the interior, the temperature range between a hot summer's day and a cold winter's night was probably greater than 50°C. The climate overall was probably hotter, drier and more seasonal than that of any other era. This may have contributed to the extinction of more than half the families of the world's land vertebrates around 260 million years ago. The hot, dry climate may also have influenced the transition from a world dominated by amphibians to one dominated by reptiles. Reptiles are better adapted to **drought** than are amphibians, which need pools of water to reproduce.

About 180 million years ago Pangaea began to break up. From 65 to 55 million years ago Australia separated from Antarctica and drifted northwards. Sixty-five million years ago Australia lay approximately between 40°S and 70°S. Today Australia lies approximately between 10°S and 40°S. Such lithospheric changes have exposed Australia to new sets of atmospheric interactions. Over time these have considerably altered the continental water budget and the biosphere. Australia has drifted into drier latitudes; the rainforests have contracted; drought-adapted plants, such as eucalypts, have flourished and spread; and a new and radically different Australia has resulted.

Continental water budgets also exhibit variations over much briefer time spans, such as days, weeks, months and years. These variations and their resulting **floods** and droughts can have devastating effects on both people and the biosphere as a whole.

FIGURE 1.3.9

Continental drift caused Australia to drift into drier latitudes. This saw lush tropical rainforests replaced by more arid environments, such as the vast Simpson Desert, which dominates the centre of the continent.

geojobs

Hydrologist

Hydrology is the science dealing with the properties, distribution and circulation of water on and below the earth's surface and in the atmosphere.

The University of Sydney offers a Bachelor of Land and Water Science and the University of Technology Sydney offers a Bachelor of Science and a Bachelor of Engineering with a focus on hydrology.

understanding the text

1 **Describe** the composition of the global water budget.
2 **Outline** the factors that determine the location, quantity and quality of water resources.
3 **Explain** why so little water ends up as streamflow in Australia.
4 **Explain** why continental water budgets vary.
5 **Describe** the climatic effects produced by the formation of Pangaea.
6 **Describe** how continental drift has affected Australia's climate.

working geographically

1 **Interpreting statistics** Study table 1.3.2. Calculate the differences between Australia and South America in terms of average rainfall and runoff.
2 **Interpreting diagrams** Study figure 1.3.8.
   a Which continent receives the greatest precipitation?
   b Which of the continents featured has the least precipitation?
   c Which continent has the highest rate of runoff?
   d Which continent has the greatest rate of evaporation?
   e What are the implications of this data for agriculture in Africa?
3 **Writing task** Write an explanation of how the distribution of water within the global water budget is the result of specific interactions between the different spheres of the biophysical environment.
4 **Interpreting photographs** Study figures 1.3.7 and 1.3.9. Explain how each of the landscapes depicted is a product of the continental and regional variations in water budgets.

discharge the volume of water passing through a river in a specified period of time.

did you know?

- Water molecules absorb large amounts of heat when they evaporate, and release large amounts of heat during condensation. These properties are important in terms of heat distribution among the world's climatic zones.
- Water has a very large heat capacity. It can store large amounts of heat without a large temperature change. This has a moderating effect on climates. Ocean currents moving from equatorial regions towards the poles help keep mid-latitude climates temperate.

FIGURE 1.3.10

Canyoning is an extreme sport that has grown in popularity in recent years. The sport takes place in dangerous, steep-sided mountain canyons where flash flooding is a constant threat.

Flooding

A river floods when its **discharge** is greater than the capacity of the river channel. The excess water spills over the river's banks and onto its floodplain. The factors affecting river discharge are outlined in table 1.3.3.

There are different types of floods. They are:

- *Slow-onset floods*. These develop over a series of days and last for one or more weeks. They can result in the loss of stock and crops and cause damage to roads.
- *Rapid-onset floods*. These occur more quickly and in the mountain headwater areas of large rivers. They may only last for one or two days but are often very destructive.
- *Flash floods*. These occur when intense storms drop large amounts of water within a brief period of time. They can occur with little warning and can reach their peak in only a few minutes.

The hydrology of rivers and the regulation of water in catchments will be examined in more detail in Unit 1.7.

TABLE 1.3.3

Factors affecting river discharge rates

Precipitation
■ *Type of precipitation*. If the precipitation falls as snow, it may be days or even weeks before it melts and runs off into waterways. If the melting is rapid and the soil underneath frozen, large amounts of runoff can cause flash flooding. ■ *Intensity of rainfall*. During storms the intensity of rainfall often exceeds the capacity of the ground to absorb it all. Excess runoff flows quickly overland and into waterways, rapidly increasing discharge. ■ *Frequency of rainfall*. The rate of infiltration is affected by the amount of water already in the soil. If the soil is still wet from earlier rain, it will quickly become saturated. If the soil has had an opportunity to dry out, it is able to absorb new rainfall. Floods are more likely to occur after an extended period of wet weather.
Catchment characteristics
■ *Rock type*. Permeable rocks, such as sandstone, readily absorb water and reduce the amount of runoff. Flooding is more common in catchments dominated by impermeable rocks, such as granite. ■ *Soil*. Sandy soils have large air spaces that enable water to infiltrate the soil. Soils with a high clay content are less able to absorb water. Clay particles are very small and fit together tightly. This makes it difficult for water to infiltrate. ■ *Slope* gradient. On gently sloping land, rainfall has time to infiltrate before it runs off. On steep slopes, rainfall runs off before it can be absorbed. ■ *Vegetation*. Vegetation slows the flow of water across the earth's surface and encourages infiltration. This, in turn, reduces the risk of flooding. ■ *Landuse*. Agricultural landuses can affect the rate of runoff. Ploughing parallel to the contours of the land (contour ploughing) can, for example, reduce runoff. The compaction of the soil by stock and farm machinery can have the opposite effect. The compacted soil forms an impermeable layer, encouraging runoff. The buildings, paving and roads of urban areas form an impermeable layer that encourages the rapid runoff of precipitation. Drainage systems guide this runoff into local waterways.

geofocus

Flooding in the United Kingdom, 2007

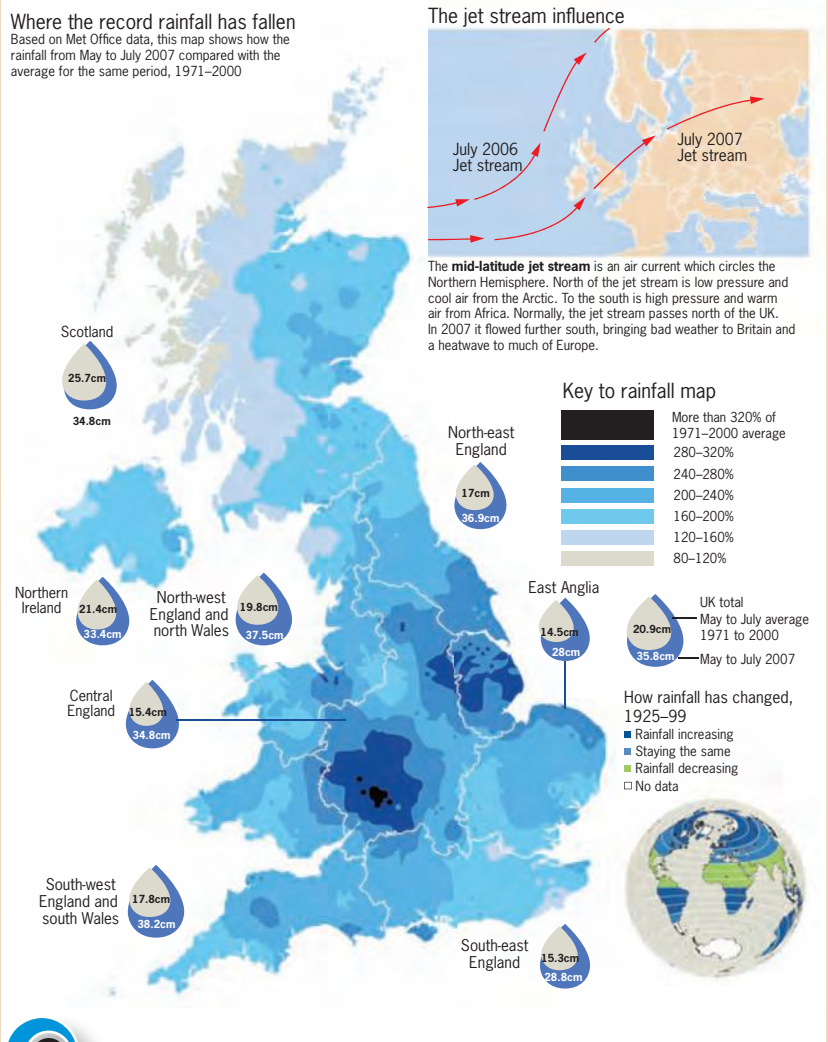


FIGURE 1.3.11

The United Kingdom under water: who was hardest hit.

In July 2007, Britain experienced its worst flooding in at least 50 years. The floods forced thousands of people to abandon their homes and left tens of thousands of families and businesses without water or electricity. Some people had to be rescued from rising waters by helicopters and boats.

A series of storms dropped a month's worth of rain in just a few hours. Added to an unusually wet June and July, this deluge caused the banks of two major rivers, the Avon and Severn, to overflow. Water levels in the western part of the Thames River rose alarmingly and in some places the river was as much as 7 m higher than usual. The country's ageing stormwater infrastructure was unable to cope with the volume of flow. The damage bill exceeded $4 billion.

The United Kingdom's Environmental Agency noted that water levels in some places were higher than during the devastating floods of 1947, widely regarded as the most severe in modern history. The floodwaters covered a huge geographical area. (See figure 1.3.12.)

FIGURE 1.3.12

The town of Tewkesbury surrounded by floodwaters.

did you know?

- Ice has a melting point of 0°C. Water has a boiling point of 100°C. Without these properties, water at normal temperatures would be a gas, and life as we know it would not exist.
- Water is the only common substance that expands, rather than contracts, when it freezes. Ice, therefore, has a lower density than water, and floats on top of it.
- Water is an excellent solvent, able to dissolve large quantities of a range of substances. This allows water to carry dissolved nutrients throughout the tissues of plants and animals.

Floods are 'acts of God'. But flood losses are largely acts of man.

Gilbert F. White, US geographer, 1942

geofocus

Flooding in Bangladesh, 2004

In 2004, some of the worst floods ever to strike Bangladesh left millions of the world's poorest people homeless. The people of this low-lying country, situated to the east of India, are accustomed to floods. They are part of the natural cycle of the massive rivers, including the Ganges, that flow across the delta on which much of the country lies. However, the floods in 2004 were beyond the norm.

FIGURE 1.3.13

Massive floods in 2004 left millions of people homeless in low-lying Bangladesh.

When the floods peaked in July more than half the country's 64 districts were flood declared and a staggering 20 million people were declared homeless. The town of Mushinganj was one of the worst affected. The town lies at the convergence of three major rivers: the Padma, Jamuna and Ganges Rivers. Much of the water that fell across South-east Asia met at this point. In the small district around Mushinganj more than 250 000 people, almost the entire population, were camping out on any high ground they could find, including bridges.

While the floodwaters meant that people were cut off, often without food, it was the risk of epidemics that made them even deadlier. In Mushinganj, cases of diarrhoea and cholera were diagnosed despite the work of emergency medical teams.

The incidence and severity of flooding in the Ganges River valley has been made worse by large-scale deforestation in the upper catchment. Deforestation increases runoff. It also results in the accumulation of sediment in river channels, which reduces the river's discharge capacity.

did you know?

A *catchment* or drainage basin is the area of land drained by a river and its tributaries. Its boundary is marked by a ridge of high land beyond which any precipitation will drain into another catchment. This boundary is called a *watershed*.

A river or stream flowing into a larger river is known as a *tributary*. Some of the precipitation that falls into the catchment will eventually find its way into the river. It will either flow across the surface of the ground as *runoff* or flow through the soil and then into the river channel. The remaining precipitation will evaporate, be absorbed by the roots of trees and plants or pass down through the soil to become *groundwater*.

Impacts of people

People's activities affect rivers in many ways. The most important of these include:

- *Reduced river flow*. Water being used for irrigation and for household and industrial uses reduces the amount of water available to support aquatic ecosystems.
- *Changes to seasonal flows*. Increases in the consumption of water in summer can reduce the amount of water available for aquatic ecosystems.
- *Temperature change*. The storage of water in large dams results in a drop in water temperature; especially when the dam is very deep. Meanwhile, industries and thermal power stations can pollute rivers with very warm water. Any change in temperature can disturb the aquatic ecosystem.
- *Disruptions to migratory patterns*. Dam walls can prevent fish from moving upstream to breed.
- *Siltation*. Increased siltation can result from landclearing and careless landuse practices. The silt can fill deep pools and dams and destroys habitats.
- *River improvements*. The removal of logs and other material from rivers may destroy fish habitats.
- *Pollution*. Pesticides can kill off aquatic plants and enter the food chain, causing genetic damage. Fertilisers can encourage excessive plant growth, including toxic algal blooms.
- *Overfishing*. This results in a decrease in fish populations.
- *Riverbank erosion*. Recreational boating can erode riverbanks.

Drought

Droughts are prolonged periods of below-average rainfall. Regions with low average rainfall are more likely to experience droughts than are places with high average rainfall. Droughts inhibit the growth of crops and natural vegetation.

Severe droughts can also contribute to *land degradation*. Wind erosion takes place when bare, dry soil is no longer bound together by the roots of trees, grasses and other plants. Loss of precious topsoil can leave a site unable to produce crops or pasture, and prone to *desertification*. Even drought-breaking rains can erode the soil by washing away unprotected topsoil.

The effects of drought on the human population vary according to the socioeconomic situation of the people in the area. In one community a drought may merely result in restrictions on car-washing, the use of garden sprinklers and the ability to top up swimming pools. In another, it can result in famine and death.

did you know?

The World Watch Institute calculates that around 6.3 billion L of fresh water is used every year to irrigate golf courses.

geofocus

The Australian drought

As the new millennium dawned, Australia found itself in the midst of its worst drought in recorded history. Climatologists believe that the drought, which began in 2001 and continued for years, was a one in 1000-year drought.

The impact of the drought was felt across almost the whole country. In May 2007, significant areas of Tasmania, normally one of the wettest areas in the country, were drought declared. In November 2007, Brisbane, Australia's third largest city, was moved on to level 6 water restrictions. (Level 5 is normally the highest.)

Another casualty of the drought has been the Snowy Mountains Scheme. The scheme relies on rains to supply its vast system of dams. These provide water for the hydro-electric power stations and irrigation in the Murray and Murrumbidgee River systems. Without the rains, the dams have fallen to record lows and Snowy Hydro announced in April 2007 that it planned to shut down some of its power stations. This has the potential to reduce the amount of electricity available to Sydney and Melbourne.

Most climatologists agree that while this drought is the result of the El Niño weather patterns that cool ocean waters off the east coast of Australia and bring drier weather, the severity of the El Niño is the result of climate change. One of the predictions of climate change is an increase in the intensity and length of El Niño events.

FIGURE 1.3.14

Severe drought has impacted greatly on the Australian environment.

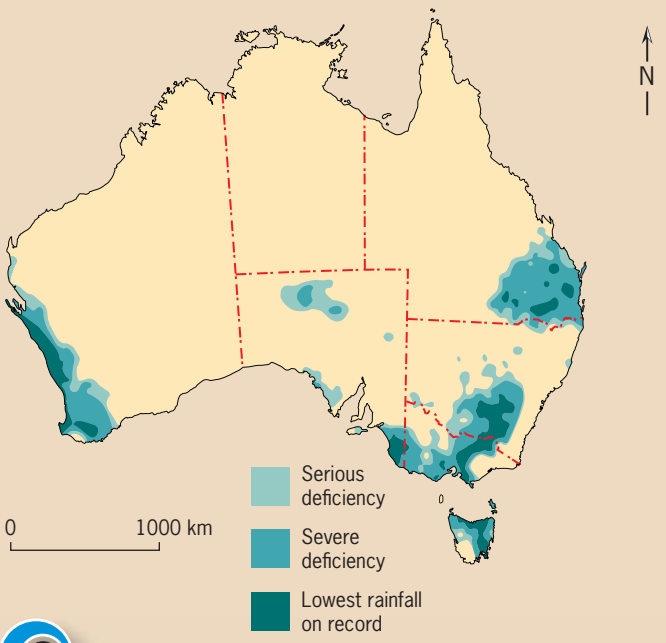


FIGURE 1.3.15

Rainfall deficiency, 1 February 2006 to 31 July 2007.

Drought leaves Snowy scheme gasping

By DANIEL LEWIS

Drought has left the might Snowy Mountains hydro-electric scheme with so little water it has become a generator of last resort.

Last month its massive storages were down to about 10 per cent of active capacity—the lowest April level since the scheme was completed in 1974.

The managing director of Snowy Mountains Hydro, Terry Charlton, said the company needed to build more gas-fired power stations to compensate for the lack of water, but was hamstrung by its public ownership…

To conserve water, Snowy Hydro is using two gas-fired power plants it already has in Victoria, it is funding a cloud seeding trial to increase snowfall and it is recycling water through its Tumut 3 power station. The water roars downhill to produce expensive peak-hour electricity then is pumped back up the hill, using cheaper off-peak power.

'We conserve water where we can,' Mr Charlton said.

If the drought continues and there is another very bad winter like last year's, with the snowpack providing little spring run-off, Snowy Hydro believes it can meet its water and electricity commitments 'into next summer'…

Water levels have been falling for a decade and Mr Charlton said a return to wetter conditions could take five years. 'We are not confident that these difficult times are going to change quickly.'…

Sydney Morning Herald, 7 May 2007

understanding the text

1 **Outline** the conditions under which flooding occurs.
2 **Define** the term discharge.
3 **Distinguish** between slow-onset floods, rapid-onset floods and flash floods.
4 **Explain** the effect of precipitation on the discharge of a river.
5 **Define** the term drought.
6 **Outline** the environmental and human costs of drought.
7 **Describe** the effects of the recent drought in Australia.

working geographically

1 **Interpreting diagrams** Study figure 1.3.11 (p. 61).
   a What is the mid-latitude jet stream? How does its positioning impact on the climate of the United Kingdom?
   b Study the inset map of the globe. Describe how the global pattern of rainfall changed between 1925 and 1999.
   c Which regions of the United Kingdom received the highest amount of rainfall in the period May to July 2007?
   d By how much did the rainfall received in the southwest of Central England exceed the 1971–2000 average?
2 **Writing task** table 1.3.3 (p. 60). Write an extended response outlining how factors related to precipitation and catchment characteristics affect river discharge rates.
3 **Mindmapping** Construct an annotated mindmap to illustrate the ways people affect rivers. See Unit 2.1 (p. 259) for directions on how to construct mindmaps.
4 **Research task** Study figure 1.3.10 (p. 60). Research canyoning and, in particular, the Swiss canyoning disaster. Investigate the dangers associated with the activity. Outline the biophysical processes that contribute to the hazardous nature of the sport. What precautions should participants take? Present the findings of your research as an oral report.
5 **Interpreting diagrams** Study figure 1.3.15 (p. 63). Identify the parts of Australia experiencing serious, severe and the 'worst on record' rainfall deficiency in the 18 months between February 2006 and July 2007.
6 **Research task** Study the Geofocus box 'Flooding in Bangladesh, 2004' (p. 62). Investigate the impacts of deforestation on the hydrology of the Ganges River catchment. How has it affected the incidence and severity of flooding? Present your findings as a written report.
7 **Research task** Using the Internet and newspaper databases conduct research into a recent major flood. Outline where the flood occurred and the conditions that caused the flood. Describe the impact of the flood on the flooded communities.
8 **Interpreting text** Read the newspaper article 'Drought leaves Snowy scheme gasping'.
   a Explain the consequences of the drought on the Snowy Mountains hydro-electric scheme.
   b Outline the strategies being employed by Snowy Hydro to overcome the drought.
   c Assess the environmental sustainability of the strategies being used.
9 **Research task** Using the Internet or other media sources investigate recent examples of drought. Outline the causes and impact of the drought. Map the area affected.

Human interactions with the hydrosphere

The uneven distribution of fresh water both globally and regionally means that management of water resources is generally necessary. Management entails the collection, storage, allocation and distribution of water to meet domestic, agricultural and industrial needs. The rising demand for water and the aspirations of countries to higher levels of economic development pose new challenges for water management.

It is estimated that global water use has more than tripled since 1950. The amount of water now used around the globe is so vast that it is measured in thousands of cubic kilometres. A continuing rise in demand will place increasing stress on management and cause tensions at local, regional and international levels.

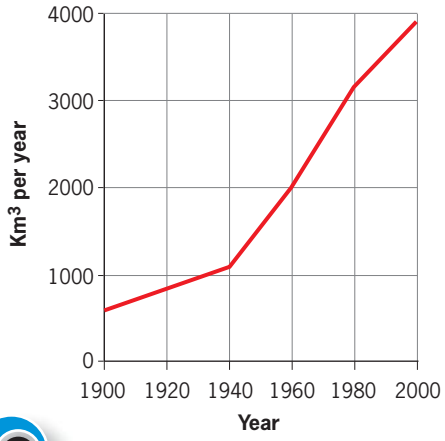


FIGURE 1.3.16

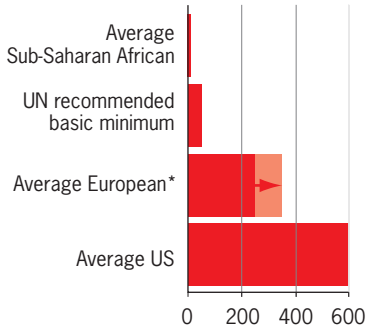
Estimated annual world water use.

The domestic sector

The amount of water used for domestic purposes varies with living standards. It is estimated that 4% of the world's population use 300–400 L per person per day, and 67% of the world's population, concentrated mainly in Asia and Africa, use less than 50 L per person per day. Sixty-five per cent of the world's rural population and 35% of the urban population don't have a water supply system.

Provision of a reticulated water supply system would increase consumption dramatically. For example, a family in a rural area of the United States using a simple standpipe pump consumes around 45 L per person per day. This is less than one-tenth the per capita daily usage of a family with mains water supply. Thus, the provision of access to a safe water supply not only leads to improved standards of living, but greater use of water.

The quality of domestic water supplies is a concern around the world, but the concerns differ between those living in developed countries and those in developing countries. In the developing world a safe water supply has many benefits, including significant health improvements and, in some cases, an improvement in the lot and status of women.



All figures approx. in L per person per day

***Consumption differs between European countries, ranging from 250–350 L per day**

FIGURE 1.3.17

Water use around the world.

The agricultural and industrial sectors

As with the domestic sector, demands for water have also increased in agriculture and industry.

Agriculture

About 84% of the world's crop land is rain-fed, but the 16% that is under irrigation uses around two-thirds of annual freshwater consumption. More efficient water use has become a top priority in order to increase production, decrease demand, slow groundwater depletion and increase a tendency towards sustainable use of water.

New irrigation technology that uses less water is just one of a range of policies that could increase the efficiency of water use. For example, many farmers are beginning to use drip irrigation, which drips water at the base of plants allowing it to soak into the soil and the root system. This uses far less water than traditional sprinklers, which waste up to 70% of the water used. Other water-saving methods include raising the efficiency of the canal systems that provide irrigation water and using treated municipal waste water for irrigation. Although large amounts of land are now irrigated by this type of recycling the total amount is less than 1% of all water used for irrigation purposes.

FIGURE 1.3.18

An estimated 4000 children die daily as a result of drinking water that has been contaminated by sewage.

geofocus

Recycling water for industry

Industry accounts for a large proportion of the water used in Australia. For most industrial processes, other than food production, the water used does not need to be of drinking water quality.

In September 2006, NSW's largest water-recycling scheme was opened at Port Kembla south of Sydney. Port Kembla is home to a massive factory operated by BlueScope Steel. The factory uses more than 7 billion L of water every year. Until the water recycling plant began operation, all that water came from the drinking water supplies of Wollongong and Sydney.

The new recycling plant uses high-tech filters to convert sewage into very high quality water. While the water is pure enough to drink, it is only used for industrial purposes. The BlueScope factory will use almost all the waste water generated by Wollongong, Bellambi and Port Kembla and this has the added benefit of reducing the amount of waste water flowing into the ocean.

The Port Kembla project is one of several water recycling programs being developed in the state. It is estimated that by 2015 more than 70 billion L of water will be recycled in NSW. (In 2006 the amount was 15 billion.)

In areas of rain-fed agriculture, water conservation has become a high priority. Micro dams, shallow wells and moisture-conserving farming techniques are part of an array of measures intended to raise food production and make such production sustainable through protecting the land and using water more wisely.

Industry

Industry uses about 23% of annual freshwater withdrawals. Industrial withdrawals are rising, particularly as industrial development accelerates in many countries of the developing world, especially in China and India. This acceleration has created demands for water for power generation, mining, processing and manufacturing. In European countries (especially Germany, France and the United Kingdom) industry accounts for 60–80% of total water demand. Industrial water is used mainly for cooling, processing and other activities that may pollute or heat the water, but not consume it.

In the countries of the developed world, there have been considerable achievements in efficient water use and the reduction of water pollution, mainly due to pollution control laws. Many industrialised countries, including Australia, have markedly increased the recycling of industrial water and have increased their industrial water productivity (the value of output per cubic metre of water used). However, past pollution can still cause problems today, and in many cases the allowable amount of effluent continues to arouse concern. Cleaning up water-based toxic residues is very expensive and authorities must find safe ways to dispose of these often poisonous substances once they have been recovered.

In countries of the developing world, incentives to pursue increased water efficiency are generally lacking, as are adequate pollution controls.

Water efficiency and anti-pollution measures are not only possible with current technology, they are also environmentally necessary and economically sound. If rising population levels are not to lead to localised water shortages, economic and social problems and environmental damage, then concerted action is necessary. Water savings are possible in all sectors of demand: domestic, agricultural and industrial. Individuals, organisations and governments must encourage sustainable water use in both the developed and developing countries.

did you know?

The various levels of water scarcity shown in figure 1.3.19 can be defined as follows:

- *Physical water scarcity*. More than 75% of river flows are allocated to agriculture, industries or domestic purposes. Defining scarcity in this way (that is, relating water availability to water demand) implies that dry areas do not necessarily have water scarcity.
- *Approaching physical water scarcity*. More than 60% of river flows are allocated. These basins will experience physical water scarcity in the near future.
- *Economic water scarcity*. Water resources are abundant relative to water use. Less than 25% of water from rivers is withdrawn for human purposes. However, malnutrition exists in these areas and they could benefit from development of additional blue and green water, but human and financial capacity are limiting.
- *Little or no water scarcity*. There are abundant water resources relative to use. Less than 25% of water from rivers is withdrawn for human purposes.

geofocus

Water scarcity

The amount of water on earth is finite. So while the amount of water on earth stays the same, the number of people wanting to access this water is growing, meaning that there is less water per person.

In total there is still more than enough water to go around. However, around one-third of the world's population live in a country considered to be water stressed and by 2025 this figure is predicted to increase to two-thirds. Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. Water scarcity simply means that there is insufficient water to maintain sufficient food production and to meet the domestic, environmental and industrial water needs of communities. The projected water scarcity in 2025 is shown in figure 1.3.19.

Water scarcity is often an economic problem and it is usually the poor that suffer the most from it. Water shortages create economic hardship when families are required to buy water or need to trek long distances to fetch it, taking them away from more economically productive activities, such as tending to crops and stock. Shortages can also result in people drinking contaminated water. This can lead to disease, ill health and even death, which also bring further economic difficulties.

The United Nations conducted a major study into water scarcity and found that it would cost more than US$100 billion a year to deal with the issues worldwide. The solutions to water shortages are very complex. Building more dams is one common suggestion. Here in Australia, several dams have been proposed in recent years as the country deals with a massive drought. However, dams are enormously expensive to build and maintain. They also cause serious environmental and indeed social damage to the ecosystems and communities where they are being built. (See the Geofocus box 'Big dams', pp. 70–1.) The use of groundwater is another common suggestion. However, groundwater supplies can take thousands of years to accumulate and their use must be carefully managed to ensure they remain sustainable.

Reducing water use is one of the easiest and most cost-effective strategies. Vast quantities of water are wasted, especially in developed countries. (See figure 1.3.17, p. 65.) Improved irrigation techniques can save billions of litres of water, treating sewage and storm water to enable the water to be recycled are other viable alternatives. Measures such as these can significantly reduce the amount of water wasted. They can therefore help address water scarcity without the need to employ expensive and environmentally damaging solutions, such as more dams.

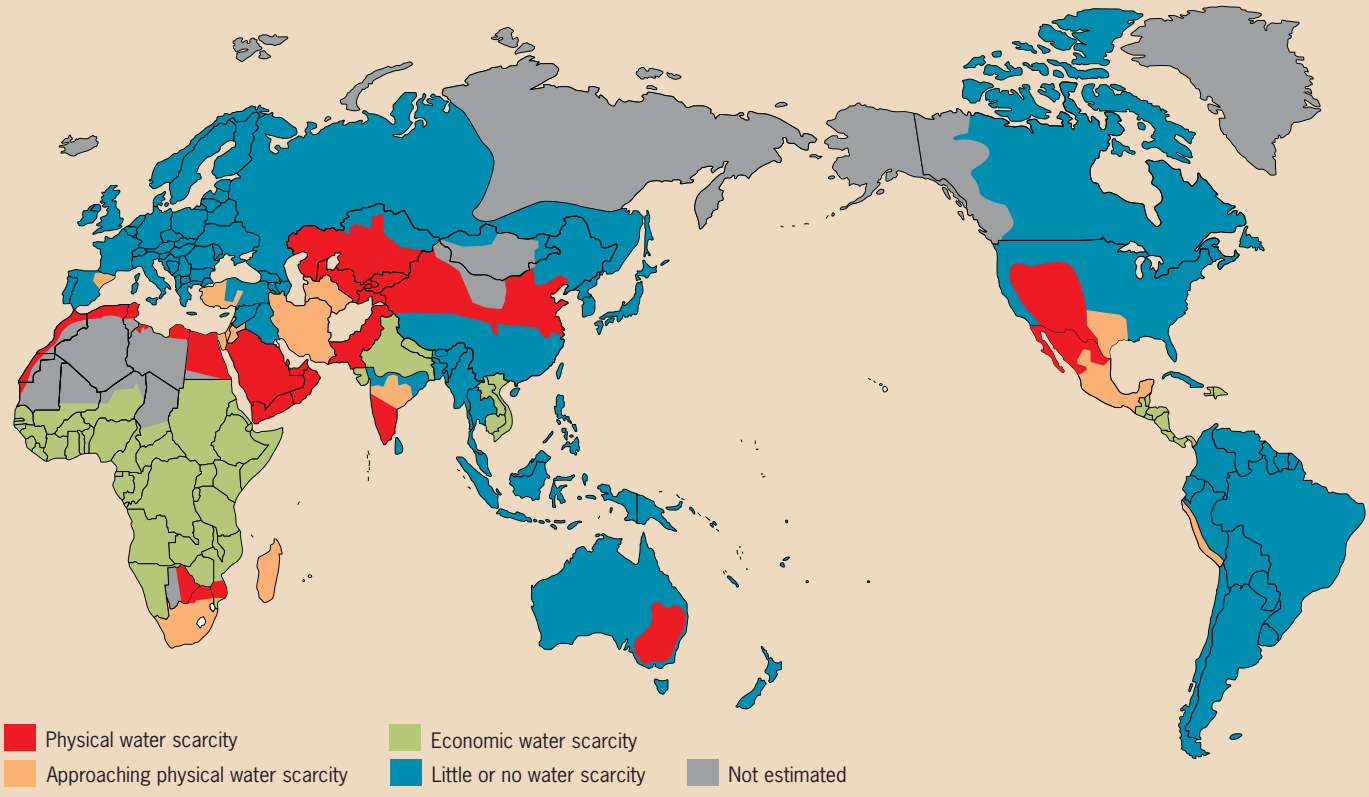


FIGURE 1.3.19

Expected extent of water scarcity, 2025.

Access to clean water

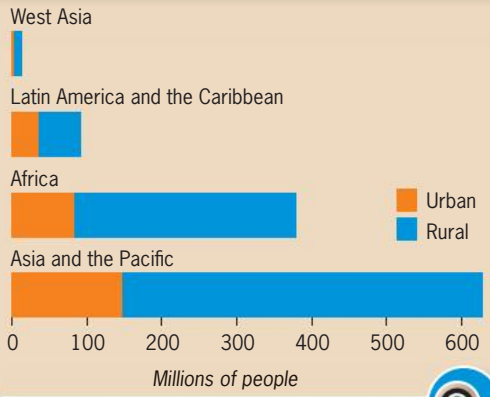


FIGURE 1.3.20

Millions of people without access to safe drinking water.

Once considered an unlimited and essentially free resource, clean water is becoming a scarce and valuable commodity. While most countries still have adequate supplies, the depletion of groundwater reserves, excessive use and pollution will limit what is available in the future.

In the past, dams, aqueducts (above-ground structures used to carry water long distances) and pipelines were built to store and transport water to meet increased demand. Today, however, economic and environmental costs provoke opposition to their construction in many places. (See the Geofocus box 'Big dams', pp. 70–1.) To ensure that we have enough water in the future we must develop ways of using it more efficiently—and keeping it cleaner while we are using it.

Access to clean water is a major issue in the developing world. Lack of infrastructure prevents 25% of the population from accessing safe water. In some countries the figure is much higher. As a result, each year up to 10 million people die from water-related diseases, such as cholera. Millions more experience periods of ill health.

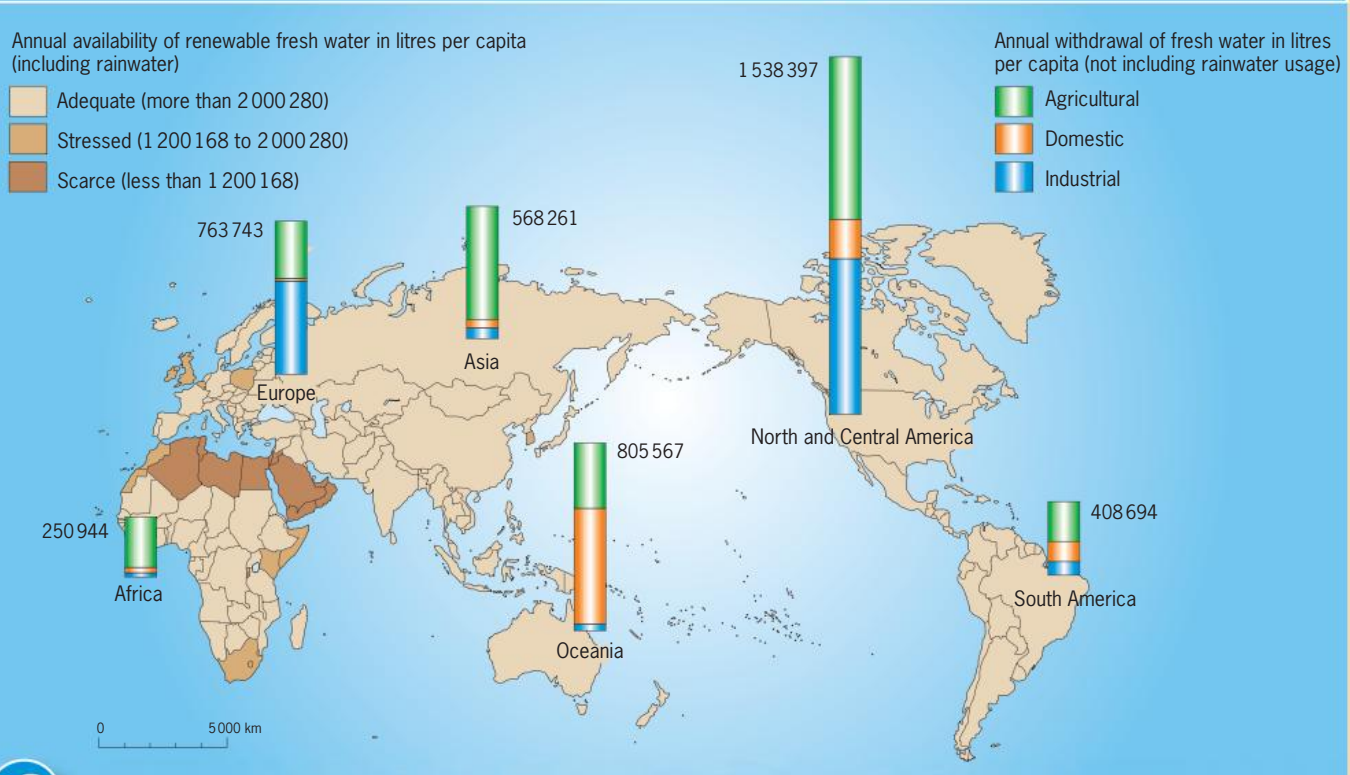


FIGURE 1.3.21

Annual availability of renewable fresh water and the annual withdrawal of fresh water for selected uses.

did you know?

Water has a very high surface tension. It can also coat solids. These two properties allow water to rise from tiny pores in the soil into the stems of plants.

understanding the text

1 **Explain** why the main sources of fresh water make up less than 0.5% of the total freshwater supply.
2 **Explain** the following statement: 'The very existence of terrestrial life is based on an uneven distribution of water.'
3 **Outline** what the management of water resources entails.
4 **Outline** how domestic water consumption varies around the world.
5 **Outline** the uses of water by the agricultural sector.
6 **Identify** the extent to which irrigated farming is a disproportionate consumer of fresh water.
7 **Explain** why the more efficient use of water in irrigated farming is seen as such a high priority.
8 **Consider** how increased efficiency in the use of water can be achieved. List some examples from the text. Can you think of further examples from each of the domestic, agricultural and industrial sectors?

working geographically

1 **Interpreting diagrams** Study figures 1.3.16 and 1.3.17 (p. 65).
   a Explain the trend in global water use.
   b By how much did estimated annual water use increase between 1900 and 2000?
   c In what year did the rate of annual world water use begin to increase rapidly?
   d What does figure 1.3.17 suggest about global inequalities in the use of water resources?
   e By how much does the average amount of water use by the United States exceed the UN recommended basic minimum?
2 **Interpreting text** Study the Geofocus box 'Access to clean water'.
   a Explain why our attitudes to the exploitation of water resources have had to change.
   b Why is access to fresh water such an important issue in the developing world?
3 **Interpreting diagrams** Study figure 1.3.19 (p. 67). Identify the regions of the world where by 2025 there is expected to be:
   a little or no water scarcity
   b economic water scarcity
   c physical water scarcity.
4 **Internet research** Using the Internet, conduct research into the social, economic and health impacts of water scarcity. In a small group, produce a digital presentation showing the results of your research. Share your presentation with the class.
5 **Graph interpretation** Study figure 1.3.21.
   a In which part of the world do industrial withdrawals account for the largest proportion of freshwater use?
   b In which part of the world do domestic uses of water account for the largest proportion of freshwater use?
   c In which part of the world does agriculture consume the largest proportion of fresh water?
6 **Group work** In small groups, brainstorm strategies for using fresh water more efficiently. Share your findings with the rest of the class. Construct a mindmap to summarise the strategies developed by the class.
7 **Writing task** Study the Geofocus box 'Recycling water for industry' (p. 66). Write a short report outlining how this new water-recycling system works and what its benefits are.
8 **Writing task** Write an extended response explaining the way that humans consume water and the impacts of this consumption.

Human impacts on river systems

Rivers are an essential element of the biophysical environment. They transport both water and sediment and are vital in bringing water to otherwise dry regions. Humans have affected river systems greatly. Few of the world's rivers have not been altered in some way, whether it is through dams, water pumping or pollution. In New South Wales, only one river, the Paroo River in the far west of the state, is considered to be free of human interference.

geofocus

The Tisza River

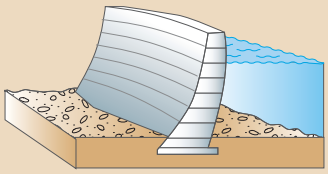
The Tisza River flows through Hungary and Romania. In February 2000 it gained international attention after a massive industrial accident left the river heavily polluted. A dam holding polluted water at a mine in Romania broke, releasing around 20 000 tonnes of mud containing heavy metals, such as lead, copper and zinc.

The toxic bloom flowed down creeks and eventually flowed into the Tisza River in Hungary. As the wave of pollution spread down the river the toxins settled into the mud on the riverbed and thousands of dead fish floated to the surface. Pollution in the river remains high as toxins continue to be released from the riverbed. Expensive clean-up operations continue.

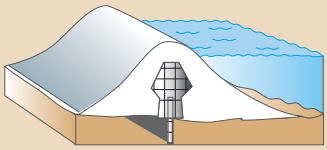
Big dams: counting the cost

Humans have sought to regulate the flow of rivers for thousands of years. The oldest known dam is the Sadd el-Kafara in Egypt. It was built out of earth and rock about 3000 BC. Today, approximately 40 000 large dams obstruct the flow of the world's rivers. Most of these have been built in the last 50 years.

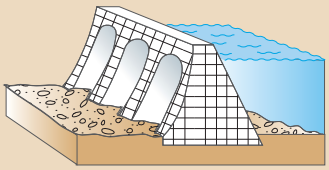
Dams have a number of functions. They enable us to produce electricity (hydro-power provides nearly one-fifth of the world's electricity); supply water for agriculture, industry and households; control flooding; and assist in river navigation by providing a more regular flow of water.



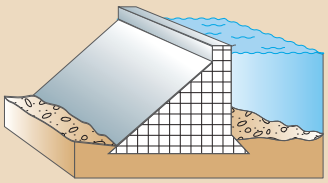
Arch dam
This has a curved shape. The inside of the curve faces downstream.



Embankment dam
This is made of a huge pile of rocks and earth. The dam relies on its sheer bulk to hold back the water.



Buttress dam
This has a series of buttresses located on the side of the dam facing downstream.



Massive dam
This is built of concrete and relies on its size and weight to withstand the pressure of the stored water.

FIGURE 1.3.22
Types of dams.

FIGURE 1.3.23
A buttress dam.

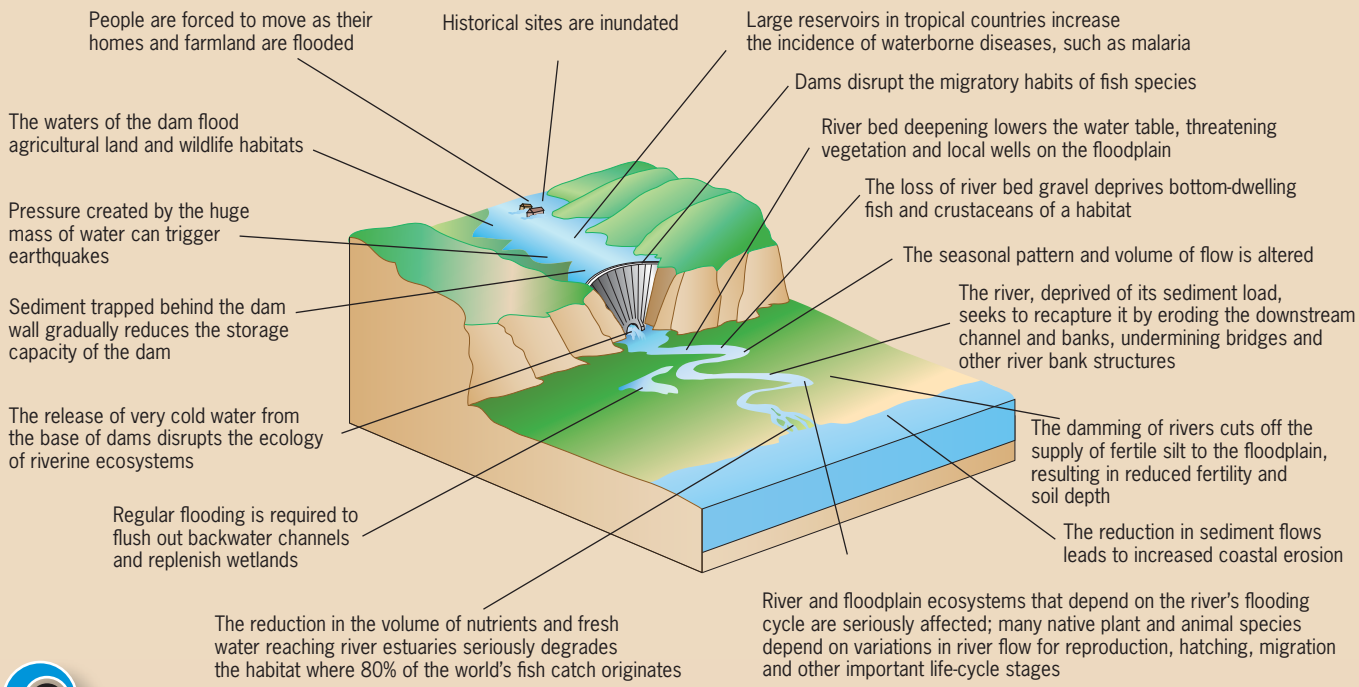


FIGURE 1.3.24
Environmental and social impacts of large dams.

There are four main types of dam design: embankment, massive, buttress and arch. (See figures 1.3.22 and 1.3.23.) The type of dam selected depends on the site's topography and geology. Earth and rock embankments, which are usually the cheapest to build, make up more than 80% of all large dams. Embankment dams are usually built across broad valleys with a ready supply of rock that can be quarried.

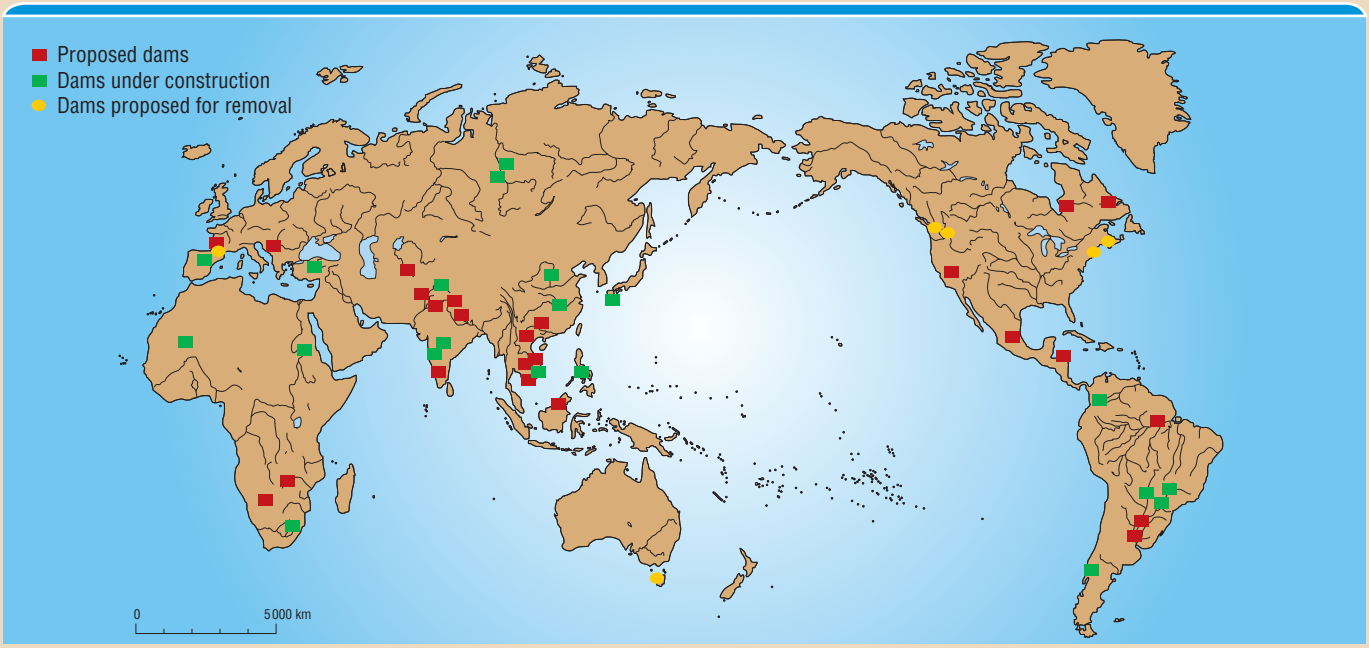
Massive dams are straight walls of concrete built across relatively narrow valleys with firm bedrock.

Arched structures, also made of concrete, are suited to narrow canyons with strong rock walls. Because of their shape, arched dams require only a fraction of the concrete required by gravity dams of a similar height.

Dams built across broad valleys often require long lengths of ancillary dams or dykes to create a reservoir.

The world distribution of large-scale water projects (all of which involve the construction of large storage dams) is shown in figure 1.3.25. These projects are the most recent examples of the way people have sought to modify the water cycle for human use. Some of the most controversial of these projects include the damming of India's Narmada River, China's Three Gorges Dam Project and Turkey's South-Eastern Anatolia Project. The vast scale of these projects reflects the technological advances that have been achieved in construction methods and materials. However, critics of such projects argue that their scale and expense, and the disruption they cause to the way of life of local communities, often make them an inappropriate form of development.

The environmental and social impacts of large dams are shown in figure 1.3.24.



Asia and Oceania

- Bakun Dam, Balui R., Malaysia
- Chisapani Dam, Karnali R., Nepal
- Kalabagh Dam, Indus R., Pakistan
- Kishen Ganga Dam, Kishen Ganga R., Kashmir
- Longtan Dam, Hongshui R., China
- Nam Theun 2 Dam, Theun R., Laos
- Pancheshwar Dam, Mahakali R., India and Nepal
- Povamkutty Dam, Povamkutty R., India
- Sambor Dam, Mekong R., Cambodia
- Ta Bu Dam, Song Da R., Vietnam
- Xekaman 1 Dam, Xekaman R., Laos
- Kawabe River Dam, Kawabe R., Japan
- Maheshwar Dam, Narmada R., India
- San Roque Dam, Agno R., Philippines
- Sardar Sarovar Dam, Narmada R., India
- Tehri Dam, Bhagirathi R., India
- Three Gorges Dam, Yangtze R., China
- Xiaolangdi Dam, Yellow R., China
- Yali Falls Dam, Se San R., Vietnam
- Scotts Peak Dam, Lake Pedder/Gordon R., Australia

Europe, Middle East and Russian Federation

- Nagymaros Dam, Danube R., Hungary (postponed)
- Rogun Dam, Vakhsh R., Tadjikistan
- Serre de la Fare Dam, Loire R., France (shelved)
- Boguchany Dam, Angara R., Siberia
- Greater Anatolia Dam Project, Euphrates R., Turkey
- Itoiz Dam, Irati R., Spain
- Katun Dam, Katun R., Russia
- Maisons-Rouges and Saint-Etienne-du-Vigan Dam, Loire R. Basin, France

South and Central America

- Corpus Dam, Parana R., Argentina and Paraguay
- Parana Medio Dam, Parana R., Argentina
- Patuca Dam, Patuca R., Honduras
- San Juan Tetelecingo Dam, Balsas R., Mexico (postponed)
- 16 dams in the Amazon, multiple rivers, Brazil
- Ita Dam, Uruguay R., Brazil
- Machadinho Dam, Uruguay R., Brazil
- Ralco Dam, Biobio R., Chile
- Urra 1 Dam, Sinu R., Columbia
- Yacyreta Dam, Parana R., Argentina and Paraguay (reservoir unfilled)

North America

- Auburn Dam, American R., USA (postponed)
- Great Whale Complex/James Bay Project, Great Whale R., Canada (shelved)
- Gull Island and Churchill Falls Hydropower Project, Churchill R., Canada
- Edwards Dam, Kennebec R., USA (committed to remove)
- Elwha and Glines Canyon Dam, Elwha R., USA (awaiting funds)
- Ice Harbor, Lower Monumental, Little Goose, Lower Granite Dams, Washington, USA
- Newport No.11 Dam, Clyde R., USA (removed)

Africa

- Batoka Gorge Dam, Zambezi R., Zambia
- Epupa Dam, Kunene R,. Namibia
- Kajbar Dam, Nile R., Sudan
- Manantali Dam, Bafing R., Mali
- Mohale Dam, Lesotho Highlands Water Project, Senqunhane R., Lesotho

FIGURE 1.3.25

Big dam projects.

geofocus

Songhua River

Located in the Jilin Province of China, the Songhua River flows through northern China and into the Harbin and Heilong Rivers which flow on into Russia. Millions of Chinese and Russians rely on these rivers for drinking water.

In November 2005, a massive explosion at a chemical factory adjacent to the river released a toxic bloom of benzene and nitrobenzene into the Songhua River. Benzene is a known cancer-causing chemical. The bloom eventually extended more than 80 km down the river system.

This contaminated the water supply of many towns and cities lining the river, including the Chinese city of Harbin, with a population of more than 1 million. In addition, millions of fish and other aquatic lifeforms were killed by the toxic bloom.

FIGURE 1.3.26

Residents of Jilin Province, China, collect trucked-in water.

geofocus

The Rhine River

The Rhine is one of the world's great inland waterways. (See figure 1.3.29.) From its headwaters in the Swiss Alps it passes through Austria, Germany, France, Luxembourg and the Netherlands before entering the North Sea at Rotterdam. The Rhine's mean discharge is 2200 m^3 per second and its catchment covers an area of 165 000 km^2. Each year some 10 000 ships, carrying 250 million tonnes of cargo, ply its waters.

The Rhine's catchment hosts Europe's largest concentration of industry, agriculture and hydro-power generation. Some of the continent's largest urban centres rely on the water supplied by the Rhine and its tributaries. Approximately 50 million people live within the catchment.

In the last 150 years, the hydrology of the river has changed dramatically. (See figure 1.3.29.) Humans have sought to exercise greater control over the river. The Rhine has been deepened and straightened and now transfers water 50% quicker than before the human intervention.

The waters of the Rhine are used for a variety of industrial processes, by farmers for agriculture and by those living in the urban centres that line the river and its tributaries. All these uses discharge waste water back into the river. The main pollutants include nutrients, toxic chemicals, warm-water discharge and salt.

The phosphates and nitrates found in detergents and agricultural fertilisers promote the growth of algal blooms.

FIGURE 1.3.27

The Rhine River: Europe's most important inland waterway.

About one-third of all nitrogen discharged into the North Sea originates from the Rhine. Toxic chemicals in the river include cadmium, lead and mercury, which accumulate in the higher levels of the food chain. Warm water released from manufacturing plants and power stations disrupts the ecology of the river. Salt in the river comes mainly from the potash mines in Alsace.

Many of the toxic pollutants have settled into the mud on the floor of the Rotterdam harbour. Dredged material must be stored because it is too toxic to be dumped at sea.

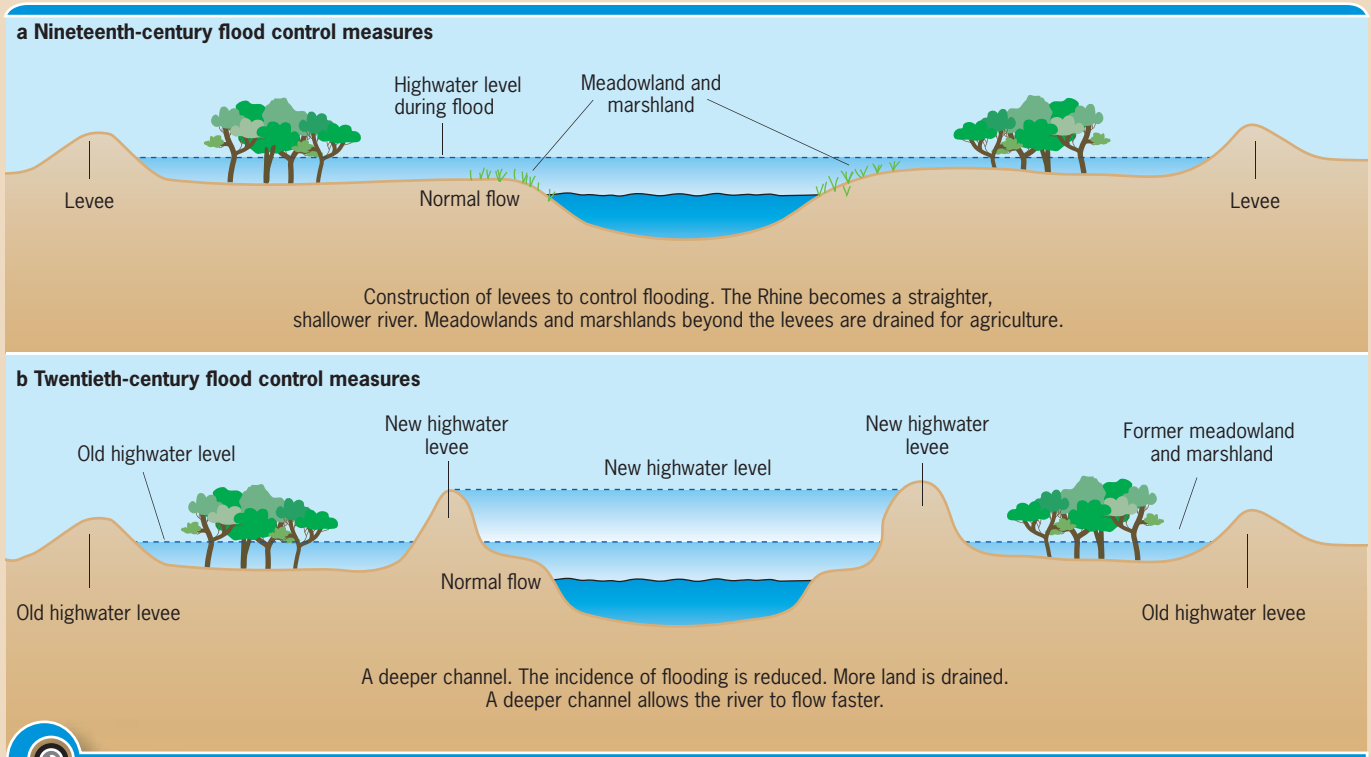


FIGURE 1.3.28

Changes in flood control.

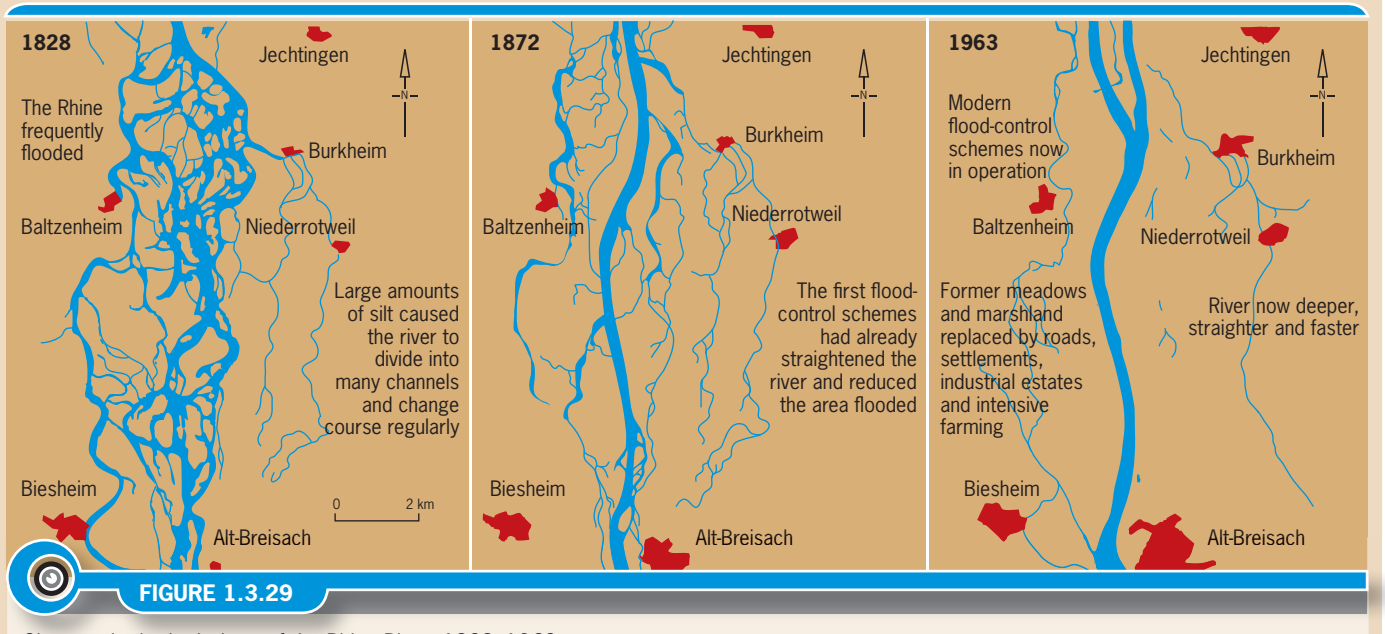


FIGURE 1.3.29

Changes in the hydrology of the Rhine River, 1828–1963.

working geographically

1 **Interpreting diagrams and Internet research** Study the Geofocus box 'Big dams' (pp. 70–1).
   a Study figure 1.3.30.
      i Outline the functions of large dams.
      ii Outline the factors that govern the type of dam built in a particular location.
      iii Name the type of dam suited to broad valleys.
      iv Name the type of dam favoured in narrow canyons with strong rock walls.
   b Study figure 1.3.25. Select one of the dams earmarked for removal. Use an Internet search engine to investigate why the dam is being removed. What benefits will be gained from its removal?
   c Study figure 1.3.25. Select one of the big dam projects in Southern or South-east Asia. Use the International Rivers Network website or other relevant sites to investigate the project. Use the following points to organise your research:
      i the project's name and location
      ii the nature, size and cost of the project
      iii the benefits to be derived from the project
      iv the environmental and social costs of the project
      v the response of local people and organisations, such as the International Rivers Network, to the project.
   d Study figure 1.3.24. Write a report outlining the environmental and social impacts of big dams.

2 **Writing and research task** Study the Geofocus box 'The Rhine River' (pp. 72–3).
   a Write a report outlining the ways in which people have interacted with the hydrosphere within the Rhine River catchment.
   b Write a report outlining how people are seeking to address the negative impacts of this interaction.
   c Supplement the information provided in the Geofocus box by undertaking your own Internet-based research. Use this information to enhance your reports.
   d Study figure 1.3.28. Write a paragraph describing how the flood-control works have affected the incidence and nature of flooding in the Rhine Valley.
   e Study figure 1.3.29. Write a paragraph describing how the activities of people have affected the drainage pattern within the Rhine River catchment.

3 **Writing task** Complete the following extended response. Assess the extent to which humans have affected river systems.

4 **Internet research** Visit the Murray–Darling Basin Commission website. Write a report on the impact of various human activities on this river system.

geoskills 7

Writing stimulus-based responses

A short-answer response may be no more than 15–20 lines long. Such responses generally require an analysis of statistical data, maps, graphs, diagrams, cartoons, or newspaper and magazine extracts.

When you study the stimulus material on which the question being asked is based, you should ask yourself the following questions:

- What information does the item convey?
- What geographical concepts are related to the stimulus material; that is, what are the trends or patterns identified?
- What are the geographical implications of the information (trends and/or patterns) conveyed by the stimulus material?

In general, the best stimulus-based responses do more than simply describe the stimulus material. Better students write about the underlying processes and use their knowledge to show that they understand the points made in the material. They write well-argued answers and employ appropriate terminology and concepts.

Generally, the writing of your stimulus-based response involves three stages.

Description

The first stage involves providing a statement that outlines the information presented in the stimulus material. It should, for example, include a statement that identifies the geographical phenomenon being examined or illustrated by the data or graphic representation and provide an outline of any trends evident. You may illustrate the trends by quoting data from the stimulus material.

Analysis

In analysing the data you should identify the range of geographical concepts or generalisations relevant to the information presented. You should demonstrate your understanding of these concepts by using the appropriate terminology in context. You should also identify the geographical processes responsible for the trends evident and provide explanations for their occurrence.

Implications

The third stage may involve doing something that is not expressly stated or requested by the stimulus material. From your knowledge and understanding of the topic you may be able to state or describe the possible results or effects of the patterns, trends or information presented. This would commonly involve (where appropriate) using precise geographical terminology, identifying a process or supplying some explanation of the observed trend.

8 geoskills

The Senior Geography Project

The Senior Geography Project (SGP) is a compulsory part of the Preliminary course. It provides you, the student, with an opportunity to apply what you have learnt in class to a practical research assignment involving the study of a geographical issue or phenomenon that is of interest to you. Most students find the SGP to be a very rewarding and enjoyable educational experience. It allows them to develop a range of competencies that are valued in the workplace and in further education.

Students, individually or in groups, should work through the steps shown in figure 1.3.30.

The SGP should be based on both primary sources (such as fieldwork, interviews, landscape observations, statistics and photographs) and secondary sources (such as existing published materials).

While the manner in which the SGP is assessed will vary from school to school, most teachers will focus on a student's achievement in each step of the research project rather than on the communication of results only.

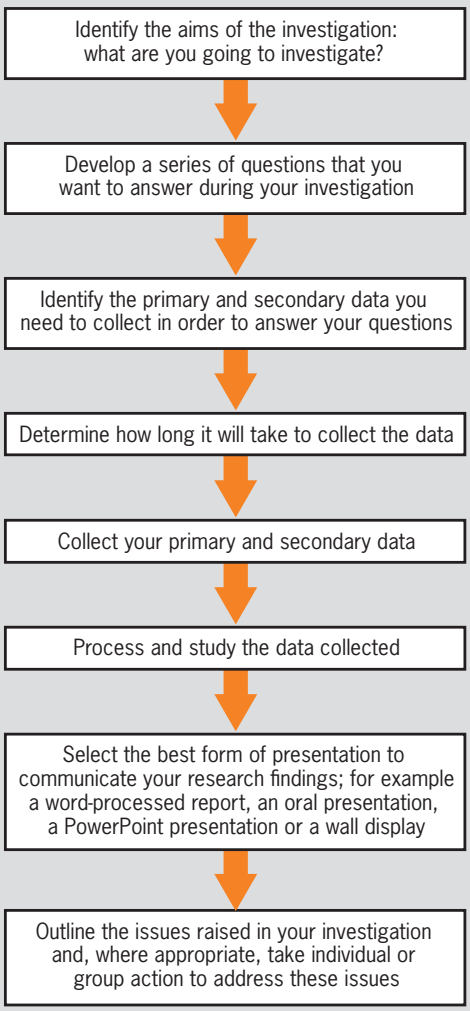


FIGURE 1.3.30

Steps in completing an SGP.

Getting started: selecting the topic

Often the most effective research projects are those that focus on a geographical issue or problem that relates to a student's personal experience and has an impact on the community in which they live.

When selecting your SGP topic a number of key questions need to be addressed. These include:

- Is the problem or phenomenon geographical? To answer this question, apply the following questions to your selected topic.
  - Is it to do with location?
  - What is it?
  - Why is it there?
  - How has it changed over time?
  - How does it affect people?
- Is the project achievable in the time available?
- Is the information required to complete the project readily available?

Warning! Many students discover, often too late, that the scope of the topic they have selected is too ambitious to be completed in the time available. It is quite often the small, seemingly straightforward research activity that achieves the best outcome. What is really important is that you demonstrate that you have a sound understanding of the

Student's name.....

Assessment criteria

	Elementary ◄► Excellent 1	2	3	4	5
Relevance of topic to geography					
Effectiveness of research techniques utilised					
Relevance of data obtained					
Depth of study					
Explanation of the research process used					
Presentation of the research findings					
Discussion of research findings					
Conclusion					
Ability to evaluate research processes utilised					
Presentation of project					
Sources utilised					

Comment .....

.....

.....

Key
5 Excellent
4 Highly satisfactory
3 Satisfactory
2 More care needed
1 Elementary achievement

Mark

Teacher's signature

.....

FIGURE 1.3.31

Sample evaluation sheet.

research process: that you can develop, apply and evaluate a research framework. Figure 1.3.31 (p. 75) gives examples of the criteria a teacher might use in assessing the SGP.

Note: When selecting your research topic it is always useful to keep in mind the range of topics to be studied during the HSC course. By relating your research project to these topics you can gain valuable insights that may ultimately enhance your assessment and exam marks. You are also encouraged to make reference to the SGP and fieldwork activities when answering questions in the HSC exam.

TABLE 1.3.4

Sample research topics

- Forest management strategies and their impact on the biophysical environment
- Factors affecting vegetation patterns in a local area
- Plant succession on sand dunes
- Plant succession on sandstone plateaus
- Coastal landform studies
- Beach erosion
- Impacts of local flooding
- Land degradation
- The impact of salinity on agricultural production and water quality
- Toxic algal blooms
- Local catchment studies
- Population movements
- Landuse patterns in a local area
- Urban decay and renewal
- Impacts of gentrification on inner-city communities
- Sources of pollution in a local community
- Changing patterns of employment in a local community
- The participation of women in a local workforce
- A study of a production unit: farm, factory or service provider
- Impacts of tourism on particular communities
- Impacts of ecotourism on the biophysical environment
- Impact of a business closure on a small community
- Waste disposal
- Waste recycling in a local community
- Effluent disposal in a local community
- Urban runoff patterns
- Energy conservation in a local community
- The impact of community action groups
- Impacts of culture contact within particular urban communities
- Changing patterns of retailing
- The impact of large regional shopping malls on small local shopping centres
- Patterns of movement related to retailing
- Patterns of crime in a local community
- Impact of economic restructuring on the location of industry within large cities
- Socioeconomic studies of local communities using Census data

Topics you might consider

Listed in table 1.3.4 are research topics that have been selected by students in the past. They may provide you with ideas or raise other issues that interest you.

Using your time effectively

Thorough planning is often central to the success of the research project you are undertaking. To help you stay on track, it is useful to develop an SGP action plan. (See figure 1.3.32.) Your teacher may assist you in maintaining your effort by monitoring your progress.

Warning! Don't leave everything to the last minute. If you do, you are unlikely to realise your full potential in this valuable learning experience.

Identifying your aims and hypotheses

Clearly stated aims and hypotheses provide the reader with an overview of your research project. They explain what you are attempting to achieve and what you expect to find. They help you to confine your research project within a manageable framework.

Name ..... **Topic** .....

Aim

Hypothesis

Objectives

Sources of information/data

Outline of method. In the table below briefly explain your plan of action and indicate when you intend to implement each stage of the plan.

Week	Plan of action	Date completed	Teacher's signature
1			
2			
3			
4			
5			

FIGURE 1.3.32

SGP sample action plan.

The *aims* of your research project represent a concise statement of what you are setting out to achieve. Aims are usually expressed in terms such as:

- to investigate
- to discover
- to identify
- to analyse
- to consider
- to explain.

An example of the aims for a topic that examined 'Toxic algal blooms in Sharksville Creek' would be:

- *Aim 1*. 'To identify the causes of toxic algal blooms in Sharksville Creek.'
- *Aim 2*. 'To investigate the impact of toxic algal blooms on the ecosystem of Sharksville Creek.'
- *Aim 3*. 'To evaluate the effectiveness of the different strategies used to manage the outbreaks of toxic algal blooms in Sharksville Creek.'

Hypotheses are the expected answers to the questions addressed in the aims of your study, and are based on your prior learnings, observations and experiences. Because they are only informed guesses they may be wrong. This does not matter. Researchers have often found that unexpected outcomes have led to important new discoveries.

For the topic above, examples of appropriate hypotheses might be:

- *Hypothesis 1*. 'Toxic algal blooms result from increased levels of phosphate in water.'
- *Hypothesis 2*. 'Toxic algal blooms destroy aquatic ecosystems by greatly reducing the amount of oxygen contained in rivers.'
- *Hypothesis 3*. 'Only those management strategies designed to reduce the amount of phosphate entering Sharksville Creek are likely to be effective.'

The number of hypotheses should be the same as the number of aims.

Some teachers may also require you to identify objectives. Objectives are the steps you take to achieve your aims. These may be quite specific and be closely related to the methodology you develop to test your hypotheses.

For the same topic, examples of objectives might be:

- *Objective 1*. 'To measure phosphate levels at various sites along Sharksville Creek.'
- *Objective 2*. 'To assess the level of biodiversity at various sites along Sharksville Creek.'

Gathering and processing information

The collection and processing of data is the 'hands-on' part of the research process. It can involve extensive fieldwork (direct observation/measurement of phenomena) and may require you to deal directly with the public. In most survey-based research involving questionnaires, observation or direct measurement, only a sample is taken. This is because of the restraints imposed by time and cost. The sample must, however, be large enough to provide reliable results. You must also decide whether you are going to target a particular group or base your research on a randomly selected sample. Normally, care should be taken to ensure that your sample includes a range of people in terms of age, gender and occupational groups.

Secondary sources of information (such as published texts, newspaper and magazine articles, government reports, videos and statistical publications) may also prove useful. Many secondary sources can be accessed via the Internet and/or Geographical Information Systems (GIS).

Gathering data

Gathering data often involves writing letters to people and organisations that may be able to provide you with relevant information and assistance. Being able to write and set out a letter is an important skill. Ask your teacher for assistance if you are unsure how to go about this. Many students become frustrated at the lack of response to their letters. People are less likely to ignore concise, well-written letters.

Warning! If you are requesting information from companies or government offices, you should remember that it often takes a few weeks for the material to be sent to you. To avoid last-minute delays, write your requests early in the planning stage.

Having decided what form your research will take, and having collected all the relevant data, it is then necessary to use the data in a way that best achieves your stated aims and proves or disproves your hypotheses.

Processing results

Processing your results must be done carefully to ensure accuracy. If you have based your research on a questionnaire, you might find it useful to use a blank copy of the questionnaire to maintain a tally of responses. If you subject your data to mathematical calculations, make sure you check your answers.

To ensure that you complete your research project in the allocated time, you might find it useful to use the SGP action plan. (See figure 1.3.32.) This will allow you to manage your time effectively.

Presenting the SGP

Forms of presentation

There are a number of ways in which you can present your completed research project. The form of presentation could include one, or a combination, of the following:

- a written report of no more than *2000* words, supported by appropriate data. *Note:* The material included in appendices should not be included in the word count.
- an audio-visual display, using appropriate information technologies and electronic media
- an oral presentation
- a pictorial essay.

You should always select the form of presentation that will best enable you to demonstrate the depth of knowledge and understanding you have developed during the project. Students who have very well-developed oral communication skills, for example, may find an oral presentation to be the best way of presenting their findings.

An audio-visual display may include one, or a combination, of the following:

- a PowerPoint presentation and accompanying oral presentation
- a podcast
- a webpage.

A pictorial essay could be presented as a wall display or be set out in an A3-size display book. It could include a wide range of pictorial material, such as maps, photographs, illustrations, cartoons and graphs. These would need to be accompanied by explanatory text.

Most students will elect to present a written report. If this is your preferred method of presentation, it is important that you follow a number of generally accepted guidelines:

- The report should be professionally presented. Using a word processor often makes this easier to achieve. Use A4-size paper and place the report in a display folder.
- If your report is handwritten, make sure the writing is neat.

It is important to ensure that your report contains the following sections:

- title page
- table of contents
- lists of tables and figures
- aims and hypotheses
- statement outlining the methodology used
- statement outlining the research findings
- conclusion or a discussion of the findings
- evaluation of the research process
- bibliography
- acknowledgements
- appendix or appendices containing a copy of the research instruments (such as survey forms and observation sheets) and other relevant information.

Check with your teacher that this structure meets their requirements and that it is suited to the type of research you are undertaking.

Title page

The first page of your written report is the title page. It should include the course name, the title of the research project, your name, your teacher's name and the date the project is due. The wording of the title should convey to the reader a concise understanding of what your research project is about. (See figure 1.3.33.)

Table of contents

The next page of your written report should be the table of contents. This should give the headings for all sections of the report and the page numbers on which they begin. By referring to the table of contents, a person reading the report should be able to see at a glance that you have used the correct report structure. (See figure 1.3.34.)

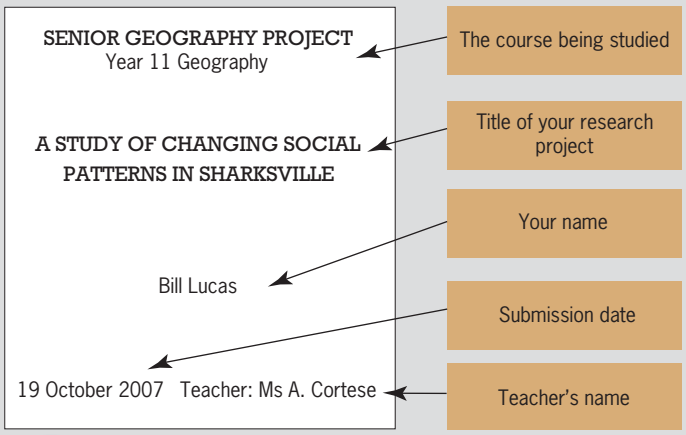


FIGURE 1.3.33

Sample title page.

List of tables and figures

The list of tables usually precedes the list of figures. In each case the titles should be listed and numbered sequentially. Figures include photographs, graphs, maps, sketches and diagrams. (See figure 1.3.35.)

Aims and hypotheses

Your aims and hypotheses can be listed in point form or as discrete (separate) statements. Space these out so each is clear, or use a format that draws the reader's attention to them.

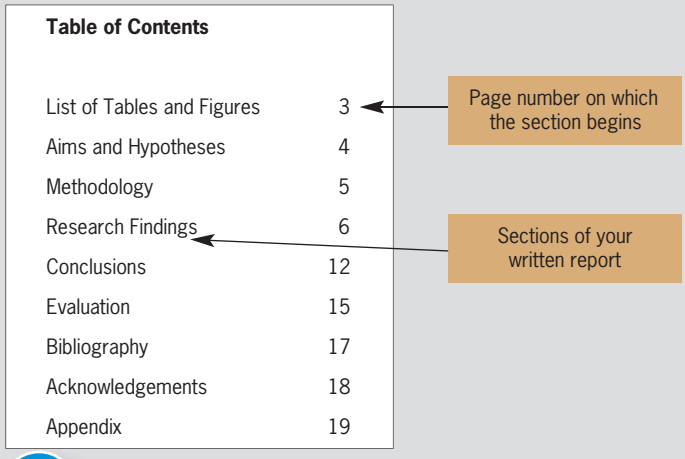


FIGURE 1.3.34

Sample table of contents page.

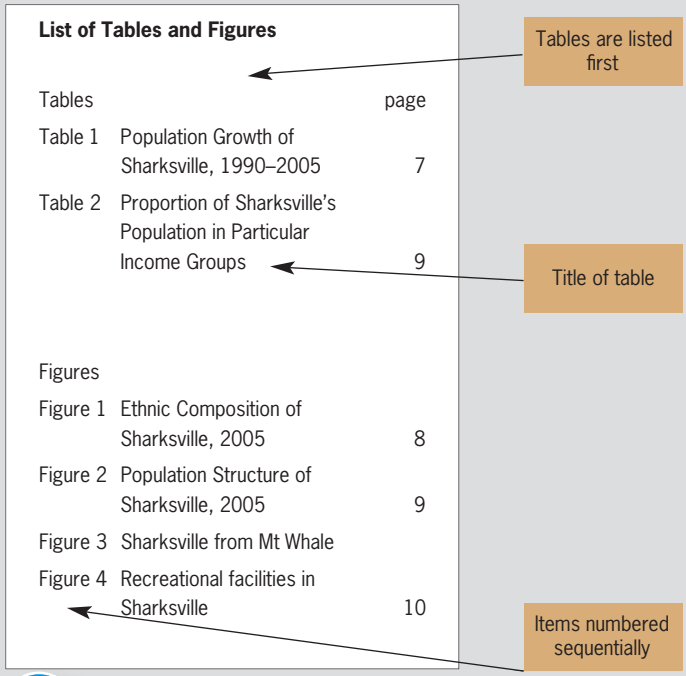


FIGURE 1.3.35

Sample list of tables and figures page.

Methodology

In the methodology section of the written report you describe how you investigated the geographical issue or problem on which your research focused and how you tested each of your hypotheses. Describe the processes you went through and explain why you adopted your particular approach. Where appropriate you should include information such as:

- how you collected your data
- why this method was selected
- the size of your sample
- how the sample was selected
- the duration of the research
- how the data was processed.

Research findings

The research findings section represents the body of your report, the place where you outline the results of your research. This can be done using appropriate graphs, tables, diagrams, photographs and maps but you should also include a written description of your results. Ensure you make reference to the tables and figures that you have used to illustrate your results. This can be done by using statements such as:

- 'The results illustrated in figure 1.2 demonstrate…'
- 'Figure 1.3 shows that…'
- 'As shown in table 2.1 …'.

Take care with your graphs, maps and other illustrative material. Use colour and make sure you follow the generally accepted conventions for their use. Ensure each figure is numbered and has a caption or title that identifies what it represents.

If you are testing more than one hypothesis, you may find it useful to break this section into different parts: one for each hypothesis.

Conclusion

In the conclusion you analyse the results of your research and evaluate them in terms of the stated aims and hypotheses.

Discuss the ways in which your findings reflected, or differed from, what you had expected. You can also offer an explanation as to why you achieved your particular results and outline any unexpected or interesting outcomes from your research.

If appropriate, you might also find it useful to reflect on the geographical implications of your research.

Evaluation

Many teachers regard the evaluation section to be the most important part of the SGP presentation. This is where you have an opportunity to demonstrate your understanding of research processes by critically evaluating the research framework you developed for your project. Even if you were disappointed with the results of your research project, you can still gain good marks by being able to identify where you went wrong and how you would address these particular problems in any future research of this nature.

In your evaluation you should outline both the limitations and successes of your research project. You should also state the problems you encountered and how these affected the final outcome. Common problems encountered by students include:

- the non-return of survey forms
- poorly constructed questions that failed to obtain the information you required
- a sample that proved to be too small
- a lack of appropriate resources
- a reluctance by individuals and institutions to give you access to the information you needed
- a research focus that was too ambitious for the time and resources available.

You should balance the discussion by highlighting the successes of your research and the benefits derived from completing the project. These might include:

- an understanding of the research process
- an enhanced understanding of geographical concepts and terminology
- improved communication skills
- skills in the presentation of data
- greater self-confidence
- a sense of achievement from completing the task.

You should conclude this section by describing how you would improve the project if it were to be repeated.

Bibliography

In the bibliography you should list the names of the secondary resources that you found useful when undertaking your research. If this book were to be included in the bibliography, you would use the following format:

> *Kleeman, G. (ed.), Hamper, D., Rhodes, H., Lane, R. & Rugendyke, B., Global Interactions 1: Second Edition, Pearson Heinemann, Melbourne, 2008.*

If references to newspaper and magazine articles are included, you should provide details as in the following example:

> *Knauer, K. 'Global warming: the causes, the perils, the solutions, the actions: What to do', Time, New York, 2007.*

Acknowledgements

The acknowledgements section is an opportunity to acknowledge and thank those individuals and organisations that have assisted you in your research.

Appendices

The appendix of a report is the place for background information that is of some relevance to your study. It might include newspaper cuttings that deal with the topic, copies of questionnaires used, and tables of data from which you have constructed the graphs used to illustrate your research findings.

The ethical responsibilities of conducting geographical research

When undertaking research it is very important that you conduct your inquiry according to accepted ethical conventions. These include:

- Respect the confidentiality and anonymity of those people providing you with information/data. If you do want to name someone in your report seek their permission first.
- Do not use deception or coercion to obtain information and/or data from people.
- Avoid exposing yourself or others to physical and/or emotional risks or harm.
- Obtain permission before entering private property.
- Minimise any damage to the environment.
- Observe academic conventions regarding plagiarism.
- Store your data in a secure place, especially if they are of a sensitive nature.
- Acknowledge the source of information and/or ideas gathered from secondary sources.

unit 1.4

> Adopt the pace of nature: her secret is patience.
> **Unknown**

> Treat the earth well: it was not given to you by your parents; it was loaned to you by your children.
> **Ancient proverb**

> Touch the earth, love the earth, honour the earth, her plains, her valleys, her hills, and her seas; rest your spirit in her solitary places.
> **Ernest Dimnet, French poet and writer**

The Lithosphere

The lithosphere is the solid, outer portion of the earth—its rigid upper mantle. The principal features of the lithosphere are the continental plates on which the ocean basins and continents are located.

In this unit we will examine the processes that shape the surface of the land. We will also focus on the landforms shaped by water, wind and ice; the formation and characteristics of soils; and the ways people interact with the lithosphere. The study of landforms, their origin, evolution, type and distribution is called **geomorphology**.

The land surface is the most visible, and one of the most influential, aspects of the biophysical environment. The structural features of the earth's surface are subject to constant change. Some of these changes are quite dramatic and easily seen, as when a volcano erupts or when a landslide tears away a hillside. Others are too slow to be visible over a human lifetime. Valleys deepen and widen and ocean waves gradually reshape the margins of the land. Mountains may seem everlasting, but after every storm our rivers are heavy with sediment washed from their slopes.

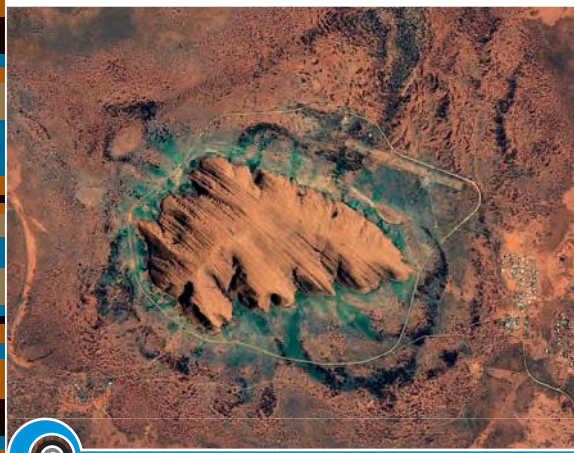
In Unit 1.4 we examine the nature and functioning of the lithosphere.

Uluru: one very big rock

In the heart of the Australian outback, a massive block of red sandstone rises up out of the flat, eroded landscape. Now known by its Aboriginal name, Uluru, rather than as Ayers Rock, this giant monolith is 348 m high, 3.6 km long and 9.4 km around. It is the largest such monolith (or single great stone) on earth. Tourists come from all over the world to watch the sunrise and sunset bring the rich colours of the rock to life. Some also climb the rock, despite the disapproval of the local Aboriginal people, who consider Uluru a sacred site.

Uluru is also referred to as an inselberg: an isolated remnant left after the slow erosion of an original mountain range. The remarkable feature of Uluru is the lack of jointing in the rock surface. As a result, scree slopes and soil do not develop on its surface. These characteristics ensured the monolith's survival, while the surrounding rock was eroded away.

Uluru is composed of coarse-grained sandstone. It also contains a significant quantity of quartz, other silicate minerals and rock fragments. The minerals present are in similar proportions to those found in granite, which makes up much of the ranges to the south of Uluru. When first exposed to the air, the rock has a grey colour. Over time, by a process known as oxidation, the iron-bearing minerals contained within the rock are weathered. This gives the outer surface layer of rock its distinctive red-brown colour.



Satellite image of Uluru.

exam-style questions

extended responses

- Outline the tectonic and gradational forces shaping the earth's surface.
- Explain the difference between physical and chemical weathering. Give examples of each.
- Outline the factors that influence the development of soils.
- Outline the ways in which people interact with the lithosphere.
- What is desertification? Explain how the activities of people have contributed to desertification.

glossary

- **asthenosphere** a layer of partially molten material within the upper part of the mantle, upon which the lithospheric plates move.
- **continental drift** a theory that proposes that all the continents were once joined together in a giant supercontinent, which subsequently split apart, with the continents drifting away from one another until they reached their present locations.
- **desertification** the spread of desert-like conditions in arid and semi-arid regions resulting from a combination of climatic changes and increasing human pressures, such as overgrazing, removal of vegetation and the cultivation of marginal land.
- **earthquakes** vibrations and shock waves caused by the sudden movement of tectonic plates along fracture zones, or faults, in the earth's crust.
- **erosion** the wearing away of land by running water, rainfall, wind, ice or other geological agents.
- **geomorphology** the study of landforms, including their origin, evolution, form and distribution.
- **gradational processes** those processes that result from gravity and the sun's radiant energy and which act upon the surface of the lithosphere and bring it to a common level. It includes the fragmentation of rocks by weathering, their mass movement downslope, and the detachment and removal of these materials by the agents of erosion and the deposition of debris at a lower elevation.
- **land degradation** a decline in the quality of natural land resources, commonly caused by improper use by humans.
- **landform** a specific physical feature of the earth's surface; for example, a plain, escarpment, valley, plateau, hill or mountain.
- **landuse** the range of uses that humans make of the earth's surface.
- **lithosphere** the outer shell of the earth, consisting of solid rock (100–150 km thick), soil and geological formations.
- **mass movement** the downslope movement of weathered rock material under the influence of gravity.
- **soil** the loose material composed of both mineral and organic matter that covers the earth's land surface. Its thickness varies from place to place.
- **tectonic forces** disturbances in the earth's crust that result from the earth's internal energy and create physical features, such as mountains, on the earth's surface.
- **tectonic plates** sections of the earth's crust that move about as distinct units on the asthenosphere on which they rest.
- **volcanism** a process resulting in the upward movement and expulsion of molten material from within the earth to the surface, where it cools and hardens.
- **weathering** the in situ physical disintegration and chemical decomposition of rocks and minerals at or near the earth's surface by atmospheric and biological agents.

FIGURE 1.4.1

Evidence of the process of weathering.

Forces that shape the earth's surface

The presence of soaring mountains, deep gorges and rugged coastlines all tell of the ongoing battle between opposing forces: tectonic and gradational. The forces of **gradation**, which result from gravity and the radiant energy of the sun, wear down and smooth the earth's surface. (See figure 1.4.1.) **Tectonic forces**, the result of the earth's internal energy, upheave the land surface. These forces deep within the earth have pushed up and created new **landforms**. If it were not for tectonic forces, the earth's surface would have been reduced long ago to a flat, featureless plain by the relentless gradational processes of **weathering**, **mass movement** and **erosion**. The Snowy Mountains of south-eastern Australia were, for example, once 500 m higher than they are today. Millions of years of gradation have lowered them to their current height and rounded form.

Catastrophic **earthquakes** and volcanic eruptions have been responsible for the formation of some of the earth's most spectacular scenery. Yet the majority of landform features associated with the earth's internal forces are the result of small, largely discrete movements that

are constantly repeated over millions of years. Most of the rock masses seen at the earth's highest elevations were originally formed on ancient ocean floors. This is evidenced by the fossilised remains of marine organisms found on top of the lofty Himalayan Mountains.

Occupying a part of the Great Rift Valley, the Red Sea (see figure 1.4.2) was formed as Arabia split from Africa due to plate tectonics. A number of volcanic islands rise from the centre of the sea. Most are dormant, but in 2007, the volcano on Jabal al-Tair island erupted violently.

Looking inside the earth

Tectonic activity, whether it be sudden and violent or slow and imperceptible, occurs within the outer shell of the earth known as the **lithosphere**. The lithosphere is the solid portion of the earth as opposed to the liquid hydrosphere and gaseous atmosphere. It encompasses all solid materials between the earth's surface and the overlying mantle of its core. As large amounts of these materials are inaccessible, their effects on the surface features of the earth are still not fully understood.

For many years, scientists have been aware that the earth's rumblings and joltings originated from movements deep within the earth. They have pondered not only the nature of the earth's interior, but ways of exploring below the surface. Scientists developed techniques that enabled them to gain a greater understanding of the structure of the earth. For example, when an earthquake strikes, the earth reverberates with shock waves. These waves, called seismic waves, travel through the earth. The speed of seismic waves varies according to the properties of the material through which they pass. From a study of thousands of seismographs, the depth, density, physical state and type of rock in each layer below the surface can be inferred.

To understand the forces at work within the lithosphere it is necessary to know how this sphere relates to the internal structure of the earth. (See figure 1.4.3.)

The core

Extending about halfway to the surface from the earth's centre is the core, which has a radius of 3400 km. Because of the intense heat at the centre of the earth, the core is thought to consist of molten rock. Scientists, however, are not certain of the physical state of this material, since the combination of high pressure and temperature at the centre of the earth cannot be duplicated in laboratories.

Surrounding the inner core is the mantle, believed to be about 2900 km thick. Temperatures in the mantle are high enough to melt rock material, but pressures are so intense at these depths that most of the mantle is rigid. However, within the upper mantle, there is a soft layer of partially molten rock known as the **asthenosphere**. Movement of material in the asthenosphere plays an important role in shaping the earth's surface.

There is a distinct boundary between the mantle and the lithosphere. The surface of this separation is known as the Mohorovic Discontinuity, or Moho, a simplification of the name of the seismologist who discovered it.

The crust

The outermost and thinnest of the earth's layers is its crust. This uppermost part of the lithosphere is the most accessible part of the earth's structure. The depth of the crust varies from 40 km beneath the continents to 6 km beneath the deep ocean floors. This variation is a result of differences in rock density in the two areas.

Rather than forming a single, continuous shell over the earth, the lithosphere is broken into a number of large units, called plates. These move over the partially molten material in the asthenosphere.

FIGURE 1.4.2

A satellite photograph of the Middle East. The Nile River and its delta are on the left in the photograph. The Red Sea is on the right.

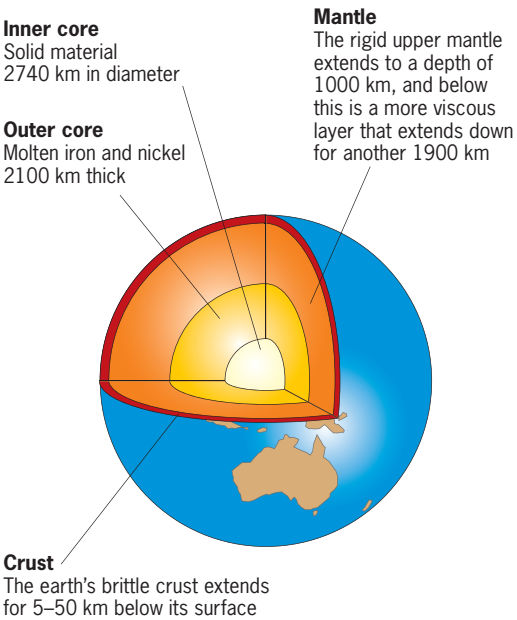
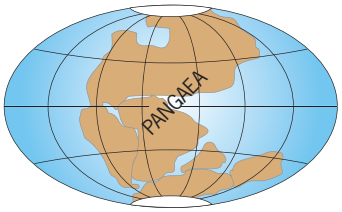


FIGURE 1.4.3

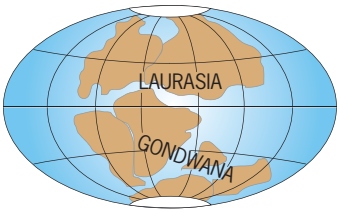
The earth in cross-section. The tectonic movements that shape the earth's surface features take place in the lithosphere.

understanding the text

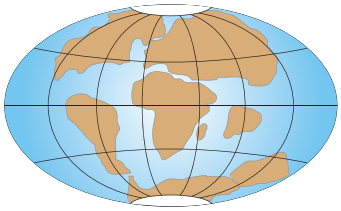
1 **Describe** the two sets of forces that shape the earth's surface.
2 What is the lithosphere? How does it differ from the hydrosphere and the atmosphere?
3 **Explain** how scientists were able to establish what is below the earth's surface when it is so inaccessible.
4 **Identify**, with the aid of a diagram, the layers that make up the internal structure of the earth.
5 **Explain** why the depth of the crust varies.
6 What are the lithospheric plates?



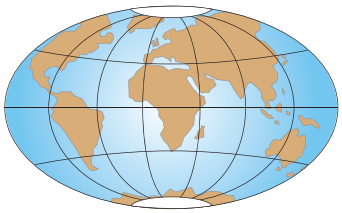
225 million years ago
One large supercontinent called Pangaea



180 million years ago
Pangaea begins to break up. Laurasia and Gondwana can now be easily distinguished



65 million years ago



Today

FIGURE 1.4.4

The movement of the continents.
(Source: *Heinemann Atlas*)

Continental drift and the origin of the continents

The publication of Alfred Wegener's theory of **continental drift** in 1915 provided an explanation for the striking similarity between the edges of the shoreline on the two sides of the Atlantic Ocean, especially between those of Africa and South America. Wegener's findings were based on the matching of fossils and rocks from the coastal regions of two continents. He suggested that the only reasonable conclusion to be drawn from this was that the currently isolated continents shifted laterally from a former 'supercontinent'.

The supercontinent was named Pangaea and was believed to consist of two main parts: Laurasia (Asia, Europe, Greenland and North America) and Gondwana (Australia, Antarctica, Africa, India and South America). Laurasia and Gondwana began to move apart about 200 million years ago. Each part of the original land mass (today's continents) slowly drifted to its present location. The broken pieces of the supercontinent, it was argued, could all fit back together like the pieces of a giant jigsaw puzzle. (See figure 1.4.4.)

Wegener's theory was generally rejected at the time, because it lacked a plausible mechanism to explain the movement of the continents.

Subsequent geological investigations of the mid-Atlantic Ocean have shown that the sediments near the mid-Atlantic ridge are thin and relatively young, while those progressively further away are broken and older. This indicates that new land is being created and by its emergence is forcing the continents further apart.

Plate tectonics

The essential points in formulating the theory of plate tectonics were:

- identification of the asthenosphere as a layer of weak, plastic-like material that acts as a lubricating layer
- identification of the cold, rigid, lithospheric plates moving like great rafts over the fluid asthenosphere
- the idea that if new oceanic crust is being continuously created along the mid-ocean ridges, either the earth must be expanding and the oceans must be getting larger, or an equal amount of old crust must necessarily be destroyed in order to maintain an earth of constant size.

Figure 1.4.5 shows how a convection current in the asthenosphere rises, separates and forms a mid-ocean ridge. The convection current sinks again where the oceanic plate meets the continental plate. As it sinks, it carries the solid rocks of the crust downwards into the earth's interior where they melt back into the asthenosphere. The places where this downward movement occurs are known as **subduction zones**.

Figure 1.4.6 shows five major lithospheric plates, as well as a number of minor ones. Scientists working for NASA have now measured the velocities of plate movements using satellites and lasers. Their calculations have confirmed earlier suggestions that the earth's plates move at speeds of between 1.5 and 7 cm per year. Australia, for example, continues to drift north at a rate of 6.7 cm per year.

Causes of plate motion

Convection currents within the earth's mantle have long been regarded as the cause of plate motion. The rising magma at the diverging mid-ocean ridges is believed to push the plates apart horizontally. The depth of mantle convection is still unknown. Some recent research suggests that it is shallow and largely confined to the asthenosphere, rather than extending further into the mantle.

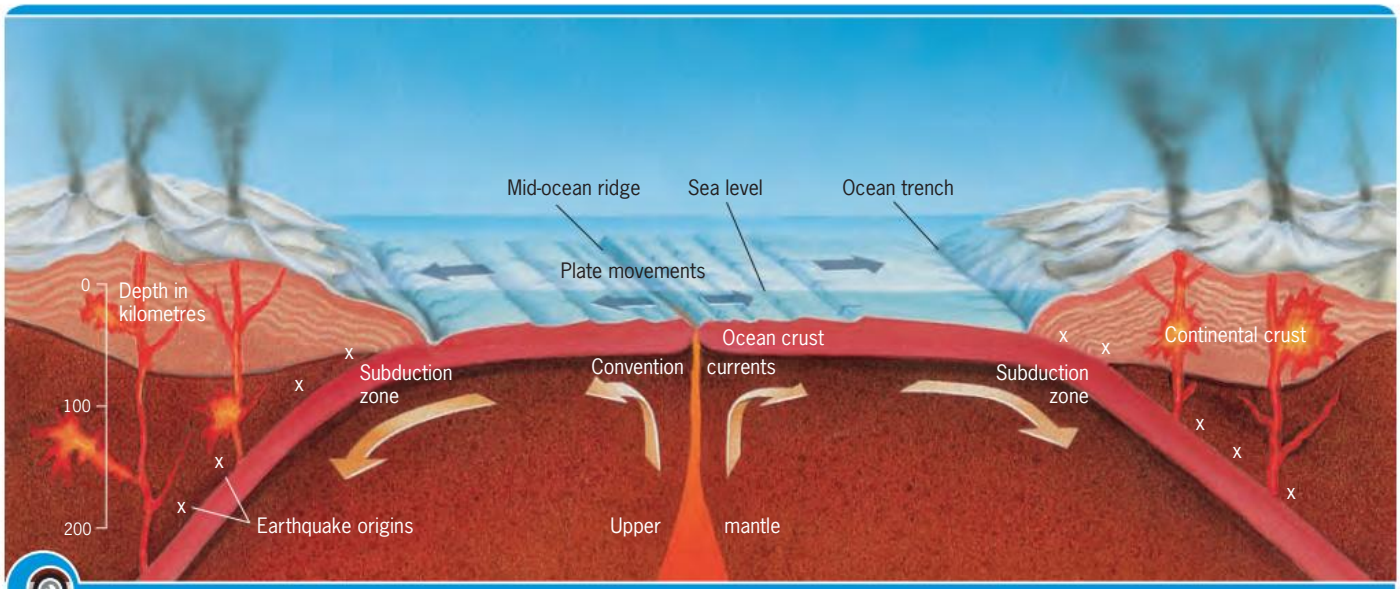


FIGURE 1.4.5

Tectonic processes.

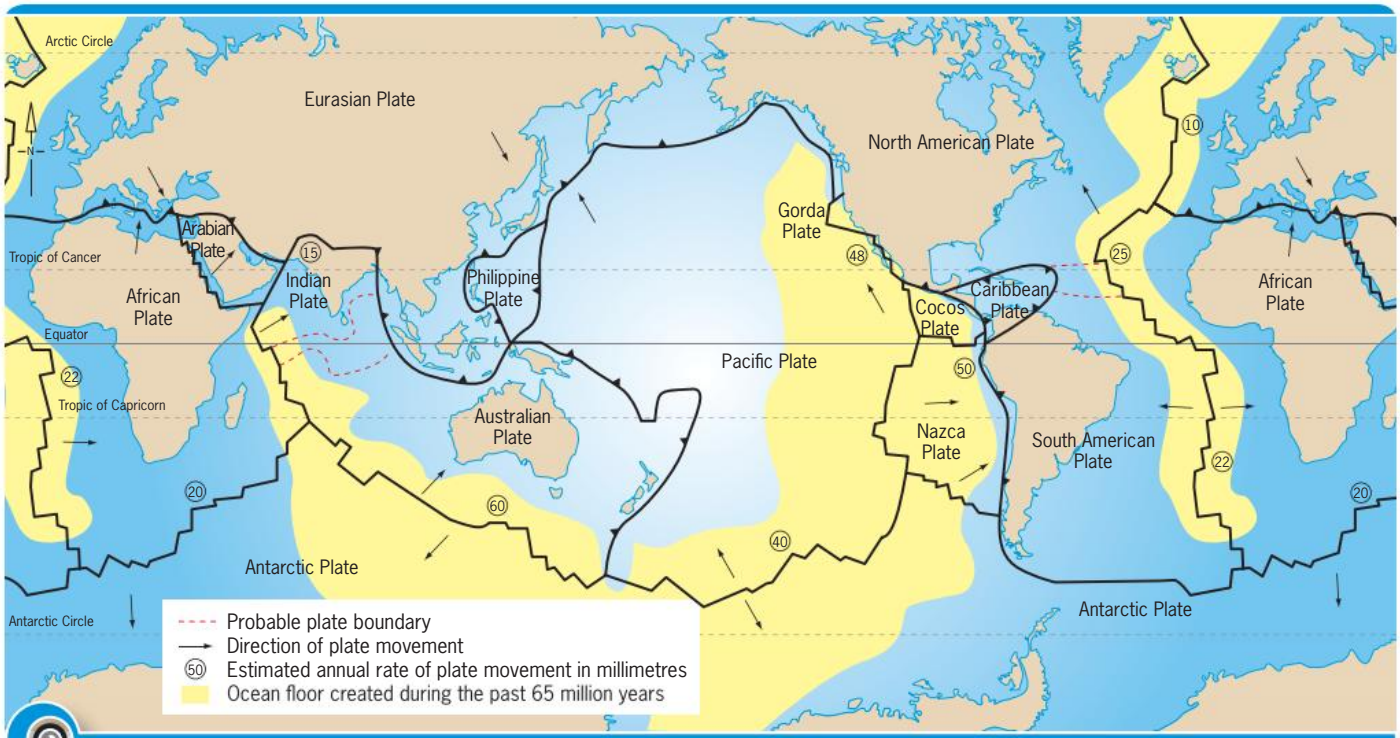


FIGURE 1.4.6

The earth's continental plates.

Plate movements

The lithospheric plates are rigid slabs of rock that move individually. For this reason, as a unit, their inner parts are relatively inactive. Almost all tectonic and volcanic activity on the earth's surface takes place at the boundaries of the plates. At the boundaries they diverge, converge or slide past one another. Each type of boundary produces distinctive and recognisable landform features.

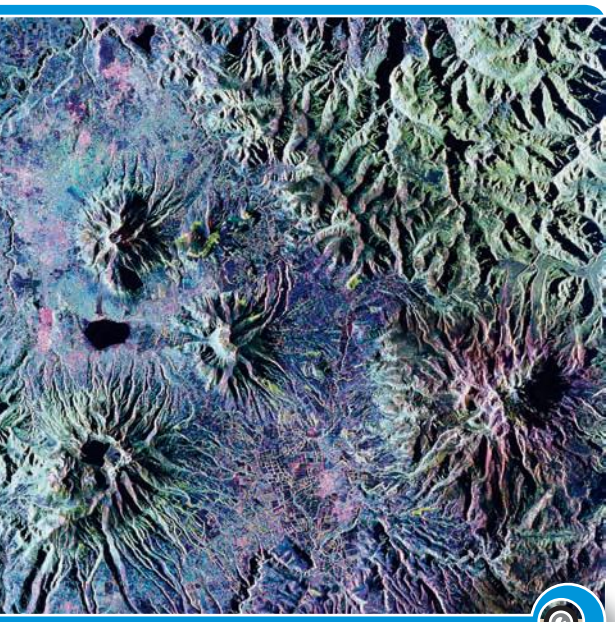
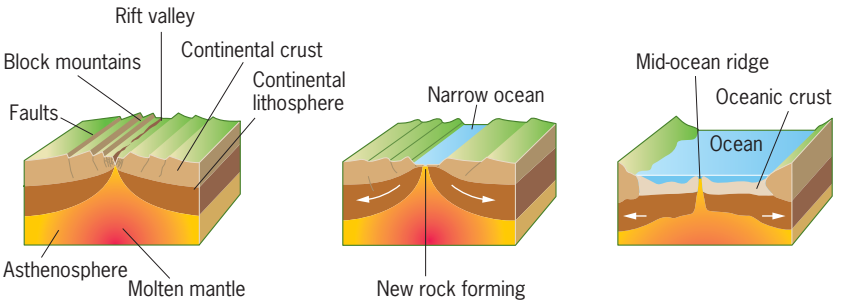


FIGURE 1.4.7

Satellite image of volcanoes in northern Ecuador.

FIGURE 1.4.8

This satellite image shows the Tibetan Plateau (upper left) and the Himalayas to the plateau's south. From the heights of the Himalayas, numerous rivers flow into the valley of the Brahmaputra River in Assam, India.



1 Plates break apart, forming rift valley, faults and block mountains (e.g. African Rift Valley)

2 Plates move apart and new rocks are formed on the ocean floor (e.g. Red Sea)

3 With further movement the sea floor spreads to form major oceans (e.g. Atlantic Ocean)

FIGURE 1.4.9

Divergence of tectonic plates.

Diverging plate boundaries

Diverging plate boundaries are the points where plates separate and new crust is created. Figure 1.4.9 shows what happens. As the plates move apart, molten material fills the gap, forming a mid-ocean ridge. These ridges extend for some 65 000 km throughout the earth's oceans. The islands of Hawaii in the mid-Pacific are, for example, the peaks of a mid-ocean ridge.

Converging plate boundaries

Converging plate boundaries are the points where plates collide. The process of sea-floor spreading increases the earth's land surface area. To balance this process, collisions between plates are necessary. The destruction of the old lithosphere takes place in the subduction zones. A subduction zone is an area where two **tectonic plates** come together, one riding over the other. The following are the types of collisions that occur:

- *Colliding oceanic and continental plates*. When an oceanic and a continental plate collide, the dense floor of the ocean is subducted (or forced down) beneath the less dense continental plate. This forms a deep trench. The descending slab of the sea floor melts and then erupts in a chain of volcanoes along the edge of the continental plate. (See figure 1.4.10a) The Andes Mountains of South America were formed in this way over hundreds of millions of years.
- *Colliding oceanic plates*. When oceanic plates collide, the plate that is older, colder and therefore denser, subducts under the other, forming a trench. This movement weakens the crust and molten rock escapes to the surface, forming islands of volcanic mountains. Chains of active volcanoes form on the landward side, parallel to the deep sea trench. Examples of such island arcs in the Pacific basin include the Aleutians, the Philippines and Japan. Figure 1.4.10a shows how such islands are formed.
- *Colliding continental plates*. When two continental plates collide (see figure 1.4.10b), neither will subduct because both are of the same density. **Volcanism** is not common in these areas, but folding of the crust, mountain-building and earthquakes occur over a broad area. The Himalayan Mountains (see figure 1.4.8) were formed in such a way and are still moving. After the breakup of Gondwana, India moved as an island some 3000 km from its original location in the Southern Hemisphere. The continents eventually collided, with India pushing deep into Asia.

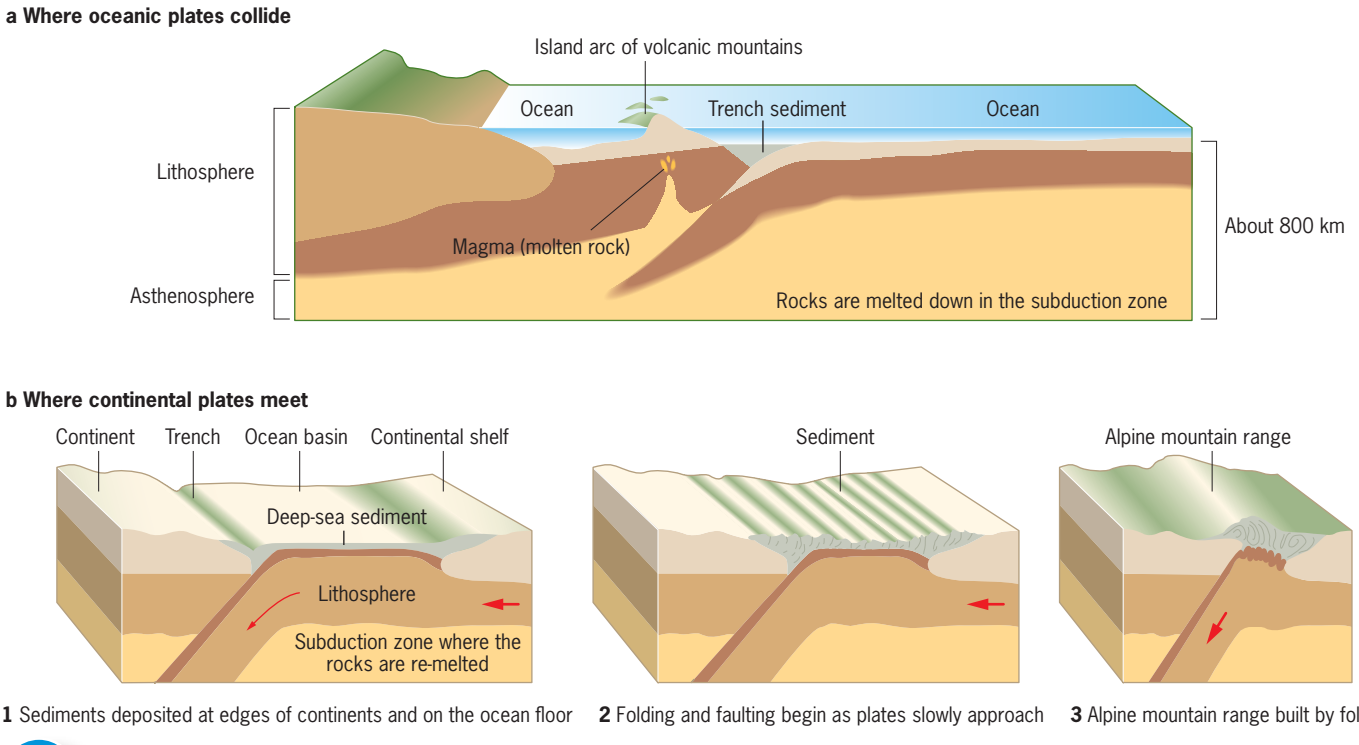


FIGURE 1.4.10

Convergence of tectonic plates.

Horizontal movements

Where plates move horizontally past each other along a single vertical fault line, the release of built-up pressure causes earthquakes. The San Andreas Fault in California is a major fault system arising from movement between the Pacific and North American plates.

Mountain-building

The world's great mountain ranges coincide with the advancing edges of the earth's continental plates. (See figure 1.4.6, p. 85.) They are therefore a product of plate tectonics. As the continental plates collide, the earth's crust thickens in an effort to absorb the impact. As it does so, pressure is exerted and layers of rock are compressed and forced upwards, folding and faulting as they go. Mountains are landform features composed mostly of steep slopes and large amounts of local relief within a specified area.

As continental movements tend to be very slow, the mountain chains they produce are dominated by folded rock strata (layers of rock) and are therefore classified as fold mountains. Folds are wave-like patterns in the earth's crust. Mountains can also be the result of faulting and volcanic activity. Faults are fractures in the rock structure. Rift valleys and block mountains are large-scale landforms associated with faulting.

Earthquakes

Earthquakes are a series of rapid vibrations caused by sudden movements within the earth's crust. These movements are usually the result of the fracturing or faulting of rock strata that have been placed under great stress. The energy released by these sudden movements travels through the earth in a series of waves that spread out from the focus and epicentre of the earthquake. When earthquakes occur in heavily populated areas they can cause widespread devastation. Most loss of life is caused

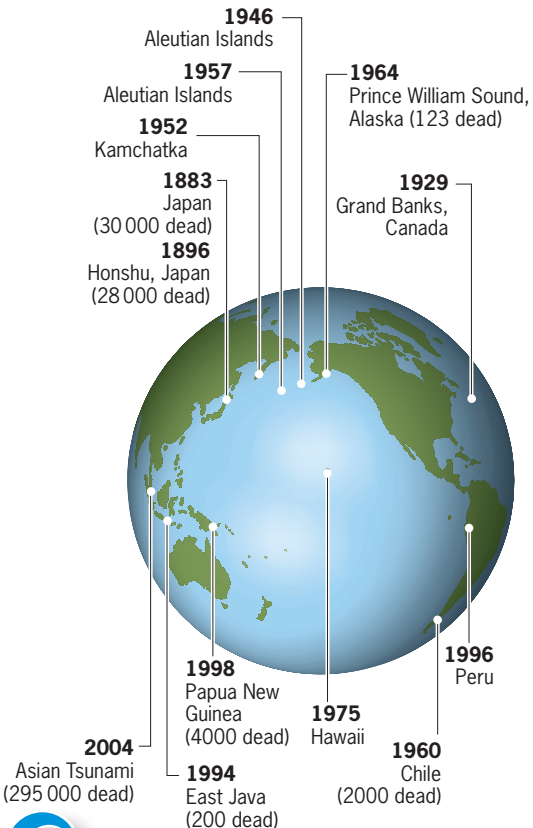


FIGURE 1.4.11

The most destructive tsunamis on record.

by collapsing buildings, fires and *tsunamis* (large earthquake-induced ocean waves). Tsunamis can devastate coastal communities. (See the Geofocus box 'Asian Tsunami disaster'.)

geofocus

Asian Tsunami disaster, 26 December 2004

On 26 December 2004, an earthquake measuring between 9.1 and 9.3 on the Richter Scale occurred off the northern coast of Sumatra, Indonesia. The force of the earthquake caused a huge tsunami to form. The resulting waves spread across the Bay of Bengal and Indian Ocean, causing massive destruction. In the absence of a tsunami warning system most coastal communities were caught by surprise.

In some places, waves as high as 10 m surged across low-lying coastal communities, destroying everything in their path. Elsewhere, the sea first retreated for hundreds of metres before surging forward. Many people, unfamiliar with such events, gathered on the beach to see what was happening. This, unfortunately, magnified the extent of the disaster.

While the exact number of deaths will never be known it is estimated that 295 000 people died in the disaster. In addition, more than 1 million people were displaced and 5 million were deprived of basic services.

Tsunamis are enormous waves, usually caused by undersea eathquakes. The waves formed by such seismic events are relatively harmless in deep water. Yet when they reach shallow water their destructive potential is magnified. This is because the waves slow down, but the energy behind them pushes the crests of the waves higher and higher. While such waves are generally only 20–30 cm high, tsunami waves have been known to reach 30 m in height.

Figure 1.4.12 shows the source and extent of the Asian Tsunami. Figure 1.4.13 highlights the destructive power of a tsunami.

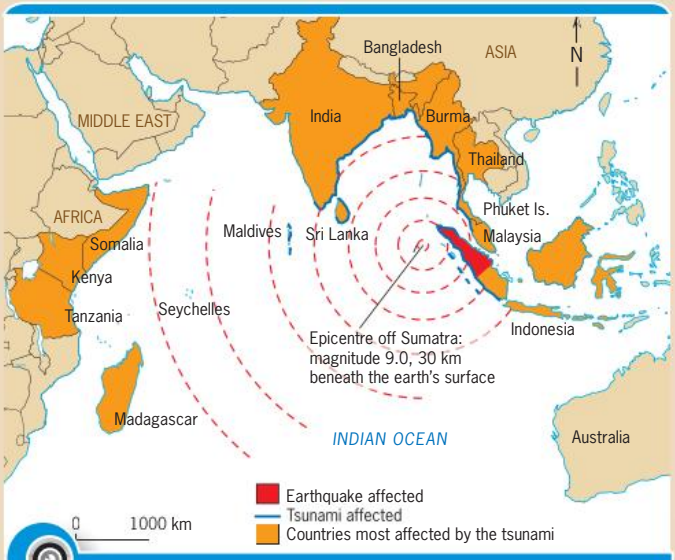


FIGURE 1.4.12

The source and extent of the Asian Tsunami, 26 December 2004.

FIGURE 1.4.13

Banda Aceh before (left) and after (right) the Asian Tsunami.

TABLE 1.4.1

Worst earthquakes in the 1900s and early 2000s

Location	Year	Magnitude (Richter scale)	Deaths
Sumatra–Andaman Islands	2004	9.3	295 000
Gansu, China	1920	8.6	200 000
Xining, China	1927	8.3	200 000
Japan	1923	8.3	143 000
Sichuan, China	2008	7.9	70 000
Kashmir, Pakistan	2005	7.6	86 000
Bam, Iran	2003	6.6	40 000
Iran	1990	7.7	35 000
Chillan, Chile	1939	8.3	28 000
Armenia	1988	6.9	25 500
Santiago, Chile	1906	8.6	20 000
Kangra, India	1905	8.6	19 000
Central Asia	1907	8.1	12 000
India/Nepal	1934	8.4	10 700
Mexico	1985	8.1	9 500
Chile	1960	9.5	4–5 000
Sanriku, Japan	1933	8.9	2 990

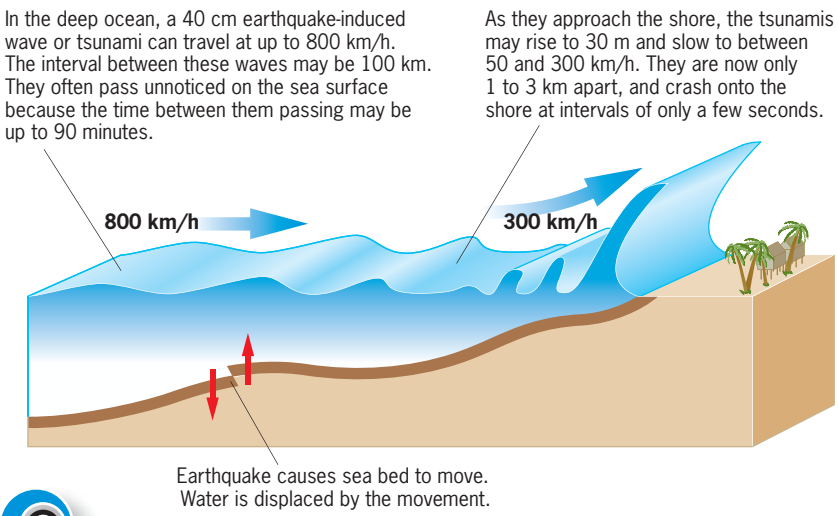


FIGURE 1.4.14

The formation of a tsunami.

Volcanic activity

Volcanic eruptions occur when molten rock reaches the earth's surface, through cracks or faults in the underlying rock structures. (See figure 1.4.17, p. 90.) Once it reaches the earth's surface, the molten material (lava) cools and hardens. Over time, successive layers of lava and volcanic ash may build up a volcanic cone. A caldera, or crater, forms when a particularly violent eruption blasts away the top of an existing volcanic cone. The most active volcanoes lie in volcanic belts that coincide with zones where there is fracture of, and collision between, the earth's crustal plates.

geofocus

Kashmir earthquake, 2005

The Kashmir earthquake of October 2005 registered 7.6 on the Richter Scale, making it similar in intensity to the famous 1906 San Francisco quake. More than 86 000 people died in the Kashmir quake and 3.3 million were made homeless in Pakistan. The situation was made even more dire by the onset of the region's harsh winter.

The affected region lies in the area of collision of the Eurasian and Indian tectonic plates. The geological activity resulting from this collision is the cause of instability in the region and was also responsible for the uplift of the Himalayan mountain range.

Most of the people affected lived in mountainous regions of Pakistan. The provision of medical and humanitarian aid was made difficult by landslides that blocked the region's roads.

The day the quake struck was a Saturday, which is a normal school day in the region. Many of the victims were children buried under collapsed school buildings. Many adults were trapped in their homes and, because it was the month of Ramadan, most people were taking a nap after their pre-dawn meal and were unable to escape from their collapsing homes. Whole towns and villages were completely destroyed in northern Pakistan, with other surrounding areas also suffering severe damage.

FIGURE 1.4.15

The search for survivors. The Kashmir earthquake of 2005 caused great human suffering.

FIGURE 1.4.16

New crust in the making.

FIGURE 1.4.17

The eruption of Mt St Helens, United States, in 1980.

Volcanic eruptions can produce landforms in a rapid and spectacular manner. Some of the world's largest mountains and many of the islands that dot the world's oceans are the result of past volcanic activity. Today there are 550 known active volcanoes on earth. Recent major eruptions have occurred at Mt St Helens in the United States (1980), Mt Pinatubo in the Philippines (1991) and Rabaul in Papua New Guinea (1994). The annual level of volcanic activity is suprisingly high. In 2007, for example, there were 19 ongoing major volcanic eruptions and 29 new eruptions. Large-scale eruptions may result in short-term climatic change as millions of tonnes of volcanic ash and smoke are released into the atmosphere, reducing the amount of sunlight reaching the earth's surface.

understanding the text

1 a **Outline** Wegener's theory of continental drift.
  b **Outline** the evidence supporting this theory. Why was it generally rejected at the time?
2 **Identify** the discoveries that helped to revolutionise our understanding of movements within the lithosphere.
3 **Explain** why the discovery of the asthenosphere is so significant to the theory of plate tectonics.
4 **State** what is regarded as the cause of plate motion.
5 **Identify** where almost all the tectonic and volcanic activity on the earth's surface takes place.
6 **Describe** the distinctive features produced at the different types of plate boundaries.
7 **Describe** the relationship between the location of the world's great mountain ranges and continental plates.
8 **Explain** how mountain ranges are formed.
9 **Distinguish** between mountains formed by folding and those formed by faulting.
10 **Explain** what an earthquake is.
11 **Explain** what a tsunami is.
12 **Identify** where most active volcanoes are found.
13 **Explain** how volcanic eruptions create short-term changes in climate.

working geographically

1 **Interpreting diagrams** Study figure 1.4.4 (p. 84). What evidence can you see to support the theory of continental drift?
2 **Interpreting diagrams** Study figures 1.4.5 and 1.4.6 (p. 85) and an atlas.
  a Name the mountain ranges formed by the collision of the following crustal plates:
    i the Indian and Eurasian plates
    ii the South American and Nazca plates.
  b Refer to an atlas and identify islands in the Atlantic Ocean that are part of the mid-ocean ridge.
  c Identify two continents that have deep ocean trenches offshore because of subduction.
3 **Using the media** Collect media reports about recent earthquakes and volcanic eruptions. These may include video recordings, webpage snapshots and newspaper and magazine articles. Write a synopsis of the material gathered and present the information to the class.
4 **Research task** Investigate one of the tsunamis shown in figure 1.4.11 (p. 87). Outline the impact of the tsunami on the communities affected.

geofocus

The Rabaul volcanic eruption of 1994

In September 1994 the town of Rabaul (see figure 1.4.18), on the island of New Britain in Papua New Guinea, was devastated by the eruption of two nearby volcanoes: Tavurvur and Vulcan. Volcanic ash, 75 cm deep, covered the town. Damage to property was severe. Most of the town's buildings collapsed under the weight of the ash. (See figure 1.4.19.) Nearby coconut plantations were devastated. Rabaul's Simpson Harbour became clogged with floating pumice. Fortunately, the detection of early warning signs by volcanologists allowed authorities to evacuate the town's 53000 inhabitants.

FIGURE 1.4.18

Rabaul.

The eruption did not come as a surprise to the people of Rabaul. The area is well known for its volcanic activity. The last major eruption occurred in 1937, when about 500 people were killed. Most of the victims were burnt to death by hot ash. Many were crushed as roofs collapsed under the weight of the ash, and deaths were also caused by rapidly moving flows of saturated ash.

Rabaul's harbour is in fact a large caldera (a collapsed volcanic cone), about 10 km in diameter. Its collapsed floor is the result of a large, explosive eruption that took place some 1400 years ago. That eruption partly emptied the underlying magma chamber (the reservoir of molten rock feeding the volcano). Many smaller eruptions have occurred since, mostly from minor cones that have developed near the caldera rim. These appear to have developed above the ring fault. This enabled the caldera floor to subside and now acts as a convenient upward pathway for molten rock.

Rabaul has been rebuilt on a new site.

FIGURE 1.4.19

Rabaul's airport was buried by more than 1 metre of volcanic ash.

Gradational processes

Whereas tectonic activity causes the earth's surface to be uneven, gradational processes work to smooth out the surface. Newly formed features of the lithosphere immediately come under attack when they are exposed to atmospheric processes and gravity. Exposed rock material is fragmented by weathering, detached by mass movement and agents of erosion and then deposited at lower elevations as debris. Gradational processes act upon the surface of the lithosphere, wearing down high places and filling in low places. (See figure 1.4.20, p. 92.) Tectonic forces constantly disturb the surface of the land, creating new landscapes upon which gradational processes can work.

We learn geology the morning after the earthquake.

Ralph Waldo Emerson, US poet

Weathering

Weathering is the in situ physical disintegration and chemical decomposition of rocks and minerals at or near the earth's surface by atmospheric and biological agents. Weathering is an essential prerequisite for many types of

Ravaged, infertile lands, famine and drought are a reflection of impoverished, petty minds and a demoralised spirit.

Paulo Lugari, Colombian idealist

erosion as it loosens surface material, making it more readily removed. The process of weathering is often unobtrusive. *Physical weathering* slowly breaks up the rocks of the land surface into smaller particles but does not change their chemical composition. *Chemical weathering* involves the actual decomposition of rocks, primarily by means of exposure to water, oxygen and carbon dioxide. Most of the original minerals formed deep in the earth's crust are changed by chemical weathering into new compounds that are stable in the atmosphere and the temperature and air pressure

FIGURE 1.4.20

A landscape scarred by gradational processes.

TABLE 1.4.2

Types of weathering

Physical weathering	
Type	**Description**
Unloading	Unloading occurs when rocks, once deeply buried, have the weight and pressure of overlying material removed. The rocks expand and may crack along joints parallel to the surface and peel off in sheets.
Frost action	When water held in the tiny fissures of rocks freezes, it expands by approximately 10% of its volume, forcing cracks to part. Recurrent freezing and thawing, especially on a daily basis, enlarges such cracks.
Organic action	The germination of seeds and the wedging of roots in the cracks of rocks exerts pressure, causing the cracks to widen. Burrowing animals, such as rabbits and earthworms, allow air to penetrate further. This may indirectly accelerate weathering.
Note: While some experts now disregard temperature change, or thermal expansion and contraction of rock, as being a significant weathering process, others argue that it is important in some contexts. In the Australian bush, for example, the extreme heat associated with bushfires can have a dramatic effect on the exterior of rocks. Experts now consider biological activity (in relation to physical and chemical weathering) to be the most influential weathering process.	

Chemical weathering	
Type	**Description**
Oxidation	Minerals react with oxygen to form oxides and, as water is also usually involved, hydroxides. Iron is the most common element in the process. Rocks containing iron appear to be rusting as their surface decays.
Solution	This is the process by which weak acids dissolve minerals in rocks and distribute them in solution. Limestone is susceptible to attack from carbonic acid, formed when carbon dioxide is dissolved in rainwater. Limestone caves and karst landscapes (those shaped by the dissolving of soluble layers of bedrock, usually carbonate-based rocks, such as limestone or dolomite) are a result of this process.
Hydration	Rocks expand as their minerals chemically combine with water. Clay minerals have an enormous capacity for such water uptake. This results in what has been termed physio-chemical weathering.
Organic acids	Organic acids are produced when water combines with the decaying organic material in humus. The acids attack or weather rocks as they seep through the soil.

conditions that exist at the earth's surface. The substantial age and stability of the Australian continent have produced a great thickness of rock that has been modified by the process of weathering. In some areas the modified rock exists to a depth of 100 m.

Mass movement

Once weathering has reduced the size of rock particles, it is easier for them to be loosened and removed from the site. When this occurs in response to gravity it is known as mass movement. In some such movements the fragments of weathered material tend to stay together and move as a unit in bulk. In other instances (for example, soil creep and flow movements) different layers of material flow at different rates.

The nature of the moving material varies greatly and includes everything from great slabs of solid rock to loose, unconsolidated rock debris and **soil**. Sometimes this form of movement will be quite abrupt, as when a landslide releases millions of tonnes of material in a spectacular plunge. At other times it will be imperceptibly slow. For instance, it may only be leaning fence posts, trees and power poles that reveal the relentless downslope movement of soil, a process often referred to as *soil creep*.

Mass movements often leave visible scars on the land surface. Heavy rainfall saturating the land surface may trigger a slump or flow (the sudden downslope movements of earth and rock). These are particularly common in clay-rich soils, which become slippery when wet. Water acts as a lubricant that weakens the binding properties of the soil and rock material. (See figures 1.4.21 and 1.4.22.)

Erosion and deposition

The shaping of the land's surface continues with the processes of erosion, and then the transportation and subsequent deposition of material. The ultimate resting place for eroded and transported material is the lowest place: the ocean floor. Eventually, most loose material will find its way to the sea. It will have been collected and carried there by the agents of erosion: wind, running water and glacial ice.

A vast range of erosion, transportation and deposition processes operate on the earth's surface. The most important of these are water, wind and ice. The action of running water (the fluvial process) is normally considered to be the dominant landscape-shaping process, and the action of waves the most dominant process in shaping coastlines.

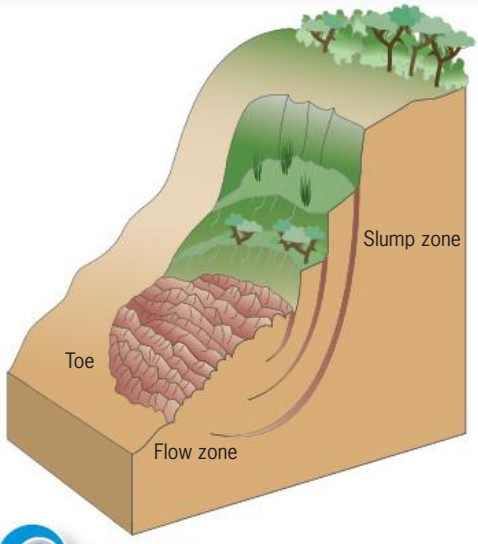


FIGURE 1.4.21

An earthflow with slump features well developed in the upper part.

FIGURE 1.4.22

The effects of an earthquake-induced mudslide in San Salvador in El Salvador, 2001.

FIGURE 1.4.23

Water-sculptured landscape—Double Arch, Utah, United States.

understanding the text

1 **Explain** the role of gradational forces in shaping the earth's surface.
2 **Define** what is meant by the term weathering. Why is it such an important process?
3 **Differentiate** between physical and chemical weathering.
4 **Outline** the ways weathered material can be moved downslope.

working geographically

1 **Writing task** Study the Geofocus box 'The Rabaul volcanic eruption of 1994' (p. 91). Using this report as a model, write your own report based on research you have undertaken on another recent volcanic eruption.
2 **Fieldwork** Examine in the field the processes outlined in this section. Use field sketches, field notes and photography to record your observations. Mount a wall display, highlighting the different features and processes observed.

FIGURE 1.4.24

North America is famous for its spectacular rocky pillars, some of which rise as high as 300 m above the floor of the Arizona Desert. The pillars are the remnants of an ancient plateau. The softer rock has been gradually eroded away, leaving these monuments to the power of nature. This process is known as differential erosion.

did you know?

- The land under your house is the product of 4.6 billion years of evolution.
- In Iceland you can actually walk on the mid-Atlantic ridge, peer into an active rift valley and later take a hot shower with water heated by underground molten magma.
- The Red Sea and the Gulf of Aden are active divergent zones.
- Areas of ancient rift valleys include Lake Baikal in Russia (the earth's deepest lake), the Rhine Valley of Europe and the Rio Grande Valley of Mexico.
- The great earthquakes and the volcanic eruptions of the Philippines, Japan and the Aleutians, as well as the disastrous eruption of Krakatoa (between Java and Sumatra in the Indian Ocean), are all consequences of active ocean–ocean convergent boundaries.
- An archipelago is a sea studded with islands. The world's largest archipelago extends for 5000 km from the Malay Peninsula down through Indonesia to New Guinea. It includes more than 13000 individual islands.
- Greenland is the earth's largest island. It covers an area of 2175600 km^2. Australia, at 785000 km^2, is the world's second largest island.
- The world's saltiest sea is the Dead Sea. Ten times saltier than the Pacific Ocean, its concentration of salt gives it a very high buoyancy.

Landforms shaped by water

The significance of water in weathering and mass movement has been examined, but it is as an agent of erosion that water is most conspicuous. In this section we will examine the landforms shaped by rivers, waves and ice. In Unit 1.7 we will examine the role of rivers in more detail.

Landforms shaped by rivers and streams

Fluvial processes

Even the impact of a single raindrop can dislodge particles of earth, feeding them as sediment load into running water or surface runoff. The running water becomes organised into rivulets and streams, collecting and carrying with it any loose material it encounters.

Running water is particularly effective in arid and semi-arid regions and where human activities have damaged the protective cover of vegetation that binds the soil together. Where rain falls on exposed earth, it quickly forms rivulets that erode deep channels, called gullies.

Once in the river, the water and its accompanying load erode the rocks and sediments over which the river flows. The processes involved are:

- *Hydraulic action*. This is the power of the flowing water itself. The surging water exerts a dragging action on the river bed and banks. This can excavate enormous quantities of poorly consolidated (that is, relatively loose) alluvial materials (sand, silt and gravel), especially during floods.
- *Abrasion*. This occurs when rock particles that are carried by the swift-flowing current strike channel walls. As they do so they grind off chips of rock and earth.
- *Corrosion*. This is due to the chemical solution of material from rocks being exposed to the stream by solvents carried in the river.

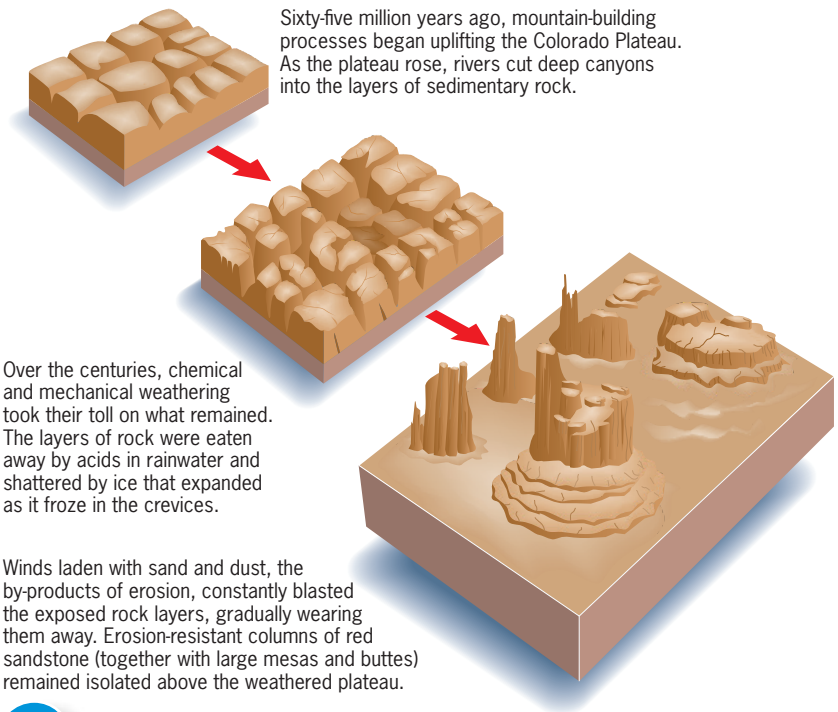


FIGURE 1.4.25

The floor of Monument Valley is hundreds of metres lower than the plateau that once occupied the area.

Material can be transported as bedload, suspension load and dissolved load. The bedload is moved by traction; that is, by rolling, sliding and bouncing along the channel bed. Once in the river, the sediment load may be temporarily deposited along the river's banks until it is brought back into motion and moved further downstream. This is usually associated with periods of high flow when the river's velocity increases. Most rivers have alluvial deposits; that is, they contain the sediment they themselves have transported and dropped.

Landform evolution

By observing the repeated cycles of river erosion and deposition it is apparent that these processes can occur quite quickly. This is especially the case when associated with periods of high river discharge or flow. In contrast, the process of landform evolution takes place slowly. Indeed, as we look around us the landscape looks static and enduring—frozen in time. This impression is misleading as landforms are continually evolving.

In the mountainous headwaters of river catchments, where gradients are often steep, rivers erode downwards, creating narrow V-shaped valleys. Interlocking spurs, river rapids and waterfalls are common landscape features, while floodplains and meanders are largely absent in this section of the river.

In the central reaches of a river system the mountains have given way to low hills. Here the land continues to undergo substantial downcutting, but the river valleys begin to broaden. Even further downstream, lateral erosion and valley widening become more prominent and floodplains with meanders start to develop.

FIGURE 1.4.26

The Grand Canyon, United States, demonstrates the erosional power of water even in arid lands.

geofocus

Migrating waterfalls

Waterfalls develop when a river flows from a hard rock layer onto a softer layer of rock. Pummelled by the water, the softer rock wears away, creating a drop-off. The cascading water may then erode the drop-off, causing the waterfall to migrate upstream. The rate of retreat is determined by the hardness of the rocks. (See figures 1.4.27 and 1.4.28.) In glacial areas, waterfalls often flow from hanging valleys into larger glacial valleys. (See figure 1.4.29.)

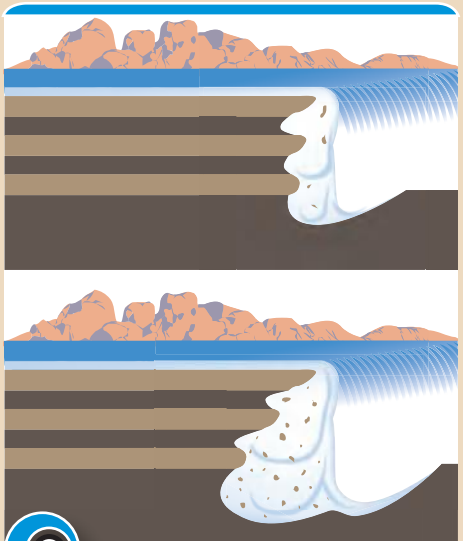


FIGURE 1.4.27

Waterfall migration.

FIGURE 1.4.28

Iguacu Falls, Brazil.

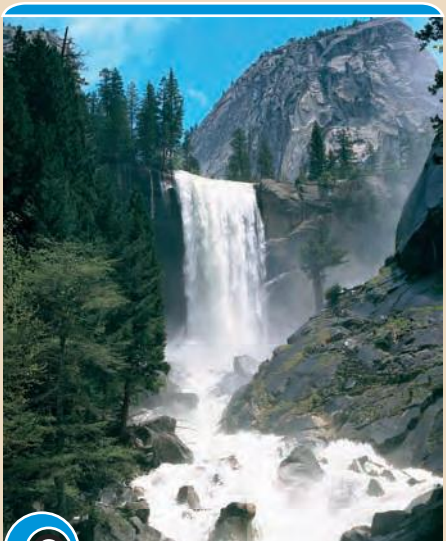


FIGURE 1.4.29

Hanging valley waterfalls (such as this one in Yosemite National Park) are a feature of landforms shaped by ice.

geofocus

Deltas

When a river empties into a lake, an inland sea or an ocean, its velocity is reduced. Its sediments accumulate to form a depositional feature known as a delta. Blocked by this mass of sand, gravel and mud, the river splits into channels. Each channel builds up its own spit of land. In this way, a broad delta forms.

Although most deltas are layered in the same way, their shape varies according to the contours of the ocean floor, the amount of sediment that has been deposited and the action of the ocean waves. A *bird's-foot delta* occurs when a rapid river current penetrates calm waters, dumping its load of sediment as fingers of sand. (See figure 1.4.30.) Where a river encounters strong ocean tides or currents, its sediments are redistributed across a broad front, creating a *cuspate delta*. When the supply of sediment is significantly greater than that taken away by waves and currents, an *arcuate delta* forms. Figure 1.4.31 shows these three types of deltas. Deltas are quite unstable landform features. Their shape and form changes, especially during major storm events.

FIGURE 1.4.30

The Mississippi River delta is an example of a bird's-foot delta.

FIGURE 1.4.31

Types of deltas. **A** A bird's-foot delta. **B** A cuspate delta. **C** An arcuate delta.

FIGURE 1.4.32

A meandering river channel.

Away from the mountains and hills, lateral erosion dominates. Valleys widen and the reduction in stream velocity results in the deposition of some of the river's load of sediment. These sediments are known as alluvial deposits. They often form extensive lowland or coastal floodplains across which the river will meander. (See figure 1.4.32.) The fine soils of those plains are called alluvium and are usually very productive.

Coastal landscapes: landforms shaped by waves

The sea works relentlessly to transform the edges of the land. As a result, our coastlines represent the most varied and rapidly changing part of the lithosphere. (See figure 1.4.35.) Waves, tides and currents from the sea; rivers and glaciers from the land; and daily weather conditions all play their part in shaping coastal environments; that is, the terrains where land and sea overlap. Coastal terrains extend as far inland as the salt water, sea spray and wind-blown sands reach, and into the ocean as far as the waves are able to move the material on the sea bed. This interface between land and sea is illustrated in figure 1.6.4 (p. 142).

Landforms shaped by wind

Winds are particularly effective in shaping landforms in areas where there is little or no vegetation. These include the world's arid and semi-arid regions and those areas in which human activity has degraded the land and destroyed the vegetation.

In the zone closest to the ground, the wind picks up weathered rock materials and uses them to 'sand-blast' larger rock structures. This process is known as abrasion and it often contributes to the formation of distinctive sculptured rock formations. (See figures 1.4.33 and 1.4.34.)

On a larger scale the formation of rock-strewn reg surfaces has been, in part, attributed to the removal of finer material by wind. This process is known as deflation.

The wind also plays an important role in moving and reshaping dunes. (See figure 1.4.36.)

geofocus

Pedestal rocks

Wind-borne sand grains follow bouncing trajectories that carry them as high as 1 m above the ground. The abrasive action of these grains cuts away the base of rock structures but leaves their tops intact. The result is a distinctive landform feature known as a pedestal rock. (See figures 1.4.33 and 1.4.34.)

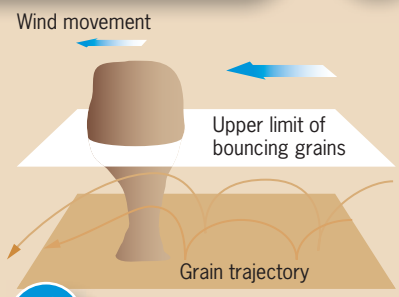


FIGURE 1.4.33
Formation of a pedestal rock.

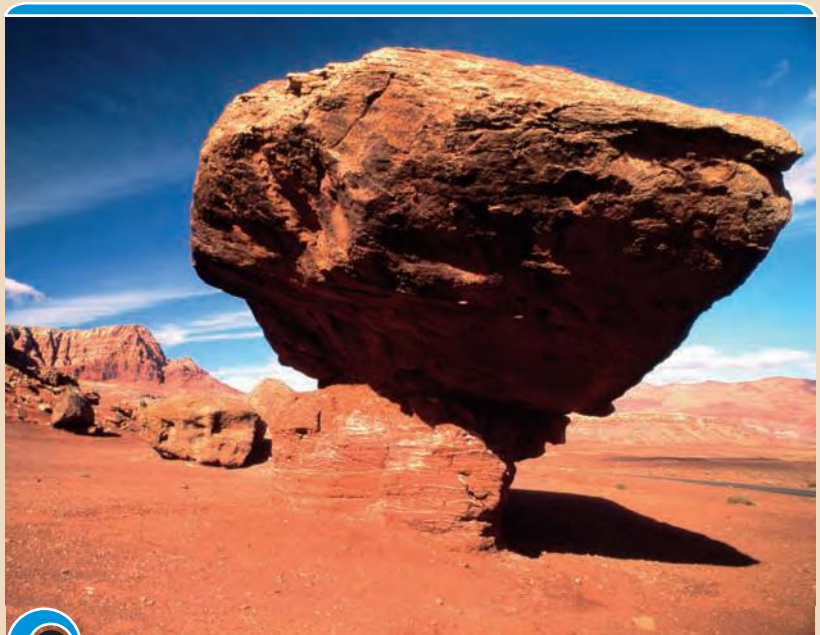


FIGURE 1.4.34
Wind-shaped pedestal rock.

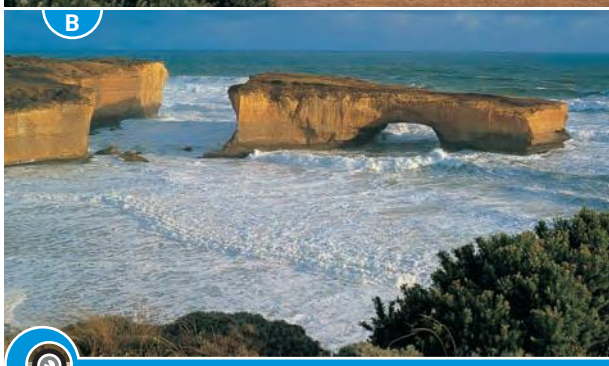


FIGURE 1.4.35
A Victoria's 'London Bridge' before it collapsed.
B Victoria's 'London Bridge' after the arch collapsed in 1990.

understanding the text

1 **Identify** the circumstances under which water erosion is most effective.
2 **Define** each of the following erosional processes: hydraulic action, abrasion and corrosion.
3 **Explain** how material in streams is transported.
4 **Describe** how fluvial landforms change as you travel from the headwaters of the river to its mouth.
5 **Identify** how far and in which directions coastal terrains extend.

FIGURE 1.4.36
Sand dunes shaped by wind.

Landforms shaped by ice

Glaciers are huge masses of ice. They form when snow that has accumulated over many years is compacted to form glacial ice. Gradually, the quantity of snow becomes greater. Due to its increasing weight, the compacted glacial ice is forced to move outwards and downwards under the force of gravity. (See figures 1.4.37 to 1.4.39.)

Ice sheets are layers of ice covering relatively flat landscapes. Both ice sheets and glaciers have great erosional and depositional power. The surface of the land is scratched and worn down by the constant grinding action of rock fragments that have been 'plucked' from the ground and embedded in the base of the ice. This process is known as abrasion. The rock-laden glacial ice grinds away the irregular surfaces over which it moves, leaving very distinctive landform features.

The most distinctive erosional features of glacial landscapes are U-shaped valleys. These form during periods of glacial activity when glaciers deepen and widen the former river valleys. Hanging valleys mark the entry point of smaller tributary glaciers. Other erosional features found in areas subject to glacial processes include cirques, arêtes and pyramidal peaks (horns). Fiords are formed when rising sea levels flood the valleys once occupied by glaciers. (See figure 1.4.40.)

FIGURE 1.4.37

Findel Glacier, Zermatt, Switzerland.

FIGURE 1.4.38

Bear Glacier, Alaska.

did you know?

Figure 1.4.38 shows the ablation zone where Bear Glacier is primarily losing ice. Pieces of the glacier that have broken off look like shards of white glass in the blue water. Upslope from the lake, the foot of the glacier is riddled with crevasses. These are cracks in the ice caused by the glacier's movement over a rough surface. As a glacier moves, it picks up dirt and debris from the rocks it passes. When two glaciers merge, as they have in Bear Glacier, the dirt and debris they carry form parallel stripes, or medial moraines, on the surface of the ice.

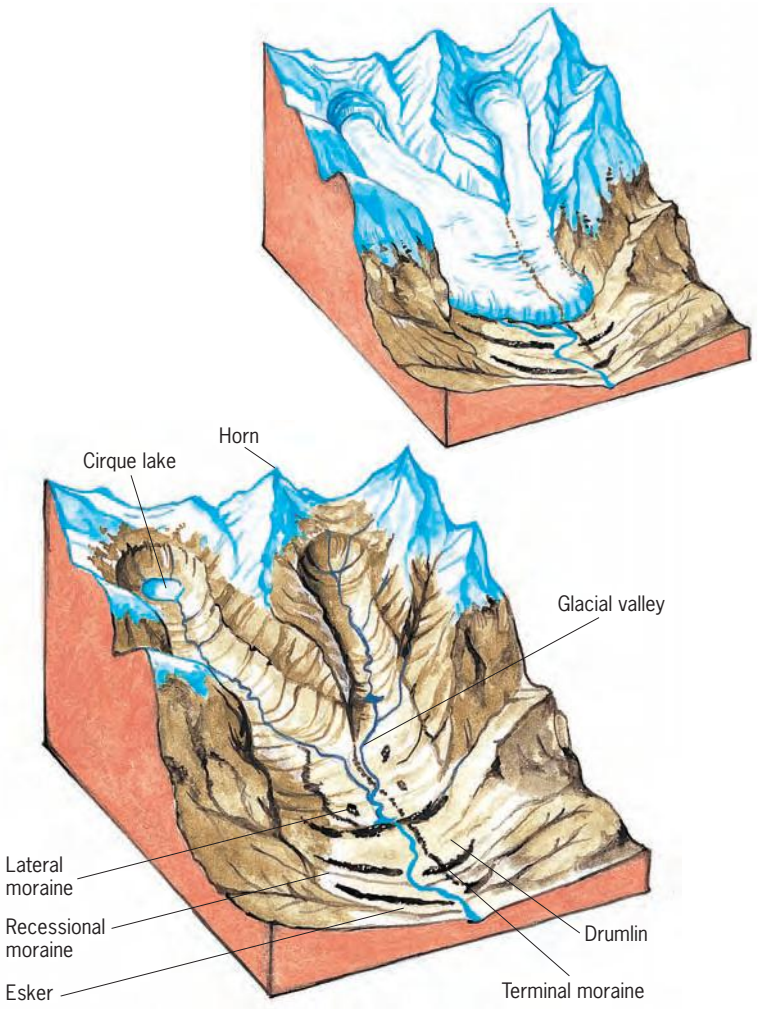


FIGURE 1.4.39

The development of glacial landform features.

FIGURE 1.4.40

Milford Sound, New Zealand.

The rocks transported by the ice can be carried for long distances before they are eventually deposited to form *moraines*. These are deposits of soil and rock once embedded in the glacial ice. Lateral moraines consist of rock debris that has accumulated along the side of the glacier. Where two glaciers meet, the inside lateral moraines may merge to form a medial moraine. The remaining rock debris, deposited at the end of a glacier forms a terminal moraine.

Valley glaciers are found in the Himalayas, Andes, Alps, Rockies and New Zealand's Southern Alps. Ice sheets occur in Antarctica and Greenland.

understanding the text

1 **Explain** what glaciers are. How do they develop?
2 **Explain** what abrasion is. How do glaciers 'abrade' the surface of the land?
3 **List** the erosional and depositional features that are characteristic of glacial landscapes. Illustrate the features listed.
4 **Explain** how fiords are formed.

working geographically

1 **Constructing diagrams** Draw a block diagram of a glacial landscape and label the landform features you have studied.
2 **Research task** Undertake library and Internet research for more detail on the processes and landform features mentioned in this section of the unit.
3 **Research task** Study figures 1.4.24 and 1.4.25 (p. 94). Use them to write a report outlining the process of differential erosion. Undertake research to investigate whether the Arnhem Land Plateau and outliers of Kakadu are the result of a similar process.
4 **Writing task** Study the Geofocus box 'Migrating waterfalls' (p. 95). Write a report outlining how waterfalls form and migrate towards a river's headwater.

Soils

Soils are a complex mix of inorganic minerals (usually in the form of clay, sand and silt), air, water and organic matter. (See figure 1.4.41.) Soils teem with hidden life: billions of micro-organisms, bacteria and fungi are vital for the conversion of inorganic and organic material into the simple nutrients that are readily available to plants in soil water. Thus, soils provide a foundation for plant and, consequently, animal life on land.

The depth of soil varies from place to place. The depth depends largely on the steepness of the land.

The development of soils is the result of the interaction of the lithosphere with the other components of the biophysical environment.

Identifying soils

Soils are developed by physical, chemical and biological processes, including the weathering of rock and the decay of vegetation. For soils to develop, two processes must take place. First, water moving down through cracks in the rock strata must cause physical and chemical changes in the original material. Second, the activities of living organisms must bring about further modifications. Where the presence of water and organisms is limited, soil development will be poor.

In well-developed soils, the action of water and organisms have changed the original rock material to the extent that different layers, or horizons, develop. Each layer has identifiable physical and chemical characteristics. The presence of these layers constitutes a true soil. It can differ markedly from its original parent material in properties and characteristics.

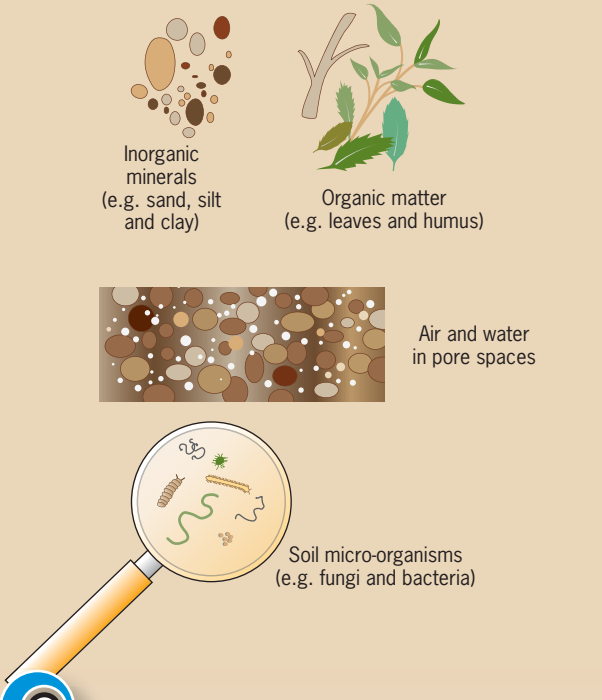


FIGURE 1.4.41

The constituents of soil.

FIGURE 1.4.42

Soils are an important resource used to produce crops and sustain the grass on which livestock feed.

did you know?

- It takes up to 400 years for 10 mm of soil to form, and between 3000 and 6000 years to produce mature soil of sufficient depth for farming.
- In a moist tropical climate, soil development on volcanic ash can increase in thickness at a rate of about 1 cm a year.
- In drier areas in Central America it has taken 1000 years to produce a soil 30 cm thick.
- The rate of soil formation under most Australian conditions is close to zero.
- There may be 1 million earthworms and 25 million insects in 1 ha of pastureland.
- As many as 1 million bacteria can inhabit 1 cm^3 of soil.

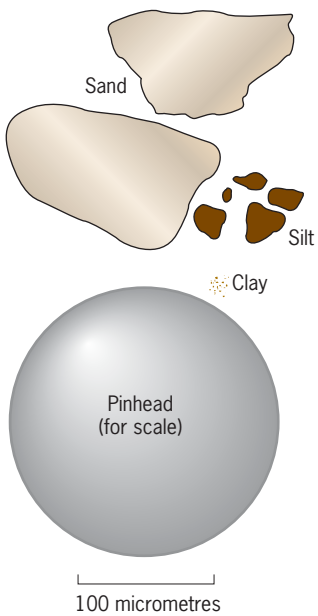


FIGURE 1.4.43

The particles that constitute the inorganic component of soil are classified acording to size.

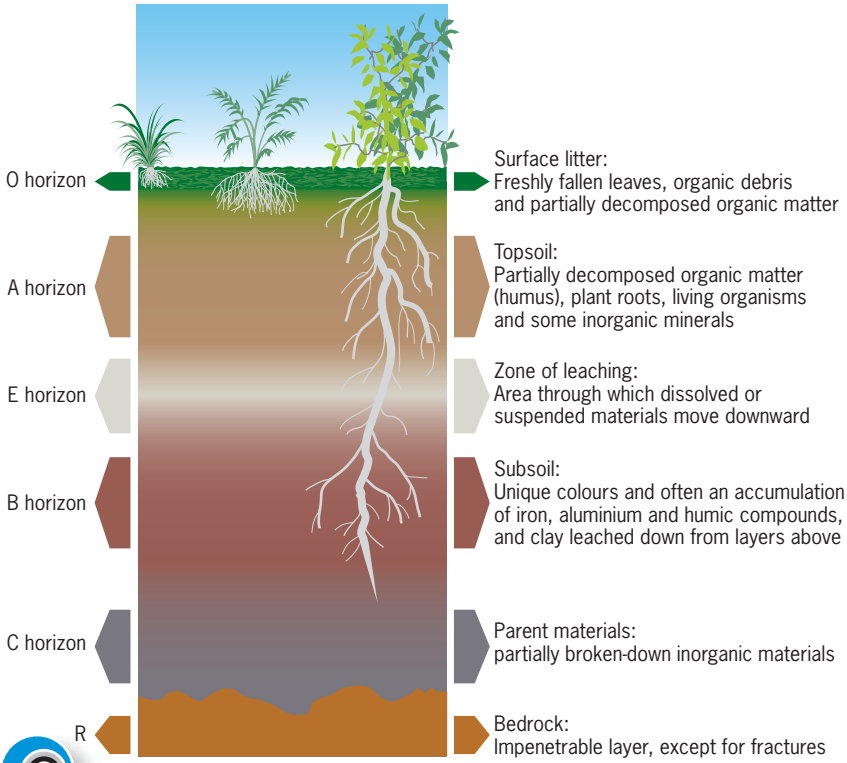


FIGURE 1.4.44

A generalised soil profile.

Soils typically comprise several horizons, roughly parallel to the surface, which together form the soil profile. Each horizon has a distinct colour, thickness, texture and composition. A generalised soil profile is illustrated in figure 1.4.44. The horizons vary in number, depending on the type of soil.

The action of climate and organisms on the parent rock material over long periods of time, and the influence of topography, produce the particular soil profile.

Soil characteristics

The four principal characteristics of soil are texture, structure, colour and acidity/alkalinity composition.

Texture refers to the size of the soil particles, which range from tiny clay particles to sand and fine gravel. Figure 1.4.43 gives an indication of the relative sizes of particles.

Structure refers to how the particles clump together in characteristic small masses called aggregates or peds. Sand falls through your fingers because it has no structure; soil particles with a high clay content cling together, creating structure. Structure is vital for plant growth as it affects the rate of water absorption. Soils are classed according to the shape of the peds: whether they are platey, prismatic, blocky or granular. Individual structures may range from tiny granules (about the size of a fingernail) to fist-size blocks. An aggregate caused by ploughing is called a *clod*.

Colour reflects the presence of identifiable substances in the soil. Dark colours occur where the humus content is high, and when it is lacking, soils are light. Some soils take on a red and yellow appearance in response to the oxidation of iron.

Acidity and *alkalinity* are important characteristics affecting plant growth. Acidity/alkalinity composition is expressed in terms of a pH value: 7 is neutral; 8.5 is alkaline; 5.5 is acidic.

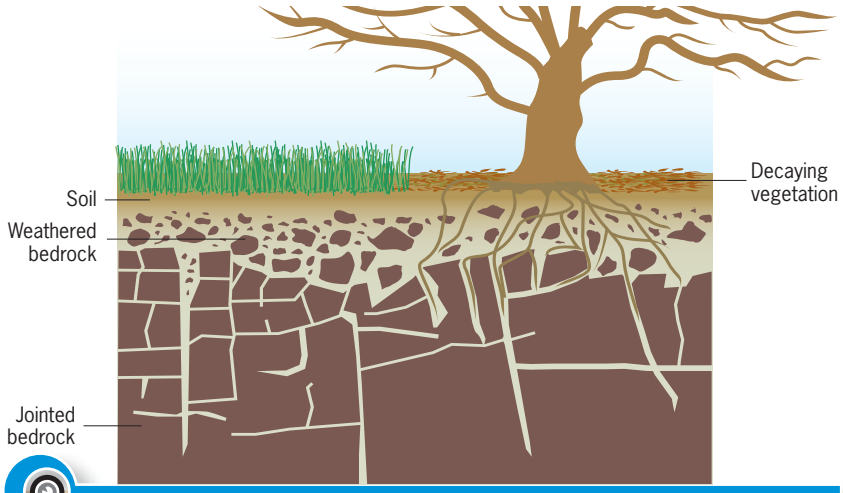


FIGURE 1.4.45

Chemical and physical weathering processes break down massive rock into small particles that form the inorganic component of soil.

Soil formation

Soil formation needs to be discussed in terms of soil-forming processes as well as soil-forming factors. The soil-forming factors control the processes, which in turn lead to the development of the soil.

Soil-forming factors

Soil formation is traditionally considered to be dependent on five soil-forming factors: parent material, climate, relief (topography), organisms (including human activity) and time.

Parent material

Some soils form directly from weathering bedrock in situ, but most are formed from materials that have been transported and deposited. In either case, the parent material provides a starting point for soil formation. Figure 1.4.45 shows how solid bedrock is broken down to form the inorganic component of the soil.

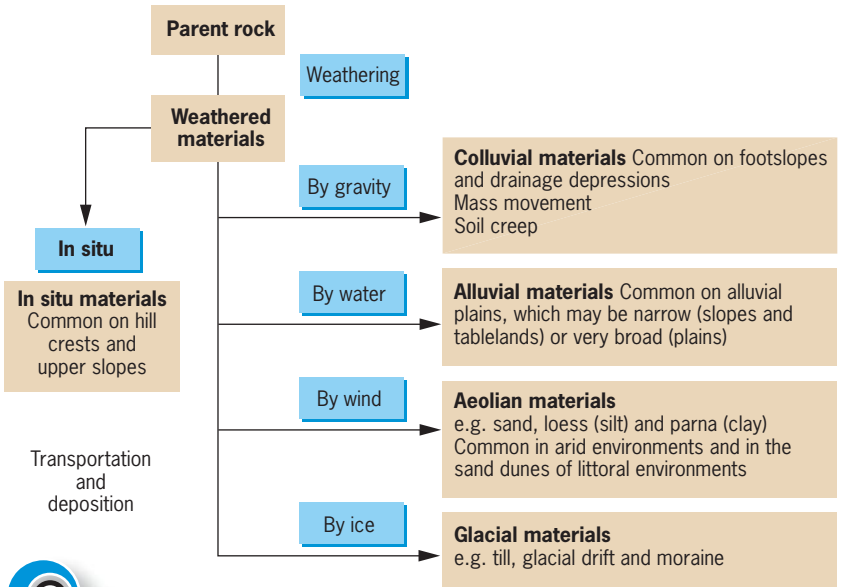


FIGURE 1.4.46

Origin of parent materials.

FIGURE 1.4.47

Soil texture refers to the size of soil particles.

FIGURE 1.4.48

When soils rich in clay dry out, they crack.

The soil is the great connector of our lives, the source and destination of all.

Wendell Berry, US writer

ferromagnesian minerals minerals rich in iron and magnesium.

bog a type of wetland that accumulates acidic peat, which is a deposit of dead plant material.

leaching the process by which soluble materials are dissolved and filtered down through the soil profile by percolating water.

translocation the movement of soil-forming materials through the developing soil profile. Translocation occurs by water running through the soil transferring materials from upper to lower portions of the profile.

colloids small particles with very high surface-to-volume ratios formed by the combination of organic and mineral materials.

did you know?

- The Ethiopian highlands is a region that has supported an agriculture-based society for thousands of years. Here the soil and vegetation have been severely degraded over the course of just two decades. A rapidly increasing population and inappropriate farming practices aimed at securing a quick financial return have reduced the people to a subsistence existence on eroded land and deforested slopes.
- In tropical Ecuador and Peru, the deforestation and cultivation of valley slopes have exposed 50% of the land to rates of erosion that exceed 1500 tonnes per km^2 per year.
- The Ganges River drains an area of just over 1 million km^2 of intensively worked farmland and heavily harvested forestland in India, Nepal and Bangladesh. The river transports 1.46 billion tonnes of sediment to the Bay of Bengal every year. The Amazon, which drains a much larger area, delivers just 363 million tonnes into the Atlantic annually.

The mineral composition and grain size of the bedrock strongly influences the type of soil formed. Siliceous parent materials, such as granite and sandstone, are relatively high in silica and quartz. As they are low in clay-forming minerals, the soils derived from them tend to be low in clay and of low fertility. Non-acidic parent materials, such as basalt, are high in **ferromagnesian minerals**. These minerals are important for clay formation and so the soils derived from them are usually clayey and often fertile.

Where a soil's parent material is not the underlying bedrock, it can be geological material that has been transported and deposited; for example, alluvial soil. The agents and the materials they transport about the earth's surface are summarised in figure 1.4.46. The agents include gravity, water, wind and ice. Of special interest are soils that develop in alpine areas. Here the parent material for the soils in **bogs** is the characteristic vegetation of the site: sphagnum moss.

Climate

Climate strongly influences soil-forming processes. The ratio of precipitation to evaporation influences the amount of water available for weathering, new mineral formation, **leaching** and the **translocation** of materials, especially clay. Where rainfall exceeds evaporation, there is a net downward movement of water. This results in eluviation or leaching. The drier the climate, the less water is available for these processes. Low temperatures also reduce weathering rates, but generally increase the rate of organic matter accumulation.

Water availability can also influence the rate of plant growth and hence the rate of organic matter accumulation and the activity of soil organisms.

Topography

The shape of the land also influences the amount of water available for weathering, new mineral formation, leaching, the translocation of **colloids**, and the downward movement of clay particles. Figure 1.4.49 shows how well-drained soils occur upslope and that water-transported material accumulates on the lower slopes and in depressions. The amount of water, minerals and clay that accumulates depends on the volume of water moving into and out of the soil profile.

Organisms

Biotic activity (including human activity) can affect the type of soil occurring at a particular location, most notably in surface soil layers. It also affects the different types of global vegetation, which are described in Unit 1.5.

Plants provide a protective cover on the soil surface, which reduces erosion. Plant roots add organic matter and form miniature channels in the soil, which greatly improve soil structure and the soil's general condition for plant growth.

Earthworms can also assist by ingesting soil and mixing it with organic matter, and by constructing channels, which aerate the soil. Micro-organisms play an important role in breaking down organic matter and in the cycling of nitrogen between the atmosphere, plants and the soil.

Human impact on the soil can be dramatic:

- clearing of vegetation and subsequent cultivation can cause erosion of the soil
- overcultivation can lead to a loss of organic matter and the breakdown of soil structure
- clearing trees and irrigation can cause water tables to rise, and bring salty water to the surface, producing saline soils.

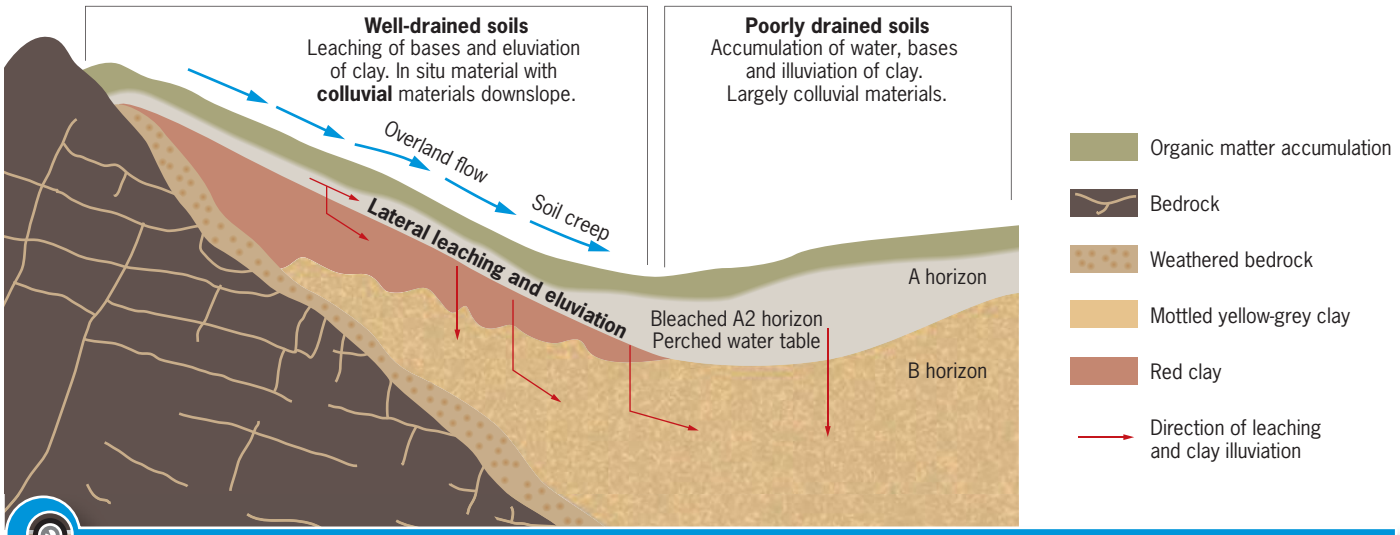


FIGURE 1.4.49

Topography and soil-forming processes.

However, human impact on the soil is not always detrimental. Drainage of poorly drained land, use of conservation farming techniques, addition of nutrients and organic matter, and use of controlled irrigation often increase soil productivity and stability.

Time

Soil type is influenced by the amount of time that soil-forming processes have been occurring. Theoretically, at least, if a sufficient period of intense weathering has occurred, all soils should approach a similar state, regardless of parent material. In practice this never occurs.

Soil-forming processes

The layer of fine particles produced by weathering does not constitute a real soil until it undergoes additional changes from the interaction of various processes. These processes are described below.

Movement of water through the soil profile

Water sinking into the ground takes with it both solid and dissolved matter from the upper part of the soil and deposits it in the lower part. This contributes to the differentiation of soil into horizons, each with its own characteristics.

This process is associated with:

- the leaching of soluble minerals, including calcium, magnesium, sodium, nitrate, chloride, sulfate and carbonate
- the movement and accumulation of organic matter, silicon compounds and iron or aluminium oxides
- clay translocation, which is the movement (eluviation) and deposition (illuviation) of suspended clay particles. This process leads to the formation of the A and B horizons, as shown in figure 1.4.50.

The speed of the above processes is dependent on the ratio of precipitation to evaporation and on soil permeability. For example, highly permeable soils, such as sands, will be more readily leached than impermeable soils.

Soil drainage

Soil drainage, particularly the amount of time a soil is wet or saturated, has very significant effects on the soil. In well-drained soils, which remain wet for only short periods of time, red and reddish-brown colours dominate. Generally, the red colour may be attributed to oxidised iron.

colluvial the material that has been transported downhill and has accumulated on lower slopes and/or at the bottom of the hill.

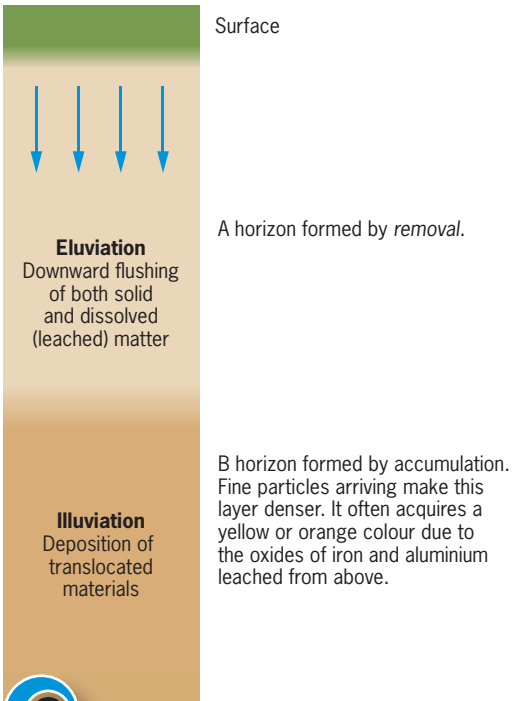


FIGURE 1.4.50

The simultaneous processes of eluviation and illuviation produce distinctive A and B horizons.

Land degradation has been called the AIDS of the earth. It leaves in its wake creeping deserts, farmlands white with crusted salt, shrivelled crops, a dying landscape. Each year it leaves vast expanses of our earth barren. Land degradation is not just a problem for farmers. It is probably the most fundamental environmental issue of our time.

Simply Living

Poorly drained soils remain wet for at least several weeks and often all winter. In these soils are found dull yellow and grey colours, which are frequently mottled with patches of red, orange, white and grey.

Continual weathering and new mineral formation

Weathering of primary minerals (those derived from the original rock) is a continual process in soils and leads to the formation of secondary minerals (clays and oxides). The secondary materials may, in turn, also be altered. Some primary minerals, such as quartz, resist weathering and remain in the soil profile for a considerable time.

Solution, precipitation and accumulation of soil components

Many compounds, such as iron and manganese, accumulate in soils. Calcium carbonate can accumulate in soils derived from parent material that is rich in it, such as limestone. It can also accumulate in dry regions where there is little leaching and these soluble constituents are not removed from the profile.

Wetting and drying

Wetting and drying out is important in soils that shrink and expand substantially with changes in moisture content. These are known as expansive soils.

Biological activity

Biological activity includes the accumulation of organic matter and the development of soil structure by plant roots, fungi, animal activity and decomposing organic matter. Numerous other biologically controlled reactions affect nutrient cycling in the soil, particularly that of nitrogen.

Human activities can also act as a biological agent. For example, cultivation and excessive grazing can lead to erosion and reductions in organic matter and degradation of soil structure.

geoskills 9

Investigating soils

Investigate your local environment to see if there is a site where you can examine a soil profile. It may be exposed at a road or railway cutting, or in a safely constructed soil pit especially dug for such a purpose. The latter is better as it is less likely to have been affected by weather.

'Reading' the soil correctly will give you an indication of the relative importance of each of the factors of soil formation. Before examining the profile itself, it is important to study the site to identify how various aspects of the biophysical environment may have affected soil formation. Where appropriate, consider the following:

- parent rock (Refer to a local geological map.)
- altitude (may be read from a local topographic map)
- angle of the slope
- aspect (bearing or compass point)
- relief (nature of the slope: uniform, convex or concave)
- exposure
- drainage (Does it shed water? For example, is it well-drained or boggy?)
- natural vegetation or type of farming (For example, consider the tree species, ground cover, crops and livestock.)
- previous few days' weather. (For example, has it been wet, dry, hot or cold?)

Examine the soil profile itself. Where appropriate, draw up a table or make a detailed, labelled field sketch.

Identify the different horizons. Indicate the depth of each horizon and describe the lower boundary. (Is it sharp, gradual, indistinct or irregular?)

Describe the characteristics of each horizon, noting any differences in:

- *Colour*. This can simply be described as it appears to the eye; for example, reddish-brown.
- *Texture*. Examine the size of the particles: clay, silt or sand.
- *Structure*. Is it structureless or do the particles cling together?)
- *Soil pH*. This may be measured by an indicator.
- *Presence of any carbonates*. Add dilute hydrochloric acid. If it effervesces it is more than 1% carbonate.
- *Soil organisms*. Note the number and type visible.

Look for any evidence of translocation of material from water moving through the soil. Examples include leaching and clay translocation.

Write a report on the soil-forming factors and the soil-forming processes that are responsible for the development of soil at this site.

geofocus

Desertification: a global problem

One-third of the earth's land surface (48 million km^2) is now threatened by the process of **desertification**: the spread of desert-like conditions in arid and semi-arid regions. (See figure 1.4.51.)

Causes of desertification

Desertification occurs where **landuse** practices in marginal areas leave the soil vulnerable to erosion by wind and water. The practices contributing to desertification include:

- overgrazing—too many livestock on too little land area
- improper soil and water resource management—leads to increased erosion, salinisation and waterlogging of soil
- cultivation of land with unsuitable terrain or soils
- deforestation without adequate replanting.

Central to the problem is the increased intensity of landuse associated with rapid population growth and high population densities. Poverty is a related issue. The poor are often forced by their desperate circumstances to exploit the lands beyond what would normally be regarded as a sustainable level of use. When combined with prolonged periods of below-average rainfall, famines are often the tragic outcome. Land degradation and incidence of famine are two of the major factors contributing to the increasing problem of environmental refugees.

Desertification in Africa

In the African Sahel region, approximately 65 million ha of productive land has been turned into desert in the last 50 years. In Sudan, the desert has spread southward at a rate of 100 km in just 17 years. With population growth rates exceeding 3% a year, the region's population is set to double in less than 25 years. This growth will place an intolerable strain on the region's fragile environment. The increased intensity of landuse will inevitably result in overgrazing and overcultivation. The enlarged herds of cattle, goats, sheep and camels will strip the vegetation, exposing the soil to erosion. Fuelwood is the people's main source of energy for cooking and heating. The deforestation associated with the collection of fuelwood makes the situation worse.

Africa is particularly vulnerable to this form of land degradation. In a harsh climate, marginally productive land easily becomes sterile. Prolonged droughts, lasting for two to three years, are common over two-thirds of the continent. Even in 'normal' years, rainfall is very unreliable and in some seasons does not occur at all. Throughout much of the region rainfall has been below average for the last 15 to 20 years. Some experts argue that this prolonged drought reflects a change in the region's climate, brought about by the large-scale removal of the natural vegetation.

In the past, people coped with the poor soils and unreliable rainfall by rotating crops and allowing the most fragile land to lie fallow for up to 20 years. This form of shifting cultivation, together with the landuse practices of the nomadic herders, was perfectly sustainable while human and animal numbers did not exceed the 'carrying capacity' of the land.

Larger population numbers and lower rainfall have upset this balance. It has forced farmers to bring more marginal land into production and to reduce periods of fallow. The environmental impact and the effects on humans of these actions have often been devastating.

War and civil unrest have also played a major role in the degradation of the land. Conflicts in Somalia, Ethiopia and Sudan have led to economic collapse and political chaos. In addition to the direct environmental damage caused by the conflict, the allocation of scarce resources to support military activities has detracted from efforts to address the region's environmental problems. Conflict and civil disorder also impact on the people themselves and their willingness and ability to deal with desertification.

The spread of deserts is not limited to Africa: it is now a global problem affecting two-thirds of the world's countries. It impacts on the livelihood of at least 850 million people and, according to UN estimates, accounts for losses in agricultural production worth $US26 billion a year. The earth's poorer countries are not the only ones affected, although they may be hardest hit by its effects. The US Soil Conservation Service, for example, estimates that 1.7 billion tonnes of the United States' topsoil is either blown or washed away each year. India loses 6 billion tonnes annually, and atmospheric scientists in Hawaii can tell when spring ploughing begins in northern China by examining the amount of suspended dust particles in the air.

In 1977, government representatives from around the world gathered at Nairobi, Kenya, for the UN Conference on Desertification, which focused the world's attention on the problems of these fragile lands. The result of this conference was a plan of action to halt or sharply reduce the process of desertification. Measures were recommended but many governments failed to implement them, citing lack of funding as the main reason.

Today, deserts continue their relentless march.

FIGURE 1.4.51

Nara boys collecting fuelwood in West Africa. Climate change, population pressure and landclearing are important causes of desertification. Desertification now threatens one-third of the earth's land surface.

understanding the text

1 **Explain** why soil is such an important part of the lithosphere.
2 **Outline** what soils consist of. How does it differ from its parent material?
3 **Describe** soil structure and why this characteristic is especially important in agriculture.
4 **Explain** what different colours in the soil indicate.
5 **List** the five factors of soil formation.
6 **Describe** the ways different parent material can affect soils.
7 **Outline** the influences that climate exerts over soil-forming processes.
8 **Outline** the ways in which the position on a slope accounts for different soil patterns.
9 **Explain**, with special reference to earthworms, the importance of biotic activity in the soil.
10 **Describe** the process of translocation. Is it important to horizon development within soil profiles? What types of materials are involved in this process?
11 **Define** land degradation. Outline a range of human activities that are held to be responsible for it.
12 **Explain** how desertification occurs in marginal areas of the world.

Human interactions with the lithosphere

The lithosphere is vital to life on earth. It supports the food webs that sustain life; it provides us with a vast array of natural resources, and it plays an important role in the purification of the water we drink. We also depend on it to dispose of some of our wastes. The rapid growth in world population and the accelerated rate and extent of our impact on the lithosphere has led to the deterioration of this vital component of the biophysical environment.

In a relatively short period of time on the geological time scale, humans have had a profound effect on the physical world around them. Nature is very unforgiving. Entire civilisations have collapsed as a result of the mismanagement of their resource base. Archaeological evidence shows that a number of agriculture-based urban societies in the Middle East once prospered between 3500 BC and 500 AD, but at the expense of their soils. Productive farmland was degraded into barren desert and then abandoned.

Some experts now argue that unless we use our knowledge and technology to work within the limits of the biophysical environment we could suffer a similar fate. Only this time it could well be on a global scale.

One of the primary issues of concern arising from human interaction with the lithosphere is **land degradation**: the decline in the quality of natural land resources, commonly caused by improper use.

geoskills 10

Presenting an oral report

Many school-based assessment programs require students to demonstrate their geographical knowledge and understanding by presenting an oral report. The information provided below will help you to develop this important skill.

The fear of talking to a large group is very common, but there are ways of overcoming this. One way is to carefully plan and prepare your presentation. This preparation should include establishing the following:

- *A clear understanding of the purpose of the report you are asked to present*. The most common purpose of an oral report is to inform an audience.
- *A knowledge of your audience*. The more you know about your audience, the more appropriate and focused your oral report will be. For example, if your audience already has a good knowledge of the topic you may choose to leave out information with which they are already familiar.
- *A well-organised body of information*. The most successful oral reports have a structure similar to an extended response or essay; that is, they have an introduction, a body and a conclusion.

It is important that the first part of your oral report tells the audience what your topic is. It is also important that you do this in a way that gains the audience's attention and relaxes you. A good way to do this is to make a formal opening statement outlining the focus of your report. This statement should be accompanied by some visual material, such as a digital image, poster, video extract or another type of stimulus. On some occasions humour can be used to gain the audience's attention.

The body of the oral report should be the focus of your presentation. The main ideas presented need to be developed and supported by examples, quotations, analogies and statistical information. These will make your presentation more interesting and memorable.

The conclusion should briefly highlight the main points you have made during your presentation. It is important to make it known to the audience that you are nearing the end of your presentation by using phrases such as 'in conclusion' or 'to sum up'.

Rather than simply reading a prepared speech, it is often more effective to use speaker's notes, which are a series of words or phrases that act as cues for your presentation. Make sure, however, that the words and phrases are written in large print and that there are not too many points per page. It is also a good idea to number the points so that you do not get out of sequence. The use of different colours and highlighter pens may prove useful as well.

To avoid 'stage fright', consider the following points before delivering your report:

- Know your topic thoroughly.
- Use numbered points on speaking cards.
- Practise your speech several times.
- Before delivery, visualise yourself as relaxed and calm.
- Do not rush your presentation.
- Use appropriate gestures and maintain good posture.
- Use a range of visual aids.
- Maintain eye contact with members of the audience.
- Vary your voice throughout your presentation.
- Stand still.

Land degradation encompasses soil degradation and the deterioration of natural landscapes and vegetation. It includes the adverse effects of overgrazing, excessive tillage (mechanical cultivation of agricultural soils by a plough), erosion, sediment deposition, mining, urbanisation, disposal of industrial wastes, road construction, decline of plant communities, and the effects of noxious (poisonous) plants and animals.

The lithosphere is at risk wherever the natural balance is altered by developments for agriculture, mining, forestry, industry, urban settlement and tourism or for infrastructure (such as roads, railways, dams, power stations, pipelines and transmission lines). Land degradation has an impact on each sphere of the biophysical environment. It affects soil, flora, fauna, water (both quality and quantity), aesthetic appeal and, inevitably, production levels.

> *Men no longer love the soil. Landowners sell it, lease it, divide it into shares, prostitute it, bargain with it and treat it as an object of speculation. Farmers torture it, violate it, exhaust it and sacrifice it with their impatient desire for gain. They never become one with it.*
>
> Pierre-Joseph Proudhon, French political philosopher

geoskills 11

Multimedia presentations

Multimedia presentations (including PowerPoint) combine various types of media, including text, graphics, clipart, digital photographs, podcasts, Internet links and music.

PowerPoint is perhaps the most popular of the multimedia presentation tools. It is a great way to communicate geographical information (including the results of a research assignment, fieldwork or your Senior Geography Project), especially if it is accompanied by an oral presentation.

There a number of points to remember when planning your PowerPoint presentation and accompanying oral report:

- Plan carefully.
- Do your research.
- Know your audience.
- Time your presentation.
- Practise your presentation.
- Speak comfortably and clearly.

(See Geoskills box 10.)

Tips for constructing effective PowerPoint presentations

The following tips will help you to constuct an effective PowerPoint presentation:

- Use a consistent and simple design template. It is acceptable to vary the content presentation style (such as bulleted lists and number of columns), but be consistent with other elements, such as font, colours and background.
- Limit the number of slides. Presenters who constantly 'flip' to the next slide are likely to lose their audience.
- Limit the number of words on each screen. Use key phrases and include only essential information. In general, use no more than six words a line and no more than six lines a slide. Avoid long sentences. Larger font sizes can be used to indicate more important information. Suitable font sizes generally range from 18 to 48 point.
- Use punctuation sparingly and avoid putting words in all capital letters. Some empty space on the slide enhances readability. Avoid abbreviations and acronyms.
- Use contrasting colours for text and background. Dark text on a light background is best. Busy, patterned backgrounds reduce readability of text.
- Avoid or minimise the use of flashy transitions, such as text fly-ins.
- Visual elements should balance the slide, enhance and complement the text and not be overwhelming.
- Use good quality (high-resolution) images that reinforce and complement your message.
- Do not read from your slides. The content of your slides is for the audience, not for the presenter. Do not turn and focus on your projected slides. Always focus on the audience.
- Learn to navigate your presentation in a non-linear fashion. PowerPoint allows the presenter to jump ahead or back without having to pass through all the interim slides.
- If possible, view your slides on the screen you will be using for your presentation. Make sure they are readable from the seats in the back row.
- Do not apologise for anything in your presentation. If you believe something will be hard to read or understand, don't use it.
- Practise with someone who has never seen your presentation. Ask them for honest feedback about colours, content and any effects or graphics you have included.

unit 1.5

> We are more than the sum of our knowledge; we are the products of our imagination.
> **Ancient proverb**

> The earth has a skin and that skin has diseases. One of its diseases is called man.
> **Friedrich Nietzsche, German philosopher**

> We must protect the forests for our children, grandchildren and children yet to be born. We must protect the forests for those who can't speak for themselves, such as the birds, animals, fish and trees.
> **Qwatsinas (Hereditary Chief Edward Moody), native American Nuxalk Nation**

The Biosphere

Ecosystems are usually able to maintain themselves. But eventually they get pushed to the limit of tolerance. Have we reached that point? Humanity is confronted by a major dilemma. The energy sources on which our standard of living depends are carbon-based. Burning the resources to produce electricity releases carbon dioxide into the atmosphere and this is altering the earth's climate. The warming of the planet is starting to impact on earth's animal and plant species and entire habitats. The stakes are enormous and bring into focus the vast, intricate network that supports life on earth. From bleached coral reefs to melting glaciers, from thawing permafrost to vanishing rainforests, the impacts of climate change are increasingly apparent. No part of nature is an island, and changes in one place can trigger profound shocks in regions thousands of kilometres away.

In this unit we focus on the biosphere: that part of the earth where all living organisms exist and interact. We examine the variety and distribution of plants and animals, the earth's terrestrial ecosystems, the factors affecting the global pattern of vegetation, and the development of local vegetation regimes.

exam-style questions

extended responses

- Account for the distribution of the world's major terrestrial ecosystems.
- Analyse the nature of people's interaction with the biosphere.
- Write an extended response on biodiversity. In your response:
  - Explain what is meant by biodiversity.
  - Explain why it is considered important.
  - Outline the threats to biodiversity.
  - Outline the actions that people can take to protect the earth's biodiversity.
- Account for Australia's unique flora and fauna.
- Explain the process of plant succession.
- Write an extended response on tropical rainforests. In your response:
  - Describe their spatial extent and ecological importance.
  - Explain the impact of people on tropical rainforests.
  - Outline the effects of forest destruction.

Learning from past mistakes

The United States is working on a multi-billion-dollar plan to depopulate vast areas of coastline along the Gulf of Mexico. It is hoped that this move will help re-establish a natural barrier against the catastrophic flooding caused by events such as Hurricane Katrina.

The Army Corps of Engineers, the body responsible for protecting the US coastline, has proposed a radical plan to rebuild the Gulf coast's wetland ecosystems. These have been disappearing at an ever-accelerating rate in recent years as urban expansion has spread like a cancer along the coastal fringe; the demand for coastal, resort-style living has driven a massive building boom.

Government agencies have also concluded that climate change has increased the threat of further devastation and that rebuilding the destroyed communities makes little sense.

Included in the overall plan is US$40 billion to be spent on the Mississippi coast. Some of the money will be spent relocating whole communities away from the coast.

The balance of the funding will be used to rebuild and protect the region's wetlands, which provide a natural barrier against flooding.

The evidence is clear: the coast is eroding, sea levels are rising and hurricanes are becoming more forceful. A retreat is the only option. Nature returns.

Destruction caused by Hurricane Katrina.

glossary

- **aquatic ecosystems** ecosystems of marine and freshwater environments.
- **biological diversity** the variety of life, encompassing the different plants, animals and micro-organisms, their genes and the ecosystems of which they form a part; also known as biodiversity.
- **biomass** the total weight of living things in a given area.
- **biomes** very large ecosystems made up of specific vegetation types and their associated fauna. Biomes recur on different continents in areas with similar climates.
- **biosphere** the surface zone of the earth and its adjacent atmosphere, in which all organic life exists.
- **climax community** the end product of succession: a community that is in equilibrium with its environment.
- **disclimax** the community that results when a climax community becomes modified or displaced; also known as a plagioclimax.
- **ecology** the study of the interactions of living organisms with each other, and with their habitats and environments.
- **ecosystem** a community of species and their non-living habitat.
- **fauna** the animal life of an area or region.
- **flora** the plant life of an area or region.
- **genetic diversity** the inherited variation that occurs within populations of species as a result of different genes or biological combinations.
- **habitat** the place where a particular plant or animal lives.
- **megafauna** large mammals and birds such as those thought to have occupied Australia up to 10 000 to 30 000 years ago.
- **natural vegetation** plants originally found in an area.
- **niche** the position and function of a plant or animal in its community.
- **photosynthesis** the process whereby plants collect energy from the sun and use it to combine carbon dioxide with water to produce organic nutrients.
- **primary succession** the sequential development of more complex plant communities. The succession may start on bare, previously uncolonised ground.
- **prisere** a complete chain of successive seres beginning with a pioneer community and ending with a climax community.
- **secondary succession** the development of a disclimax community once an original community has been removed or destroyed by human activities (such as forest clearance) or by natural activities (such as fires and cyclones).
- **sere** (plural seres) a stage in the sequence of events in which a plant or animal community in an area develops over a period of time.
- **species** a group of closely allied plant or animal types that can reproduce with each other.
- **species diversity** the number of different species or species richness.
- **succession** natural changes in the structure and species composition of a community over time.
- **symbiotic relationship** mutually beneficial relationships that develop between species.
- **terrestrial ecosystems** communities of plants and animals spread broadly over the surface of the continents.

Life on earth

Life can only be created and sustained in the presence of moisture, sunlight and nutrients. These elements only occur together on or near the surface of the land and in the sea. The biosphere is the global realm that encompasses

FIGURE 1.5.1

The biotic elements of the biosphere. **A** Plants. **B** Animals. **C** Micro-organisms.

all living things: from the creatures on the ocean floor and the insects burrowing beneath the soil to the animals and plants on the earth's surface and the spores floating high in the atmosphere. It includes all living (biotic) organisms (plants, animals and micro-organisms) and their excrement and dead remains. It also consists of the non-living (abiotic) environment, such as rocks, water and air. Thus, the biosphere incorporates and is the meeting point for the other three spheres. Every living thing is dependent upon this environment for its basic requirements.

Ecosystems

No organism can live in isolation, as figure 1.5.2 illustrates. An individual of a **species** is intimately related to others and the environment in which it lives. Each is a member of a population, which in turn forms a part of a larger community. A community, together with its non-living environment, forms an **ecosystem**.

A tidal pool on a rock platform or a huge expanse of tropical rainforest both represent an ecosystem, though on a different scale. The term 'ecosystem' comes from the Greek work *oikos*, meaning 'house', with the implication being that a household interacts within a functional physical structure. Thus, we can think of an ecosystem as a group of organisms living together in the environment that immediately surrounds them. Each ecosystem has a characteristic community of plants, animals and decomposers that are adapted to a certain set of environmental conditions.

Life has a variety of functions within the different levels of the biosphere. Individuals of a species must come together and usually touch in order to mate and nurture their young. Feeding territories are established, with different species occupying their own **niche**, and all sharing the resources (such as nutrients) available within the ecosystem. An ever-changing network of interactions sustains an ecosystem of species living in many curious and interdependent ways.

The world's ecosystems are dynamic. They respond to change, whether brought about by natural or human forces. There are, however, limits to how rapidly the biological communities within ecosystems can adapt to the stress of change without being degraded or destroyed, as we shall see in this unit.

The amazing array of plants and animals on earth reflects how these organisms have adapted, through evolution, to different environments, or a different range or set of physical conditions. The many ecosystems that exist can be broadly divided into two groups: aquatic and terrestrial. Major ecosystems in the hydrosphere are called **aquatic ecosystems** and include life forms of marine environments (for example, the open sea, ocean inlets and coral reefs) and freshwater environments (for example, rivers, lakes, dams and wetlands). The major land ecosystems are called terrestrial ecosystems and comprise the communities of plants and animals spread across the surface of the continents.

Terrestrial ecosystems

Within terrestrial ecosystems, the largest recognisable subdivision is the **biome**, a very large ecosystem made up of specific vegetation types and their associated **fauna**. (See figure 1.5.4, p. 112.) Biomes recur on different continents in areas with similar climates. Although the biome includes all organisms interacting within the life layer, the vegetation, with its enormous **biomass**, forms the most conspicuous part of the ecosystem. Thus, biomes are classified according to the characteristic vegetation within the ecosystem.

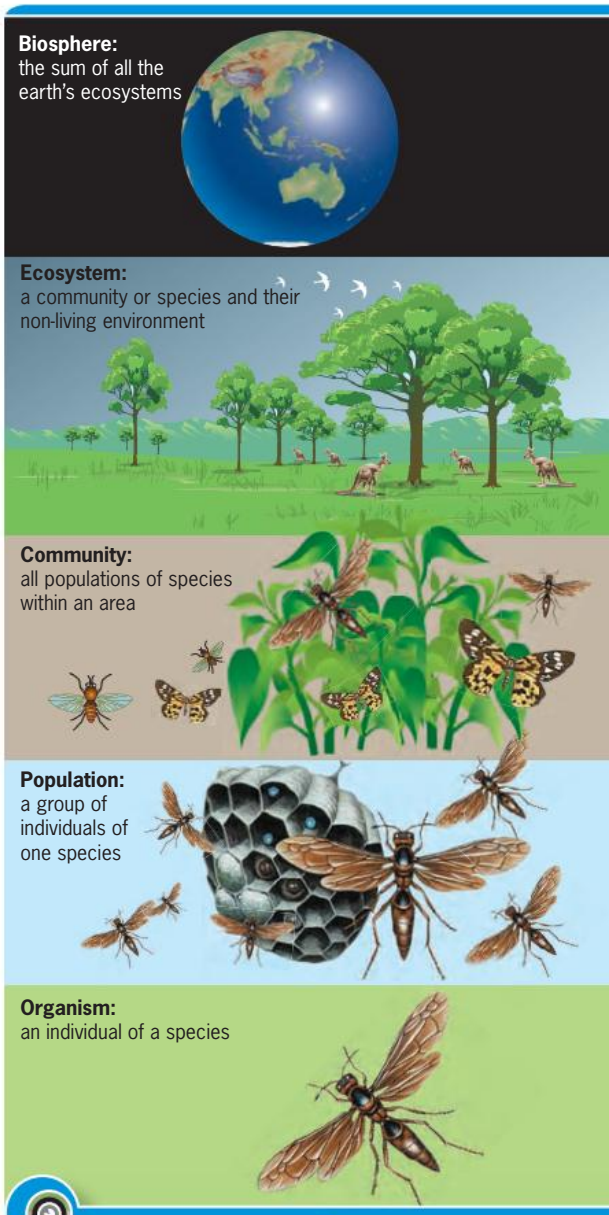


FIGURE 1.5.2

Levels within the biosphere.

FIGURE 1.5.3

Each ecosystem has its own characteristic community of plants, animals and decomposers.

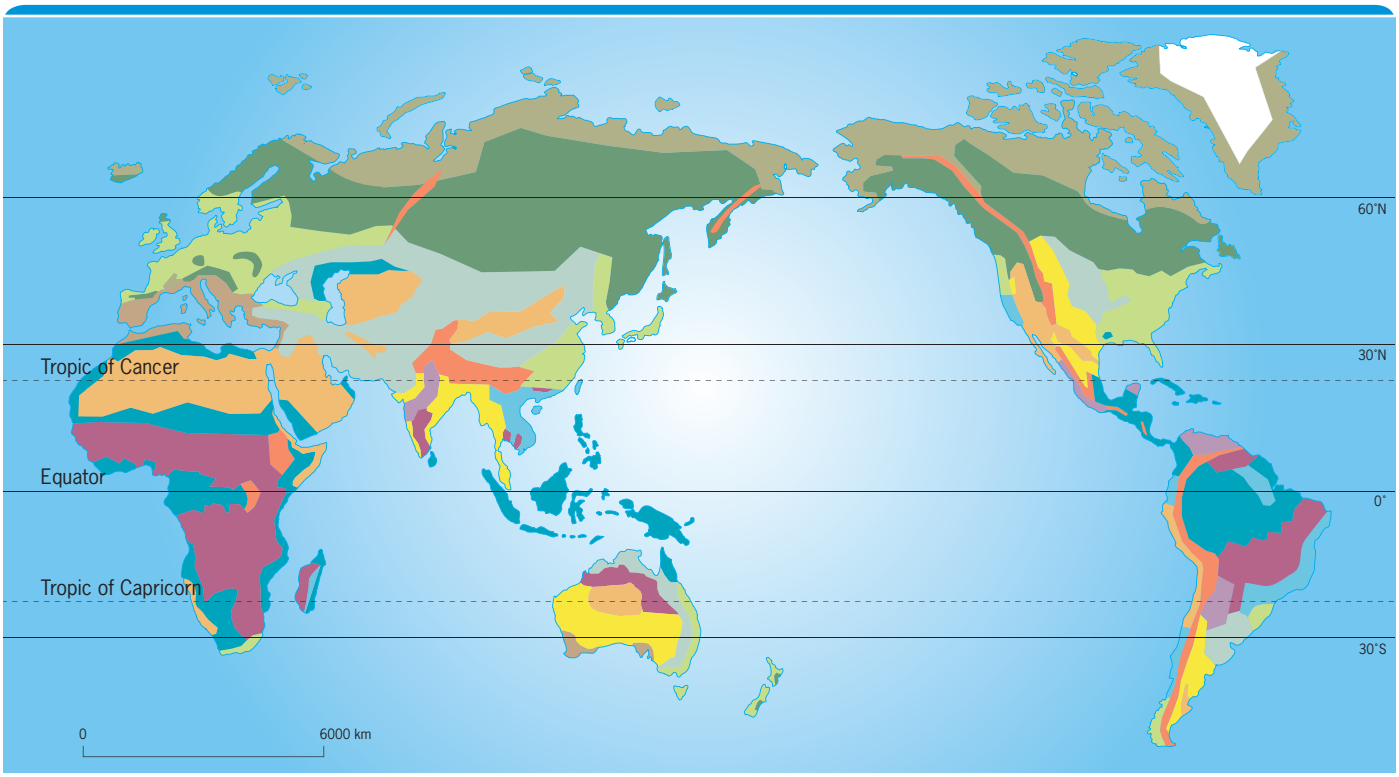


FIGURE 1.5.4

The earth's major terrestrial ecosystems or biomes.

FIGURE 1.5.5

Tundra: a terrestrial biome threatened by climate change.

Listed below are the principal biomes. They appear in order of availability of soil water and heat:

- forest—ample soil water and heat
- savanna—transitional between forest and grassland
- grassland—moderate shortage of soil water; adequate heat
- desert—extreme shortage of soil water; adequate heat
- tundra—insufficient heat to sustain vegetation growth throughout the whole year.

The actual number and names of biomes vary between authorities, and there are no absolute distinctions between them: just as climates grade into each other, so do vegetation types. Nevertheless, it is undeniable that similar climates in different places bring about similar types of vegetation. The concept of biomes is an attempt to describe this process on a worldwide scale.

One of the most well-known examples of a biome is the equatorial or tropical rainforest, which grows in wet, hot climates, such as Brazil, Zaire, Malaysia and parts of coastal Queensland. At the other end of the climatic gradient are the Arctic areas of Canada, Greenland and Russia's Siberia. There tundra vegetation occurs. A similar type of vegetation can also be found on the high mountains of Tibet, in the Andes and even on the mountains of New Guinea, where similarly cold conditions exist.

Factors affecting the global pattern of vegetation

Because plants are immobile and unable to generate their own heat, they are completely controlled by their environment. As the environment changes from region to region, so does the vegetation.

Four main types of factors interact to produce each distinctive biome:

- climatic, such as water supplies, temperatures, light and wind
- topographic, such as altitude, angle of slope and aspect
- edaphic (related to soils)
- biotic (related to the living environment).

Climatic factors

There is an obvious relationship between vegetation and climate because all plants need certain moisture and temperature conditions to survive and grow.

Precipitation

The availability of water is the most important controlling factor in the distribution of vegetation. Precipitation is considered to be the limiting factor that determines whether the biomes of the world's land surface are forest, grassland or desert. Water is very important for plant growth and development because it is vital to processes such as **photosynthesis**, germination and the transport of nutrients. Plants continually lose moisture from their leaves by transpiration, and this must be balanced by a comparable uptake of soil water.

Because precipitation is the major source of water supply in most places, it usually determines the amount of water available to plants. However, rainfall effectiveness (whether the moisture is available to plants at the right time) is more important than rainfall totals. Moisture availability through precipitation can be affected by:

- *Timing*. Does it coincide with the growing season? Is it concentrated in summer when moisture loss through evapotranspiration is high?
- *Intensity*. Does it fall as steady, soaking rain allowing beneficial soil infiltration to occur? When major storm events occur, how much water is lost as surface runoff?

Heavy rainfall throughout the year supports forests of various types. Tropical rainforests flourish where there is ample water; as the supply of water diminishes, the vegetation responds accordingly. This is readily observable when moving inland from the east coast of Australia. Pockets of tropical rainforest survive along the coast. These give way to wet sclerophyll forests, which give way, in turn, to dry sclerophyll forests further inland.

If most of the rain falls in summer, when evaporation rates are especially high, there may be inadequate soil moisture to support trees, and grasslands thus predominate. Savanna grasslands are characteristic of tropical latitudes, while prairies are typical in the temperate, mid-latitude areas.

In deserts, water availability is limited and transpiration rates are potentially high. This produces smaller plants specially adapted to reduce water loss and survive the effects of extreme aridity. The little rain that falls triggers a profuse growth of ephemerals (plants with very short life cycles). (See figure 1.5.7, p. 114.) Plants adapted to low water availability include mulga, cacti (see figure 1.5.6) and saltbush. These are classified as xerophytes.

Alpine and tundra vegetation is usually characterised by dwarf plant forms. These are more able to handle the low availability of moisture and low rates of transpiration.

understanding the text

1 **Outline** the conditions that make it possible for life to exist on earth.
2 **Explain** what a biosphere is.
3 **Define** the term ecosystem.
4 **Explain** why the world's ecosystems are described as 'dynamic'.
5 **Distinguish** between terrestrial and aquatic ecosystems.
6 What is a biome?
7 **Explain** why the earth's major biomes are identified by their characteristic vegetation type.

working geographically

1 **Interpreting diagrams** Study figure 1.5.2 (p. 111) and the text and then define each of the following terms: organism, population, community and ecosystem.
2 **Interpreting diagrams** Study figure 1.5.4 and describe the distribution of the earth's main terrestrial ecosystems.

FIGURE 1.5.6

Desert plants survive in the dry environment by reducing water loss.

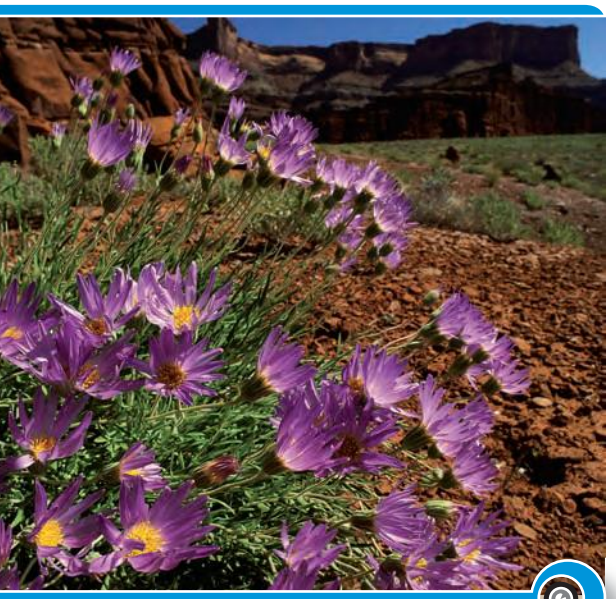


FIGURE 1.5.7

Rainfall triggers the short life cycle of ephemeral plants.

Temperature

For each plant species there is an optimum temperature range and a maximum and a minimum beyond which irreparable damage occurs. Most plants prefer temperatures between 10° and 35°C for effective photosynthesis.

Global differences in temperature are reflected in the different forest types:

- Constant mean monthly temperatures above 16°C, accompanied by adequate precipitation, produce optimum conditions for plant growth. Broadleaf evergreen trees predominate in tropical rainforests.
- Seasonal variations in temperature and precipitation with five months below 6°C, or a dry season, produce broadleaf deciduous forests.
- A period of more than six months below 6°C provides only a short growing season and coniferous, or boreal, forests dominate.

The importance of differences in average temperature and average precipitation on a continental scale is evident when examining the gradual transition from one biome to another. When it is realised that similar climates on different continents support similar vegetation, the overall distribution of biomes by latitude bears a strong resemblance to the latitude-based differences in climate. Figure 1.5.8 shows the relationship between biomes and the main climatic parameters (rainfall and temperature).

FIGURE 1.5.8

The relationship between biomes and climate.

Light

All green plants require light: their leaves act like miniature solar panels, collecting the sun's energy and using it to combine carbon dioxide with water to produce organic nutrients through the process of photosynthesis. This stored chemical energy provides the food for most other organisms.

As intensity of light determines the amount of energy available for photosynthesis, ecosystems near the Equator have a much higher energy input than polar ecosystems. It stands to reason, therefore, that the biomass of a tropical rainforest far exceeds the meagre biomass of a ecosystem: 45 kg of dry carbon per square metre compared with 0.7 kg of dry carbon per square metre.

Within a tropical rainforest ecosystem, individual species of plants have remarkably adapted to survive the low light intensity on the shaded forest floor. Ferns have numerous fronds, which are capable of individually turning to capture any shaft of sunlight briefly available. (See figure 1.5.10.)

FIGURE 1.5.9

Some plant species have adapted to climatic extremes.

Winds

Moving air is common in all ecosystems and normally has little effect on vegetation, apart from occasional storm damage. However, if winds are strong and continuous (for example, on coastal headlands, ridge tops and mountain slopes) only vegetation that is wind resistant can survive. Winds can cause physical damage and asymmetrical shapes in plants. (See figure 1.5.11.)

Persistent winds can also reduce moisture availability by evaporating more water from the soil and even increasing the rate of transpiration from the plants themselves. Winds, however, are not entirely destructive. They can assist in the transportation of pollen, spores and seeds and thus are important for plant dispersal.

FIGURE 1.5.10

Ferns have adaptations that allow them to capture a shaft of light penetrating the rainforest canopy.

Topographic factors

Vegetation patterns are affected indirectly by altitude, aspect and the degree of slope. These topographic features modify the climate and also have an impact on soils.

Altitude

With increasing elevation, there is a decrease in both soil depth and air temperature and an increase in the exposure to wind. These combine to limit the conditions for plant growth. As altitude increases there is a noticeable decrease in the:

- number of plant species
- height of plants
- density of plants
- growth rate of plants
- length of the growing season.

As one moves up very high mountains a distinct vertical zoning of vegetation is revealed. This zoning is similar to the changes observed when travelling from the Equator to the poles. Both increasing latitude and elevation result in a shift to cooler vegetation types with a decrease in community diversity. (See figure 1.5.13, p. 116.) The Andes (see figure 1.5.12, p. 116) rise to glacier-clad summits from the rainforests on the east and the deserts on the west. In the Andes nearly all the world's latitudinal temperature and vegetation zones can be observed in vertical **succession**.

FIGURE 1.5.11

Vegetation shaped by wind.

FIGURE 1.5.12

In the Andes nearly all the world's latitudinal temperature and vegetation zones can be observed in vertical succession.

Slope

The steepness of the slope is important because it influences the stability of the surface material and the amount of water retained in the soil. Steeper slopes assist erosion and are more susceptible to mass movement. The end result is skeletal, rocky soils with a low moisture content. This makes a poor medium for plant growth. By contrast, soils on valley floors are rich in mineral particles, nutrients and organic matter, making them more fertile and productive. This is because these soils are the recipients of material transported from adjacent slopes.

Aspect

The orientation of a slope alters sunlight and temperature conditions. North-facing slopes in the Southern Hemisphere are more favourable for plant growth than those facing south (especially in winter). This is because these slopes receive the most direct solar radiation.

Edaphic (soil-related) factors

Most plants are dependent on soils as a medium in which to grow because soils provide the water, air and nutrients necessary for growth. Vegetation, in turn, has an impact on a soil's characteristics. Soils and vegetation, therefore, have an intimate mutual relationship. On a global scale, the distribution of vegetation and soil types present similar patterns. This is evident when comparing figures 1.5.4 (p. 112) and 1.5.14.

Similarities emerge, for example, between the distribution of lateritic soils and tropical rainforests; desert soils and desert and temperate grassland vegetation; and podzolic soils and temperate forests, including coniferous (boreal) forests. These similarities are not the result of chance. They are due to the overriding importance of climate, which influences both soils and vegetation.

Mature soils in different biomes of the world vary widely in colour, texture, mineral content, pore space, acidity and depth. Many of these characteristics can be attributed to the vegetative cover and the associated climate. Soil profiles typically found in five types of biomes are illustrated in figure 1.5.15.

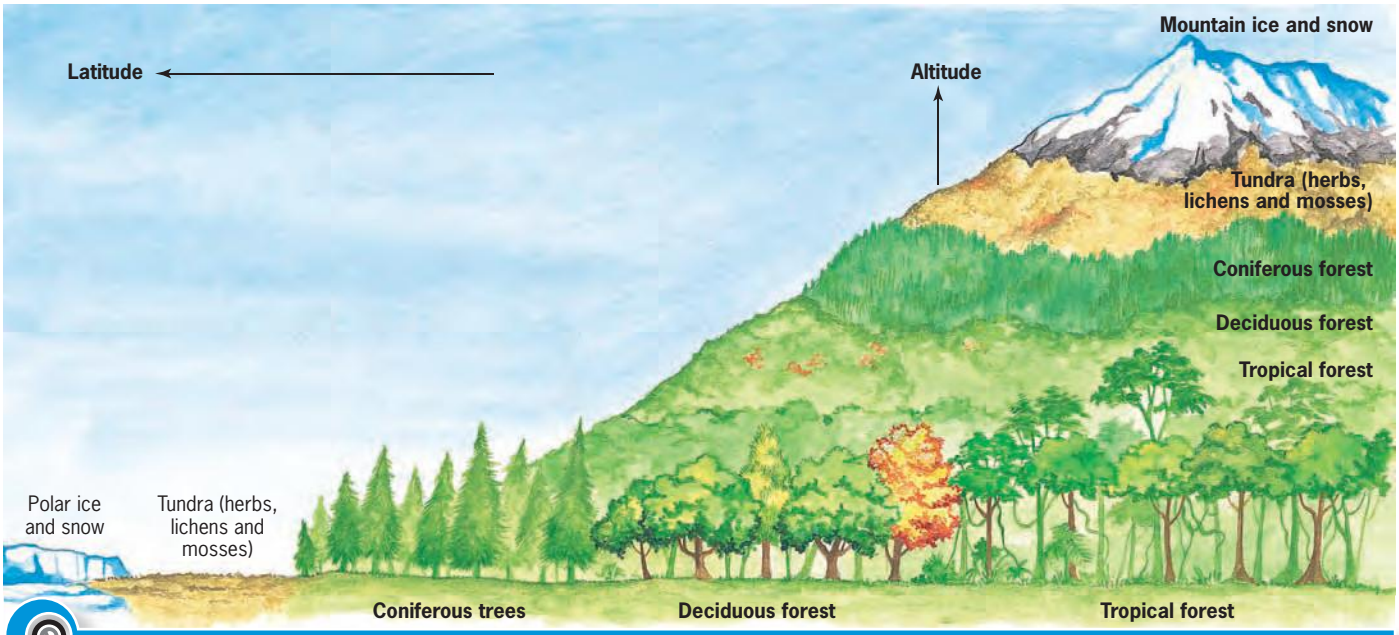


FIGURE 1.5.13

The relationship between latitude, elevation, vegetation type and biodiversity.

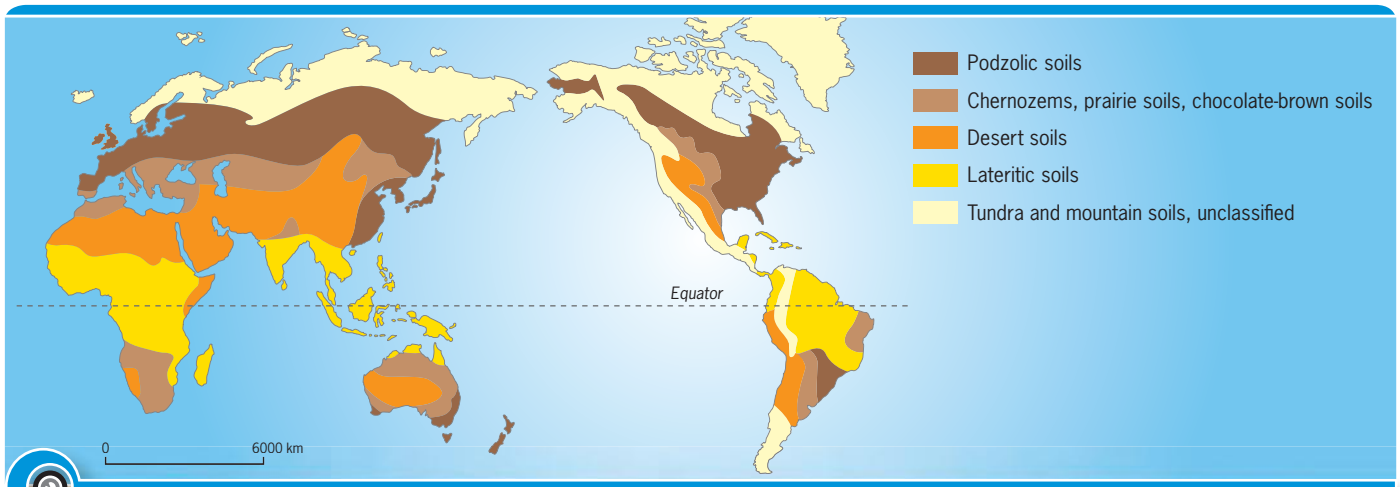
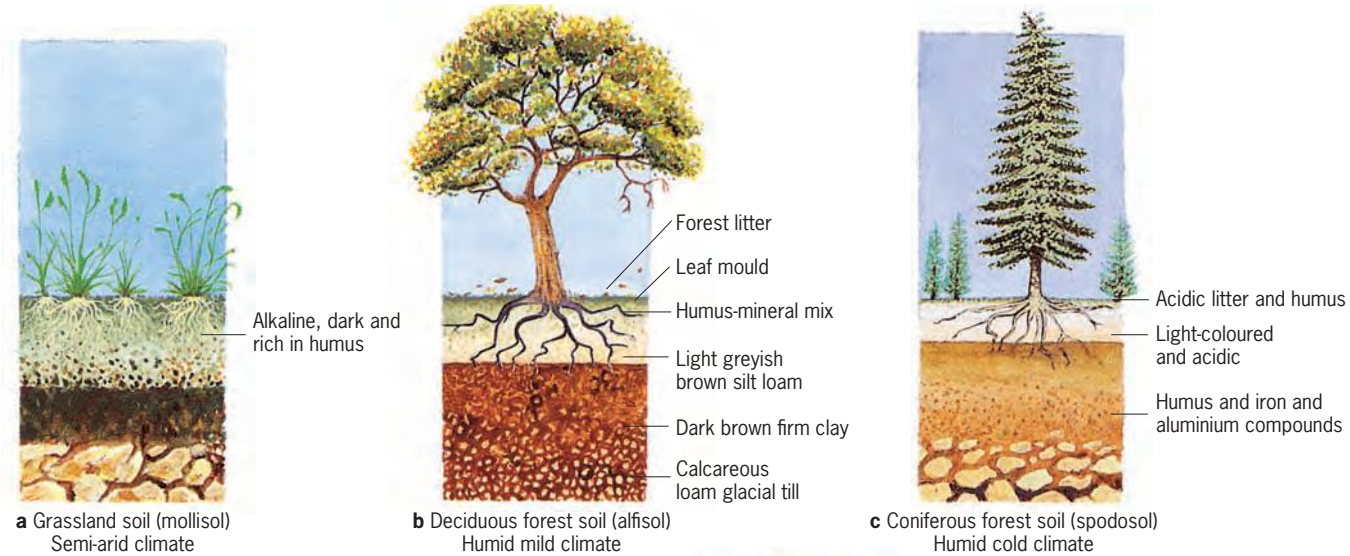


FIGURE 1.5.14

Generalised pattern of world soil types.



a Grassland soil (mollisol)
Semi-arid climate

b Deciduous forest soil (alfisol)
Humid mild climate

c Coniferous forest soil (spodosol)
Humid cold climate

d Desert (aridisol)
Hot dry climate

e Tropical rainforest soil (oxisol)
Humid tropical climate

FIGURE 1.5.15

Soil profiles typical of five selected biomes.

working geographically

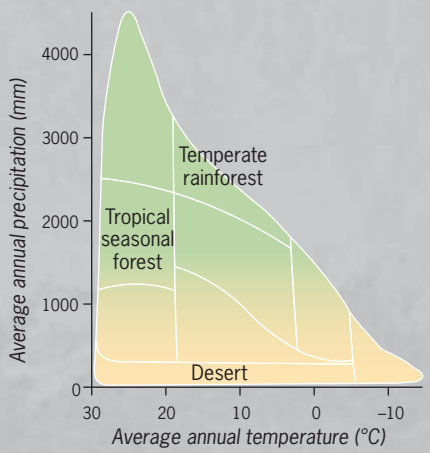
1 **Research task** Vegetational response can be matched to changes in temperature, which are determined by energy input. Investigate why this energy input is different at the Equator and the higher latitudes near the poles.

2 **Interpreting diagrams** Study figure 1.5.8 (p. 114). Write an explanation outlining how distinctive biomes are the outcome of the interaction between average temperature and average precipitation.

3 **Interpreting diagrams** Study figure 1.5.13 (p. 116). Write a report describing the impact of latitude and altitude on the pattern of vegetation.

4 **Research task** Undertake library or Internet research into:
- a plant adaptation to different light intensities
- b special adaptations made by plants and animals in two contrasting types of biomes.

5 **Interpreting diagrams** Using the information in figures 1.5.8 (p. 114) and 1.5.13 (p. 116), complete the following graph by locating each of the earth's major ecosystems (tundra, boreal forests, temperate grasslands, temperate deciduous forest, savanna and tropical rainforest).



6 **Interpreting diagrams** Study the map of soil distribution on a global scale (figure 1.5.14, p. 117) and compare it with the generalised map of global vegetation (figure 1.5.4, p. 112).

7 **Interpreting diagrams** Examine the soil profiles in figure 1.5.15 (p. 117) and then complete the following tasks:
- a Account for the differences in colour and fertility between grassland and desert soil.
- b Describe the characteristics of the soil profile in areas of coniferous forest. Suggest reasons why these soils are light coloured and acidic.
- c Identify which soil type offers the greatest potential for agriculture. Justify your answer.

Biotic factors

Biotic factors result from the multitude of relationships that exist between plant and animal species within an ecosystem. A biome is not merely a random collection of plants and animals but a highly complex, interactive community. Human activities are the most significant biotic factor influencing vegetation and its companion fauna.

Plant competition

Plants grow by forming organic compounds from sunlight, atmospheric carbon dioxide and water. In doing so, they compete with each other for these vital ingredients. Nowhere is this battle more apparent than in a tropical rainforest, which teems with diverse life forms engaged in a relentless struggle. (See the Geofocus box 'Strangler figs and epiphytes'.)

An example of a remarkable mutually beneficial relationship between plants is the one that has developed between the largest and one of the smallest organisms: trees and fungi. Mycorrhizal fungi weave their threads into a mat around the roots of trees. This acts like a sponge, mopping up soil water that is rich in nutrients. The nutrients are fed to the tree, which, in turn, provides the fungi with simple sugars.

Relationships between plants and animals

Among the intriguing features of biomes are the extensive networks of relationships that have developed between plants and animals. Over time, species adapt to one another: animals to plants, animals to animals and, as shown with strangler figs and epiphytes, plants to plants. Each successive generation refines its ecological niche. Plants and animals tend to become more specialised and particular species develop mutually beneficial (**symbiotic**) **relationships** with others. In many cases, plants and their pollinators and seed-dispersal agents have evolved together; one ultimately dependent on the other.

Hummingbirds, for example, are highly specialised pollinators. They feed on concentrated nectar, which fuels their high metabolism rate and their ceaseless hovering and darting. Their long bills are often exactly matched in length to the flowers on which they feed. This is a remarkable example of co-evolution, which ensures that only a pollinator can reach the nectar. (See figure 1.5.18.)

FIGURE 1.5.16

Intensive agriculture. Humans possess the ability to manipulate their environment to meet their needs.

geofocus

Strangler figs and epiphytes

Strangler figs (*Ficus* spp.) are the one of the great exploiters of the plant community, and use ingenious ways to secure space, sunlight and nutrients. There are many different species of strangler fig in the rainforest. Each has its own specific wasp pollinator and all fruit prolifically. (As many as 100 000 fruits have been found on a single tree.) Birds and monkeys feed on the fruits and are largely responsible for the dispersal of its seeds.

Occasionally one of these countless seeds lodges in the branch of a tree and germinates. The seedling initially sends out a long aerial root to the ground. Then, once it has locked into the soil, the young fig starts to grow, sending more roots down to the ground from its perch. As these roots cross over one another, they fuse together. (See figure 1.5.17.) The fig also sends out its own foliage above that of the host tree. Starved of sunlight, the host tree dies, its trunk encased in the fig's roots. In this way, the fig avoids competition on the ground, seizing the place of the original tree. The fig has successfully established itself in the canopy where sunlight is at a premium.

Another way in which plants gain access to light without investing in lengthy stems or roots is for them to live on other (host) plants. Epiphytes (such as mosses, lichens, ferns, orchids and bromeliads) anchor themselves to a host tree. Unlike the fig, they do not live at their host's expense. Epiphytes are not parasitic, because they use their own root system to trap debris and moisture. Some trees actually send out roots from their trunk into the epiphyte to trap this resource.

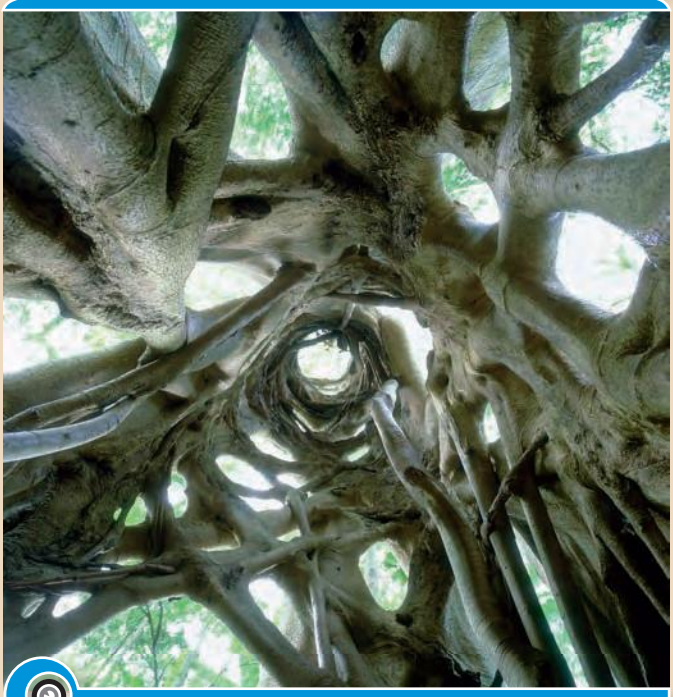


FIGURE 1.5.17

The roots of the strangler fig have wrapped themselves around the trunk of the original host tree, which has subsequently died and rotted away.

Many plants rely on insects or animals for pollination. They also rely on highly mobile animals (such as birds, bats and monkeys) to ensure a wide dispersal of their seed.

Not all relationships between plants and animals are beneficial. An ongoing conflict exists between plants and a marauding army of herbivores that rely on plants for their basic food source. Plants have evolved many ingenious defences, including thorns and spikes and various types of defensive chemical compounds. Usually, little serious damage is done in this continual war unless excessive numbers are involved and natural balances are upset. The latter are often triggered by human activity. The introduction of rabbits into Australia resulted in their reaching plague proportions, stripping the land bare, and making it vulnerable to erosion.

Human activities

Human activities are the most significant of all the biotic factors operating today. As the human population and its domination in the biosphere increase, so does the threat to other life forms.

While human populations remained relatively small and the environmental impacts of human activity were limited, the biosphere was virtually unaffected. However, more and more of the environment has been brought under direct human control. This has been as a result of the establishment of agriculture, the subsequent industrial development and, in recent times, the unprecedented increase in human numbers.

FIGURE 1.5.18

The hummingbird, a highly specialised pollinator.

did you know?

- Between 1990 and 2005, Thailand lost about 9% of its forest cover or approximately 1.4 million ha.
- Since the 1960s a series of ambitious plans to develop and colonise the Amazon have taken a heavy toll on the forest environment, with an area of forest more than twice the size of Victoria being cleared. Recent policies designed to protect the environment and the rights of the indigenous forest dwellers have slowed the annual rate of loss from 8.1% in 1990–2005 to 0.63% in 2000–05. (Note that these periods overlap.)
- The Amazon Basin recycles its own rain by returning to the atmosphere massive amounts of moisture through transpiration.
- In the past 300 years the proportion of the earth's surface covered by forest has been reduced from 60% to just 25%.
- During the 1990s the total area of the world's tropical rainforest declined by 9%. Tropical rainforests continue to be cleared at a rate of 80 000 km^2 a year, an area twice the size of Tasmania.
- At the current rate of deforestation, 4–8% of rainforest species will be extinct by 2015 and 17–35% by 2040.
- The trees in a rainforest canopy do not touch one another, but neatly interlock. The reason for this 'crown shyness' is not known, but it may prevent the spread of disease or make access from one tree to another difficult for predators.
- Most of the world's biodiversity is located in the tropics. About 40–90% of the world's species live in tropical rainforests and as many as 1000 species of trees may be found in 1 km^2 of tropical rainforest.

TABLE 1.5.1

Extent of human control of ecosystems

Type of control	Examples
Direct physical control	■ Confinement of animals or plants by enclosures of any kind ■ Exclusion of animals or plants by devices of any kind ■ Physical support given to organisms (mainly plants), such as stakes and trellising ■ Pruning, trimming and mowing ■ Weeding ■ Persecution of organisms by physical means, such as shooting, buffeting and scarring ■ Performance of minor operations on a routine basis, such as shearing, dehorning, docking, castration and hoof care ■ Cropping/harvesting: removal of all or part of certain plants or animals and their transfer from the system to the point of consumption
Chemical control	■ Poisoning unwanted organisms, whether plant, animal, insect, fungus or bacteria ■ Stimulating growth by adding nutrients ■ Chemically inducing changes in organism behaviour or characteristics, such as through the use of defoliants, colourants, hormones, attractants and repellents
Habitat control	■ Ploughing or other modifications to soil, earth or rock ■ Provision of special environments, such as glasshouses, greenhouses and beehives ■ Provision of shelters, such as windbreaks ■ Microclimatic modification to deter unwanted organisms ■ Introduction or exclusion of fire ■ Habitat destruction (such as deforestation, swamp draining and filling) leading to local or global extinctions
Biological control	■ Spread of disease to unwanted species, such as myxomatosis in Australian rabbits ■ Introduction of predator or parasite specific to unwanted species, such as cactoblastis on Australian prickly pear ■ Introduction of species to niche, such as marram grass for sand dune stabilisation in south-eastern Australia
Genetic control	■ Regular importing of strains of organisms with special characteristics (usually high yield) ■ Importing genetic material, such as use of artificial insemination ■ Control of plant or animal breeding within the system, such as use of selective breeding, selective hybridisation ■ Scientific interventions to bring about genetic changes that act as a means of controlling and perhaps eliminating unwanted species
Behaviour control	■ Subjugation, such as 'breaking' of horses ■ Training of animals to respond to stimuli, such as to attack unknown humans and to feed at sound of buzzer to facilitate harvest ■ Stimulating inherent responses of organisms to light/dark, heat/cold, high/low humidity, etc., such as by extending day length with lamps and by refrigeration to simulate winter and induce 'spring' behaviour on removal from refrigeration
Water-cycle control	■ Supply or removal of water by any means ■ Weather modification

Source: P. Chapman & S. Codrington, *Understanding our Earth*, Pitman, Carlton

TABLE 1.5.2

How people have influenced biomes

Ecosystem	Percentage of the world's land	Vegetation	Effect of people on the ecosystem
Equatorial and tropical rainforest	8%	Many different types of trees; dense layers of plants; adapted to high rainfall throughout the year.	The effect depends on the type of use: ■ hunters and gatherers: very little effect ■ shifting cultivators: large short-term effect, when forest is cleared; after fields are abandoned, forest regrows; that is, medium-term effect ■ timber-cutting: large effect as large areas of trees are cut down ■ clearing for farming: large effect as forest is totally removed.
Temperate forest	7%	Forests of different trees, many of which are deciduous; trees adapted to moderate rainfall and cool winters, warm summers.	Many of the world's temperate forests have been cleared and the land is used for crop growing. People have had a major effect on this ecosystem.
Coniferous (or boreal) forest	14%	Forests of evergreen trees, mainly conifers; trees adapted to cold winters and low rainfall.	People have changed some areas more than others. In Canada and the eastern part of Russia, some forests have not been used. In the USA and Norway, they are used for grazing and herding. In western areas of Russia, the effect of people is higher as the forests have been cleared for crop growing.
Savanna (grassland)	24%	Areas near Equator have trees and grasses; closer to deserts, grasses dominate; grasses adapted to a wet and a dry season.	Major effect of people: ■ herding and ranching: fires have been used to clear trees and encourage grasses ■ areas of overgrazing where stock numbers are too high: erosion results ■ grasslands ploughed for crops: danger of erosion.
Temperate grassland	7%	Tall grasses in wetter areas, and scattered trees; shorter grasses where drier.	Most of these grasslands have been cleared and ploughed for crop growing. Areas of grassland have been improved, or replanted with better grasses, for livestock grazing.
Mediterranean	1%	Shrubs and trees adapted to summer drought and winter rains.	Most vegetation has been cleared and soil ploughed for tree crops and other crops; some grazing.
Hot desert	21%	Sparse cover of shrubs and grasses; plants adapted to low rainfall and long periods without rain.	Areas in Africa and Asia are used for nomadic herding. In the USA, Australia and South America, they are used for ranching (cattle/sheep). Very fragile ecosystem: although stock numbers are low, many areas are overgrazed and erosion is a problem.
Tundra	5%	Mosses, lichens and plants; adapted to cold temperature and low rainfall.	Very little effect, although tourism can destroy the vegetation.
Polar	11%	Ice caps: no vegetation.	People have had little direct impact on ice caps, but fishing of krill and other marine life is having an effect on polar ecosystem. Also, pollution from water areas is starting to affect marine life.
Cities and industrial areas	2%	Natural vegetation cleared and people build a new environment (houses, roads and factories).	Major impact, as people change the nature of the ecosystem. Pollution of air and water is having a major impact on all the world's ecosystems.

Source: P. Chapman & S. Codrington, *Understanding Our Earth*, Pitman, Carltona

understanding the text

1. **List** the four factors that determine the global pattern of vegetation.
2. **Explain** why water is vital to the growth and development of plants.
3. **Outline** the factors that affect rainfall effectiveness.
4. **Give** one example of how the seasonal distribution of rainfall affects the pattern of vegetation.
5. **Outline** how plants have adapted to low water availability.
6. **Explain** how global differences in temperatures are reflected in vegetation types.
7. **Explain** why plants need light.
8. **Outline** the nature of the relationship between biomass and the intensity of light.
9. **List** five ways in which vegetation is influenced by wind.
10. **Explain** the impact that altitude, slope and aspect have on vegetation.
11. **Describe** the relationship that exists between vegetation and soil.
12. **Describe** the vegetation changes you would expect to encounter when moving downslope from skeletal soils on a ridge top to the deep alluvial soils of a valley floor.
13. **Explain**, with reference to an example, what is meant by a 'mutually beneficial relationship' between species within an ecosystem.
14. **Explain** why the impact of humans on the biosphere has increased.

working geographically

1. **Writing task** With reference to tables 1.5.1 (p. 120) and 1.5.2 (p. 121), write a report outlining the nature and extent of human control and influence on the world's major ecosystems.
2. **Research task** Undertake Internet or library research into examples of mutually beneficial relationships that have developed between species of plants and animals in a tropical rainforest. Present your findings as a short report.

The extent of human control of ecosystems is illustrated in table 1.5.1 (p. 120).

Humans possess one quality that sets them apart from all other species: the ability to manipulate their environment to suit themselves. (See figure 1.5.16, p. 118.) Technological developments continue to enhance this ability and have enabled humans to acquire an unprecedented level of control over nature.

The dominance of ecosystems by humans has diminished the space available for other species. Most obvious has been the loss of **natural vegetation**. In fact, many of the biomes have been significantly altered by human activities, as is evident in table 1.5.2 (p. 121).

Biodiversity

Many ecologists believe that we are on the verge of an episode of major species extinction, rivalling other periods when a significant portion of global fauna and **flora** was lost. The most recent of these was the disappearance of the dinosaurs some 65 million years ago. Whereas earlier extinctions were related to natural phenomena, such as climatic or geological dislocations, experts claim that the current episode is human-driven. The rapid conversion and degradation of **habitat** for human use; the accidental and deliberate introduction of exotic species; overharvesting of animals, fish and plants; pollution; human-induced global climatic change; and industry, agriculture and forestry are all activities that destroy or impair natural ecosystems and the species within them.

What is biodiversity and why is it important?

Biological diversity (or biodiversity) is the variety of life and encompasses the different plants, animals and micro-organisms, their genes and the ecosystems of which they form a part. Scientists define biodiversity at three levels: genetic, species and ecosystem:

- ***Genetic diversity***. This is the inherited variation that occurs within populations of species as a result of different genes or biochemical combinations. This has an important practical use, especially in agriculture where resistance to pests arises and new traits may be sought.
- ***Species diversity***. This refers to the number of different species, or species richness. This provides us with a host of useful products that could well determine the health and living standards of growing human populations. As well as providing new food sources, products extracted from wild species are valuable to the pharmaceutical industry.
- *Ecosystem diversity*. This is the variety of habitats, communities and ecological processes in the biosphere that play a vital role in protecting catchments, purifying water, regulating temperature, regenerating soil, recycling wastes, and maintaining the quality of the air we breathe. Plants and animals also supply us with many of the medicines that are used to cure human diseases.

Debates about the threats to biological diversity have tended to overlook micro-organisms. They facilitate the addition of nitrogen to soils and the decomposition of animal and plant proteins in the soil.

All species and communities have an inherent right to exist. They form part of a world that is an independent whole. The world belongs to the future as well as the present, and no species can claim it as its own. Ultimately, the actions of any species, including humans, will be guided by ecological limits.

FIGURE 1.5.19

The drying of the land resulting from climate change is increasing the frequency and severity of forest fires. This endangers whole forest ecosystems.

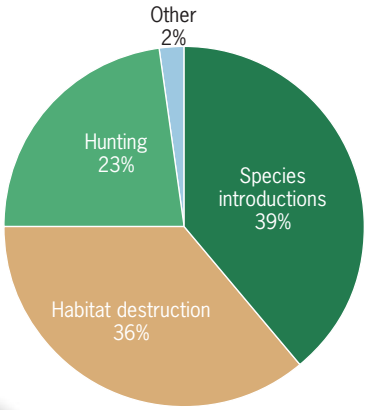


FIGURE 1.5.20

Known causes of animal extinction since 1600.

Threats to biodiversity

A World Conservation Union analysis of animal extinctions that have occurred since 1600 found that, where the cause was known, 39% resulted from species introductions, 35% from habitat destruction and 23% from deliberate extermination. (See figure 1.5.20.)

Species introductions can be deliberate or accidental. Exotic species can wipe out local flora and fauna either by preying on them or outcompeting them for food and space.

Habitat destruction is considered to be the biggest current threat to biodiversity. Habitat loss takes several forms. Among them are the outright loss of areas used by wild species when they are converted to human use. Habitat loss can also be degradation and fragmentation, where native species are deprived of food, shelter and breeding areas and end up being squeezed into smaller and smaller areas of undisturbed land.

Hunting can lead to the uncontrolled exploitation of, and trade in, wildlife. It has decimated some species. Large mammals, such as elephants, are still targeted by poachers despite the global ban imposed on ivory trading in 1989. Wild birds are among the animals threatened by illegal trade in exotic species.

Pollution is a major threat in aquatic (and land) ecosystems. Acid rain, for example, has been held responsible for a serious decline in amphibian species.

The eventual extinction of a species generally results from a culmination of these related causes. Habitat destruction pushes species into small, isolated areas. Here they fall victim to the intrusion of other species, including humans, from adjacent, cleared areas.

Protecting biodiversity

Unprecedented concern about gene, species and ecosystem loss have prompted two approaches to biodiversity conservation: protecting habitats and protecting individual species and populations.

geofocus

Biodiversity Convention

The Biodiversity Convention is an international agreement signed by 157 countries at the International Environment Summit in Rio de Janeiro in June 1992. Initially, the United States did not sign the Convention at Rio. This was on the grounds that to do so would unduly interfere with its biotechnology industry. The United States has since signed. The Convention has now been ratified by more than 30 countries, including Australia, and came into force on 29 December 1993.

The Convention is the first all-encompassing international instrument for the protection of wildlife. Parties to the Convention must agree to undertake measures relating to:

- in situ and ex situ conservation
- sustainable use of biodiversity
- incentives to encourage conservation and sustainable use
- improved public understanding of biodiversity and the need for its conservation
- access to and transfer of relevant technologies
- the provision of financial resources to encourage developing countries to implement the provisions of the Convention.

understanding the text

1. **Explain** what biodiversity means and outline why it is important.
2. To which other events in the past has the loss of biodiversity been compared? How does the current wave of extinctions differ?
3. **Define** the three levels of biodiversity.
4. **Outline** the threats to biodiversity.
5. **Name** the two approaches to biodiversity conservation.
6. **List** the conditions that protected areas must meet if they are to be effective.
7. **Explain** what ex situ conservation is.
8. **Outline** the measures the signatories to the Biodiversity Convention have agreed to undertake.

working geographically

1. **Interpreting diagrams** Study figure 1.5.20 (p. 123). Write a paragraph outlining the known causes of animal extinction since 1600.
2. **Research task** Investigate, through library and Internet research, some of the causes of animal extinctions, as shown in figure 1.5.20 (p. 123).
3. **Writing task** Write an exposition on the following topic: 'The earth's biodiversity is under threat. Does it matter?'

Protecting habitats

Parks and reserves, where human activity is limited, have been at the heart of strategies to protect threatened habitats and maintain biodiversity. There are, however, deficiencies in the current network of protected areas. To adequately safeguard biodiversity, protected areas must:

- be large enough to effectively protect and conserve land in intact ecosystems and allow evolutionary processes to continue into the future
- have boundaries that reflect environmental rather than political needs
- be well-managed and adequately funded
- take into account the interests of local people. When people who once depended on the resources of an area are excluded from that area, they sometimes resort to destructive activities, such as poaching. They do so because they have no other way of supporting their families
- be surrounded by a 'buffer zone' where human activity is carefully managed. Changes in areas surrounding the protected zone may interrupt breeding and migration patterns and affect air and water quality.

Protecting individual species and populations

While strategies to protect individual species and populations are important, they can only support a small percentage of threatened species. Measures include offering legal protection to individual species and developing management plans designed to protect them. Another measure is ex situ (outside natural habitats) conservation, using zoos and seedbanks. Ex situ methods provide an insurance against the loss of genetic and species diversity in the wild and offer opportunities to reintroduce or bolster wild populations.

geofocus

Evolution of Australia's flora and fauna

Australia's flora

The evolution of Australia's flora can be traced back to the continent's very beginning when it was part of the supercontinent Gondwana. When Australia and Antarctica were connected as part of a single land mass, the predominant vegetation was rainforest. Despite the high latitude, the climate was warm and moist. When Australia broke free and began its northward drift, it carried with it a sample of Gondwana's flora; the rainforests of Queensland support one of the greatest concentrations of primitive flowering plants in the world.

For most of its 50-million-year existence as an isolated continent, Australia was covered with extensive, diverse tropical or subtropical rainforest. By the time the Europeans arrived in 1788, Australia's rainforests survived only in isolated pockets along the east coast: just 1% of the continent's land surface. This dramatic transformation of the Australian landscape was a response to a changing climate, changing soils and the use of fire on a continental scale. Of all the continents, Australia has vegetation that burns the most readily and over the largest area.

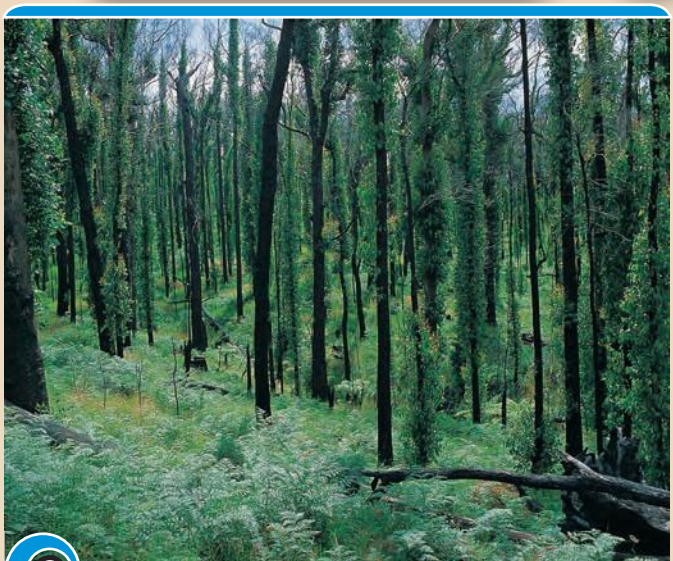


FIGURE 1.5.21

Trees recovering from damage caused by a bushfire.

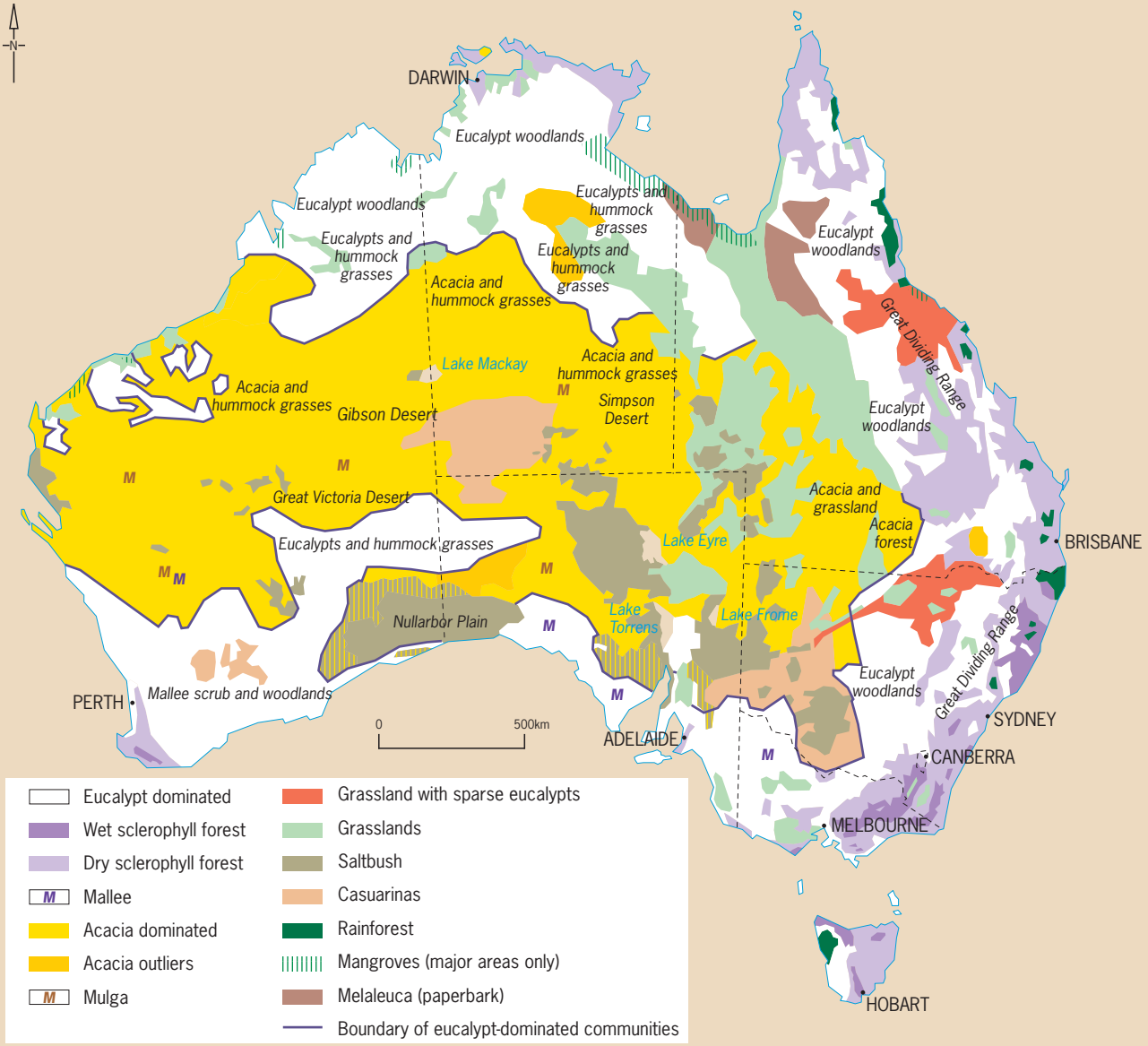


FIGURE 1.5.22

Australia's pattern of vegetation.

Climate

The northward drift of the Australian continent carried it into the latitudinal belt characterised by subsiding air. Between 20° and 30° south, this sinking air suppresses cloud formation and rain. It also spreads out across the surface, which results in air flowing predominantly off the continent.

The drying of the climate resulted in rainforest retreat, the development of vegetation types adapted to aridity and the continent's relatively infertile soils.

Soil

Australian soils are among the oldest and poorest in the world. This is due to the lack of nutrient renewal, which is normally associated with the formation of new lithospheric material. The poor quality of Australia's soils are also a result of the loss of nutrients over a very long time through wind and running water.

Over millions of years, plants evolved to cope with the infertile soils. Many developed sclerophyll characteristics; for example, small, thick leathery leaves, which need to be replaced less often than leaves on deciduous trees. Sclerophyll is a Greek word meaning 'hard-leaved'. The hardness of the leaves comes from lignin, which prevents the leaves from wilting in the dry conditions. This enables sclerophyll plants to grow in the phosphorus-deficient soils of Australia.

Sclerophyll leaves have aromatic oils and waxes to inhibit insect attack. The presence of these compounds and a lower water content result in high levels of combustibility, which explain why many of these plants burn so explosively.

FIGURE 1.5.23

Over millions of years, plants evolved to cope with Australia's infertile soils and arid climate. Many developed sclerophyll characteristics; for example, small, thick leathery leaves.

Fire

Bushfires have always been part of the Australian biophysical environment, with many started by lightning. Fires were relatively infrequent when the Aboriginal people first arrived in Australia, more than 60 000 years ago. By the time Europeans arrived, fire had transformed the landscape and smoke haze could be seen regularly on the horizon.

Aboriginal people had adapted their lifestyles to the conditions they found and had learnt to manage the land to meet their needs. Their main tool in doing this was fire. They made frequent use of fire to keep the country more open and easy to traverse; to restore biodiversity, promote the growth of fresh green grass, which would attract animals; to signal and hunt; and for the more obvious purposes of warmth and cooking.

There is considerable evidence from fossil pollen and charcoal records to suggest that the purposeful use of fire extended from the earliest days of Aboriginal settlement. While fires had always occurred, it was only after the arrival of the Aboriginal people that they became more frequent and intense.

The main impact of the increased frequency of bushfires was to further restrict the extent of rainforests and to favour those plants best adapted to fire or to regeneration in its wake. Such adaptations include:

- *Epicormic buds*. Many eucalypts, especially those that burn frequently, have deep-set epicormic buds, which are protected by thick, insulating bark. With the crown of the tree destroyed by fire, hormones trigger these buds to produce new shoots. This new growth produces a halo, or fuzzy effect, around the branches of the trees.
- *Lignotubers*. Other plants survive underground as lignotubers, which sprout from the base of the tree after all the above-ground parts have been consumed by the flames.
- *Stimulus for reproduction*. While others are killed outright, the fire's heat triggers the opening of woody fruits and seeds. These are released onto the ash-fertilised ground from which competing plants and seed-eating animals have been temporarily removed.

Australia's fauna

The main geological and climatic events that shaped the flora of Australia also influenced, in comparable ways, its fauna. Although little of the fossil evidence of Gondwana's wildlife is available, the supercontinent's fauna is thought to have included species largely adapted to living in rainforests. Evidence suggests that there were monotremes (egg-laying mammals like the platypus), marsupials, birds, reptiles and amphibians.

As the Australian continent experienced climatic fluctuations and eventually an increase in aridity, the vegetation responded accordingly. Forests and woodlands became increasingly fragmented and the areas of grassland extended. These provided bountiful resources for diverse communities of herbivorous animals.

For more than a century it has been known that there were large land mammals and birds living in Australia. Known collectively as **megafauna**, these animals became extinct 16 000 to 50 000 years ago.

The events leading to the extinction of Australia's megafauna have long been a source of considerable debate. Some experts believe that climatic change was the main contributing factor; others held that it was the impact of the Aboriginal people, especially through their use of fire. Sustained over long periods, the regular burning of the land fundamentally altered its pattern of vegetation and, consequently, the whole food chain based on it. The impact of the Aboriginal people on the Australian environment is discussed in the Geofocus box 'People and the Australian environment: the Aboriginal experience'.

working geographically

1 **Interpreting text** Study the Geofocus box 'Evolution of Australia's flora and fauna' (pp. 124–6).
   - a What factors have played a part in the dramatic transformation of Australia's pattern of vegetation?
   - b Why did Aboriginal Australians make frequent and purposeful use of fire?
   - c What scientific evidence links the increased incidence of fire with the presence of the Aboriginal people?
   - d What adaptations have many Australian native plants developed in response to frequent burning?
   - e What name is given to the large land mammals and birds that only became extinct some 16 000 to 50 000 years ago? What factors may have been responsible for their extinction?

2 **Writing task** Write a report outlining the factors responsible for Australia's unique pattern of vegetation.

geofocus

People and the Australian environment: the Aboriginal experience

The notion that Indigenous Australians lived in harmony with nature for tens of thousands of years, without impacting significantly on the Australian environment, is an appealing one for Aboriginal people and white Australians alike. But is it accurate?

A growing number of prominent scientists now believe that the Aboriginal people, far from being merely passive caretakers of the Australian environment, had a far-reaching impact on it. Professor Tim Flannery, for example, argues that Aboriginal people hunted some of Australia's biggest animal species into extinction and, in the process, transformed the landscape. The theory is, however, somewhat contentious because it conflicts with Indigenous peoples' own concept of their past. But the evidence cannot be ignored.

Flannery, a professor at Sydney's Macquarie University, concludes that Australia's Indigenous peoples were responsible for the disappearance of most of the 60 or so species of giant marsupials that lived in Australia until 16 000 to 50 000 years ago.

These giant marsupials were the equivalent of the large herbivores found elsewhere in the world: the elephants, giraffes and rhinos. There were also huge reptile predators, including a giant 7 m long goanna-like creature and large, land-based crocodiles.

Having survived for millions of years, these giant marsupials and reptiles became extinct quite suddenly and, based on radiocarbon dating of fossil remains, relatively recently.

The disappearance of the megafauna has often been blamed on climatic change, but some scientists, including Flannery, now reject this as the principal cause. They argue that there were no climatic changes dramatic enough to account for the animals' extinction. The last Ice Age, for example, occurred some time later.

What did occur about this time was the arrival of people on the Australian continent. What then followed mirrored what always happens following the arrival of people on previously uninhabited land masses: the bigger wildlife was hunted to extinction.

The larger animals reproduce slowly. They also find it difficult to hide and, for the most part, are slow moving. Humans armed with spears proved a very dangerous predator.

Flannery contends that by killing off the large marsupials the Aborigines did enormous damage to the environment, possibly even altering rainfall patterns. The loss of so many herbivores meant there was a great deal more vegetation to provide fuel for fires. This, in turn, caused dramatic changes in Australian flora and, ultimately, soil composition and rainfall.

After initiating these changes, Aboriginal people settled into a way of life that established a new equilibrium with the environment they had created. This continued for tens of thousands of years until the arrival of Europeans in 1788.

According to Flannery, the Australian ecosystem has now sustained two tremendous assaults. The first was by Aboriginal people perhaps 16 000 to 50 000 years ago. This assault resulted in the extinction of most of the large predators and herbivores and the introduction of fire as a key environmental factor. The second assault was by European settlers. By forcing Aboriginal people off their land, the settlers removed the one stabilising influence on the Australian environment. They also introduced many exotic (or foreign) species and new technology. As a result, an additional 20–30 species have disappeared.

Adapted from 'Man and his environment: the Aboriginal experience', *Sydney Morning Herald*, January 2003

FIGURE 1.5.24

Aboriginal hunters with their prey.

working geographically

Interpreting text Read the Geofocus box 'People and the Australian environment: the Aboriginal experience'.

a What question does this text set out to answer?

b What do some scientists think was the impact of the Aboriginal people on the Australian environment? Why is this theory a contentious one?

c What impact did the Aboriginal people have on Australia's giant marsupials?

d Why were large animals vulnerable?

e How did the demise of the large marsupials affect the environment as a whole?

f Describe the relationship that the Aboriginal people established with the environment following the extinction of large marsupials.

g What was the second major assault on the Australian ecosystem?

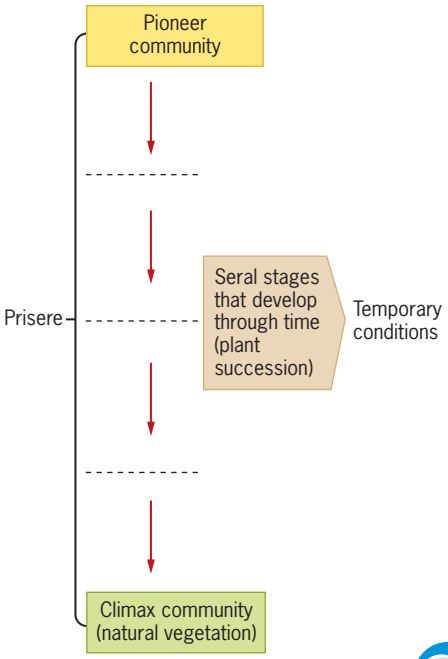


FIGURE 1.5.25

A prisere, showing seral progression.

did you know?

- More than 80% of Australia's plant and animal species only occur in (are endemic to) this country. This percentage of endemic species is higher than for any other country. Ninety per cent of our mammals, 70% of our birds, 85% of our flowering plants, 88% of our reptiles and 92% of our frogs are endemic.
- Estimates of the number of the world's species vary significantly. They range from 3 to 30 million. At most, 1.8 million species have been identified.
- While most birds, mammals and plants have been scientifically recorded, little is known about other orders, such as the insects, which make up an overwhelming majority of the species described to date. Similarly, not much is known about micro-organisms, which recent work reveals to be more diverse than scientists had previously thought.
- Australia's mallee moths are an example of our indirect dependence on biodiversity. There are 6000 species of mallee moths. They are the principal feeders on dead eucalypt leaves, which they break down for incorporation in the soil.

Development of local vegetation

When viewed on the global scale, vegetation patterns are largely a product of climate. On more local scales, however, other factors become important. These include:

- *Topographic situation*. Altitude has a considerable influence on local site conditions. This is because it directly affects temperature and other phenomena through its influence on lapse rates (the change in temperature with altitude in the atmosphere) and cold air drainage (the downslope movement of air). Actual position on a slope also has a direct bearing on rates of soil accumulation, which vary along the slope. Rates of infiltration of water and movement of water through the soil vary with slope angle and position. Aspect affects temperature and rates of evapotranspiration.
- *Geology*. This provides the parent material from which soils are formed. Soils, in turn, provide the rooting environment for plants.
- *Animals*. These influence local vegetation patterns through the extent of their herbivorous behaviour and the dispersal of seeds and pollen.
- *Fire*. This is mainly the result of human interventions (deliberate or accidental).

What is apparent is that vegetation is an integral part of the biophysical environment in which all factors are interconnected. Vegetation is dynamic; always changing in large or small ways as it responds immediately or over time to a wide range of environmental influences, both natural and human-induced.

For example, a wetland ecosystem that has been drained leads to the disappearance of those species of the community that are adapted to living in waterlogged habitats. These are replaced by species that are more characteristic of drier conditions. Such drained land may be used for agriculture, but should it be abandoned, it is quickly invaded by other species and turns into grassland, scrub or, given sufficient time, woodland.

Plant succession

Succession is a natural change in the structure and species composition of a plant community. In general, succession leads to the formation of the most complex community of organisms possible in an area, given the controlling factors of the biophysical environment.

A **sere** (plural seres) is the name given to each stage in a sequence of events in which the vegetation of an area develops over a period of time. A **prisere** is the complete chain of successive seres. (See figure 1.5.25.) The first plants to colonise an area are called the pioneer species. Each succeeding community alters the local microclimate and surface conditions. This makes possible the appearance of a community that is more demanding in terms of soil moisture and nutrient levels. As time advances, the plant community becomes taller, more diverse and more permanent. Eventually a stable community is attained. The plant community that is the end product of succession (that is, one that is in equilibrium with its environment) is known as the **climax community**. It may take hundreds or even thousands of years for climax vegetation to become established. Providing that it is not destroyed or severely damaged by humans or natural disasters, this community is stable and self-perpetuating; that is, able to sustain itself into the future.

No part of earth's surface supports a climax community indefinitely. In most areas there is a mosaic of communities at various stages of succession. There are two types of succession: primary and secondary.

Primary succession

Primary succession is the sequential development of more complex plant communities that may start on bare, uncolonised ground that has never had any vegetation growing on it before. Bare areas are rare, but they do occur where there are newly constructed deposits of mineral sediment, such as on sand dunes, lava flows from volcanoes, landslips and glacial debris left by melting ice. Most bare areas today are left exposed because the existing vegetation has been destroyed by fire or covered with volcanic ash. Often this devastation is caused by natural disasters.

Secondary succession

Secondary succession occurs when a community is removed or destroyed by human activities (such as forest clearance) or natural events (such as fire and cyclones). When the climax community becomes modified or displaced, the resultant plant community is known as a **disclimax** or plagioclimax. In many settled areas the natural process of plant regeneration is disrupted by activities such as farming, grazing and burning.

Yangtze river dolphin driven to extinction

By IAN SAMPLE

The Yangtze river dolphin, until recently one of the most endangered species on the planet, has been declared officially extinct following an intensive survey of its natural habitat.

The freshwater marine mammal, which could grow to eight feet long and weigh up to a quarter of a tonne, is the first large vertebrate forced to extinction by human activity in 50 years, and only the fourth time an entire evolutionary line of mammals has vanished from the face of the Earth since the year 1500.

Conservationists described the extinction as a 'shocking tragedy' yesterday, caused not by active persecution but accidentally and carelessly through a combination of factors including unsustainable fishing and mass shipping.

In the 1950s, the Yangtze river and neighbouring watercourses had a population of thousands of freshwater dolphins, also known as Baiji, but their numbers have declined dramatically since China industrialised and transformed the Yangtze into a crowded artery of mass shipping, fishing and power generation. A survey in 1999 estimated the population of river dolphins was close to just 13 animals…

Sam Turvey, a conservation biologist at London Zoo, worked with Chinese government scientists to survey the entire 1669 km stretch of the Yangtze river downstream of the giant Three Gorges Dam to Shanghai, a region which has been the natural habitat for river dolphins…

Around half of all river dolphins were killed as a result of indiscriminate and often illegal fishing practices. Though banned for the past 30 years, some ships still drag long lines of unbaited hooks. 'They just drift through the water snagging everything. They slash and entangle and suffocate the dolphins,' said Dr Turvey. Low employment in the 1980s and 1990s saw a rise in unskilled fishing.

Dr Turvey said conservation organisations had been quick to call for action to protect the river dolphin, but many were too cautious to take meaningful action.

'The loss of such a unique and charismatic species is a shocking tragedy. The Yangtze river dolphin was a remarkable mammal that separated from all other species over 20 million years ago. This extinction represents the disappearance of a complete branch of the evolutionary tree of life,' Dr Turvey added.

The Guardian, 8 August 2007

did you know?

Every 30 seconds, somewhere on earth, a species becomes extinct.

understanding the text

1. **Identify** the important factors that determine vegetation at a local scale.
2. **Outline** the process of plant succession and identify its stages.
3. **Differentiate** between primary and secondary succession.
4. **Explain** what is meant by a disclimax.

geofocus

Tropical rainforests

A tropical rainforest represents a 'biological library' that, in some instances, dates back 100 million years. The tragedy is that rainforests are being destroyed by fire and the chainsaw before we have had a chance to unlock their treasures.

Rainforests are the most complex ecosystem on earth, unmatched for their biomass and diversity of species. A greater variety of life is packed into one square kilometre of rainforest than in any other square kilometre on earth. They are the home of more than half of all known species, and destruction of even small areas of forest can often result in species loss or extinction.

Rainforests once formed a continuous band of green around the equatorial and tropical regions of the plant. This band was broken only by the sea and pockets of land where the climate was unsuitable for rainforests to grow. Now these forests form a broken mosaic. The ever-dwindling areas of virgin forest are interspersed with areas that have been disturbed; some only slightly, others irrevocably. It has been estimated that half the world's tropical rainforest has been lost; down from 16% of the earth's surface to just 7%. This makes what is left even more valuable.

Rainforest ecosystems are found where conditions for plant growth are optimal: intense heat and light energy and abundant, well-distributed precipitation. The largest areas of rainforest are found in Central and South America (which have nearly three-fifths of the world's total), South-east Asia and Central and West Africa.

A tropical rainforest is a multilayered, tree-dominated community with a closed canopy where light penetration is substantially reduced through each stratum and most of the growing tissue is in the above-ground biomass. The tallest trees may be as high as 60 m and their trunks 5 m in diameter. Trees of this size, which tower over their neighbours, are known as emergents. Below them the forest canopy becomes more continuous, the crowns of the adult trees interlocking and casting shade over everything below. Clinging to trunks, branches and even each other are an amazing profusion of plants, including lichens and mosses, ferns and orchids. All these plants are adapted to very specific levels of illumination. Draped across the canopy are the woody stems and foliage of climbing plants and lianas, which help interlock the structure of the rainforest.

Rainforest ecosystems are very difficult to re-establish or regenerate. Once the cycle of nutrient replacement is disrupted by clearing, the nutrient level of the soil declines rapidly. If the forest's canopy of leaves is removed, the harsh tropical sun penetrates into the lower stories or levels of the forest. This alters the forest's microclimate and kills off the shade-loving vegetation. In such conditions it is unlikely that the forest will ever regenerate.

The annual loss of tropical forests now approaches 17 million ha and the rate of loss continues to accelerate. During the 1980s the annual rate increased to 0.9% from the 0.6% experienced during the late 1970s. Asia's rate of deforestation (1.2%) was the highest, followed by Latin America (0.9%) and Africa (0.8%). During the period 1990–2005, the average annual deforestation was highest in Africa (0.6%), followed by Latin America and Asia (both 0.4%).

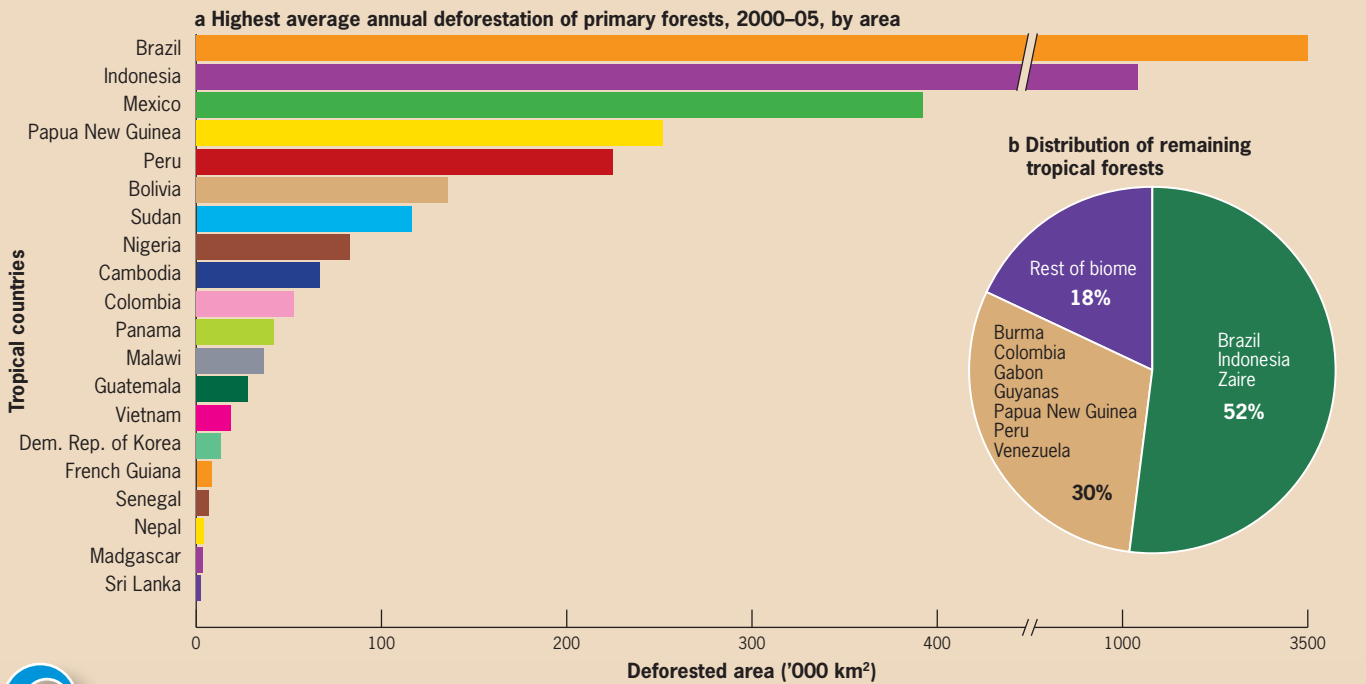


FIGURE 1.5.26

Rates of tropical forest deforestation and distribution of remaining tropical moist forests.

The destruction of these forests results in the loss of untold numbers of potential new resources: tropical plants are used to produce medicines and industrial products. The forests are also home to some 100 million people who stand to have their traditional way of life destroyed.

The main causes of tropical forest deforestation are the conversion of forest to agricultural land and logging. As the world's population grows, more land must be devoted to production of food. Large areas of the Amazon, for example, have been burnt to create grasslands for cattle ranching. The impact of logging depends on the type of logging carried out. If forests are logged selectively and then left to regenerate, the use of these forests can go on indefinitely. Unfortunately, most logging is done by clearfelling, a method that involves the total clearing of the land.

In the debates on the conservation versus the exploitation of rainforest, the importance of forests to science has not always been fully appreciated. Even today we lack a detailed understanding of rainforest ecosystems, especially the immensity of their biotic diversity. We still don't know how they interact, why they have persisted over millions of years and how they are driven by change.

A multitude of intimate relationships exists between the myriad specialist organisms that inhabit a rainforest. We have little or no knowledge of the ecological niches of these organisms. Studies of the ecological relationships between species have only just begun. The sad reality is that we are rapidly losing the chance of furthering our knowledge.

Effects of forest destruction

There are five main effects of deforestation:

- The areas cleared of tropical forest generally make poor farming land. The soils are naturally low in nutrients and once exposed to heavy rainfall they are leached and easily eroded.
- Water quality within catchments declines as the turbidity (the amount of suspended silt) of water increases.
- Increased runoff and river channel siltation results in an increase in the frequency and severity of flooding.
- The people who live in the forest are displaced as their traditional habitat is destroyed.
- It is feared that the large-scale destruction of the earth's tropical forests will alter the earth's climate.

Vast amounts of carbon are stored as wood fibre and leaf matter. Deforestation often results in the release of this stored carbon into the atmosphere. The burning of forests is thought to account for as much as one-quarter of all the carbon dioxide released into the atmosphere each year. The onset of the greenhouse effect could be lowered dramatically if the rate of deforestation was reduced. Scientists have estimated that deforestation accounts for more than 10% of global warming.

Human impact on tropical rainforests

The rapid increase in the size of the human population and the resulting intensification of landuse has led to the accelerated loss of the earth's forest ecosystems. The lowland tropical rainforests have been among the worst affected. (See figure 1.5.28.)

For thousands of years, people have impacted on these forests in minor ways. Small patches of the forest were cleared by groups who practised a 'slash and burn' style of agriculture. This involves clearing and utilising a plot of land and subsequently abandoning it when the soil loses its fertility. This involved only small areas, which soon regenerated when the cultivators moved on. Small human populations, poor hand tools, and the vigorous growth of vegetation combined to ensure that the rainforest regenerated effectively.

Once a clearing is abandoned it soon becomes covered by weeds, grasses and shrubs. As seeds are dispersed from the adjacent forest, trees begin to colonise the area.

Given time, the trees will dominate and will shade out the earlier opportunistic species and develop the characteristic microclimate under the 'new' or 'restored'

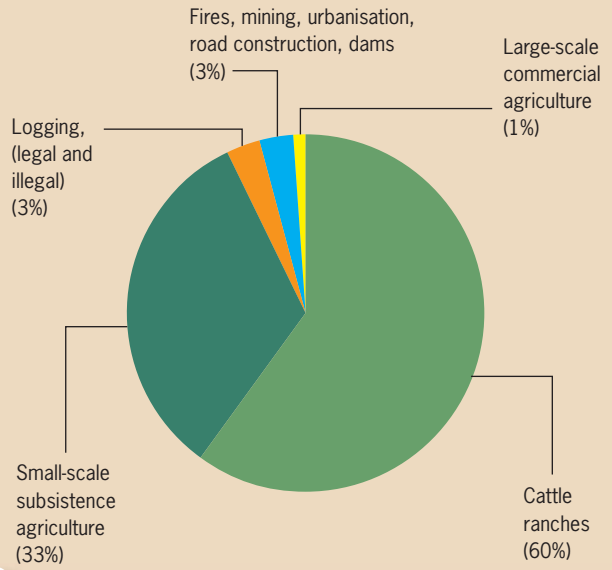


FIGURE 1.5.27

Causes of deforestation in the Amazon, 2000–2005.

FIGURE 1.5.28

Rainforest destruction.

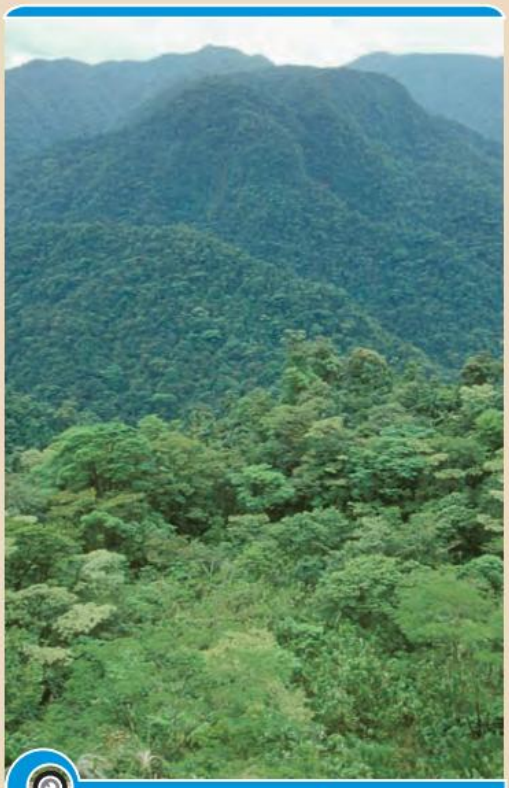
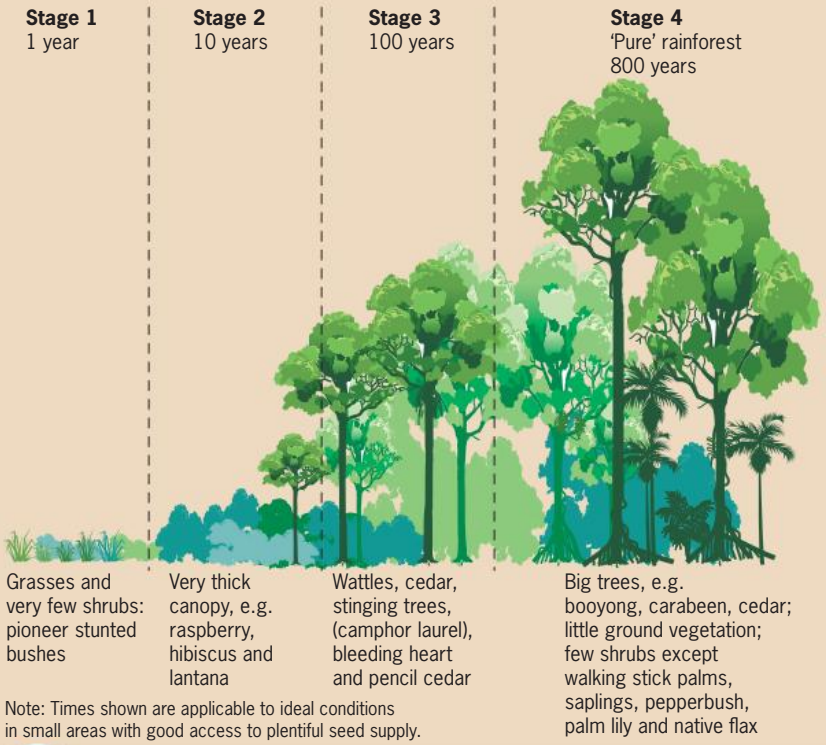


FIGURE 1.5.29

An intact tropical rainforest canopy.



Note: Times shown are applicable to ideal conditions in small areas with good access to plentiful seed supply.

FIGURE 1.5.30

Stages in the natural regeneration of a tropical rainforest.

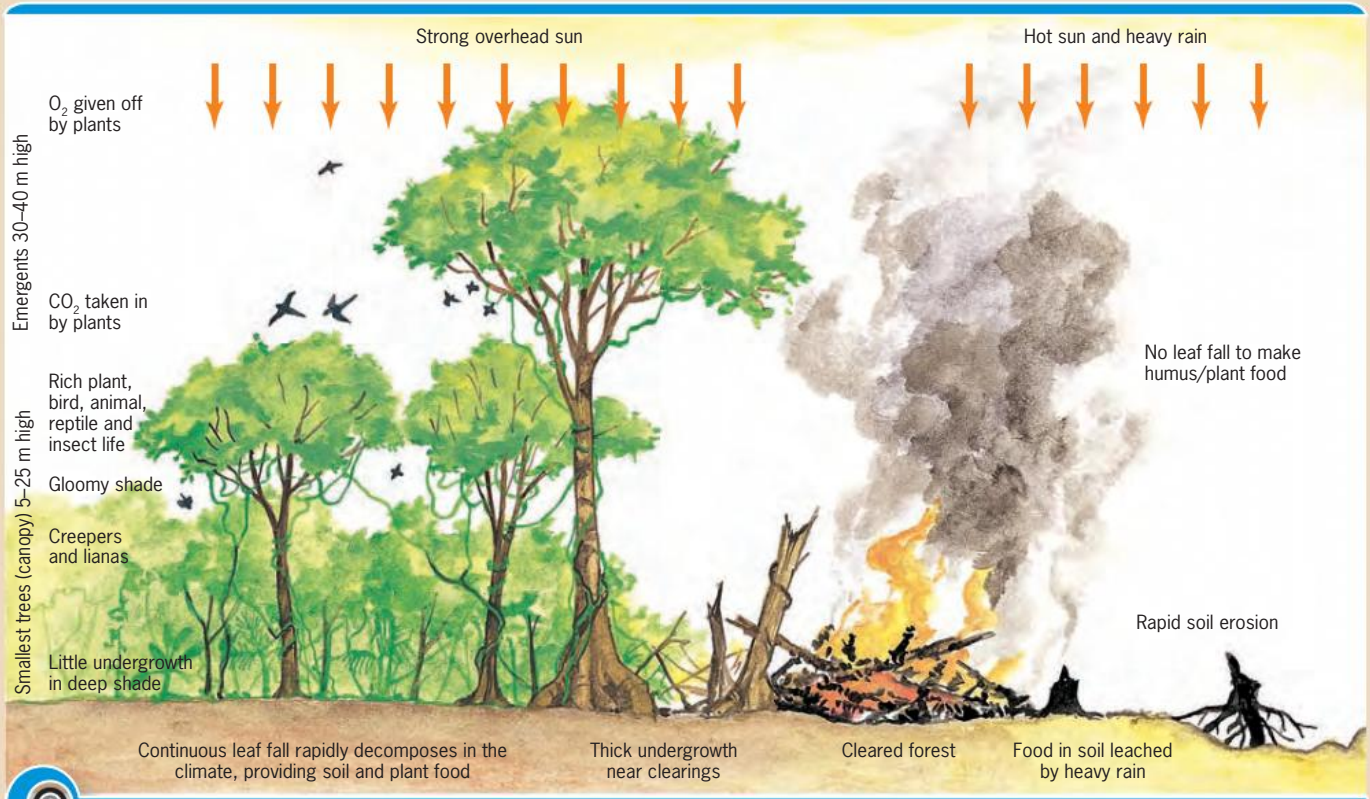


FIGURE 1.5.31

The impact of burning on a rainforest.

canopy. These stages in natural regeneration are illustrated in figure 1.5.30.

The time required for the natural regeneration of a tropical rainforest is widely debated. Conservative estimates suggest that it takes at least 800 years on flat, relatively fertile ground for a rainforest to develop to the mature stage. If human impacts alter the factors that govern seral progression, this time scale can increase dramatically. In many instances, human interventions are so extensive that they disrupt the progression completely and a disclimax community results.

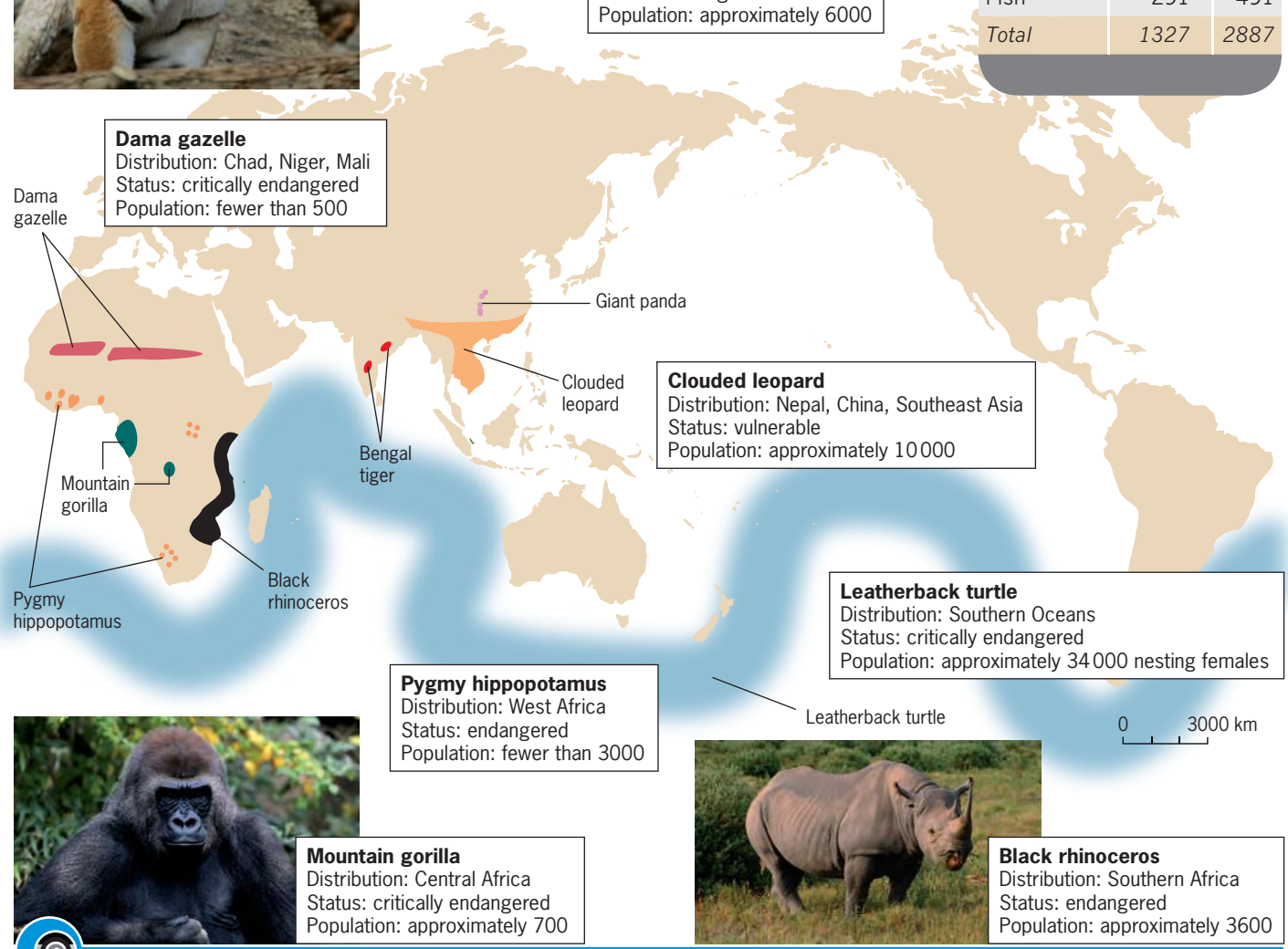
In the Amazon Basin, for example, the large-scale burning of the forest to create grazing land for cattle has had a disastrous impact on the ability of the forest to regenerate. The naturally poor soils quickly become infertile. Exposed soils on sloping land are rapidly leached of their nutrients and removed by the increased runoff. Such soils are incapable of supporting profitable agriculture or the regeneration of the original forest ecosystem. The impact of such human disturbance is shown in figure 1.5.31.

Bengal tiger
Distribution: Southeast Asia
Status: endangered
Population: 3000–4000

Giant panda
Distribution: Central China
Status: endangered
Population: approximately 6000

TABLE 1.5.3
Endangered species

Class	1996–98	2006
Mammals	484	510
Birds	403	532
Reptiles	100	174
Amphibians	49	1180
Fish	291	491
Total	*1327*	*2887*



Mountain gorilla
Distribution: Central Africa
Status: critically endangered
Population: approximately 700

Black rhinoceros
Distribution: Southern Africa
Status: endangered
Population: approximately 3600

FIGURE 1.5.32

An estimated 7725 animal species are threatened with extinction. Many of these species live in Africa and Asia and many are at threat because of hunting and/or habitat loss. A few examples of threatened species are shown here.

geofocus

Natural temperate grasslands: the Monaro

Natural temperate grasslands are considered by scientists to be as rich in species diversity as the earth's tropical rainforests. (See figure 1.5.33.) But much of the biological action that occurs in this ecosystem takes place on a smaller scale. Most grassland plants are of relatively small size and have low stature (near to ground level). This makes the community much less obvious to the untrained eye. Grasslands have also been taken for granted and undervalued because of their unimpressive appearance. Right across the earth's temperate zone, vast areas have been displaced by crops, pastures, urban settlements and infrastructure. Although now considered one of the most threatened ecosystems on earth, temperate grasslands have, until recently, attracted little attention from conservationists. Instead, most conservationists have directed their efforts into raising public awareness of other threatened ecosystems, most notably forests.

Natural temperate grasslands have been cleared or modified on every continent of the world. However, a survey initiated by the World Wide Fund for Nature in the early 1990s found substantial areas of grassland on the Monaro tablelands of south-east New South Wales. A grassland is a natural vegetation community in which grasses provide the dominant vegetation cover. The naturally dominant native grass species in the Monaro region are the kangaroo grass and poa tussock, but there are many more minor grass species. In terms of richness of plant species, the non-grass herbaceous plants, commonly referred to as forbs, are far more numerous than the grasses. Forbs include a wide variety of daisies, peas, orchids, lilies and many other small herbs. Surveys have revealed well over 600 species of native herb plants in the temperate grasslands of south-east Australia. The grasslands are also home to countless animals, such as birds, reptiles, amphibians, insects and small mammals.

Human impact on temperate grasslands

Aboriginal people made good use of the Monaro grasslands. It was a rich source of food for them. They wandered freely across the region, taking advantage of animals as well as plants. The yam daisy or murnong was used for its large tap root and formed an important part of their diet. Records show that in a single day an Aboriginal woman might collect 2000 plants or 8 kg of roots, which were then either eaten raw or cooked in a variety of ways.

Australia's indigenous peoples had an intimate understanding of the grassland **ecology**. They were aware that a build-up of a heavy grass layer, where the tussocks crowded each other, could reduce the variety of plants and animals they harvested. They responded by developing a sophisticated system of 'firestick farming' using low-intensity fires to patch burn and remove dead, rank (old) grass. This maintained the inter-tussock spaces and restored the abundance and diversity of plants, such as the yam daisy. The grasslands became a mosaic of old and new growth. This provided an ideal habitat for the smaller animals, which flourished in response. Fires also produced fresh grass growth, which attracted kangaroos for hunting.

Australia's rolling, temperate grasslands impressed European settlers because they provided good pasture and arable land that didn't need clearing. They quickly displaced the Aboriginal inhabitants and introduced sheep and cattle, eventually in excessive numbers. These heavy, hard-hooved animals not only compacted the soil but also trampled the plants and, unlike the native herbivores, cropped their leaves far too close to the ground. The impact on the native grassland was devastating and was further compounded by the introduction of rabbits and weeds. Later, in an effort to

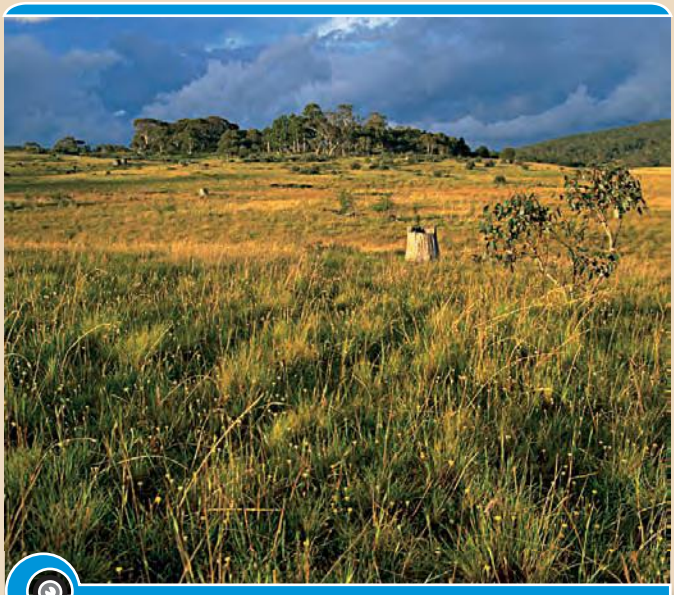


FIGURE 1.5.33

Native grassland on the southern Australian Capital Territory/ New South Wales border.

FIGURE 1.5.34

The threatened Monaro golden daisy on a roadside near Adaminaby, New South Wales.

improve productivity, farmers replaced the native grasses with introduced pastures and applied fertilisers. The long-lived, deep-rooted native grasses and forbs were replaced by exotic plants, which were much less well suited to the Australian environment. These introduced pastures have been unable to withstand the frequent droughts that are so common in Australia. This has left the ground vulnerable to soil erosion and land degradation.

The temperate grasslands of Australia are almost gone. The original area was probably about 2 million ha. There are now less than 10 000 ha. This means that 99.5% of the original grassland vegetation has been removed or substantially altered. Of even greater concern, especially in terms of ecological sustainability, is that there are only a few areas greater than 500 ha where this ecological community survives intact. Not only has there been a dramatic decline in area but also in the condition of the remaining grasslands. Most of what has survived is now mainly found in tiny remnants in cemeteries, along the sides of rail lines and roads and on travelling stock reserves. They have survived more by accident than by any deliberate management strategy and these are simply the areas that have been spared from cultivation or continuous grazing.

Adapted with permission from Life and Death in the Grass, *Native Vegetation Management, Australian Native Conservation Agency*

Recognising the value of native grasslands

Biodiversity

Temperate grasslands are one of Australia's rarest, most biologically diverse ecosystems and their disappearance would be a major loss to the continent's biodiversity. Approximately 11 species of plants and animals found on the Monaro are considered endangered or vulnerable and at least three animal species that once lived there are thought to now be extinct. The millions of yam daisies that an early settler noted covering the region have largely disappeared. This has severed an important link to the past, as this plant was so significant to the diet of Aboriginal Australians.

The ecology of these grasslands is poorly known and there may be species that have not yet been formally listed or even described by science, but are worthy of protection. Rare species include the striped legless lizard (*Delmar impar*) and the vulnerable Monaro golden daisy (*Rutidosis leiolepis*). (See figures 1.5.34 and 1.5.35.)

In general, much of the world's food comes from grasslands or grassland plants. With so many species of plants in Australian grasslands, if we are to find new food or genetic resources, then this would be a good place to begin the search. Of special importance is the soya bean, a legume known as *Glycine max*. There are eight known species of *Glycine* in the world, seven of which are only found in the grassland ecosystems of Australia. Two of these are endangered and at least two are found in the grasslands of the Monaro. Australian grasslands offer a potential source of the genetic material needed to develop a genetically improved soya bean.

Function

Native grasslands play an important role in maintaining the earth's life-support systems. For example, they help ensure that water quality, soil fertility and stability are maintained and act as a natural pest control. The presence of unimproved native grassland areas helps maintain the ecological health of the Monaro.

Utility value

At certain times of the year and over long periods, especially in prolonged drought, the native grasses provide an important resource for agricultural production. Most of the grasses are deep-rooted perennials capable of surviving such conditions. The value of many species, such as the forbs and native legumes, is not known and has been largely overlooked. Many native legumes flourish in grasslands and may provide a useful source of soil nitrogen for other plants.

Sourced from Monaro Remnant Native Grasslands Project, World Wide Fund for Nature and Upper Murrumbidgee Catchment Co-ordinating Committee, Grassland Management Field Day Information Sheet

Management considerations

Some form of defoliation (leaf removal) is a natural process and essential in maintaining the ecological health of most grasslands. Without the regular removal of some herbage, excess grass will accumulate and die. This can inhibit the growth of many plant species in the sward (the surface layer of ground containing the mat of grass and grass roots). Kangaroo grass is a common dominant native perennial (a plant that lives more that two or three seasons and normally flowers annually). It is known to become less vigorous and even die out when heavy growth has accumulated over a number of years without defoliation. Also, the majority of the forbs grow in the inter-tussock spaces. When the grasses close over these spaces, it shades out these smaller species and they can be lost.

Before the introduction of domestic livestock and rabbits, the inter-tussock spaces were kept open by native animals, including kangaroos, smaller mammals and insects, such as grasshoppers. Fire was also important; both naturally occurring from lightning strikes and those lit by Aboriginal people. Since European settlement, the grazing of domestic livestock has been, and is likely to continue to be, the main method of defoliation in many native grasslands.

FIGURE 1.5.35

Monaro golden daisy in grazed native pasture on the Monaro.

FIGURE 1.5.36

Typical Monaro landscape near Nimmitabel, New South Wales.

FIGURE 1.5.37

Kangaroo grass and flowering forbs in a travelling stock reserve.

In summary, the principles underlying defoliation management strategies are as follows:

- Herbage mass must be managed by grazing, mowing or burning.
- The timing, frequency, degree and selectivity of defoliation must be managed to suit the grassland.
- The grassland needs to be allowed to accumulate substantial growth between defoliation events.
- All the native species need to be allowed to flower, set seed and establish new plants.
- Grazing of grassland should be avoided or there should be only very light grazing from the onset of flowering until seed set.
- Stock should be removed from grassland when feed quantity or quality becomes inadequate for livestock maintenance.
- Mowing or burning should be avoided from the onset of flowering until seed set.
- Avoid producing windrows or clumps of grass clippings when mowing or slashing.
- Grassland should only be burnt when soil moisture, herbage mass, weather and fire regulations allow.
- Burning should only be carried out in patches, burning a different patch each time.
- Fences should be maintained in sound, stock-proof condition.

The Monaro Grassland Conservation Management Network

The Monaro stands out as a region where a significant area of biodiverse native grassland remains. This is becoming recognised both locally and beyond, and people are beginning to look to Monaro for guidance in regard to management and even as an ecotourism destination.

The Monaro Grassland Advisory Committee has established a Conservation Management Network (CMN) of native grasslands across the region. The CMN provides links between the managers of native grasslands to promote and assist in their retention and good management. It operates in conjunction with a group of CMNs, in a variety of ecosystems across New South Wales and Victoria.

A CMN is a network of areas containing remnants of an ecosystem of interest, across all land tenures, and their land managers. The network can provide avenues for managers to learn from each other's experience, visit other areas of the same ecosystem and access technical and funding assistance.

The Monaro Grassland Conservation Management Network was formed in 2002 to assist farmers and other local land managers to share their knowledge and obtain expert advice on grassland management. The network was established by the World Wide Fund for Nature—Australia, with the support of the Monaro Grassland Advisory Committee and financial assistance from the NSW Environmental Trust. Since 2003 it has been supported by the Southern Rivers Catchment Management Authority. The network is a locally managed group that provides opportunities for members to support each other's work as well as raise public awareness of the diversity of plants and animals that occur in the native temperate grasslands.

The establishment of the CMN is also a recognition that the pastoral and cultural heritage of the Monaro region was founded on the grasslands. It is an acknowledgement that careful management of the landscape will ensure the heritage of the grasslands is maintained. The Monaro is becoming known for its native grasslands and people are looking to the region for examples of informed conservation, ecotourism and even artistic inspiration.

Managing Native Grassland: A Guide to Management for Conservation, Production and Landscape Protection, WWF Australia

working geographically

1 **Research task** Study figure 1.5.32 (p. 133). Access the websites of the International Union for Conservation of Nature and Natural Resources and the World Wildlife Fund. Investigate the range of endangered species identified by the bodies. Outline at least one strategy being used to protect an endangered species. Evaluate the success of such programs.

2 **Research task** Study the newspaper article 'Yangtze river dolphin driven to extinction' (p. 129). Using the media, find an example similar to that featured. Write a 100-word synopsis of the article.

3 **Interpreting text** Study the Geofocus box 'Tropical rainforests' (pp. 130–3).
- a Why are rainforests considered to be among the world's most complex ecosystems?
- b Evaluate the extent of our understanding of rainforest ecosystems.
- c Briefly describe the main characteristics of a tropical rainforest.
- d What are the main effects of forest destruction?
- e What are the stages in regeneration of a rainforest?
- f Why is a rainforest able to regenerate from the disturbances caused by the traditional 'slash and burn' style of agriculture?
- g Why is it unlikely that with the current rate of disturbance, rainforests will regenerate to the former levels of complexity?

4 **Interpreting diagrams** Study figure 1.5.26 (p. 130).
- a In which countries does the annual rate of rainforest clearance exceed 100 000 km^2?
- b Where are the largest remaining areas of tropical forests? What are the rates of deforestation in these countries?

5 **Research task** Undertake research into the rate and extent of forest destruction in one of the countries listed in figure 1.5.27a (p. 130).

6 **Interpreting diagrams** Study figure 1.5.31 (p. 132) and explain the impact of rainforest clearing on soil quality.

7 **Interpretating text** Study the Geofocus box 'Temperate grasslands: the Monaro' (pp. 134–6).
- a Explain why the disappearance of the temperate grasslands has largely been ignored.
- b Describe the nature of these grasslands.
- c Justify the importance of the Monaro region's grasslands.
- d Compare the traditional management of the temperate grasslands to that of Europeans.
- e Outline why temperate grasslands hold so much value.
- f Relate the suggested management of these grasslands to the functioning of the ecosystem.
- g Outline the significance of the status of the Monaro Grassland's Conservation Management Network as a community organisation.

geojobs

Bushland regenerator

Bushland regenerators work to restore disturbed native bushland as closely as possible to its natural state. They:
- remove weeds
- poison and remove unwanted tree species
- collect and propagate seed from native species
- replant native trees, shrubs and grasses
- manage natural ecosystems
- eradicate feral animals (domestic animals that have gone wild)
- map vegetation.

TAFE offers a Certificate in Bush Regeneration.

unit 1.6

> In every outthrust headland, in every curving beach, in every grain of sand there is the story of the earth.
> **Rachel Carson, US marine biologist**

> The sea, once it casts its spell, holds one in its net of wonder forever.
> **Jacques Cousteau, French conservationist, scientist and filmmaker**

> Follow the river and you will find the sea.
> **French proverb**

Coastal Environments and the Management of Coastal Sediments

Coasts are one of the most dynamic and fragile environments on earth. This means that they are constantly changing: reshaped by the relentless forces of the biophysical environment. Waves, tides, currents and the wind are all active agents of change along any coastline.

The exact boundary between land and sea is not always easy to determine. This is because the line where the land and sea meet is constantly changing, with the rise and fall of tides and the passing of storms. Most of the interaction between land and sea takes place in the **foreshore** area: the land lying between the high-water mark and the low-water mark. It is the part of the coastline that is covered and uncovered by the ebb and flow of the tides. The coast is defined as all areas within or neighbouring the foreshore. The coast acts as a vital buffer zone between the land and the sea.

Going under: global warming's impact on coastal communities

In 2005, the government of Tuvalu requested the assistance of the Australian Government. This tiny country, with a population of approximately 12 000, was not asking for increased aid or peacekeeping assistance. Instead, it was asking that Australia consider allowing the entire population to move to Australia. Why would such a request be made? It is simply because Tuvalu and other Pacific island countries, including Kiribati (population 105 000), are being inundated by the rising ocean around them.

Scientists are not exactly sure by how much sea levels will rise over the coming century. Estimates range from around a 30 cm rise (created by a 2°C increase in sea temperature) to as much as 1 m with a 4°C increase in temperature.

In 2002, the residents of Shishmaref, a tiny Inuit village in Alaska, became the first people to be displaced by factors directly linked to climate change. The retreat of the ice sheets exposed the village to attack by violent sea storms. So devastating were these storms that the village people voted to leave their ancestral home and relocate to another village 20 km away. At least the people of Shishmaref had somewhere to relocate to; the people of the island countries of the Pacific have nowhere else to go.

The Inuit village of Shishmaref, Alaska, had to be relocated inland after the ice that protected the village from massive storm waves melted due to climate change.

exam-style questions

extended responses

- Explain the biophysical processes that shape the coastal environment.
- With reference to a coastal environment you have studied, describe the interactions between the four components of the biophysical environment.
- Explain how an understanding of biophysical processes contributes to the sustainable management of the coastal environment.
- Write an extended response on the management of coastal sediments. In your answer:
  - Identify and explain the key biophysical processes related to the origin, transportation and deposition of coastal sediments.
  - Outline how the activities of people can disrupt coastal sediment budgets.
  - Evaluate the strategies used to manage coastal sediments.
- 'New technologies and management strategies ensure that the demands of humans can be met while protecting the coastal environment.' Outline the range of management strategies used to manage the coastal environment and evaluate their effectiveness.

glossary

- **coastal dunes** the deposits of wind-blown sand that accumulate behind a beach.
- **coastal environment** an area extending as far inland as the salt water, sea spray and wind-blown sands reach, and into the ocean as far as waves and currents are able to move material on the sea bed.
- **coastal resources** the natural and cultural resources of the coastal environment.
- **coastal sediment budget** the amount of sediment available for beach construction. It is determined by deducting sediment outputs from sediment inputs.
- **coastline** the boundary between the land and the sea. The coastline's landward limit is normally determined by the reach of storm waves.
- **constructive waves** flat waves with low levels of energy that bring sediment from offshore stores onto the coastline.
- **currents** the flow or movement of a large body of water in an ocean, caused mainly by prevailing winds, the earth's rotation and the distribution of land masses.
- **destructive waves** steep waves with high levels of energy that cause coastal landforms to be eroded.
- **emergence** the upward movement of land masses created by the melting of ice caps during the last Ice Age. As the ice melted, the downward weight was reduced, causing the land to rise.
- **foredune** the coastal dune or line of dunes nearest the sea that usually are eroded by storm waves and later rebuilt by further wind deposits of sand.
- **foreshore** the land lying between the high-water mark and the low-water mark; the area covered and uncovered by the ebb and flow of the tide.
- **groyne** a rock or concrete wall built at right angles to the beach to obstruct the drift of sediment or to minimise beach erosion.
- **longshore drift** the movement of sediment by currents running parallel to a beach.
- **sea wall** rock and concrete structure commonly built at the foot of the foredune. They are designed to protect property from coastal erosion.
- **sediment** sand and small rock particles or silt created by the erosion of rock structures along coasts or in inland areas.
- **submergence** the creation of landforms by rising sea levels associated with the warming that occurred following the last Ice Age.
- **swash** the upward surge of water that moves up a beach slope when breakers crash onto the shore.
- **swell** ocean waves that spread out from their area of origin. Their wavelength increases and their height decreases as they travel. The swell affecting Australia's southern and eastern coastlines originates in the Indian Ocean.
- **tides** the rise and fall of the sea twice a day. Associated, primarily, with the gravitational pull of the moon as it orbits the earth.
- **waves** caused by the frictional drag of wind blowing over a body of water. The formation of waves involves the transfer of energy from the wind to the surface of the body of water.

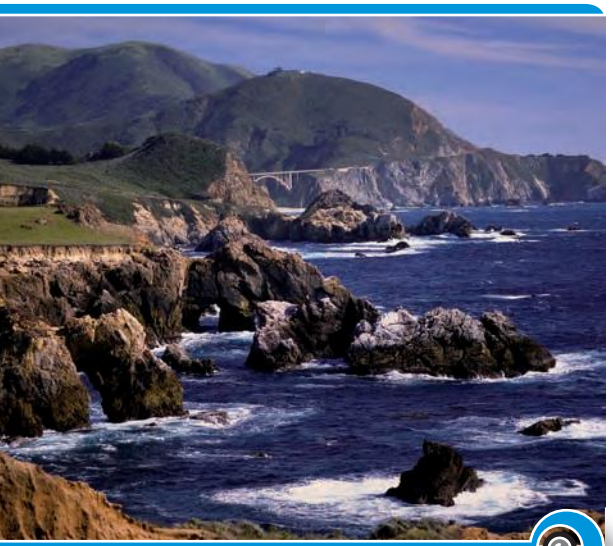


FIGURE 1.6.1

A coastal landscape dominated by erosional features.

The coastal environment

The **coastal environment** extends as far inland as salt water, sea spray and wind-blown sands reach, and into the ocean as far as the **waves** and **currents** are able to move material on the sea bed. Therefore, the coastal environment takes in the coastal waters and all areas to the landward side of the coastal waters in which there are physical features, ecological or natural processes or human activities that affect, or potentially affect, the coast or **coastal resources**.

Parts of the coastal environment clearly have strong interactions between the land and sea, including beaches, dune systems, coastal marshes, mangroves and fringing coral reefs. Other parts may be more distant from the coast (either inland or out to sea) but they nevertheless play an important role in shaping it. One of the most important of these is the river systems that bring fresh water and **sediments** to the coast.

The coastal environment has been, and will continue to be, placed under multiple, intense and often competing pressures. It is this fact that directs special attention to the planning and management of the coastal environment. The challenge is to find *sustainable* ways of dealing with the demands placed on coastal resources.

geofocus

Human impacts on the coastal environment: change over time

Humans have deliberately modified the coastal environment and exploited its resources for thousands of years. Ancient civilisations throughout the world built ports and sea walls and diverted the course of rivers. They managed their fisheries and they farmed the rich coastal soils. Mangroves were cleared and land reclaimed.

Most of these interventions were works of civil engineering. That is, structures were built to modify the flow of water and/or sediment. Because most of these structures were built by hand, the scale and intensity of their impacts on the coastal environment were limited. Over the centuries, the ability of people to influence coastal processes increased as construction techniques improved. The historic Italian city of Venice (see figure 1.6.2) represents one of the most famous examples of people's capacity to modify the coastal environment.

The technological limitations to large-scale modification and exploitation of the coastal environment were dramatically reduced as a result of the Industrial Revolution, which started in Europe in the mid-nineteenth century. Major modifications of the coastal environment were now possible. Large rivers could be dammed or diverted and vast areas of coastal wetlands could be converted to urban or agricultural land.

FIGURE 1.6.2

The ability of humans to modify the coastal environment is evident in the construction of Venice, which began in the sixth century.

FIGURE 1.6.3

Coasts are highly dynamic ecosystems.

Population growth is the cause of many, if not all, coastal problems. The scale of this growth has been staggering. Worldwide, the number of people now living within 60 km of the coast has reached 4.2 billion. If the present trend continues there will be 6 billion people living in coastal areas by 2030.

Population growth in coastal areas has two main causes. First, it reflects the general trend in population growth in developing countries (see Unit 2.1), which is linked to rural–urban migration. Second, it indicates the movement of people from inland areas to the coast, which often offers people more economic, social and recreational

understanding the text

1 **Explain** why coasts are described as one of the most 'dynamic' environments on earth.
2 **Explain** why it is difficult to determine the exact boundary between the land and sea.
3 **List** the biophysical forces that shape coastal areas.
4 **Define** the following terms: foreshore, coast and coastal environment.
5 **Identify** the main problems affecting the coastal environment.
6 **Outline** the causes of rapid population growth in coastal areas. Describe the impact of this growth.
7 **Explain** why we need to develop our understanding of how the coastal environment functions.

working geographically

1 **Using ICT** Using Google Earth, explore the Venice lagoon. Specifically focus on the extent to which humans have modified the biophysical environment.
2 **Writing task** Write a paragraph explaining why ancient civilisations had only a limited impact on coastal environments.
3 **Writing task** Write a paragraph outlining the impact that the Industrial Revolution had on people's ability to modify and exploit the biophysical environment.
4 **Interpreting photographs** Study figures 1.6.1 (p. 140) and 1.6.3 (p. 141). As a class, describe the nature of the biophysical environment shown in the photographs. Identify the dominant agents shaping the environment.
5 **Writing task** Study figure 1.6.4. Write a report outlining the factors affecting the coastal environment, showing how each factor impacts on coastal environments.

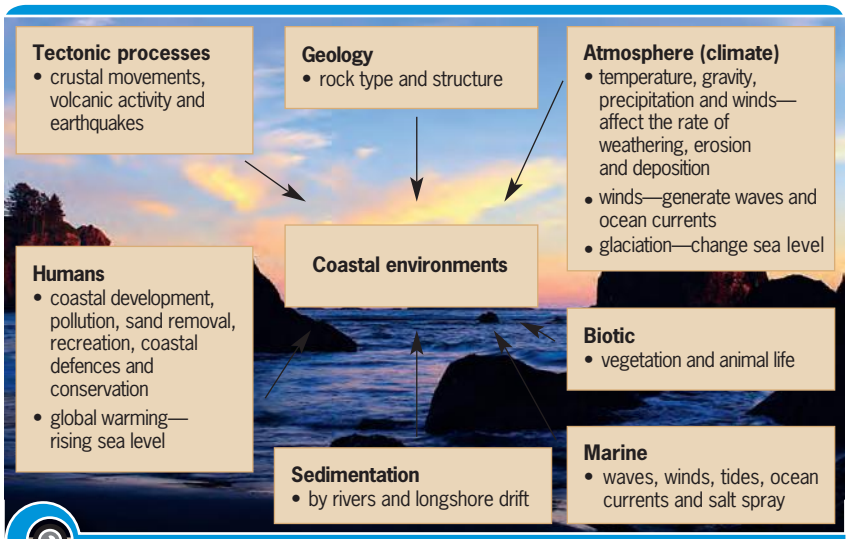


FIGURE 1.6.4
Factors affecting the nature of the coastal environment.

opportunities than inland areas. Further, the growth of world trade led to the development of port cities. The coast's attractiveness also draws people who seek a coastal lifestyle and the coast is a popular choice for holidays and retirement. In response, many urban areas are being developed or expanded to meet the needs of new coastal residents for housing, sanitation and transport.

People's activities initiate changes in the functioning and structure of the coastal environment. As a result, coasts need careful monitoring and management. To manage coastal environments effectively, we must first come to understand how the environment functions and develop an awareness of the processes that shape and alter the coastal zone. This unit focuses on the nature of the coastal environment, the ways in which humans interact with it, and how they seek to manage coastal sediments.

Waves: shaping the coastline

Of all the agents of *erosion* active in the shore zone, waves are by far the most important. The sea is never still and the surface is easily set in motion. The transfer of energy that takes place when a wind blows over a large body of water creates waves. This energy can be carried over vast distances until it is released on the coast. Any surfer, having been dumped by a breaking wave, can testify to how much power waves have.

Waves move across the open sea as ocean **swell** and do not change their form until they move into shallow water. When they approach a shoreline, the *frictional drag* of the sea bed slows down the base of the wave more than the crest. The wave begins to be transformed from a *wave of oscillation* to a *wave of translation*. As the base of the wave slows, the wave increases in height until it breaks as surf. The manner in which waves break is illustrated in figure 1.6.5 and explained in more detail on page 145.

Waves of oscillation occur in deep water, where wave energy near the surface completes one vertical circle with the passage of each wavelength. When the wave enters shallow water, the circular flow of energy is distorted by the frictional drag of the sea floor. When this occurs, both energy and matter are propelled upward and forward. *Potential energy* is translated into *kinetic energy*.

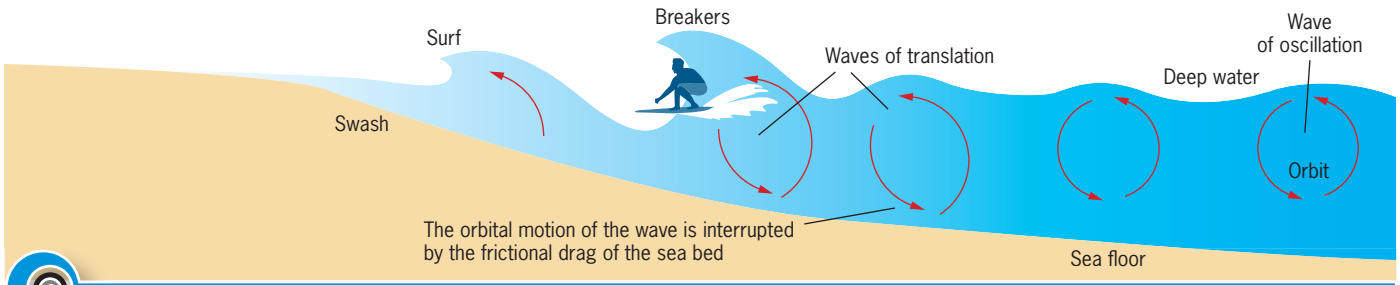


FIGURE 1.6.5

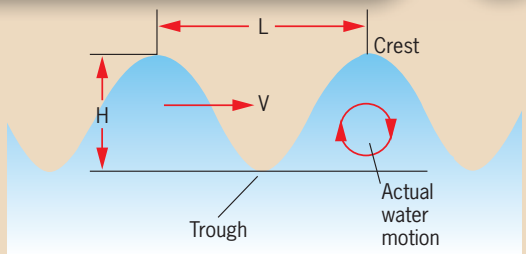
How waves break.

geofocus

Wave-related terminology

A number of terms are used when discussing waves. They include:

- *fetch*—the maximum distance the wind has blown across open water without interruption
- *frequency*—the number of crests passing a fixed point in a minute
- *swell waves*—waves that move well away from the area where they were generated
- *velocity*—the distance travelled by a wave in a specified period of time
- *wave height*—the vertical distance between the top of the wave's crest and the bottom of the wave's trough
- *wavelength*—the horizontal distance between successive crests
- *wave period*—the time taken for two successive crests to pass a given point
- *wind waves*—waves produced by the local prevailing wind.



KEY
H Height of wave
L Distance between wave crests
V Velocity of wave

FIGURE 1.6.6

Features of a wave.

TABLE 1.6.1

Describing wave conditions

Height (M)	Description	Effect
0.0	Calm (water appears 'glassy')	No waves breaking on the beach
0.0–0.1	Calm (water is rippled)	No waves breaking on the beach
0.1–0.5	Smooth	Very small waves breaking on the beach
0.5–1.25	Slight surf	Waves rock buoys and small boats
1.25–2.5	Moderate surf	Sea becoming furrowed
2.5–4.0	Rough surf	Sea deeply furrowed
4.0–6.0	Very rough surf	Sea much disturbed with rollers having steep fronts
6.0–9.0	High waves	Sea very much disturbed with rollers having steep fronts; damage occurring to the sea front
9.0–14.0	Very high waves	Towering seas; severe damage occurring to the sea front
Over 14.0	Phenomenal waves	Huge waves causing very severe damage to the sea front (these conditions are associated with cyclones)

Source: Adapted from Bureau of Meteorology

The two main elements of a wave are the *crest* and the *trough*. (See figure 1.6.6.) The trough is the base of the wave, while the crest is its peak.

FIGURE 1.6.7

The energy contained in waves is a powerful force of change in the coastal environment.

abrade the action of rock scraping against and wearing away other rock.

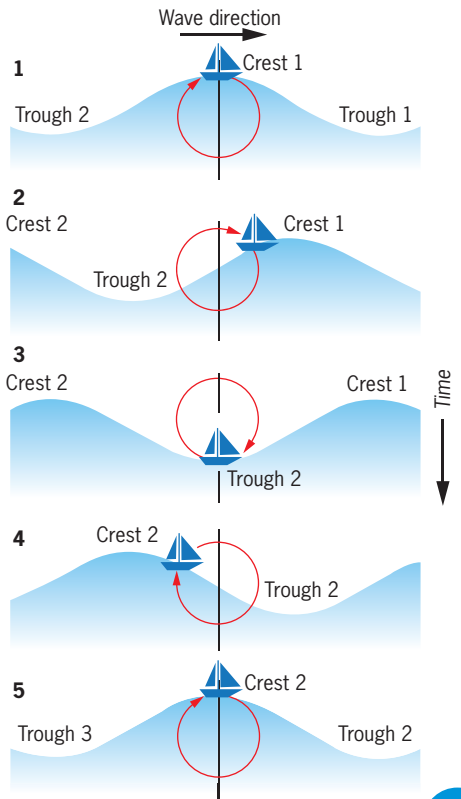


FIGURE 1.6.8

Movement of an object in deep water.

In times of fair weather, waves cause little erosion. Instead, they tend to build beaches by depositing sand and rock fragments. During storms, and especially when coasts are hit by cyclones, massive waves pound the shoreline. The violent uprush of tonnes of water against the shoreline, whether it be a sandy beach or a rocky headland, causes accelerated rates of erosion. It has been estimated that in fair weather, the force exerted by a wave is about 900 kg/m^2. Storm waves, on the other hand, can exert as much as 30 000 kg/m^2. Waves striking the shore are powerful erosive forces. The features of waves are examined in more detail below.

In many cases it is the oblique angle with which storm waves strike the coast that does the most damage. During a storm, the sea often appears grey because of the large amount of sand and other sediments being picked up and carried in suspension.

The constant attack by wind-blown sand and wind-induced waves grinds and **abrades** the features of the **coastline**. This forms wave-cut platforms and cliffs, caves, arches and stacks. The products of this erosion are sorted: the heavier sands and gravels remain close to shore. The lighter particles settle as layers of silt on the sea bed, where the sea is deep and still. Given the dynamic nature of the earth's crust, they may well emerge above sea level in some future mountain range. The erosional and depositional landform features of coastal environments are examined in more detail on pages 150–64.

Wave types

As already noted, waves are by far the most important agent of erosion shaping the coastal environment. (See figure 1.6.7.) Waves are formed by wind blowing over the ocean surface, the energy of the wind being transferred to the wave. The two main types of waves are wind waves and swell waves.

Wind waves are produced by local winds and travel in the same direction as the prevailing wind. For example, a north-easterly wind will produce waves that travel towards the south-west. The height of wind waves is determined by the strength of the wind, the length of time the wind has been blowing and the **fetch**. The faster the wind speed, and the longer the duration of the fetch, the higher the wave and the longer the wave period. Wind waves are steeper than swell waves and have shorter periods and wavelengths. The offshore and onshore movement of air is the product of the differential heating and cooling of the earth's surface (see Unit 1.2, p. 32) and plays an important role in the formation of wind waves.

Swell waves are wind-generated waves that have moved away from the area in which they were formed. They often originate in deep oceans affected by intense low-pressure systems. As swell waves move away from areas of low pressure, they become more rounded and regular in height and period. Swell waves can travel thousands of kilometres. As they move, their height decreases and their period and wavelength increase; that is, they gradually lose their energy. The most common swell waves impacting on the coast of south-east Australia are produced by the low-pressure systems that pass to the south of the continent. In summer and autumn this pattern can be disrupted by lows and tropical cyclones in the Coral Sea, which can generate large north-easterly swells.

In deep water, the frictional drag of the wind on the sea surface causes water and floating objects to move in an orbital (circular) motion. As shown in figure 1.6.8, floating objects don't move forward. Instead, they have quite significant vertical movements.

When you look at the surface of the open sea you will notice that waves form a complicated pattern of crests and troughs, with waves of different

geoskills 12

Wave experiment: the effect of wind on waves

Aim

To investigate the relationship between wind and waves.

Materials

You will need a tank tray, sand, small rocks, a fan and water.

Method

Construct a 'beach' at one end of the tray and then fill the tray with water to a depth of about 3 cm. Point the fan at a 45° angle to the water. (See figure 1.6.9.) **WARNING! Do not let the fan or its power cord touch the water.**

Turn the fan on low and observe the height and the frequency of the waves. Gradually increase the speed of the fan and observe the changes to the size and number of waves that take place.

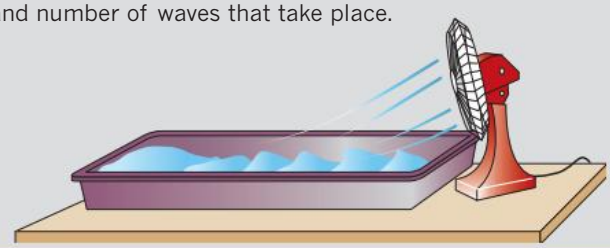


FIGURE 1.6.9

The effect of wind on waves experiment.

shapes moving in different directions. There is considerable interaction between waves: faster moving waves overtake slower waves. Sometimes the waves combine to create an abnormally high wave (referred to as a *king*, or *rogue*, *wave*). It is these king waves that cause much of the damage to the shoreline and put property and boats at risk.

Why do waves break?

As the wave moves closer to the coast it begins to interact with the sea floor. This increases friction and the orbital movement of the water begins to become *elliptical* (oval-shaped). With increased interaction, the wave begins to change shape. As the depth between the wave and the sea floor declines, the wave steepens. With the water depth continuing to decline, the wave continues to steepen until it collapses under its own weight. The critical depth is around 1.3 times the height of the wave. Therefore, a wave with a height of 1 m will break when the water depth reduces to 1.3 m. Higher waves will break further from the shore.

Wave refraction

Wave refraction or bending occurs when the waves encounter an uneven coastline. The direction of the wave is changed. Advancing waves first come into contact with the headland where their forward motion is slowed by the **frictional drag** of the sea floor. The waves entering the bay continue on at their original velocity. As they advance, the wave front bends to reflect the shape of the coastline. As a result, all waves strike the shoreline head on. This *refraction* causes energy to be concentrated on the headlands, which are actively eroded while the bays become areas of sediment deposition. (See figure 1.6.14, p. 147.)

understanding the text

1 **Explain** how waves are created.
2 **Explain** what happens when waves enter shallow water.
3 **Outline** the impact that storm waves can have on the following:
   a the dune system
   b features of the built environment, such as homes, roads and bridges.
4 **Explain** why the sea appears grey during a storm.
5 **Explain** the difference between wind waves and swell waves. Outline how each is formed.
6 **Outline** the factors that determine the height of wind waves.
7 **Explain** what happens to swell waves as they move away from the area in which they were formed.
8 **Explain** how king, or rogue, waves develop.
9 **Define** in your own words the term 'fetch'.

working geographically

1 **Interpreting diagrams** Study figure 1.6.5 (p. 143). Define the term frictional drag. Outline its role in the formation of waves.
2 **Interpreting diagrams** Study figure 1.6.6 (p. 143). Copy the illustration into your workbook. Annotate your sketch with definitions of the terminology used in the Geofocus box 'Wave-related terminology' (p. 143).
3 **Interpreting diagrams** Study figure 1.6.8. Describe what happens to a floating object in an area affected by swell waves.
4 **Fieldwork** Undertake fieldwork. Visit a beach and use table 1.6.1 (p. 143) to describe the wave conditions observed.
5 **Fieldwork and recording observations** Study Geoskills box 12.
   a In your workbook, draw a table with four columns. Use these column headings:
      - fan speed (V)
      - wave height (H)
      - wave period (T)
      - effect on beach.

      Record your observations of wave height and period.
   b Examine the effect that the waves had on the beach you have constructed. In the table write a brief outline of what happens to the sand and small rocks as the speed increases.

frictional drag interactions between surfaces that cause a reduction in velocity.

did you know?

Storm waves can have immense power. Engineers had to install steel grids over the windows of a 45 m high lighthouse to stop the windows being smashed by the waves.

Constructive and destructive waves

Waves are the most important cause of change on beaches and other landforms that are created by the movement of sand and other sediment. Whether waves serve to build (construct) beaches or to erode (destruct) them depends on the characteristics of the wave. (See figure 1.6.15.)

Constructive waves tend to be *surging* or *spilling* waves. They are the result of swell and usually have high levels of fetch. The wavelength is long (commonly over 100 m), but the wave height is small (often less than 1 m). The result is a long wave period, with fewer than eight waves breaking each minute. Individual waves break near the shore and have low levels of energy. The **swash** is quickly dispersed into the particles of sand, or other sediments, that make up the beach. Over time, constructive waves deposit large quantities of sediment on the shoreline. This causes the beach to grow. (See figure 1.6.15a.)

Destructive waves serve to remove sediment from beaches and other landforms. They are *steep* waves that are usually *plunging*. They are more common where the fetch is short and are often the result of localised storm activity. The waves break out from the shore and their energy is very high. As the wave moves up the beach, the backwash remains strong. It removes sediment particles as it goes. (This is discussed in greater detail later in the unit. See figure 1.6.15b.)

Wave types in the near-shore zone

The gradient (or steepness) of the sea floor ultimately determines the types of waves that will break onto the shore. There are four main types of waves. They are shown in figures 1.6.10 to 1.6.13.

FIGURE 1.6.10

Collapsing waves occur when the whole wave becomes unstable and collapses on top of itself.

FIGURE 1.6.11

Plunging waves form when the crest of the wave curls over the front face and falls into the base of the wave. This produces large amounts of foam and a high splash. It is often called a dumper.

FIGURE 1.6.12

Surging waves occur when the crest of the wave remains unbroken while the base of the wave moves up the beach.

FIGURE 1.6.13

Spilling waves occur when the wave crest becomes unstable and topples down the face of the wave. This wave is often referred to as a roller.

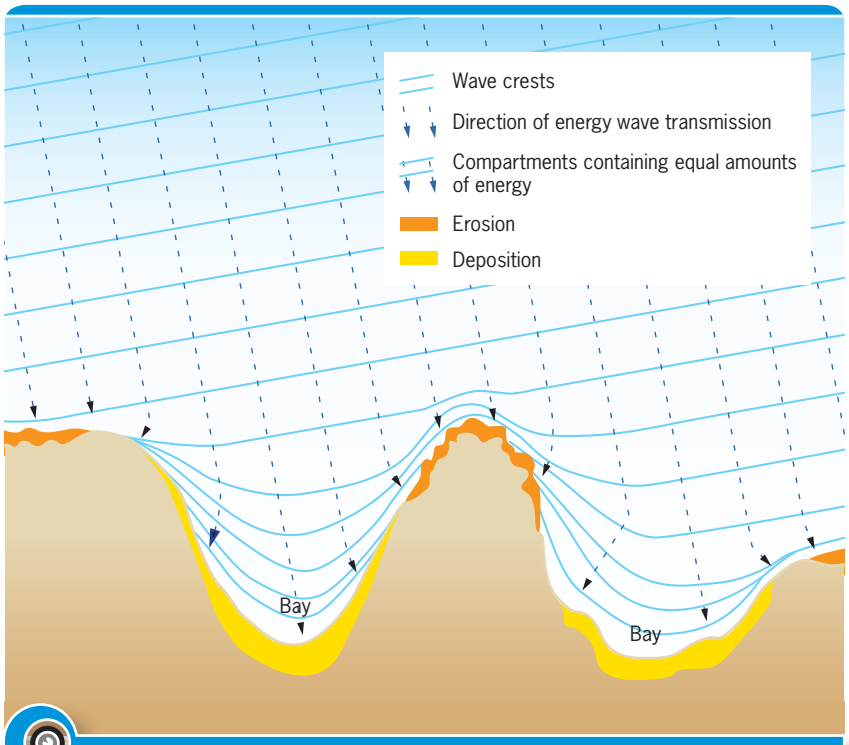


FIGURE 1.6.14

Wave refraction.

geofocus

Storm surges

A storm surge is created by intense low-pressure systems or cells (cyclones). Cyclones (called hurricanes in North America) form over the ocean and cause air to rise rapidly. This rising air 'pulls' up the sea surface with it. Storm surges can do enormous damage to coastal areas. They can cause widespread erosion of beaches and destruction of the built environment.

In 2005, a massive storm surge of several metres was generated by Hurricane Katrina in the southern states of the United States. The surge caused billions of dollars worth of damage. See the Geofocus box 'Hurricane Katrina, 2005' (pp. 148–9) for more information.

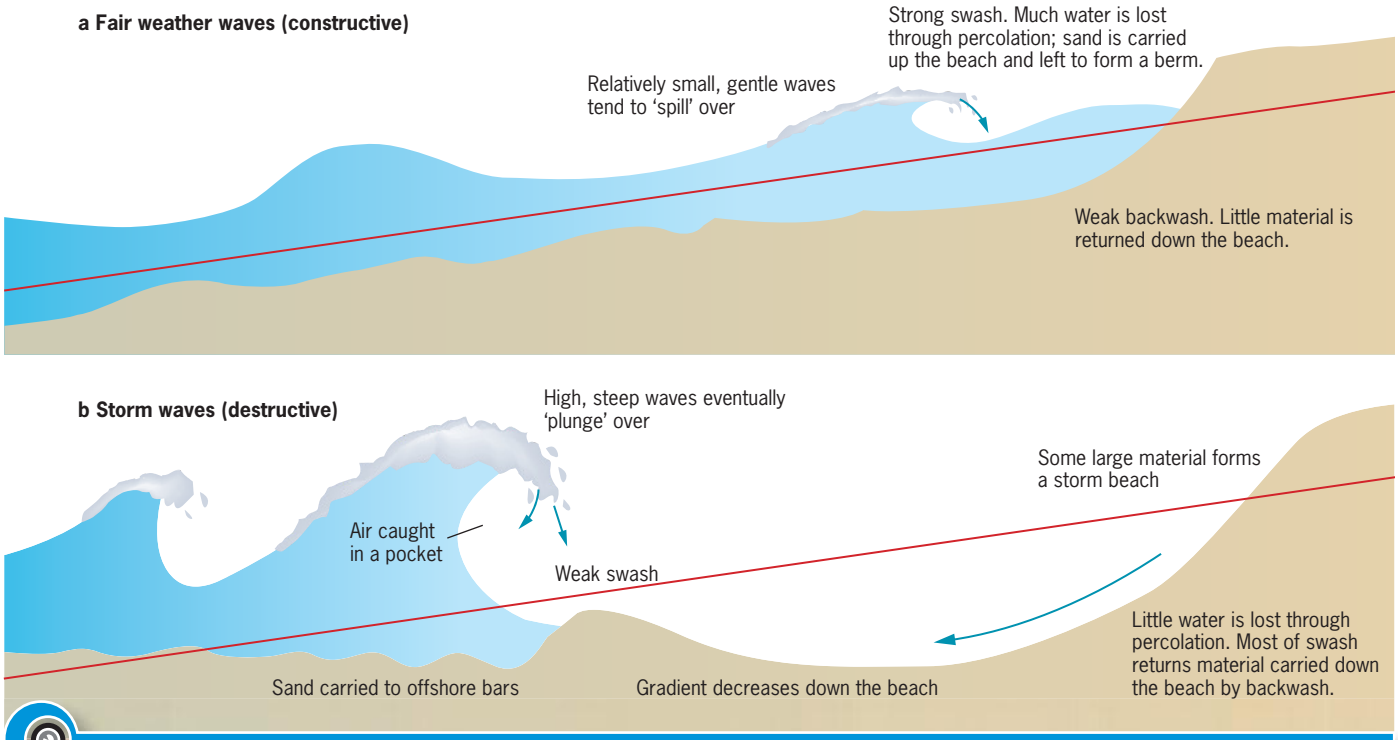


FIGURE 1.6.15

Differences between constructive and destructive waves.

Hurricane Katrina, 2005

Katrina was the costliest and one of the deadliest hurricanes in US history. Katrina formed over the Bahamas on 23 August 2005 and crossed southern Florida before intensifying to a Category 5 hurricane in the Gulf of Mexico. The storm weakened to a Category 3 before crossing into Louisiana and Mississippi.

The storm surge generated by the storm caused severe damage along the Gulf coast. It devastated the Mississippi cities of Bay St Louis, Waveland, Biloxi, Gulfport, Ocean Springs and Pascagoula. In Louisiana, the flood-protection system of New Orleans failed in 53 different locations, ultimately flooding 80% of the city.

Due to its sheer size, Katrina devastated the Gulf Coast as far as 160 km from the storm's centre. Katrina was the eleventh tropical storm, fifth hurricane, third major hurricane, and second Category 5 hurricane of the 2005 Atlantic season.

At least 1836 people died as a result of Hurricane Katrina and the subsequent flooding. The damage done by the storm is estimated to have cost US$81.2 billion, making it the costliest natural disaster in US history.

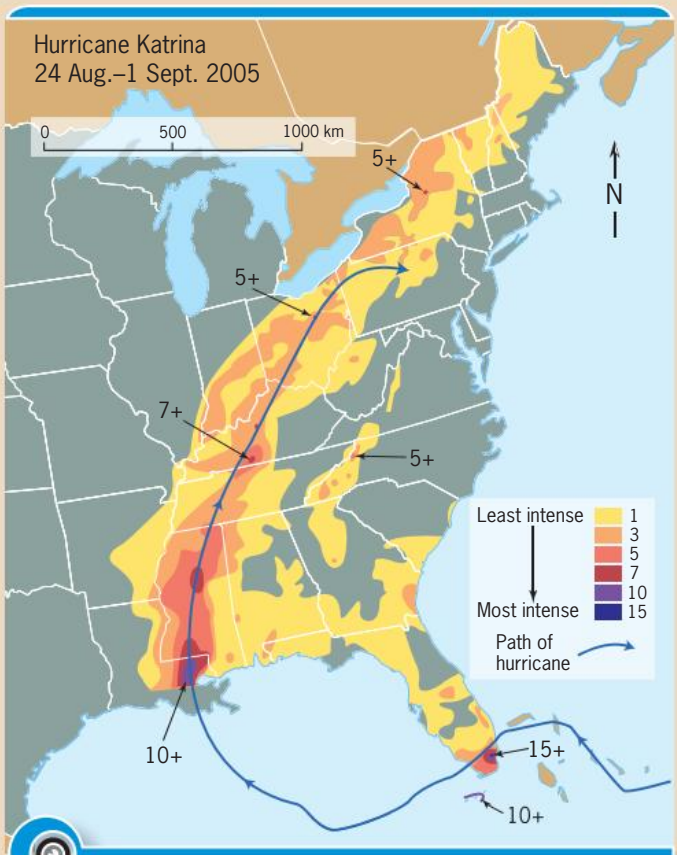


FIGURE 1.6.16

Rainfall intensity map of Katrina highlights the regions of the United States worst affected by the hurricane.

FIGURE 1.6.17

Satellite image of Hurricane Katrina.

FIGURE 1.6.18

The coastal foreshore of Biloxi, Missouri, in 1998 and the same location following a massive storm surge caused by Hurricane Katrina in 2005.

Criticism of the reaction of the federal, state and local governments to the storm was widespread. Despite a long history of flooding in the region, all levels of government failed to act in a timely and organised manner, which further exacerbated the problems.

Environmental impacts

Hurricane Katrina had a major impact on the biophysical environment. The hurricane and accompanying storm surge caused extensive beach erosion. In some cases, coastal environments were completely devastated. Approximately 150 km east of the point where the hurricane made landfall, the sand of Dauphin Island (a barrier island) was transported across the island and dumped into the Mississippi Sound. This effectively relocated the island closer to the land. The storm surge and waves from Katrina also devastated the Chandeleur Islands, which had already been affected by Hurricane Ivan in 2004. Overall, more than 20% of the local marsh wetlands were permanently inundated by water as a result of the storm.

The lands lost were the breeding grounds for marine mammals, brown pelicans, turtles and fish and a range of migratory bird species.

The floodwaters of New Orleans contained a mix of raw sewage, bacteria, heavy metals, pesticides, toxic chemicals and about 24.6 million L of oil. During the cleanup effort, the floodwaters were pumped into Lake Pontchartrain, seriously affecting the ecology of the lake.

FIGURE 1.6.19

Flood damage in New Orleans.

geolinks

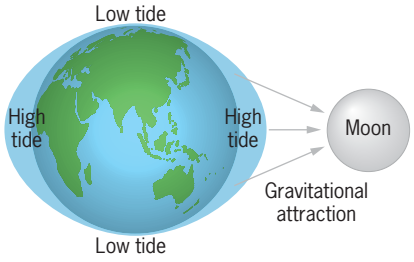
For more information on the impact of Hurricane Katrina on the coastal environments of the southern USA access the National Oceanic and Atmospheric Administration's report online.

Tides and currents

A **tide** is the alternate rise and fall in the level of the sea. These twice-daily variations are caused by the gravitational pull of the moon and, to a lesser extent, the pull of the sun and the rotation of the earth. The moon pulls water to the side of the earth closest to it. This creates a bulge, or *high tide*. A similar bulge develops on the opposite side of the earth to compensate. Between the two bulges, water is repelled, causing a *low tide*. (See figure 1.6.20.)

Once every 14 days the moon and sun are in alignment. The increased gravitational attraction results in a *king tide*. When king tides and *storm surges* coincide, the destructive power of the latter is enhanced.

The flow or movement of a large body of water in an ocean is referred to as an *ocean current*. These movements are caused by prevailing winds, the earth's rotation and the distribution of its land mass. They are also attributed to differences in the temperature and salinity of water bodies. Ocean currents play an important role in determining climate and are capable of transporting sediments over long distances.



(not drawn to scale)

FIGURE 1.6.20

Tides are created by gravitational forces, especially the gravitational pull of the moon.

understanding the text

1 **State** the critical depth at which a wave breaks.
2 **Describe**, in brief and with the aid of a sketch, the process of wave refraction. Outline how refraction affects the pattern of erosion in coastal regions.
3 **Distinguish** between constructive waves and destructive waves. Under what conditions do each occur?
4 **Describe** what storm surges are. Outline the processes that create them.
5 **Outline** what causes a king tide. Describe the role of the moon in determining tidal variations.
6 **Define** the term ocean current. What are they caused by?

working geographically

1 **Writing task** Study figure 1.6.14 (p. 147). Write a paragraph explaining how wave refraction is affected by the shape of coastal landform features.
2 **Internet research** Access the Texas General Land Office Coastal Issues site. Outline the causes of coastal erosion along the Texas coastline.
3 **Writing task** Study the text 'Wave types in the near-shore zone' (p. 146). Write a report comparing the four main types of waves in the near-shore area.
4 **Research task** Undertake library and Internet research. Investigate the economic and social costs associated with storm surges to coastal communities. Write a report outlining your findings.
5 **Writing task** Study figure 1.6.20 (p. 149). Write an explanation outlining the causes of the earth's tidal variations.
6 **Research task** Study the Geofocus box 'Hurricane Katrina, 2005' (pp. 148–9). With the aid of an atlas, identify the states affected by the disaster.

runoff the portion of rainfall that runs off as overland flow. It is the water that does not infiltrate the soil and rock nor is evaporated back into the atmosphere.

flow-through the portion of rainfall that percolates (infiltrates) rock structures and flows through it via cracks in the rock structure.

did you know?

About two-thirds of the world's population live near the coast and are either directly or indirectly affected by the ocean through recreational and economic activities.

Coastal erosion and deposition

Coastal landform features can be classified as either erosional or depositional, depending on the nature of the processes responsible for their formation.

Coastal erosion

The sand and other sediments that make up beaches had to come from somewhere. While some comes from the transportation of inland sediment through the river system, a great deal comes from within the coastal environment itself. Waves, tides and wind actively erode the coast and create sediment.

The processes of erosion include:

- *Wave pounding*. When steep waves break, they have considerable energy, generating shock waves of up to 30 tonnes per square metre. This weakens rock particles, causing them to become dislodged.
- *Hydraulic pressure*. As waves smash against headlands, small parcels of air are trapped in cracks in the cliff face. The air becomes compressed, and the resultant pressure may, over time, break off pieces of rock.
- *Abrasion/corrasion*. Breaking waves hurl sand, fine rock particles or even boulders at the cliff face and rock platform, wearing them away. This is the most rapid and effective form of coastal erosion.
- *Attrition*. Large pieces of rock that have already been broken away from the cliff are broken down into smaller and more rounded particles as they collide with each other.
- *Corrosion/solution*. This involves chemical reactions that cause the bindings between rock particles to weaken. Salt crystals, for example, expand as they form, eventually causing rocks to disintegrate. The carbonic acid in salt water is particularly effective at corroding rocks containing limestone.
- *Non-marine processes*. Cliffs can also be eroded by rain either falling directly onto them or as a result of **runoff** and **flow-through**. This may result in mass movements; that is, landslides, soil creep and slumping.

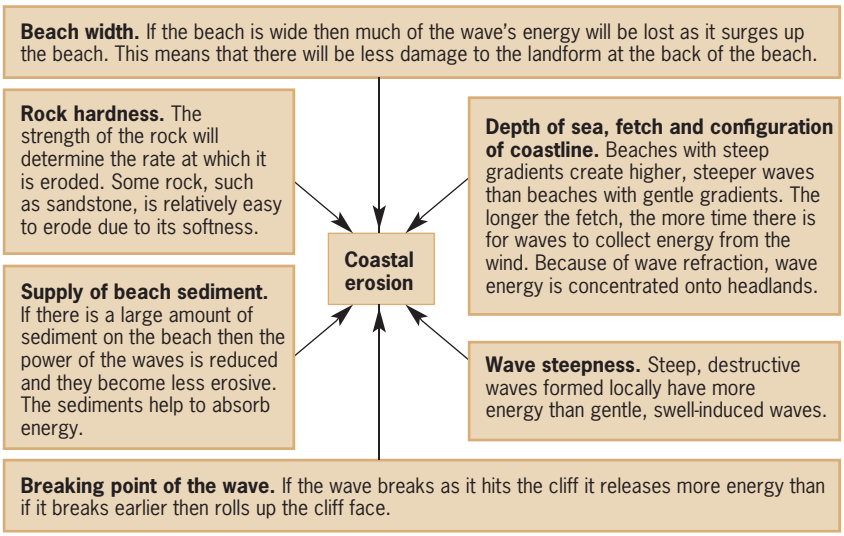


FIGURE 1.6.21

Factors that affect the rate of erosion along a coastline.

Human-induced coastal erosion

As living near the sea becomes more popular, the pressure on the coastal environment increases. Rates of erosion are greatly increased when people walk over cliff tops and sand dunes. This destroys vegetation that normally holds soil and sand particles together. The construction of sea defences designed to reduce erosion often create many other problems for the coastal environment. (This will be examined in more detail later in the unit.)

Erosional landforms

Headlands and bays

Headlands and bays are found in coastal areas where there are alternating masses of erosion-resistant and less-resistant rock. The less-resistant rock is eroded at a faster rate than the surrounding harder rock. This process is referred to as *differential erosion*. The more-resistant rock outcrops form headlands, with bays occupying the areas where the softer rock has been eroded. Over time, the headlands retreat due to wave refraction, which concentrates wave energy onto the headland.

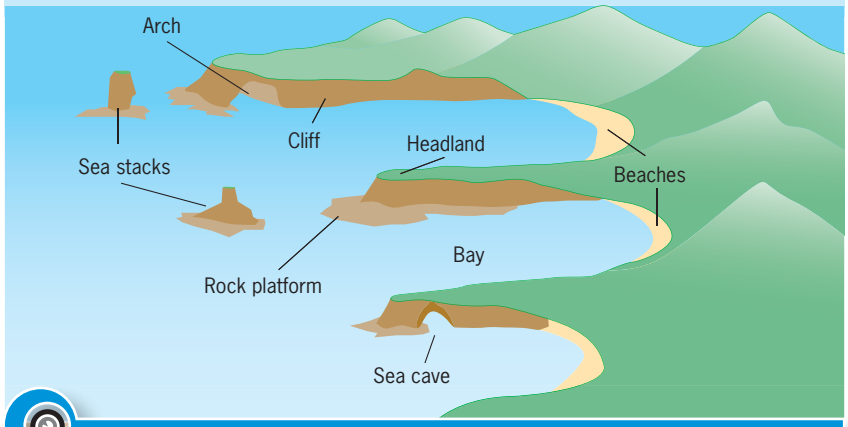


FIGURE 1.6.22

Coastal landforms created by erosion.

FIGURE 1.6.23

Wave-cut platforms, such as this one at Ulladulla on the south coast of New South Wales, are the result of several erosion processes acting in unison.

FIGURE 1.6.24

Wave pounding is a major source of coastal erosion.

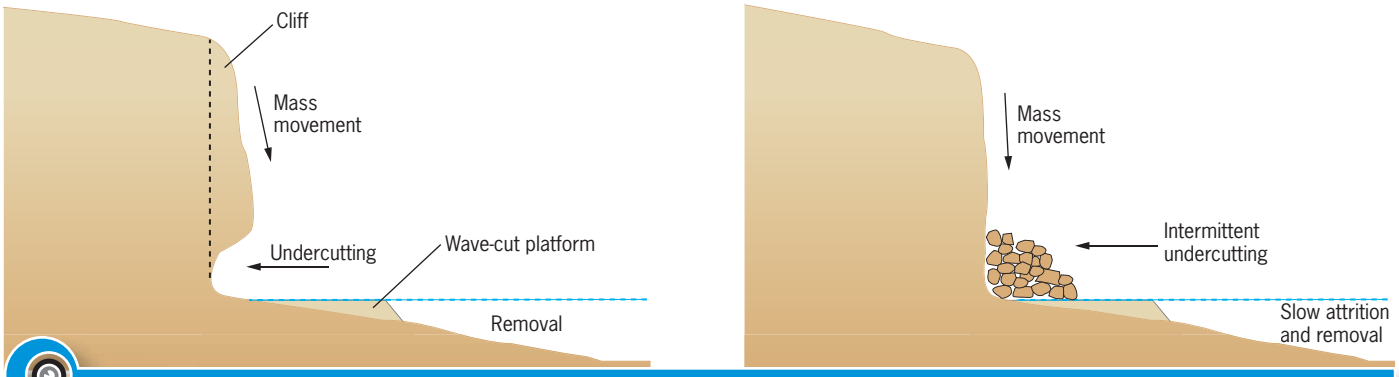


FIGURE 1.6.25

Formation of cliffs and wave-cut platforms.

FIGURE 1.6.26

The blowhole at Kiama on the south coast of New South Wales.

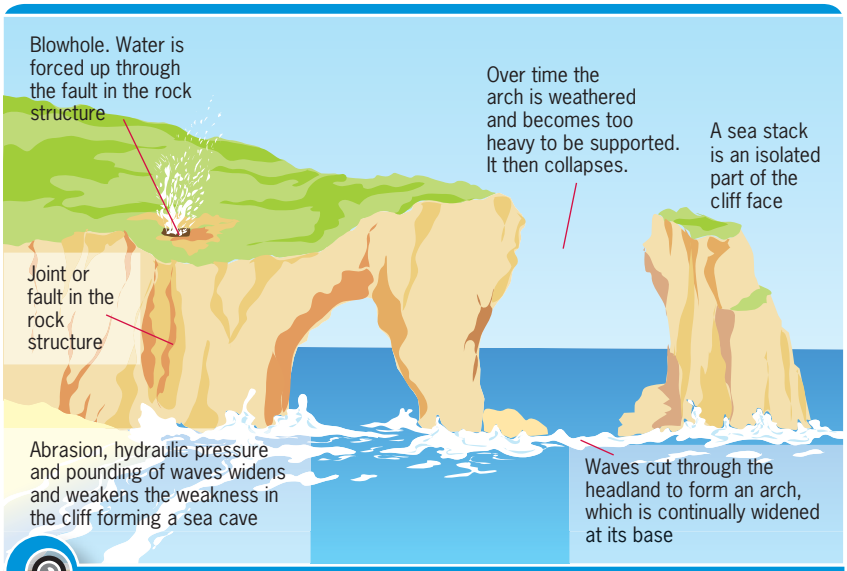


FIGURE 1.6.27

Formation of sea caves, blowholes, arches and stacks.

Wave-cut platforms

The erosive power of waves is greatest when they break at the foot of a cliff. This results in the undercutting of the cliff face. The processes of hydraulic action and abrasion create a *wave-cut notch*. Over time the notch becomes deeper until the rock above it collapses. The process is then repeated. Eventually a wave-cut platform is created. (See figure 1.6.23, p. 151.)

Sea caves

Caves develop along a line of weakness at the base of a cliff that has been subjected to wave action over an extended period of time. As the rock weakens, the cave is extended deeper into the cliff face.

Blowholes

If the weakness in the rock extends up from the roof of a sea cave to the top of the cliff then a blowhole may develop. As waves crash into the sea cave, the water and air are compressed and forced up the line of weakness to be expelled from the top of the cliff as a jet of water. (See figure 1.6.27.) One of Australia's best-known blowholes is located at Kiama in New South Wales. (See figure 1.6.26.)

Arches and stacks

Arches are created when sea caves are cut horizontally through a headland, forming a land bridge. Eventually the bridge collapses, leaving a sea stack. Victoria's famous Twelve Apostles were formed this way. (See figure 1.6.28.)

FIGURE 1.6.28

Located along the Victorian coast west of Melbourne, the world famous Twelve Apostles are a collection of sea stacks created by the collapse of arches.

did you know?

The coastline around Yorkshire in the north of England has been eroded so much that the coast has retreated by more than 3 km in the last 1500–2000 years.

geofocus

Sea level change: submergent and emergent coasts

Coasts in their present form are, in terms of geological time, quite young. Sea level varies with changes in global climate. Humans can speed up these changes, as in the case of global warming. However, climatic change (and the resulting variations in sea level) is a naturally occurring phenomenon.

The world's sea level was at its lowest about 18000 years ago when the amount of water stored as ice was at its maximum. As the temperatures began to rise and the ice caps retreated, the sea level began to rise. The rising sea level changed the shape of the coast and altered the pattern of erosion and deposition. It also drowned some river and glacial valleys and altered the migration pattern of animal and plant species.

Submergence occurs when a sea level rise causes some low-lying areas to be inundated by the sea, creating bays and inlets known as rias. Sydney Harbour is a result of this process. The harbour was once a river valley created by several substantial rivers draining the Sydney Basin. As the sea level rose, the sea slowly moved up the valley, creating the harbour as we know it today. (See figure 1.6.29.) In areas affected by the processes of glaciation the U-shaped glacial valleys were submerged to form fiords.

Emergence takes place when areas of land are raised above sea level by tectonic processes. It can also occur when the weight of the land is reduced when ice caps melt. *Raised beaches* are a common example of an emergent landform feature. As the land rose, beaches and cliffs were raised above the waves, leaving them out of the reach of wave erosion. In some parts of Scotland, wave-cut platforms, sea caves and notches can be seen on cliffs high above the existing sea level.

FIGURE 1.6.29

Sydney Harbour is an example of a drowned river valley or ria.

understanding the text

1 **Outline** the main sources of sand and other sediments along a coast.
2 **Explain** the processes of wave pounding and hydraulic pressure.
3 **Distinguish** between the processes of corrasion (abrasion) and corrosion (solution).
4 **Name** the erosional process by which large pieces of rock are broken into smaller and more rounded particles.
5 **Outline** the non-marine processes that contribute to the erosion of coastal landforms.
6 **Explain** how the activities of people affect the rate of erosion in coastal environments.
7 **List** the factors affecting the rate of coastal erosion.
8 **Define** the term differential erosion.

working geographically

1 **Mindmapping** Construct a mindmap to illustrate the processes of coastal erosion.
2 **Writing task** Study figure 1.6.21 (p. 150). Write a report outlining the factors affecting the rate of coastal erosion.
3 **Writing task** Write an explanation outlining how beach width and rock hardness determine the rate of coastal erosion.
4 **Constructing diagrams** With the aid of a series of diagrams, explain how a sea stack is formed.
5 **Writing task** Write a paragraph explaining the difference between runoff and flow-through (infiltration).
6 **Writing task** Write an explanation of how the depth of the ocean and fetch affect the level of erosion.
7 **Writing task** With the aid of a diagram, write an explanation outlining the formation of headlands and bays.
8 **Constructing diagrams** With the aid of a series of diagrams, write an explanation of how wave-cut platforms are formed.
9 **Constructing diagrams** Draw a series of diagrams to illustrate the formation of sea caves and blowholes.
10 **Interpreting text** Study the Geofocus box 'Sea level change' (p. 153).
   a Describe the condition under which submergent coasts are formed.
   b Distinguish between rias and fiords.
   c Outline the processes that are responsible for the formation of emergent coasts.

did you know?

Sand bars

Much of the sediment that is moved off beaches is 'stored' in offshore bars. These are concentrations of sand close to where the waves break. During the construction of beaches, these bars provide a great deal of the sediment used. When beach destruction takes place, much of the sediment is returned to the sea and stored in the bar.

Coastal deposition

Waves, tides and currents move and sort coastal sediments. Under natural conditions this process involves constant movement, with sediments being brought into and out of the coastal zone. Beaches act as a temporary store of sediment. Beach sediments can be removed by the process of *sediment erosion* and then relocated within the coastal zone. Consequently, the sediment being used to build one beach may have come from the erosion taking place on another.

As each wave moves onto the beach it carries sediment with it. However, the energy of the wave also gives it the potential to remove sediment from the beach. The strength of the wave will ultimately determine whether it is *constructive* or *destructive*. Because steep, plunging waves have high levels of energy they tend to be destructive. This explains why our beaches are often left with little sand after severe storms. During storms the strong winds increase the energy in waves.

How do waves move sediment?

As the wave enters shallow water and breaks, turbulence and the to-and-fro movement of the water place stress on individual grains of sediment. This causes the grains to become detached from the main body of sediment. The grains can then be held in suspension, where they can be carried along by the energy of the wave.

Movement of sediment up and down the beach

When waves break on beaches, they produce a turbulent body of water known as *swash*. This surges up the beach slope, carrying with it fine sediment. The uprush stops when the wave's energy is spent. Much of the water soaks into the beach. The rest flows back down the beach slope under the influence of gravity as *backwash*, taking some sediment with it. In fair weather, (constructive) waves move sand and other sediments up and

FIGURE 1.6.30

Swash and backwash transport sediments on and off beaches.

down the beach in this manner. In big storms, (destructive) waves erode or scour the beach downwards and move this material out to sea. This often causes serious erosion problems. Figures 1.6.14 and 1.6.15 (p. 147) show how the height and angle of a wave determine its impact on beaches.

Beach drifting

Swash and backwash can also result in the movement of material along a beach. When waves strike the coast at an angle, the swash is directed onto the shore at an oblique angle. When the wave is spent, the backwash retreats down the beach by the most direct route. Thus, particles pushed up the beach come to rest along the beach at a different point from where they started.

Longshore drift

A related process to beach drifting is **longshore drift**. When a coast is hit by strong, onshore, wind-induced waves or swell there is an accumulation of excess water. This escapes as a current that runs parallel to the shore and away from the wind. This is known as a longshore current. Turbulence in the surf zone keeps material suspended. These wave-induced currents

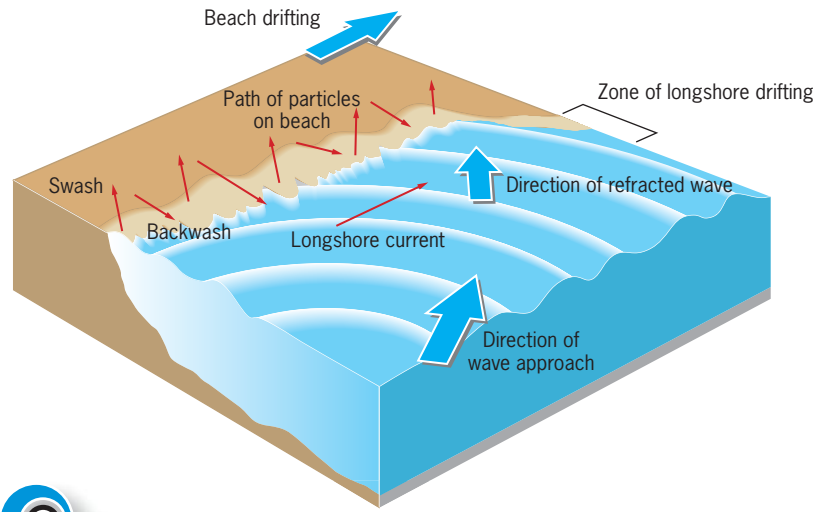


FIGURE 1.6.31

Longshore drift and beach drifting.

did you know?

Coastal regions almost everywhere are now struggling to cope with the explosion in the human population. Throughout much of the world, coasts are overdeveloped, overcrowded and overexploited. Coastal waters are often horribly polluted with untreated (or partially treated) municipal, industrial and agricultural wastes. Rivers bring in more pollutants, including chemicals and heavy metals, along with increasing loads of erosion sediment torn from the hinterlands. Globally, little is being done to manage this crisis.

Already nearly two-thirds of humanity—some 3.6 billion people—crowd along a coastline, or live within 150 km of one. Within three decades, if current trends continue, 75% of humanity, or 6.4 billion people, will reside in coastal areas. This is nearly 1 billion more people than the current global population.

geoskills 13

Investigating longshore drift

The impacts of longshore drift can be seen along almost any beach in eastern Australia. This activity gives you an opportunity to study this process in the field.

Pre-excursion activities

Use topographic maps and aerial photographs to familiarise yourself with the coastal environment you will study. Make sure you have a thorough understanding of the relevant concepts and terminology. Note the season.

Study 1

Visit the southern end of a beach and, with a long tape measure, determine the width of the beach by measuring from the incipient **foredune** to the low-tide mark.

Move along the beach in a northerly direction, taking measurements as you go.

Study 2

Throw a piece of buoyant material, such as foam or a tennis ball, at the water's edge. Remember to recover whatever you throw into the water.

Draw up the following table and complete it as you move along the beach.

Location	Estimated distance from southern end	Width of beach (m)

1. Record the length of time it takes for the object to move a measured distance along the beach. Also note the direction that it moves. Record the data and compare them with your results from the activity for Study 1.
2. Draw field sketches or use a camera to record the shape of the berm and the characteristics of the dune vegetation.
3. Construct an annotated cross-sectional profile of the beach. Mark on the following features: offshore bar, low-tide mark, high-tide mark, beach berm (see figure 1.6.37, p. 158), foredune and colonising plant species. Use accurate measurements to construct your profile.
4. Display the results of your fieldwork in the classroom or mount a display in a public area of the school.

understanding the text

1. **Identify** the processes that move and sort coastal sediments.
2. **Define** the term sediment erosion.
3. **Distinguish** between swash and backwash.
4. **Outline** the impact that constructive and destructive waves have on the beach profile.
5. **Explain** the process of beach drifting.
6. **State** the angle of attack or incidence that is thought to be the most effective for longshore movement of sediment.
7. **Explain** the effects of longshore drift along the east coast of Australia.
8. **Explain** the function of an offshore bar. Where are they found?

shingle the loose and completely water-worn gravel on the sea-shore.

are very effective in moving sediment. Figure 1.6.31 (p. 155) shows how beach drifting and longshore currents move sediment on a beach.

The rate of drift depends on the energy of the wave and the angle at which it strikes the beach. An angle of 30° is believed to be the most effective for longshore movement of sediment. The impact of longshore drift can be seen along most beaches in eastern Australia. The southern ends of beaches are usually narrower than the northern ends. This is because the prevailing longshore currents tend to run from the south towards the north and the waves strike the beaches from a more southerly direction. When humans block the longshore movement of sediments, this impacts on the beaches to the north of the obstruction, by reducing the amount of sediment available for beach building. (This will be examined in greater detail later in the unit.)

Coastal sediment budgets

Sediment is material that is transported to and from coasts by the wind (atmosphere) and water (hydrosphere). Sediment is usually sand, **shingle**, coral and silt (very fine mud). Processes of erosion in inland areas and along coasts produce the sediment. Inland sediments are transported to the coast via river systems. Rivers erode their banks and transport the soil and sand washed into them by runoff.

Sediment flows in and out of coastal systems. Waves, tides, currents and the wind constantly move sediment around the system and to different systems. The amount of sediment that enters the system is referred to as the *sediment input*, while the amount that leaves is known as the *sediment output*. By deducting the sediment output from the sediment input we are able to determine the **coastal sediment budget**. (See figure 1.6.32.)

Sediment budget = sediment inputs – sediment outputs

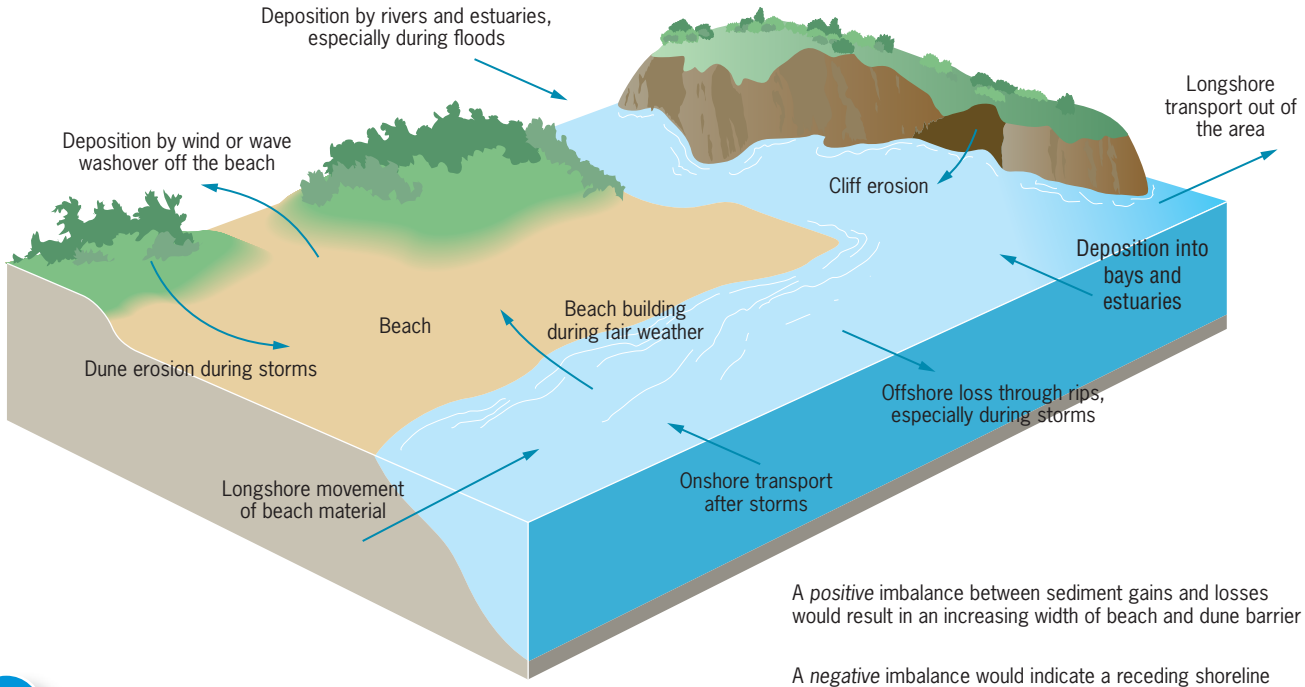


FIGURE 1.6.32

Sources and movement of sand along a coastline.

The area from which sediment is eroded and then deposited is known as the *sediment compartment*. The compartment will vary in size, but along Australia's east coast it is usually defined as a headland at either end and a bay with beaches in between. Sediment is moved both within and between compartments.

understanding the text

1. **Identify** the materials that are classified as coastal sediment.
2. **Explain** the origin of coastal sediments.
3. **Explain** the terms sediment input and sediment output.
4. **Explain** how the sediment budget is determined.
5. **Define** the term sediment compartment.
6. **Describe** the structure of most sediment compartments found along Australia's east coast.

working geographically

1. **Constructing diagrams** With the aid of a diagram, explain the process of longshore drift.
2. **Writing task** Study figure 1.6.32. Write a report outlining the sources and movement of sediments in the coastal environment.

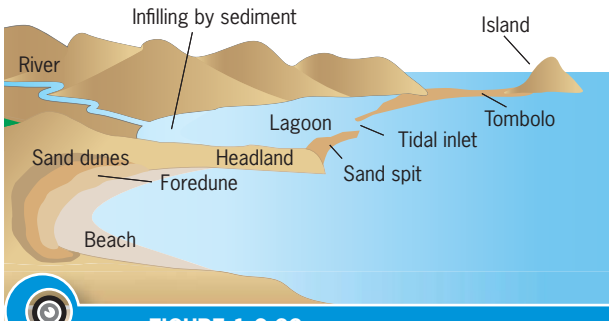


FIGURE 1.6.33

Depositional landform features.

FIGURE 1.6.34

Beaches are the most common type of depositional landforms.

Depositional landforms

Depositional landforms develop where the rate of accumulation of sediment exceeds the rate of depletion. Areas that are sheltered from strong prevailing winds are more likely to accumulate sand and other sediments.

FIGURE 1.6.35

A beach berm.

FIGURE 1.6.36

A foredune.

Beaches

Beaches are accumulations of loose sediment built up by the actions of waves and near-shore currents. They extend from the low-tide level to the upper limit reached by the largest storm waves. Beaches are one of the most *dynamic* and fragile landforms on earth; their profile is constantly changing as sediments are removed and then replenished. Beaches are sensitive to the strength of winds and currents, the height of waves and tides, and the ever-increasing impact of humans.

Most beaches are composed of sand or pebbles. However, the nature of the beach material is ultimately determined by the type of sediment transported to the coast by rivers and the type of material stored in the *offshore deposits*.

The nature of the lithosphere in headwaters of river systems is a very important factor in determining the nature of beaches. Most beaches in Australia are composed of sand derived from the weathering and erosion of sandstone. This material makes up many of Australia's coastal and inland geological features.

Beach components

Beaches can be divided into three main zones: the swash zone, the berm and foredune, and coastal sand dunes.

The *swash zone* is the part of the beach where the waves 'run up' the beach face. The further up the beach the wave runs, the more energy it loses. Eventually the wave ceases to have any forward energy and the swash returns to the sea as *backwash*.

The berm and *foredune* (see figures 1.6.35 and 1.6.36) are accumulations of sediments at the edge of the swash zone. A *berm* is a a ridge or terrace of sand. The berm and foredune have two very important functions:

- They act as a protective barrier against the erosive power of the sea and also against the inland movement of sand and salt.
- They are *reservoirs of sand* that feed eroding seas. During a constructive phase, sediments are deposited on the beach and foredune; the berm is extended seaward. During a destructive phase, sand is taken from the foredune. This leaves the main dune system protected from erosion. The berm retreats towards the back of the beach.

Sand dunes

Sand dunes are large accumulations of sand on the landward side of beaches. They are formed when onshore winds blow sand inland. Sand dunes are particularly important because they provide a vital buffer zone between the sea and the land. They are a store of sand from which sand can be withdrawn in times of attack by destructive storm waves. Dunes that run parallel to the main beach are often referred to as *parallel dunes*.

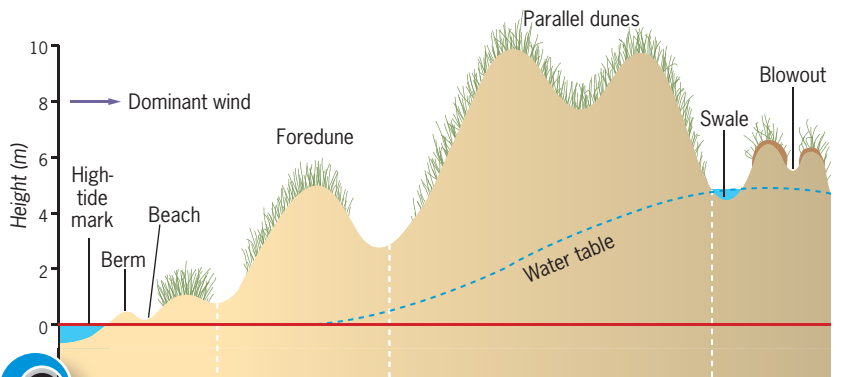


FIGURE 1.6.37

Cross-section of the main components of a beach system.

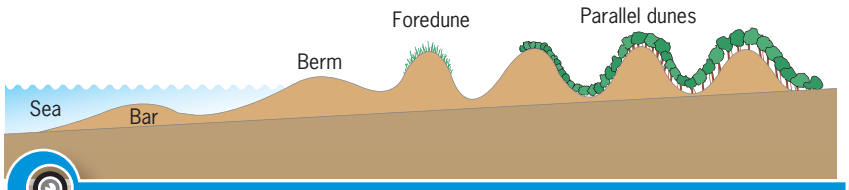


FIGURE 1.6.38

Cross-section of a dune system.

Formation of dunes

Waves and longshore drift deposit sand in the swash zone. As the tide recedes, the sand deposits dry out, allowing sea breezes to move the sand inland. This is known as *aeolian transport*. Seaweed and other debris may trap some of this sand. Over time plants begin to colonise the sand deposits, making them stable. *Embryo dunes* are the first to develop and gradually become stabilised by grasses known as *pioneer grasses*. (See figure 1.6.40.) These grasses trap more and more sand, causing the dune to grow. As more and more sand accumulates, the embryo dune may develop into a *foredune*. The dune continues to grow until its increasing distance from the shoreline cuts off the supply of sand. A new generation of dunes becomes established in front of the initial dune. (See figure 1.6.38.)

As the dune matures, other plants and animals begin to move in and establish their dominance. This causes the dune to become even more stable. The soil profile takes on a grey colour, as the amount of organic matter starts to increase. Eventually, a more complex soil profile, capable of supporting more complex plant communities, develops.

The impact of people on dunes has been substantial. Dune systems have been levelled to make way for car parks, housing estates, commercial developments and parklands. This has a major impact on the amount of sand available for beach replenishment and exposes the coastal environment to greater destruction during severe storms.

Where dunes remain intact they can be seriously degraded if access is not restricted. Trampling of dune vegetation by plants and animals exposes the dune to erosion by wind. Wind is funnelled along the tracks, gouging out the sand and creating a dune *blowout*. (See figure 1.6.42.) At this stage the dune is said to be *wasting*. Blowouts allow sand to continue moving inland. A blowout may develop into a *parabolic dune*. These are U-shaped dunes with the open end pointing upwind. (See figure 1.6.39.) (These impacts will be discussed in greater detail in *Global Interactions 2: Second Edition*.)

Sand spits

Sand spits are long, relatively narrow accumulations of sand extending from the coast into the sea. (See figure 1.6.43, p. 160.) They usually end in a *recurve* (hook shape) that bends back towards the land. Their creation

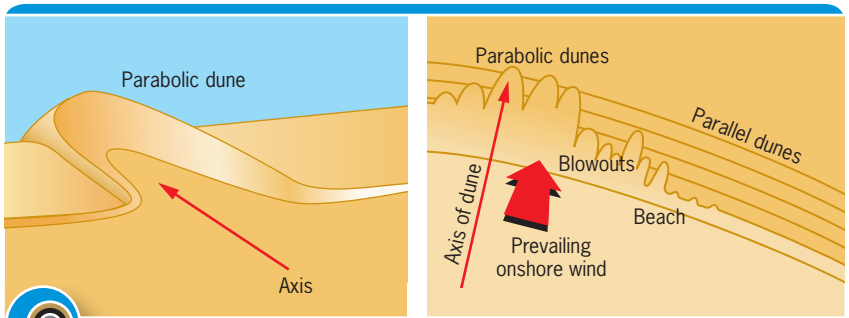


FIGURE 1.6.39

The formation of parabolic dunes.

FIGURE 1.6.40

Pioneer grasses are the first vegetation to grow on the embryo dunes. As the grasses spread they help to bind the sand together and stabilise the dune.

FIGURE 1.6.41

In coastal areas around the world, dune systems have been destroyed to make way for urban developments.

FIGURE 1.6.42

Dune blowouts are the result of the vegetation cover being removed from a dune surface, exposing the sand to wind erosion.

FIGURE 1.6.43

A sand spit as viewed from space.

FIGURE 1.6.44

The Coorong is a vast barrier system that supports a complex ecosystem along the South Australian coast east of Adelaide.

did you know?

Aeolian processes are those that relate to wind. They include the movement of all wind-carried, wind-blown and wind-deposited matter. Aeolian erosion removes exposed, unconsolidated surface material. Wind-blown material often blasts solid surfaces in a process known as abrasion. Coastal dune systems are the product of aeolian deposition.

is related to wave action and their shape is determined by the rate and direction of sediment flow. (See figure 1.6.45.) *Salt marshes* often develop on the landward side of a sand spit which, over time, can become quite stable. The waterway behind the spit is often shallow and calm, making them popular places for human recreation. When a spit extends across a bay linking two headlands it is called a *bar*.

Tombolos

A tombolo is a sand spit that links an island to the mainland or another island. (See figure 1.6.46.) There are several famous tombolos in Australia. One joins Barrenjoey to the mainland at Palm Beach on Sydney's Northern Beaches; another is located at Port Stephens. Tombolos form when sediment accumulates in the less turbulent water on the sheltered side of an island.

Barriers

Barriers are elongated accumulations of sand running roughly parallel to the shore and separated from it by a *lagoon*. (See figure 1.6.44.) Barriers are similar in structure and composition to offshore bars but they are never completely covered by water. During large storms the barrier may be breached, allowing the sea access. With time and the movement of sediment the breach will be repaired.

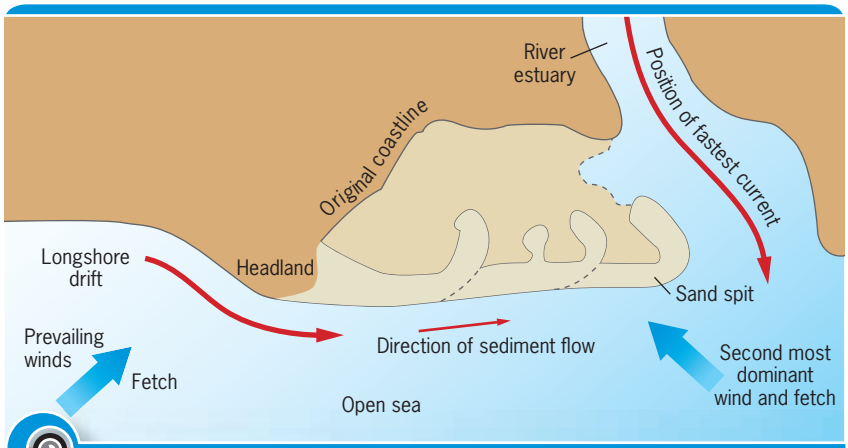


FIGURE 1.6.45

Formation of a sand spit.

FIGURE 1.6.46

An oblique aerial photograph of the tombolo at Port Stephens.

geofocus

Dee Why Lagoon and barrier

Dee Why is located on a *peninsula* extending north from Port Jackson (Sydney Harbour) towards Broken Bay. This peninsula, known as Sydney's Northern Beaches, is one of the most heavily populated and developed areas along the Australian coastline.

Dee Why Lagoon is situated directly behind Dee Why Beach and is blocked from the sea by a periodic barrier. The barrier, which is built up during constructive phases of beach building, is often breached by storm waves. It is during these times that the lagoon is flushed out and its water replaced.

The fresh water flowing into Dee Why Lagoon comes from the surrounding *catchment*. Figure 1.6.47 shows the topography of the land surrounding the lagoon. The bowl-shaped catchment ensures that water flows down the hillsides and into the lagoon. These waters support large bird and fish populations as well as an extensive range of aquatic plants.

The catchment of the Dee Why Lagoon has, over several decades, been transformed by the activities of people. (See figure 1.6.48, p. 162.) This development has resulted in a significant increase in pollution levels.

When the lagoon's access to the sea is blocked, pollutants tend to accumulate. This sets off a chain of events that degrade the lagoon's ecology. Nutrient-rich runoff is a major problem. As the nutrient level increases, the lagoon becomes an ideal breeding ground for *algae*. (See figure 1.6.49, p. 162.) Algae suffocate aquatic flora and are poisonous to many of the animals. Furthermore, the stagnant water containing the rotting algae is a source of complaint for nearby residents, who object to the smell. The residents often lobby local authorities to breach the barrier and flush out the lagoon.

The flushing of the lagoon provides a short-term solution, but it does not address the real issues and does not take into account the natural processes of barrier construction and destruction. In a bid to reduce the level of solid pollutants entering the lagoon, *rubbish traps* have been installed. (See figure 1.6.50, p. 162.) These catch large pieces of rubbish, such as bottles and cans. This does not, however, stop the high levels of nutrients entering the lagoon. Water quality will remain a major environmental issue for as long as untreated nutrient-rich *storm water* is allowed to flow into the lagoon. (See figure 1.6.51, p. 162.)

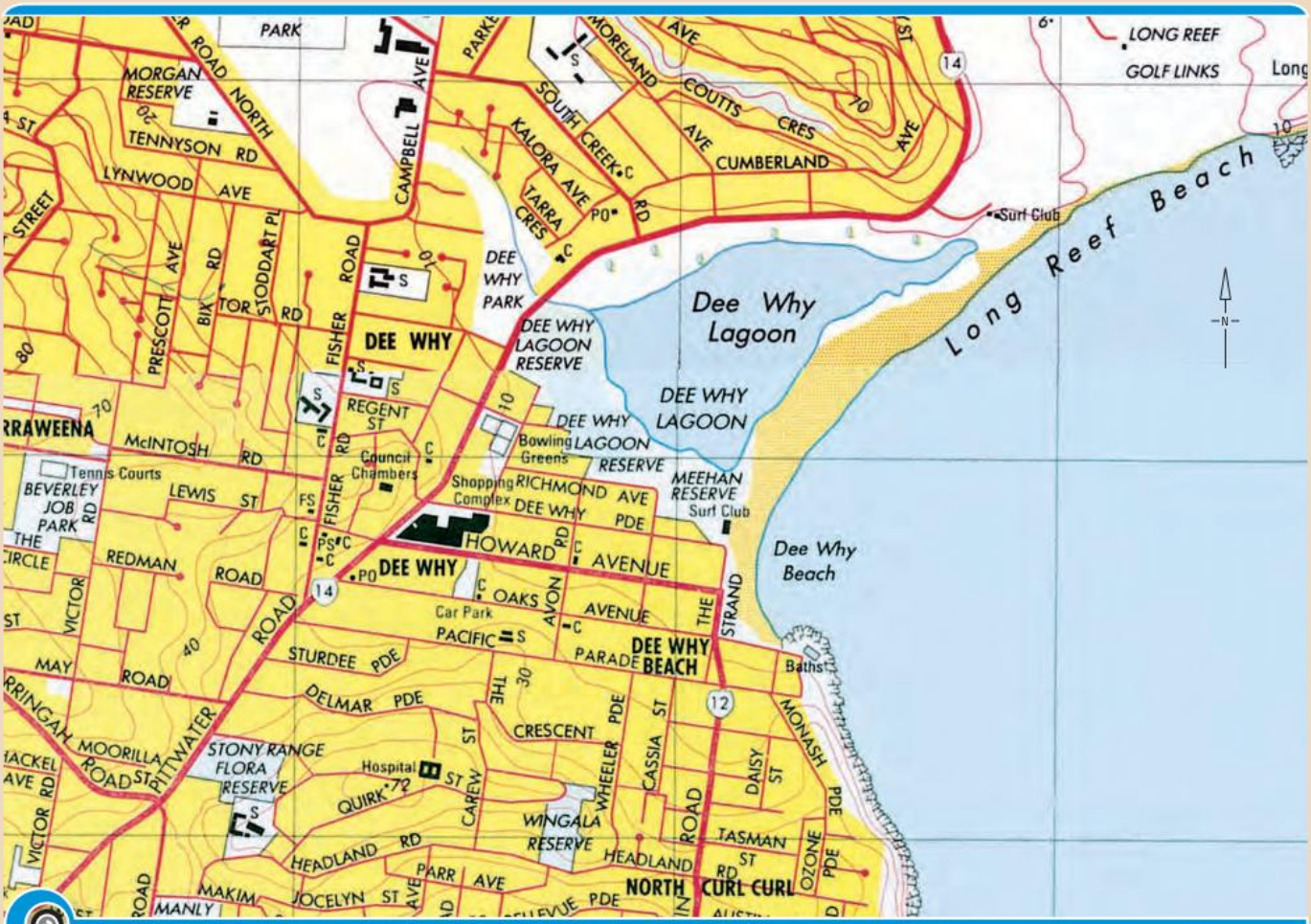


FIGURE 1.6.47

Topographic map of Dee Why, showing Dee Why Lagoon and Beach and the catchment area for the lagoon.

FIGURE 1.6.48

Vertical aerial photograph of Dee Why showing the extensive urban development around the lagoon.

FIGURE 1.6.49

Nutrients accumulate in the lagoon as a result of urban runoff. These nutrients promote the growth of algae, which affects other aquatic plant life.

FIGURE 1.6.50

Rubbish traps collect solid waste (such as drink cans, plastic bags and packets) before they enter the lagoon system.

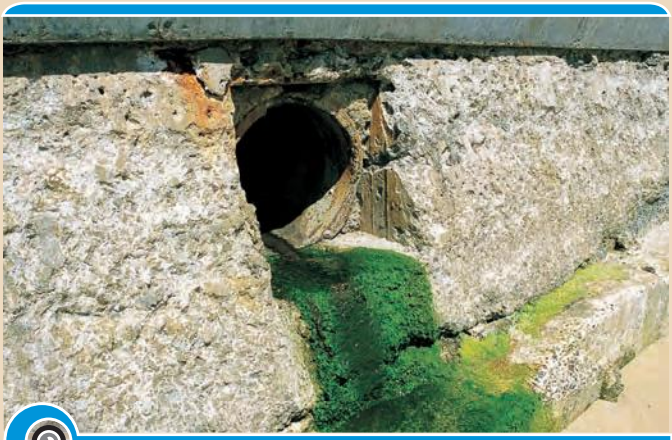


FIGURE 1.6.51

Water quality in the lagoon is affected by storm water runoff.

working geographically

1 **Internet research** Access the Coastal Management page at the South Australian Department for Environment and Heritage site.
   - a Select the coastal geomorphology section and briefly outline the main geomorphic features of the South Australian coastline.
   - b Explain how the South Australian coastline has evolved over time.

2 **Writing task and group work** Study the Geofocus box 'Dee Why Lagoon and barrier' (pp. 161–2).
   - a Study figures 1.6.47 (p. 161) and 1.6.48. Describe the shape of the land surrounding Dee Why Lagoon. Explain how this shape would impact on the drainage pattern of the area.
   - b Study figure 1.6.48. With a partner, brainstorm the effects that this type of development would have on the lagoon ecosystem. As a class, list the management issues associated with Dee Why Lagoon.
   - c Write a short report to outline the strategies that have been adopted to address the problems affecting the lagoon.
   - d In groups, develop a management plan to address the issues identified by the class in activity 2b. Share your group's plan with other members of the class.
   - e Conduct a class debate on whether the barrier at Dee Why Lagoon should be opened to allow the lagoon to be flushed out when algae become a problem. Having listened to the debate, conduct a ballot to determine a response.

geofocus

The formation of Fraser Island

Fraser Island provides a good example of the way that interactions between the various components of the biophysical environment affect coastal sediment processes and landforms. In common with other landforms resulting from the accumulation of coastal sediments, the island is constantly changing. It started to take shape millions of years ago as the sandstone mountain ranges of Eastern Australia were eroded. The sediment produced by this erosion was swept out to sea by large and powerful rivers. The prevailing currents and longshore drift moved the sediment towards the north. (See figure 1.6.53).

Over thousands of years the sediment banked up against the rocky headlands of Hervey Bay. During the last great Ice Age the sea level rose and fell several times, exposing and *submerging* the sandy sediment. During times of low sea level the exposed sand was transported by wind and heaped into huge dune systems, in a process known as **aeolian deposition**. With the ending of the Ice Age, the sea rose to its current level. It flooded the area, leaving only the tops of these great sand dunes exposed as islands.

Time has seen the exposed dunes stabilised by primary vegetation, such as grasses. This has gradually created the nutrients that could support larger shrubs and ultimately trees. With a high annual rainfall (in excess of 1500 mm) the conditions for plant growth are ideal. Furthermore, a thick blanket of humus (decaying plant matter) and minerals formed an almost watertight layer just below the surface. This trapped rain water, providing a rich source of fresh water across the island.

FIGURE 1.6.52

A complex ecosystem has evolved on Fraser Island. It is a unique environment and, as a result, the island has been listed as a World Heritage site.

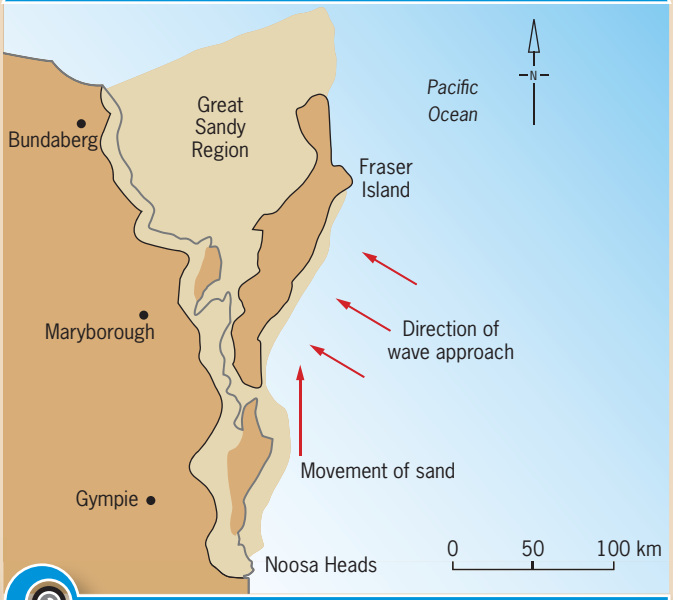


FIGURE 1.6.53

The sediment flows and wave patterns along the east coast of Australia that have led to the formation of Fraser Island.

Estuaries and salt marshes

Estuaries develop where rivers enter the sea. They are often funnel-shaped and affected by the ebb and flow of the tide. In the estuary the river's fresh water and sediment mix with the salty sea water. This constant mixing creates nutrient-rich silt, which supports a number of complex plant and animal communities.

The banks of estuaries are often lined with *estuarine mangroves*. (See figure 1.6.54.) Mangroves play an important role in cleansing the environment and providing habitats and breeding grounds for a number of important fish and bird species. They also have significant commercial value. The economic viability of the fishing industry, for example, depends on the fish that breed in the mangrove ecosystem.

The environmental importance of estuarine mangroves has only been recently acknowledged. In the past, large areas of mangroves were destroyed to make way for canal estates, factories, playing fields and rubbish dumps.

FIGURE 1.6.54

Highly adapted mangrove forests are often found along the banks of estuaries.

Salt marshes are found in sheltered coastal areas, such as estuaries, and behind spits. They are areas that are inundated by sea water regularly, but only for short periods of time. As the tide retreats, the remaining sea water evaporates, creating *saltpans*. The only vegetation that can grow in these areas are certain algae and a small number of salt-tolerant plants, such as grassworts and cord grasses. Salt marshes are easily eroded. This makes them very fragile and susceptible to human interference. Extensive salt marshes are found on Rottnest Island off the Western Australian coast. In New South Wales, salt marshes are found in 101 of the state's river estuaries.

understanding the text

1 **Outline** the circumstances under which depositional landforms develop.
2 **Explain** what a beach is. How are they defined? Why are they one of the earth's most dynamic landforms?
3 **State** what determines the type of sediment found on beaches.
4 **Explain** what occurs in the swash zone of a beach.
5 **Outline** the functions of the beach berm and foredune.
6 **Explain** what sand dunes are. Note the functions they perform.
7 **Outline** the process of dune formation and stabilisation from 'embryo' to 'mature' stages.
8 **Outline** the impacts that people have on sand dunes.
9 **Explain** what a blowout is. Outline the processes that create them.
10 **Explain** what a parabolic dune is.
11 **Outline** how sand spits are formed.
12 **Explain** what a tombolo is. How do they develop?
13 **Describe** the processes that lead to the development of sand barriers. How do they differ from offshore bars?
14 **Explain** what an estuary is.
15 **Explain** why estuarine mangroves are such an important coastal resource.
16 **Outline** the conditions under which salt marshes develop. Explain why they are considered to be fragile ecosystems.

working geographically

1 **Writing task** Write a report outlining the formation and stabilisation of sand dunes. In your report be sure to include diagrams and flow charts.
2 **Writing task** Study figure 1.6.39 (p. 159). Write an explanation outlining the formation of parabolic dunes.
3 **Undertake research** Undertake research. Investigate how a tombolo is formed. Draw a series of sketches to explain the processes.
4 **Interpreting text and research task** Read the Geofocus box 'The formation of Fraser Island' (p. 163).
   a Describe the process that created and transported the sand that forms Fraser Island.
   b Outline the impact of the last Ice Age on the development of the island's unique geomorphology.
   c Explain why plants are able to grow in such a sandy environment.
   d Undertake research on Fraser Island. Compile a report on the different types of flora and fauna that exist on the island. Construct a map of the island, detailing the major features of the island and the movement of the sand dunes over the years.

Human impacts on coastal processes

In a natural system, the processes of sediment deposition and erosion ensure that the coastal environment can recover from the impact of major disturbances, such as storms. In their natural state, therefore, coastal environments are resilient and able to cope with significant change.

Issues arise when human activities begin to disturb these coastal processes. For example, major problems are created when humans interfere with the coastal sediment budget through:

- sediment removal; for example, during sand mining operations
- blocking the flow of sediment into or out of a sediment compartment
- damaging coastal sediment landforms.

Figure 1.6.55 outlines some of the human impacts on the coastal environment.

It doesn't need much: 0.5, 0.6 of a degree starts to be a considerable problem. So, you don't need a huge temperature increase to start increasing both the frequency and the ferocity of cyclones.

Professor Ian White, Australian National University

Impact of climate change

The last decade has been the warmest in recorded history and there is now overwhelming evidence that the global climate is beginning to change. Global warming will have a profound effect on the coastal zone. As temperatures rise, the particles that make up sea water expand. This causes the ocean level to rise. Referred to as thermal expansion, this may cause sea level to rise between 30 cm and 1 m over the coming century. Such a rise in sea level would have catastrophic consequences for coastal environments and the communities that live in them.

The tiny Pacific island countries of Kiribati and Tuvalu may disappear altogether as sea levels rise and consume these low-lying countries. Changes in sea temperature will also impact on aquatic species. For example, coral reefs require very specific temperature ranges in order to survive. Even a slight change can be enough to kill off the reefs.

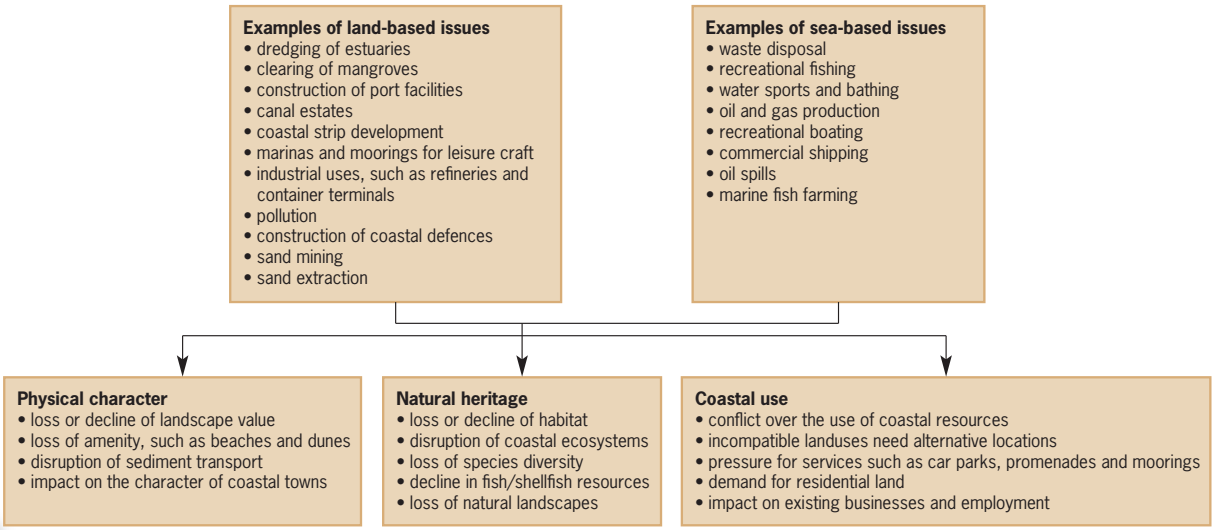


FIGURE 1.6.55

Major human impacts on the coastal zone and their consequences.

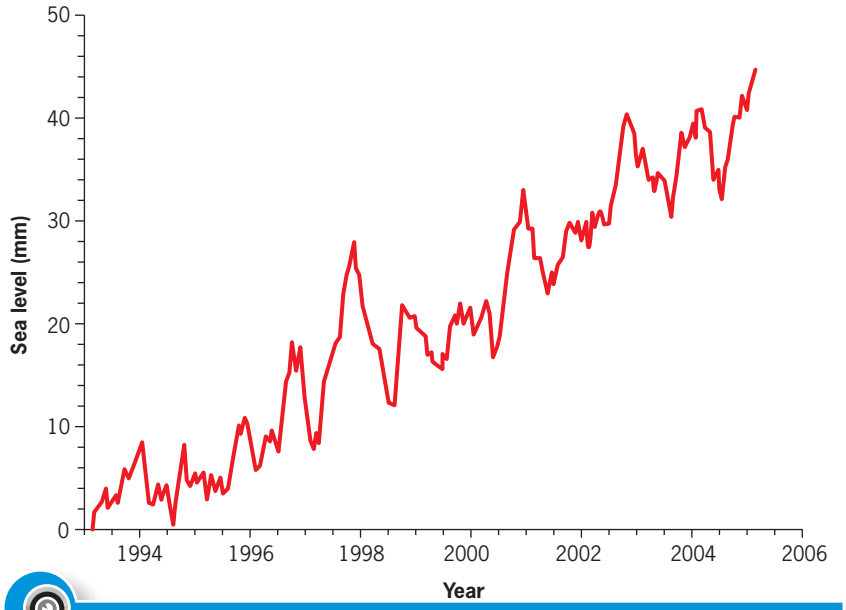


FIGURE 1.6.56

Sea level rise associated with climate change.

FIGURE 1.6.57

Sand mining results in the destruction of dune systems.

Sea level rise will also impact on the coastal sediment budget. As levels rise, more land is covered by ocean. A recent study conducted in the Republic of Ireland found that as much as 150 000 ha of coastal land is at risk of severe erosion along the west coast. Erosion on such a scale will dramatically alter the natural flow of sediments in the region.

Another major consequence of climate change will be the increased risk of severe storm events. Massive storm events, such as Hurricane Katrina in the southern United States, have caused huge damage to the coastal environment around the Gulf of Mexico. (See the Geofocus box 'Hurricane Katrina, 2005', pp. 148–9.) As such big storms become more common, further damage to coastal environments is likely to occur.

Impact of sediment removal

Coastal sediments are a rich source of minerals. They have been used in a range of industrial processes, including glass manufacturing. *Sand mining* (see figure 1.6.57) involves the total destruction of the dune system and the associated vegetation. While storm waves have the power to remove thousands of cubic metres of sand, it is usually replaced over a period of months. As the dune is rebuilt and revegetated, it regains its stability and the dune system recovers.

Unfortunately the impact of mining is often far more extensive and the rate of recovery much slower. Even where the dunes have been artificially restored and vegetated, the dune and vegetation patterns are different from those that naturally occur; that is, former levels of complexity do not return for many years. Because of this, sand mining is often the source of widespread community debate and opposition.

In recent years there has been considerable public opposition to increased mining on the Kurnell Peninsula, south of Sydney's Botany Bay. Sand is mined in the vast dunes there for the construction industry, but there has been rising public opposition to the loss of the dune fields. (This is discussed in greater detail in *Global Interactions 2: Second Edition*.)

Sediment is also taken from offshore bars and the barriers that accumulate around the mouths of estuaries. This is done to clear a channel for shipping and to gather sediment for sand-replenishment activities. (This will be discussed in greater detail later in the unit.)

The *dredging* of sediment disturbs the balance of the sediment budget. By reducing the amount of sediment held in storage, less sand is available to rebuild the beach after major storms.

Blocking sediment flows

The unimpeded flow of sediment is critical to the natural processes that shape the coastal environment. When people alter or block the flow of sediment, the impact on the coastal environment can be significant. It is rare that the movement of sediment is intentionally disturbed or blocked. Instead, it usually results from the construction of 'coastal-management' devices, such as **sea walls**, **groynes** and breakwaters.

Blocking the flow of sediment from inland areas to the sea can also have a major impact on the coastal environment. The construction of large dams, for example, can prevent sediment reaching the sea.

Can there be too much sediment?

The amount of sediment in a compartment is a fine balance between having enough for rebuilding after storm damage and having room to store any 'spare' sediment. Human actions usually result in there being too little sediment. However, land clearing and poor management

understanding the text

1. **Identify** the ways in which people interfere with coastal sediment budgets.
2. **Explain** how climate change affects sea levels.
3. **Describe** the possible impacts of global warming on coastal environments in the Pacific.
4. **Describe** the impact of sand mining on coastal dune ecosystems.
5. **Outline** the impact that sand dredging has on local sediment budgets.
6. **List** some of the ways people impede the flow of coastal sediments.
7. **Explain** the impact of large dams on coastal sediment budgets.

geofocus

The effects of Iron Gates Dam

The huge Iron Gates Dam stretches across the River Danube on the border of Romania and Serbia. Since its completion in 1972, the dam has had a major impact on the amount of sediment reaching the Black Sea. The dam protects more than 26 000 km^2 of land from flooding. However, the dam also stops the flow of essential sediments downriver. Instead of being swept out to sea, the sediments are now being trapped behind the dam wall.

The loss of sediment has reduced the ability of coastal landforms to rebuild after storms and has had a significant impact on marine life. The tiny particles of sand washed down by the Danube are the main source of dissolved silicates in sea water. (Silicate is a glassy or stony component of sand made up primarily of the element silicon.) The silicates are essential nutrients for diatoms, single-cell algae that bloom in huge numbers on the sea surface. Diatoms are a critical link in the food chain of the Black Sea. With fewer silicates reaching the Black Sea, the diatoms are being replaced by other species of algae that do not have a silicate requirement. These new algae are poisonous and cannot be eaten by other marine creatures. This has placed the whole ecosystem under stress.

FIGURE 1.6.58

The Danube Iron Gates Gorge. The construction of the Iron Gates Dam has had a significant effect on sediment flows into the Black Sea.

of inland soils can greatly increase sediment inputs and disturb the equilibrium of the sediment budget. When this occurs there can be a range of impacts. Estuaries can become clogged and animal and plant communities can be degraded. Coral reefs and sea grass beds are particularly vulnerable. Sediments can smother sea grass beds and increased turbidity can destroy corals causing them to die out.

Impact of sea defences

The dynamic nature of the coastal environment does not always fit the needs of people. Constant change and unpredictability in their environment are not desired by people who live on the coast. To overcome this, people have sought to exercise a degree of control over coastal processes. The construction of groynes and sea walls are examples of the methods used to control coastal erosion and manage the movement of sediment.

Groynes

Groynes are rock or concrete structures that are built at right angles to the beach and extend into the *littoral zone*; that is, the area between high-tide and low-tide levels. In this zone, sediment is moved by longshore drift. (See figure 1.6.61, p. 168.) The purpose of the groyne is to stop the flow of sediments within or between compartments. They are often used to prevent sand barriers extending across the mouth of a river or harbour. *Breakwaters*, which are similar to groynes, are used to protect estuaries from storm waves and to prevent the channel from becoming clogged with sediment.

Sea walls

Sea walls, like groynes, are examples of a *structural scheme* or *'hard' management strategy*. They are usually made of concrete or stone and are designed to protect the coastline from erosion. (See figure 1.6.60, p. 168.)

working geographically

1 **Writing task** Study figure 1.6.55 (p. 165). Write an extended response, outlining the issues affecting coastal environments and the extent to which these impact on the physical character, natural heritage and use of coastal resources.
2 **Fieldwork** Study figure 1.6.55 (p. 165). Undertake fieldwork. Visit a coastal environment. Compile a list of the land-based and sea-based issues affecting the environment observed. Assess the impact of these issues on the area visited.
3 **Internet research** Undertake Internet research. Investigate the long-term consequences of sea-level rise for the island countries of the Pacific Ocean. Use your findings to prepare an oral report, and present your results to the class.
4 **Writing task** Study the Geofocus box 'The effects of Iron Gates Dam'. Write a paragraph outlining the impact of the dam on the sediment budget and ecosystem of the Black Sea.

FIGURE 1.6.59

Scouring along the base of a sea wall.

FIGURE 1.6.60

Sea walls, such as this one along the beach at Glenelg in South Australia, are designed to protect coastal areas from erosion.

FIGURE 1.6.61

Groynes are used to stop sediment flows along a coastline.

People often build too close to the *active zones* of the beach: the areas that are subject to constant change. Wave action can undermine these buildings and in some cases destroy them.

While sea walls are an effective means of preventing erosion at specific points of the coastline they often have detrimental impacts on the adjacent beach. The main problem is *scouring*. (See figure 1.6.59.) Under normal conditions, wave energy dissipates (spreads out or is absorbed) as the wave surges up the beach. When sea walls are present, the surging wave is brought to a stop before it has lost all its energy. The resulting turbulence gouges or scours out the sand at the base of the sea wall. The presence of sea walls make it very difficult for a beach to develop a profile similar to that found under normal conditions.

understanding the text

1 **Outline** the roles of sea defences.
2 **Describe** the construction and purpose of groynes.
3 **Explain** what is meant by the term hard management strategies.
4 **Outline** the functions that sea walls perform.
5 **Explain** why sea walls have become necessary in some places.
6 **Define**, in your own words, the term scour.
7 **Explain** the link between the construction of sea walls and beach scouring.
8 **Outline** the land-based activities that can greatly increase the amount of sediment reaching the coastal environment.
9 **Describe** the environmental impacts of increased sediment flows.

geofocus

The Tweed River groynes

The Tweed River is located on the far north coast of New South Wales. The river provides a sheltered port for the area's extensive fishing fleet and a growing number of leisure craft. For many years, longshore drift has resulted in accumulation of large quantities of sand in the mouth of the river. This has caused the river to become shallow and dangerous for the increasing number of boats using the river. In the 1960s, the decision was made to construct two groynes (or breakwaters as they are more commonly known) to protect the mouth of the river. Once in place, the groynes would ensure that the river mouth remained open and navigable at all times. (See figure 1.6.62.)

The NSW Department of Public Works constructed the two groynes, one either side of the river mouth. This effectively extended the river to beyond the littoral zone and thus overcame the problems caused by longshore drift. Sand is now being trapped behind the southern groyne rather than building up in the river mouth.

Along the east coast of Australia, longshore drift moves sand from the south towards the north. The construction of the groynes stopped this movement, starving the beaches to the north of the Tweed River of sand. Experts calculate that the beaches of Coolangatta and Surfers Paradise were deprived of between 5 to 15 million m^3 of sand in the 20 years following the construction of the groynes.

Isolated from their source of sediment, the beaches of the Gold Coast have been stripped of their sand by storm waves on a number of occasions. Kirra Beach has been among the worst affected. Storm waves have eroded the beach and threatened property. To address the problem, expensive sea defences (including sea walls) have been constructed. These, in turn, have impacted on nearby beaches.

In an effort to artificially maintain the northerly movement of sediment, sand has been dredged from the mouth of the Tweed River and pumped to Kirra Beach. From there, wave action transports it along the beaches of the Gold Coast. While this provides some temporary relief, the sand remains vulnerable to erosion during storms. Sand pumping is also an expensive process to maintain on a permanent basis.

The example of the Tweed River defences demonstrates the coastal environment's sensitivity to change. The importance of sediment transport, via longshore drift, was not taken into account when this management plan was put in place. Consequently, the beaches to the north have been degraded and attacked by the sea.

FIGURE 1.6.62

The mouth of the Tweed River on the far north coast of New South Wales. This vertical aerial photograph (taken looking towards the north) clearly shows the buildup of sediments on the southern side of the groynes.

geofocus

The sea walls on Sydney's Northern Beaches

The beaches to Sydney's north are densely settled. People have been attracted to this part of the city by its spectacular physical setting and coastal lifestyle. Much of the development that has taken place has failed to take into account the fragility of the coastal environment. In some places the activities of people have had quite a detrimental impact.

Of greatest concern is the construction of apartments and other developments on the active parts of the beaches. At Collaroy and Narrabeen, buildings have been constructed on the foredune, one of the most dynamic parts of the beach.

The destruction of the dune system by urban development has resulted in accelerated rates of beach erosion. The removal of the foredune means that the beach no longer has a store of sand on which to draw during severe storms.

In an attempt to reduce the erosion of the beach and to protect property, local authorities and property owners have constructed crude sea walls out of large boulders and rubble. These structures have resulted in increased scour and restricted access to the beach. The walls also detract from the visual appeal of the beach. Furthermore, they are very expensive to construct and maintain, and the increased scour has meant that an extensive sand-replenishment program is required, adding to the cost.

With the rising costs of maintaining the walls and the continued erosion of beaches, many local people are suggesting that funds should be directed to property *buy-back schemes*. Such a scheme would see local councils and the NSW State Government buying houses and properties built on the foredune. These could then be demolished and the foredune re-established on the vacant land. In several parts of the Northern Beaches such a program is already in operation. The cost is considerable but the long-term costs are likely to be less than maintaining the sea walls and conducting sand-replenishment programs.

Queensland's Gold Coast: a surfer's paradise or an environmental disaster?

The Gold Coast, located in the south-east corner of Queensland, is one of Australia's most densely populated coastal areas. (See figure 1.6.63.) By 2006 there were around 500 000 people living in the Gold Coast region and thousands of tourists staying in the area every week. The region is also one of the fastest growing in Australia, with the population predicted to be close to 690 000 by 2021. (See table 1.6.2.)

The rapid development of the Gold Coast has placed major stress on the coastal environment. The area was originally dominated by a vast, low-lying coastal plain with an extensive dune and barrier system. The plain was criss-crossed by the meandering Nerang River, and this created a complex estuarine system behind the barrier. Now the environment is dominated by massive canal housing estates (see figure 1.6.64), sprawling resort complexes and towering high-rise developments. These housing estate areas were created by dredging the coastal waterways and flattening and

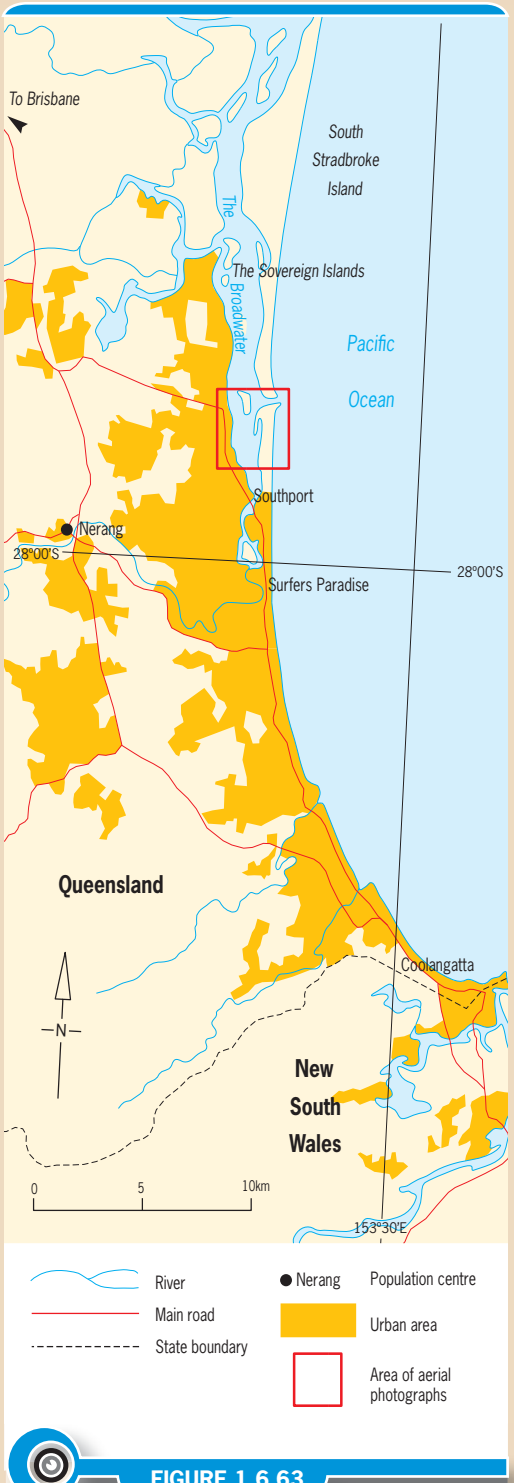


FIGURE 1.6.63

The Gold Coast, with the location of Southport indicated. Source: *Heinemann Atlas*.

TABLE 1.6.2

Projected population increases for the Gold Coast

	Population	Year achieved	No. of years taken
Actual	100 000	1976*	–
	200 000	1986*	10
	300 000	1993	7
	400 000	2000	7
Projected	500 000	2007	7
	600 000	2014	7
	700 000	2021	7

*Indicates approximate year, due to data availability

FIGURE 1.6.64

Canal estates have transformed the complex estuarine environment that once dominated the Gold Coast.

extending existing islands. Such developments dramatically alter sediment flows in the estuaries, which ultimately impacts on the coastal sediment budget.

Many high-rise developments have been built onto the dune system. This has completely destroyed the system and, consequently, the natural processes of sediment flows have been greatly disrupted. During the winter storm season, the beaches are left without a source of sand for replenishment. Where the dune system is partially intact, trampling by tourists as they access the beach has left much of the dune system devoid of the vegetation it needs to hold the sand together. As a result, there is a problem with dune erosion.

Figure 1.6.65 indicates the extent of the human impact on the Gold Coast. These images of the Southport Spit were taken years apart. They show how hotels, housing estates and other developments have transformed the Southport Spit from an extensive barrier system with significant dunes into a far less natural environment.

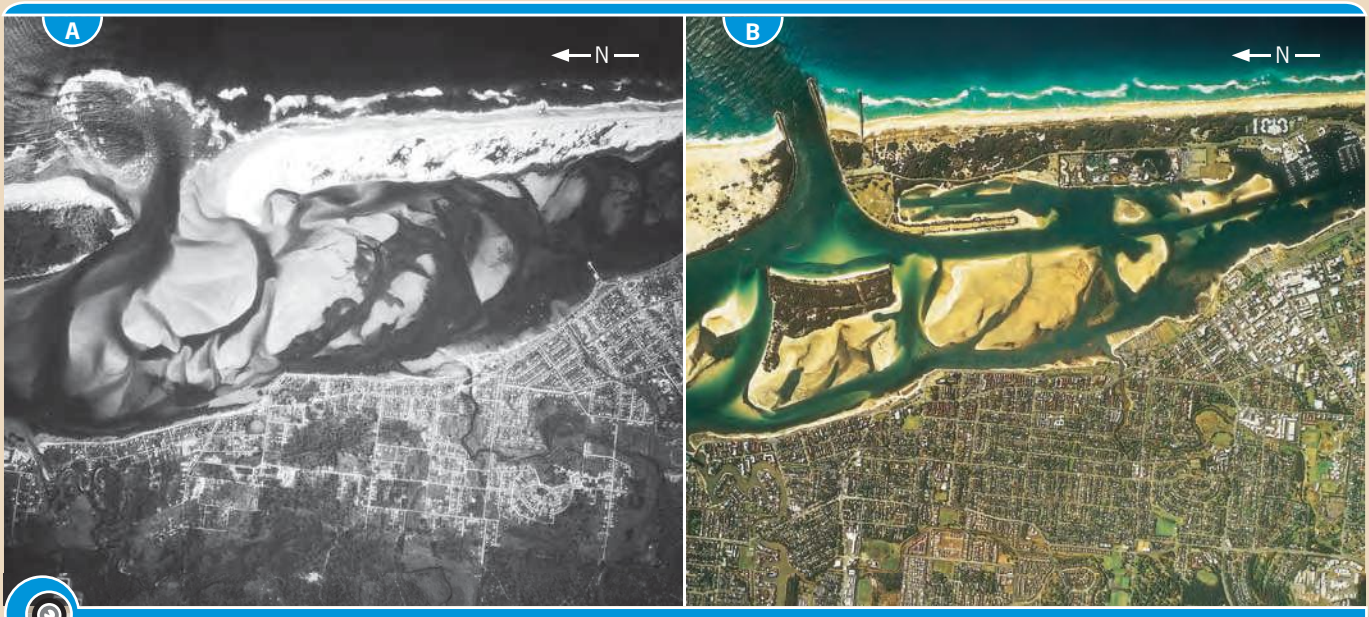


FIGURE 1.6.65

Southport Spit. **A** 1955. **B** 1997.

working geographically

1 **Interpreting photographs** Refer to figure 1.6.59 (p. 168). Describe the construction of the sea wall and suggest reasons why it was necessary to build the wall at this location.

2 **Interpreting photographs** Refer to figure 1.6.60 (p. 168). Explain the cause of the scouring shown in the photograph.

3 **Writing task, constructing photo sketches and role play** Study the Geofocus box 'The Tweed River groynes' (p. 169).
   - a Outline the reasons for the construction of the groynes and their impact on the environment. Assess the effectiveness of the management strategies used to reduce these impacts.
   - b Construct an annotated photo sketch of figure 1.6.62 (p. 169).
   - c Conduct a class role-play of a Tweed Council meeting about whether to demolish the Tweed River groynes. One group will take the perspective of a Tweed River tourist-boat operator, another a fishing boat captain, a third group the perspective of a surfer and the fourth a rate-payer. Each group should present an argument to the council outlining their perspective on the proposal.

4 **Writing task** Study the Geofocus box 'Sea walls on Sydney's Northern Beaches' (p. 169). Write a short report outlining the reason for the sea walls being constructed and their impact on the coastal environment.

5 **Interpreting text and photographs** Study the Geofocus box 'Queensland's Gold Coast'.
   - a Using the data in table 1.6.2, calculate the percentage increase in the population of the Gold Coast from 2007 to its estimated number in 2021.
   - b Write a short report explaining the impact of rapid population growth on the environment of the Gold Coast.
   - c Refer to figure 1.6.64. Outline the human impacts on the natural environment evident from such canal estate developments.
   - d Compare the photographs in figure 1.6.65. Working in small groups, list the ways in which the Broadwater estuarine area changed between 1955 and 1997. Consider whether these changes have been beneficial. Speculate on the impact of these changes on coastal processes. Share the main points raised in your group's discussion with the rest of the class.

FIGURE 1.6.66

Sand replenishment involves replacing lost sand with new sand. This is an expensive exercise and only deals with the symptom rather than the cause of disruption to sediment flows.

Sustainable development and coastal management

The demands that humans place on coasts are many and varied. Humans rely on coastal areas for settlement, economic gain and recreation and as a buffer against the power of the sea. Effective management of this critically important ecosystem can only occur if its managers have a thorough understanding of the functioning of the ecosystem and the processes that operate within it.

By developing an understanding of coastal processes, environmental managers can adopt strategies that allow humans to make use of the coast and at the same time minimise their impact on it. The management strategies we adopt need to be compatible with the principles of *sustainable development*. When we apply the principles of sustainability we are able to identify unsustainable practices. It also allows us to develop plans to better manage our environment. Figure 1.6.67 illustrates the sustainable and unsustainable approaches to the use of coastal resources.

It is important to note that sustainable development is not, in itself, a management strategy. Rather, it is a way of thinking against which specific management strategies can be assessed and evaluated. The central idea of sustainability is that the current generation leaves important environmental assets, such as the coastal environment, in at least as good condition as when we inherited them. Of particular importance is the influence that sustainable thinking has on decision-making processes. Economic and environmental decisions can no longer be made in isolation from each other.

Sustainable development involves reassessing the way in which resource, environmental, social and equity issues are addressed in decision-making processes. It requires us to consider the environmental impact of a development proposal before it is allowed to proceed. If the proposal is likely to have a detrimental impact on the environment, and the impact cannot be successfully managed, then it should be modified or abandoned. Translating the principles of sustainable development into actions aimed at improving the long-term management of coastal areas involves careful planning. (See figure 1.6.70.)

Effective planning can help to minimise the impact of people on coastal environments. (See figure 1.6.68.) Urban and transport planning can, for example, avoid developments that have the potential to degrade the coastal environment. Recreational uses of the coastal environment can be organised

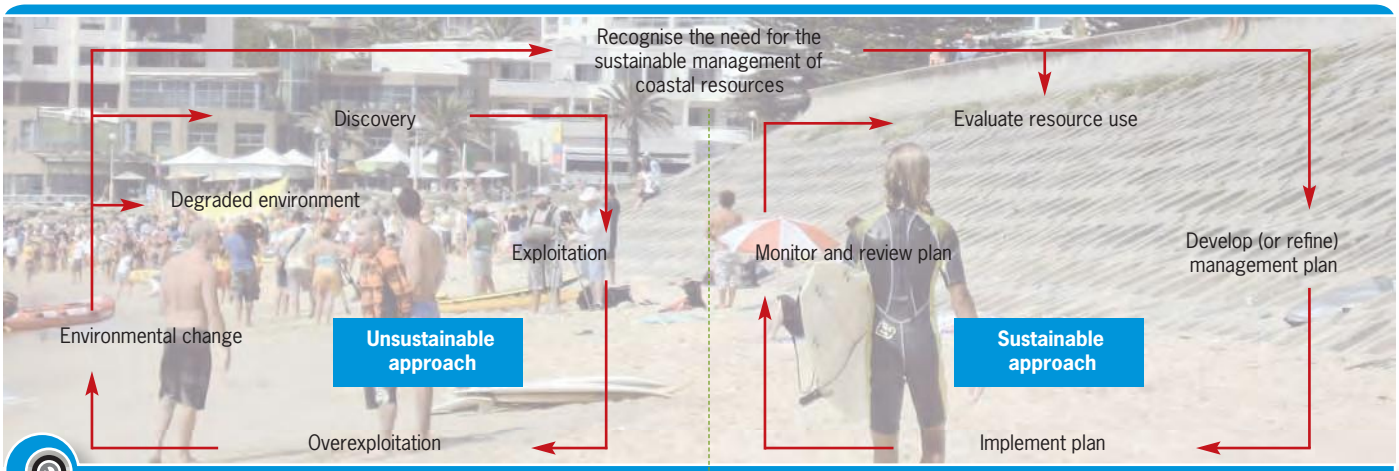


FIGURE 1.6.67

Sustainable and unsustainable approaches to the use of the coastal environment.

in a way that does not concentrate the impact on vulnerable parts of the environment. Pollutants can be intercepted and treated before they are able to degrade the coastal environment. Computer modelling can be used to predict the likely impact of a groyne or sea wall on the flow of sediment.

To achieve its objectives, coastal planning needs to involve all the relevant stakeholders in the day-to-day management of coastal areas. These include the local residents, government departments, industrial and recreational users, the fishing industry and tourism operators.

Management strategies

Using advanced technology and scientific processes, many new developments in the area of coastal management have emerged in recent years. These have enabled authorities to better manage the coastal environment and repair some of the damage caused by poor management practices in the past. Some of these (structural) developments are outlined below.

Of course, the best way to manage our coastal environments is to lessen the impacts that humans have on them. This involves reducing the level of development in coastal areas, particularly on dune fields. By leaving this natural buffer in place we greatly reduce the need for expensive engineering solutions. Such an approach requires the adoption of landuse zoning regulations that control urban development in coastal areas.

Honeycomb sea walls

As discussed earlier, the major problem associated with sea walls is the reflection of wave energy, leading to an increase in scour. Honeycomb walls allow wave energy to dissipate. These walls are built from interlocking *cellular blocks*. (See figure 1.6.69.) The holes in the middle of the blocks are filled with sand, and pioneer grasses are encouraged to take root. The vegetation binds the sand together, reducing the effects of aeolian (wind-related) erosion and trapping wind-blown sands. This replicates a sand dune, and the concrete blocks also act as a defence against severe wave erosion.

Using plants to reduce wave energy

When reed-like plants are grown in shallow waters near the beach they significantly reduce the erosive power of waves. The stems of the plants are a source of frictional drag, which reduces the water's velocity. The roots of the reeds give strength to sediment structures. Figure 1.6.71 (p. 174) demonstrates the effect that vegetation can have on wave height. Given that the height of a wave bears a direct relationship to its erosive power, any reduction in wave height will result in reduced rates of erosion.

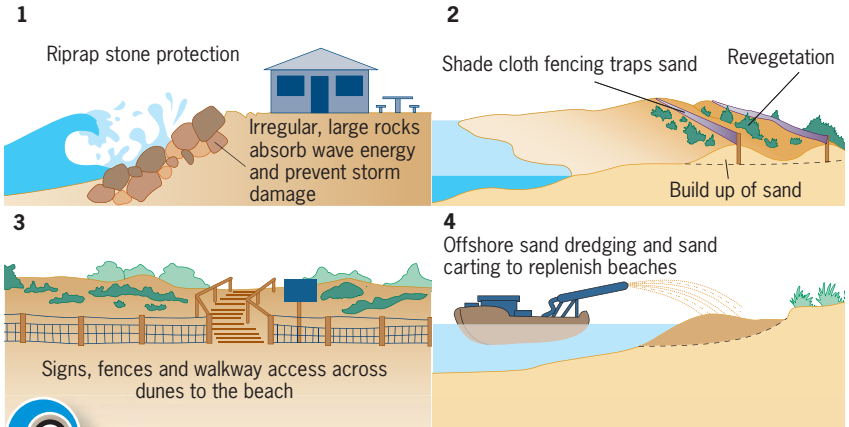


FIGURE 1.6.68

Various approaches to coastal management.

FIGURE 1.6.69

Honeycomb sea walls significantly reduce scour compared with conventional solid walls. Unlike solid walls, honeycomb sea walls absorb, rather than reflect, much of a wave's energy.

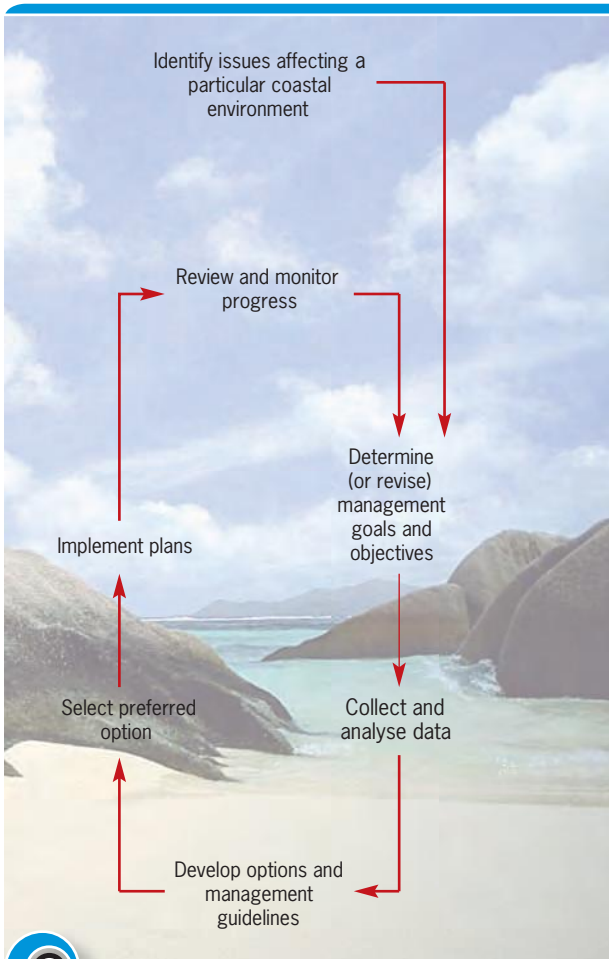


FIGURE 1.6.70

A coastal management plan.

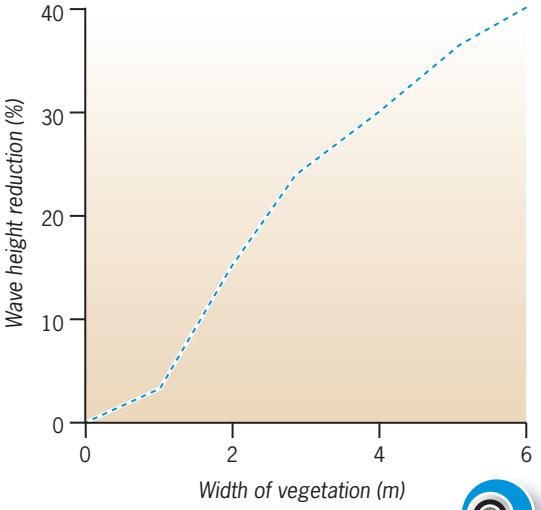


FIGURE 1.6.71

The relationship between vegetation and a reduction in wave height and therefore energy.

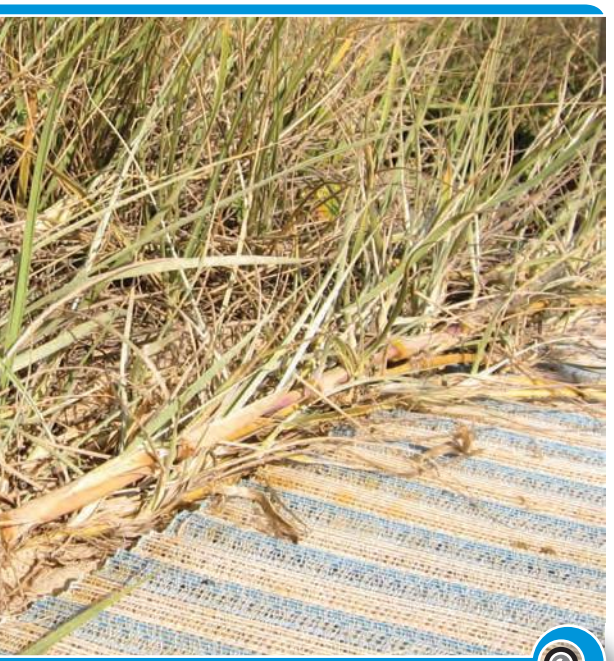


FIGURE 1.6.72

Geotextiles protect seedlings and young vegetation from damage. As the plant grows, the textile simply biodegrades.

When mangroves are used, the power of waves is reduced even further. This demonstrates the need to protect these vital mangrove ecosystems.

A special type of material made from jute is used to protect young aquatic plants from being washed away by wave action. The material, known as *geotextile*, is laid over the top of the seedlings. (See figure 1.6.72.) As the seedlings grow, they push through the material. Eventually, when the roots of the plants are well established, the material biodegrades.

Wave breakers

Rolls of fibre-based material or, in extreme cases, rocks placed inside a wire mesh, are sometimes placed in the shallows. There they help to reduce the velocity of waves hitting the beach.

Dune-protection methods

Dunes are vital components of coastal ecosystems. Easily damaged by humans, they are also one of the most fragile parts of these ecosystems. As the 'Gold Coast' Geofocus box (pp. 170–1) demonstrates, beach users can easily damage dunes by trampling their sand-binding vegetation. By fencing off the dunes, people can be funnelled onto specially constructed pathways. This greatly reduces the amount of disturbance. (See figure 1.6.73.) Well-vegetated dunes reduce the rate of erosion and increase the level of coastal protection.

Sand pumping

Elaborate pumps are sometimes used to move sediment along a coast. They are especially useful where the process of longshore drift has been interrupted, as in the case of the Tweed River groynes.

FIGURE 1.6.73

Fencing off dunes and 'funnelling' beach-goers into walkways is a highly effective and cheap means of reducing damage to dune systems and the fragile vegetation that stabilises them.

understanding the text

1. **Explain** how honeycomb sea walls differ from the more conventional types of sea walls. Why are honeycomb sea walls effective in reducing beach scouring?
2. **Describe** how reed beds reduce the power of waves.
3. **Explain** the role of geotextile in stabilising coastal sediments.
4. **List** the structural and non-structural methods used to protect coastal dunes.
5. **Explain** the best way of ultimately protecting and managing coastal areas.

working geographically

1 **Writing task** Write a newspaper editorial explaining why coastal managers need to have a thorough understanding of coastal processes in order to correctly manage the coastal environment.
2 **Writing task** Study figure 1.6.67 (p. 172). Write a report outlining sustainable and unsustainable approaches to the use of coastal resources.
3 **Interpreting diagrams** Using figure 1.6.71, write a paragraph describing the relationship between wave height and the width of vegetation.
4 **Brainstorming** In a group, brainstorm ideas about ways to protect a dune system, other than fencing it off. Present your ideas to the rest of the class.
5 **Hypothetical** Coastal management evaluation

Background: You are now a coastal management expert. The Jackson Shire Council has asked you to prepare a report on the best ways to manage Golden Beach.

- The beach is heavily developed, with high-rise apartments and hotels built on the foredune area. The parallel dunes have been destroyed, except for a small section. This section is privately owned by a company whose main activity is the development of shopping centres.
- About 10 years ago, in response to repeated requests by local property owners, the local council constructed a sea wall. The wall has increased scouring along most of the beach.
- A sand-replenishment program was developed to replace the disappearing sand.
- A groyne has been built at the southern end to protect a private marina. This has further reduced the supply of sediment.

Task: With your knowledge of coastal processes and the latest coastal management strategies (both structural and non-structural), develop a long-term plan for the protection of this beach.

geoskills 14

Photographic images

Photographs are used extensively to record and illustrate geographical information. Photographs are useful as they:
- record how a place or environment looks at a particular point in time
- allow us to compare different environments
- allow us to study how places and environments have changed over time
- are easy to interpret, and demonstrate relationships between different phenomena.

The most commonly used types of photographs are ground-level photographs and aerial photographs (vertical and oblique).

Ground-level photographs

Ground-level photographs are taken at ground level with the camera held horizontal to the ground. They are particularly useful for showing features in detail, but do not show the spatial distribution or arrangement of features.

Aerial photographs

Aerial photographs are a photographic image of part of the earth's surface taken from an aircraft. They provide a vivid picture of a landscape and allow us to see relationships between elements of the biophysical and built environments. They are also an excellent way of examining the rate of environmental change. Images taken at different times can be compared and analysed.

Vertical aerial photographs are taken from a specially equipped aircraft with a camera pointing directly towards the earth's surface. Because the photograph is taken from directly above, spatial patterns are clearly visible. However, specific features may be difficult to identify because we only see a plan view of them. With practice, vertical aerial photographs become much easier to interpret.

Oblique aerial photographs are taken from an aircraft with the camera pointing at an oblique angle to the ground.

Oblique aerial photographs are often easier to interpret than vertical aerial photographs because the sides of objects can be seen as well as the tops. In addition, the photographs are often more detailed because they are taken at a lower altitude.

The main disadvantage of oblique aerial photographs is that there is no consistent scale. Features in the foreground appear larger than those in the background.

Taking useful photographs

Taking photographs that are useful to geographers involves:
- deciding what the photograph is going to show
- choosing what is to be included and excluded
- including a generally recognised feature that gives the viewer some indication of scale
- choosing the appropriate distance between the camera and the subject
- ensuring that the feature being photographed is centred, and is the focus of the viewer's attention
- ensuring that the technical aspects of the photograph are correct (the lighting is adequate and the picture is in focus).

Interpreting photographs

When interpreting photographs follow these steps:
1 Examine the photograph carefully. Is the photograph an oblique or vertical aerial photograph or has it been taken at ground level? Look for familiar built features that will give you some indication of scale.
2 Identify the photograph's main features. These may be grouped under the following headings:
   - features of the biophysical environment—landforms (such as relief/drainage patterns), climate and vegetation
   - features of the built environment—landuse, transport networks and settlement (rural/urban).
3 Ask yourself the following questions:
   - Is the area predominantly characteristic of the biophysical or built environment?
   - What is the biophysical nature of the environmen; for example, fluvial, coastal, arid, glacial or mountainous?
   - To what extent has the area been modified by humans?

unit 1.7

"To put your hands in a river is to feel the cords that bind the earth together."
Barry Lopez, US author and environmentalist

"A river is more than an amenity... It is a treasure. It offers a necessity of life that must be rationed among those who have power over it."
Oliver Wendell Holmes Jr, US Supreme Court justice

"Streams represent constant rebirth. The water flows in, forever new, yet forever the same; they complete a journey from beginning to end, and then they embark on the journey again."
Tim Palmer, US author and environmentalist

Catchments and River Regulation

By the mid-2000s much of Australia was drought affected. The extended dry spell began in 1998. Four years later came the one-in-100-years drought. In 2006 it was declared a once-in-a-millennium event. Every city, bar Darwin, faced water restrictions. Rivers were reduced to a trickle and Australians were reminded of how reliant we are on the waters carried by the country's rivers.

Sadly, many of our rivers show signs of degradation. Excessive water extraction, regulation by dams, landclearing and salinity all threaten the availability and quality of Australia's water resources. Nowhere are these stresses more apparent than in the catchment of the River Murray.

The Murray is the lifeblood of Australia's farming country. It is a legendary river that flows from its headwaters in the Snowy Mountains to the Southern Ocean. Today it is a river in crisis. Climate change and the onset of a prolonged drought, combined with excessive water withdrawals and salinity, have taken a heavy toll on the river's ecosystem.

In this unit we focus on catchments and river regulation. In doing so we examine how an understanding of biophysical processes contributes to the sustainable management of such environments. The River Murray is examined in some detail.

exam-style questions

extended responses

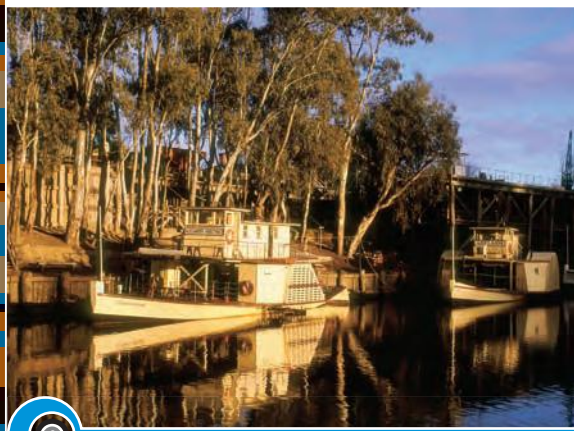
- Describe the factors that determine the nature of rivers and explain the functions of river systems.
- Evaluate the sensitivity of river ecosystems to human-induced and natural change.
- Analyse the importance of an understanding of key biophysical processes for the effective management of catchments.
- With reference to a river you have studied, discuss the advantages and disadvantages of river regulation.
- 'The environmental costs of river regulation outweigh any economic benefit derived from the exploitation of water resources.' Assess the accuracy of this statement with reference to the Murray River system or another river system you have studied.
- Salinity is the most important environmental issue confronting Australia. Write an extended response outlining the causes of salinity in the Murray River system and explain how the problem is being addressed.
- Identify and explain the key biophysical processes that relate to river regulation.

The Murray River: a watery superhighway

In the nineteenth century, the Murray River was one of Australia's busiest trade routes. Paddle steamers plied the waters up and down the river, carrying millions of bales of wool from the sheep stations along the rivers of the Murray–Darling Basin. Most of the settlements along the rivers relied entirely on the paddle steamers to bring in the goods that they required. These goods ranged from food and clothing to machinery and, of course, the steamers also carried passengers.

The port of Echuca, located in north-central Victoria, was one of the busiest ports in Australia throughout the late 1800s. At its height, more than 200 paddle steamers were based in Echuca. The giant wharf at Echuca was built out of river red gums and has three separate levels to cope with fluctuations in river heights, which varies depending on whether the river is in flood or drought. The construction of railways throughout Victoria and New South Wales saw a decline in the amount of cargo carried by the steamers. The paddle steamers were seen as slow and outdated and eventually the trade declined. Many of the paddle steamers were broken up for scrap.

Today, Echuca is a major tourist attraction and several historic paddle steamers continue to operate from the port. Now carrying tourists instead of cargo, they provide a glimpse into the river's once key role in the development of inland Australia.



The vast red gum wharf and historic steamers at the Port of Echuca.

glossary

- **algae** a group of relatively simple plants that generally live in an aquatic or moist environment.
- **aquifer** a layer of rock or gravel that holds water and allows it to move through.
- **artesian** a term applied to a body of water confined in an aquifer.
- **benthic** relating to those plants and animals that inhabit the floor of lakes, rivers and oceans.
- **biochemical oxygen demand (BOD)** The amount of oxygen used when organic matter undergoes decomposition by micro-organisms.
- **biota** all living organisms, including plants and animals.
- **drainage texture** the channel type, density and pattern of a drainage network.
- **environmental flow** a proportion of a river's flow considered necessary to maintain its riverine ecosystem.
- **epilimnion** the surface layer, or stratum, of water in a water body.
- **horizon (soil)** an identifiable layer in a soil profile, distinguished as a result of soil-forming processes.
- **hypolimnion** the bottom layer in a water body.
- **impermeable** a layer of rock through which groundwater cannot pass.
- **infiltration** the movement of water through the soil surface.
- **lentic** referring to still or slow-moving water bodies.
- **lotic** referring to fast-moving water bodies.
- **morphology** the study of shape (of the ground or landscape).
- **organic** living material and its by-products.
- **permeable** rocks or soils that allow water to pass into them.
- **porosity** the degree to which water may pass through matter.
- **regulated** relating to streams and rivers that have their flow controlled by dams or weirs.
- **riverine** relating to a river.
- **runoff** the proportion of rainfall that does not infiltrate the soil and flows into river channels.
- **stratification** appearing to be layered.
- **tectonic** relating to the processes of the earth's crust.
- **topography** the detailed surface of an area.
- **transpiration** the loss of water vapour from plants via the leaves and, to a lesser extent, the stems.
- **turbidity** the clouding of water by the suspended sediment.
- **unregulated** relating to streams and rivers that have not had their flow controlled by dams or weirs.

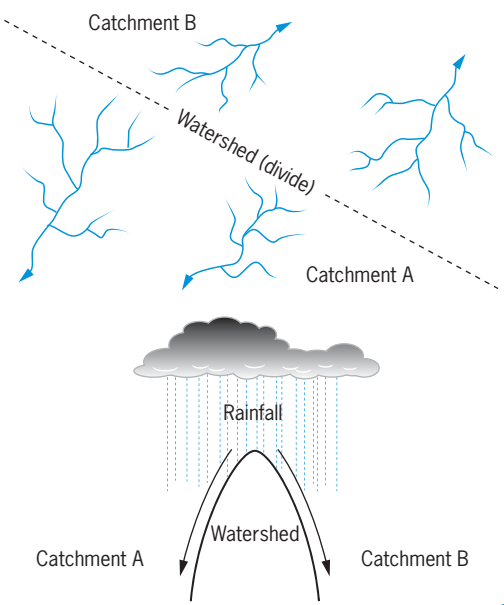


FIGURE 1.7.1

Two river catchments and the watershed that divides them.

River catchments

Rain falling at relatively higher points in the natural landscape will be divided between two river systems. A line joining such points is called a *watershed* and it marks the boundary between river *catchments*. (See figure 1.7.1.) Rivers are generally fed by a network of smaller rivers or streams and these are called *tributaries*. It is possible to study catchments of tributaries or to consider river systems in their entirety. An example of such a catchment is the Murray–Darling catchment, which covers more than 1 million km^2 and is studied in detail later in this unit.

A catchment can be described as an *open system*. It forms part of the *hydrological* or *water cycle*. (See Unit 1.3.) When a catchment is viewed as a system then it is characterised by:

- *inputs*—precipitation (mainly rain and snow)
- *outputs*—water is lost from the system to the sea or through evaporation, **transpiration** (from plants) or human use.

Within the system some of the water is stored, either in lakes or in the soil, or it passes through a series of transfers. For example, it infiltrates and becomes part of the groundwater or it passes into another catchment, in a process known as throughflow. The system is more than a flow of water. The water also transports nutrients, soil and **organic** material. As such, rivers have a crucial function in transforming the lithosphere and biosphere and should, therefore, be seen as more than just systems of the hydrosphere.

FIGURE 1.7.2

Rivers form an important part of the hydrological cycle.

The functions of rivers

Hydrological functions

As noted opposite, rivers are drainage systems that transport water (under the influence of gravity) from higher points to lower points of the **topography**. The systems are generally fed by *precipitation*. However, we cannot say that these systems drain the water to the oceans because this is not always the case. Some rivers drain into lakes (such as Lake Eyre in South Australia) or inland seas, where the water is lost through evaporation. The water flow in unregulated rivers, or those without dams or weirs, responds directly to precipitation in the catchment; although, as we shall see later, there may be considerable rainfall without **runoff** reaching the rivers.

Geomorphic functions

River systems transport many materials, either as solids or in solution. In effect, rivers are part of the mechanism that moves and redistributes many of the products of the weathering that breaks down the catchment's landform features. Given the appropriate river channel and flow characteristics, rivers are able to move substantial-sized boulders.

Unless the flows are particularly rapid, most objects larger than small pebbles tend to be moved along the river bed. It is the finer materials (the sands, silts and clays) that are suspended and carried along in the turbulent waters.

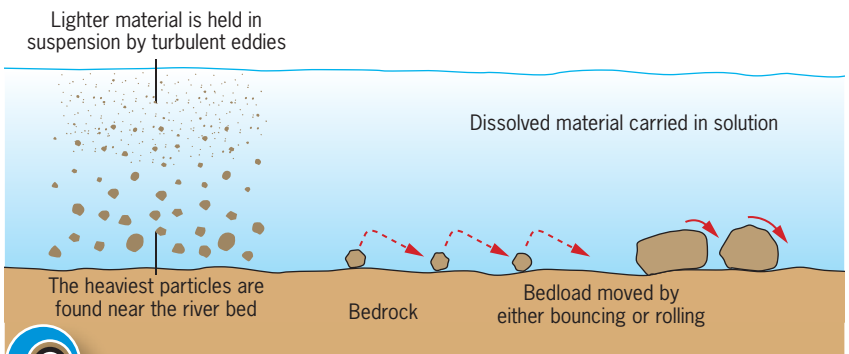


FIGURE 1.7.3

The processes of sediment transport in a river.

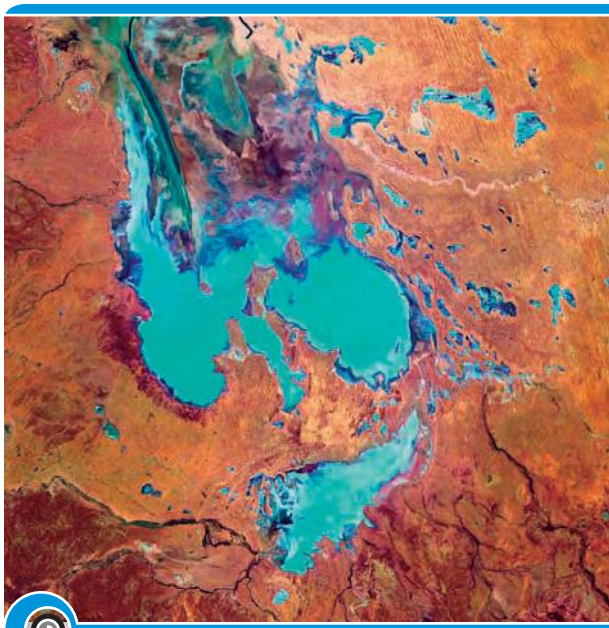


FIGURE 1.7.4

Most rivers flow towards the sea. However, some (such as those in inland Australia) flow towards massive inland lakes, such as Lake Eyre.

did you know?

Lake Eyre covers an area of 9300 km^2 and sits 15 m below sea level. It fills only a few times a century. Lake Eyre can only fill when the rivers of Queensland's channel country in the north-east receive enough water to push through the dry maze of channels on the edge of the Simpson Desert.

FIGURE 1.7.5

Rivers carry vast amounts of sediment, helping to create unique landforms, such as the Ganges Delta in the Bay of Bengal. The delta here is made of sediments derived from the Himalayan Mountains hundreds of kilometres inland.

FIGURE 1.7.6

Rivers support diverse communities.

On its way downstream, the river waters and the material carried in it erode the river bed and banks. Only rocky outcrops resist the action of the rivers. For the banks and gravel beds, however, there is often a process of both erosion and deposition. In essence, there may well be a general downstream movement of material through the system, yet most of the river features may remain relatively static. However, too much supply may create excess deposits that raise the river bed or banks; too little supply may lead to erosion with inadequate replenishment.

Sand, being a coarser material, generally stays within the river channel, where it is suspended by the faster-flowing water. Provided it is not obstructed in its path, the sand may eventually pass from the river system to the coastal zone where it may nourish the beaches. (See Unit 1.6.) While the silts and clays may eventually reach the ocean (see figure 1.7.5), they can also be carried away from the river channel and deposited onto floodplains in times of flood.

Not all processes involving river flow and movement of materials are in equilibrium or balance. Periodically, the geometry of the river becomes unbalanced and the course takes a different path. Evidence of this can be seen in figure 1.7.7. The landform features remaining after this redirection of flow are referred to as *relict* features.

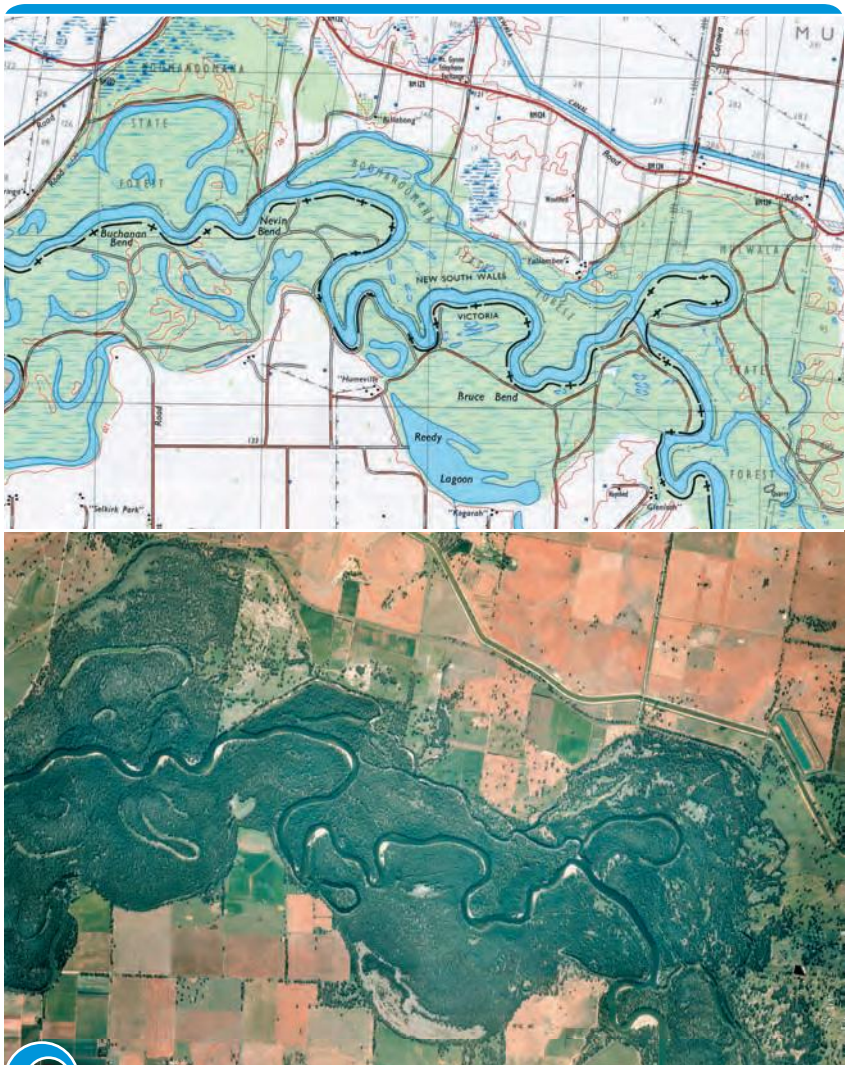


FIGURE 1.7.7

Topographic map extract (top) and aerial photograph (bottom) showing relict river landform features.

Ecological and scientific functions

Rivers are described as **linear ecosystems** because many life forms depend on life-supporting materials passing through their habitat. Major changes to the river environment may threaten the more sensitive plants and animals. Modification of their habitat may jeopardise their ability to reproduce or to seek shelter from predators. In addition, a native aquatic species may be displaced by the entry of another competitor in the food web; that is, an introduced species.

The *aquatic ecosystem* performs a crucial function in terms of the health of the river itself. A balanced system will help maintain good water quality. If all natural checks and balances can be maintained, it will minimise the chance of devastating ecological problems, such as *algal blooms*. The aquatic ecosystem has a certain degree of resilience and can, to some extent, adapt to change and adjust to long-term environmental trends. However, rapid alterations can upset the balance and lead to irreparable *river degradation*. Occasionally, natural events bring about substantial changes, yet it is the human impacts within catchments that almost always represent the key factor responsible for the stress threatening the health of river systems.

Human values

Rivers are particularly important in an economic sense. People rely on them for watering stock, irrigation, domestic and industrial water supplies, hydro-electric power, commercial fishing and river transport. They are also a source of sand and gravel for building and construction. Rivers also offer considerable recreational opportunities. In some locations they are sites of cultural significance, particularly to Aboriginal people. The Ganges River has spiritual significance for India's Hindu population.

understanding the text

1 **Define** the term river catchment. How are the boundaries of a catchment determined.
2 **Explain** why a catchment can be described as an 'open system'.
3 **Outline** the hydrological functions of rivers.
4 **Outline** the geomorphic functions of rivers.
5 **Explain** what happens to the sediment carried by rivers.
6 **Explain** why rivers are referred to as 'linear ecosystems'.
7 **Outline** the ecological functions of rivers.

working geographically

1 **Constructing diagrams** Develop an annotated flowchart that shows rivers as an open system.
2 **Interpreting diagrams** Study figure 1.7.3 (p. 179). Write a report outlining the processes by which sediments are transported by rivers.

What determines the nature of a river?

Nearly all river systems are comprised of a network of tributaries occurring in a hierarchical system or *stream order*. (See figure 1.7.8, p. 182.) When managing river systems it is important to consider that all these water courses are interconnected.

geoskills 15

Topographic maps

A topographic map is a detailed, large-scale map of part of the earth's surface, illustrating selected features of the biophysical and built environments. It shows the height, relief and slope of the land, drainage patterns and vegetation. It also shows a range of built features, such as settlements and transport linkages.

Being able to interpret topographic maps is an important geographical skill. It allows us to:

- locate features of the biophysical and built environment
- describe distributions and patterns
- identify relationships between features.

Legends and map symbols

Symbols are used on maps to show the location of features, such as towns, roads, rivers and vegetation. Many symbols look like the features they represent. The colours used for the symbols may also provide a clue to their meaning. The importance of a feature might be shown by the size of the symbol, the thickness of the line or the size of the printing used. The meaning of each symbol is explained in the map's key, or legend.

The legend is an important part of any map. It allows us to interpret the features shown, and it provides us with information about the scale of the map and the contour interval selected. When working with maps *always* check these details; never assume that the cartographer has used a particular scale or contour interval.

Grid and area references

The location of features on a topographic map can be found by using grid and area references.

Grid lines are a series of numbered vertical and horizontal lines drawn on a map. The horizontal lines are called *northings* and the vertical lines are called *eastings*. Northings are numbered from the south to the north (from bottom to top). Eastings are numbered from west to east (from left to right).

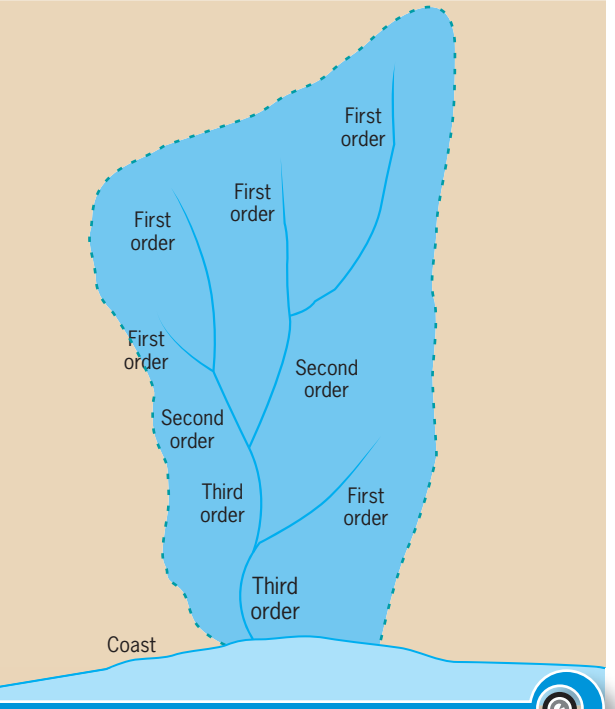


FIGURE 1.7.8

Stream order. First-order streams flow into second-order streams. Second-order streams flow into the larger third-order streams.

river capture a geological event that results in one river or stream capturing or intercepting a part of another.

FIGURE 1.7.9

Rivers that originate in alpine regions will have a highly seasonal flow. Maximum flows will occur in spring as winter snows begin to melt.

There are three relatively permanent factors that influence the character of a river. These are the climate, the geology (the nature of the earth's crust) and the **morphology**, or shape, of the river basin.

Climate

The primary function of the river is to transport catchment runoff to a lower point in the topography. Obviously, the climate, in particular the precipitation and temperature, will have a major bearing on the volume of water flowing directly from the catchment to the river channel.

Higher temperatures will increase the rate of evaporation during and following rainfall and so reduce runoff. Under cold conditions, precipitation reaching the surface as snow has the potential to accumulate and does not provide substantial runoff until it melts in the warmer spring temperatures. Thus, for catchments originating in cold alpine regions, the winter accumulation of snow (see figure 1.7.9) and the subsequent spring thaw results in a marked seasonal flow regime in the river.

Geology

The geology of the catchment affects the nature of a river in at least two important ways. The nature of the soil produced reflects the parent material from which it has been derived. Therefore, the degree of **infiltration** and the nature and amount of sediment yield will be very much a function of the geology. Sandstone-dominated landscapes, for example, produce very porous, sandy soils. Erosion of these soils contributes sand to the river system. The geology will also strongly influence the river channel pattern, either through encouraging the channels to follow fault lines or by encouraging the river to flow through channels that have eroded into weaker rock types.

Although not generally observable in the short term, unless due to earthquakes, **tectonic** activity can have a major bearing on the paths of rivers. If a plateau is uplifted, river gradients can be modified, causing flow reversals and **river capture**. Volcanic activity may also obstruct river channels and cause a diversion.

Figure 1.7.10 shows how the underlying geology of a region can divert water from one catchment into another. Figure 1.7.13 shows the impact of geology on drainage patterns.

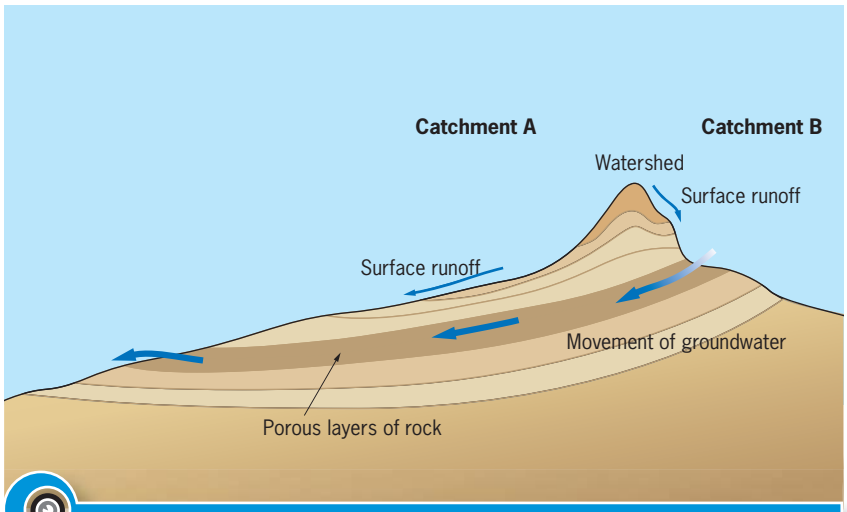


FIGURE 1.7.10

This diagram highlights the relationship between the nature of the lithosphere and river systems. Precipitation falling in catchment B is lost to catchment A as a result of the porous underlying rock and soil in catchment B.

geofocus

River-related terminology

Discharge is the amount of water that flows from the catchment into another river system, the sea or a lake. Discharge (Q) is calculated by multiplying the mean stream velocity (V) by the cross-sectional area (A); that is, Q = A x V. It is expressed as cubic metres per second.

Within a catchment-based river system, discharge (including materials carried by water) is a function of eight major factors: inputs, vegetation, slope, **drainage texture**, infiltration, groundwater, sediment and nutrient yield.

Stream velocity is the speed at which water flows within its channel. Stream velocity is influenced by the following factors:

- *The shape of the channel*. The speed of flow is faster in channels that are as deep as they are wide compared with channels that are wide but very shallow or very deep and narrow.
- *The roughness of the channel's bed and banks*. Water flowing through a channel full of large rocks is more turbulent but slower than water flowing through a channel lined with fine silt.
- *The gradient, or slope, of the river*. As a river approaches the sea, its gradient decreases. However, because the channel is deeper, the velocity of the river actually increases.

Figures 1.7.11 and 1.7.12 show how the velocity of water within a river channel can vary. The slowest flow occurs where the water comes into contact with the river bed and banks.

Stream capacity refers to the ability of a river to transport its load. It is expressed as the amount of sediment that can be moved past a particular point over a specified period of time. Stream capacity increases as sediment size within the channel decreases, and as stream discharge increases.

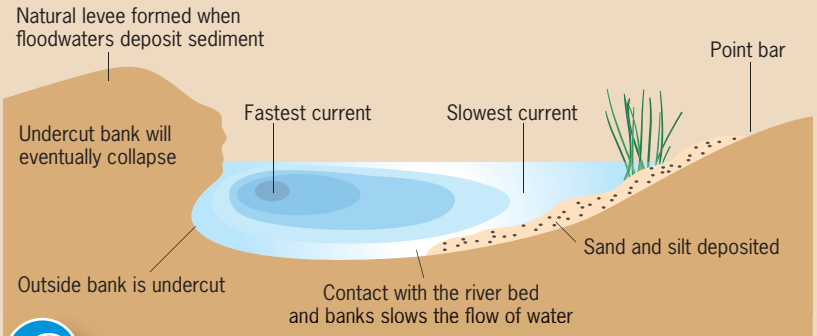


FIGURE 1.7.11

Water velocity in the cross-section of a river.

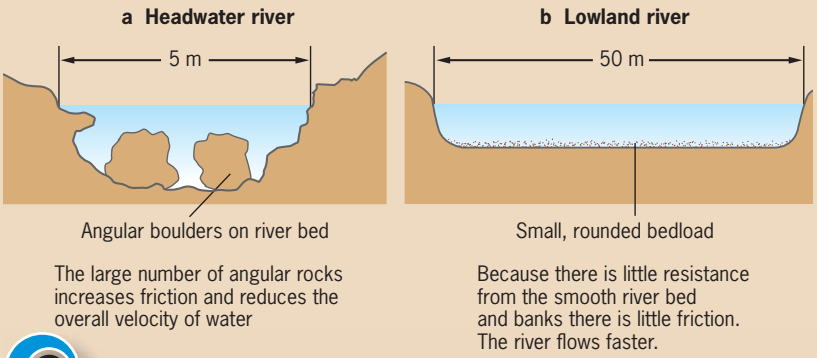
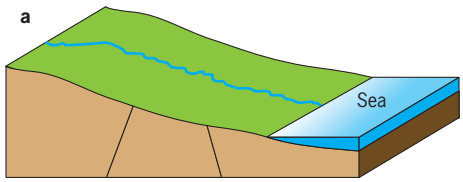
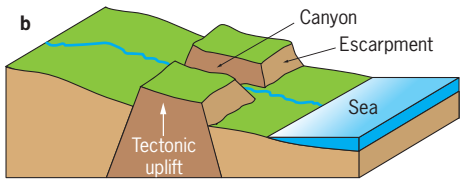


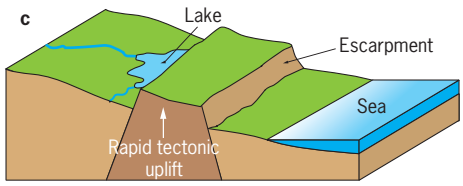
FIGURE 1.7.12

Why a river's water velocity increases towards its mouth.





Slow tectonic uplifts may allow the river to maintain its existing path but result in the formation of canyons or valleys.



Rapid tectonic uplifts can result in changes to drainage patterns and the formation of lakes.

FIGURE 1.7.13

An example of the impact of geological processes on river systems.

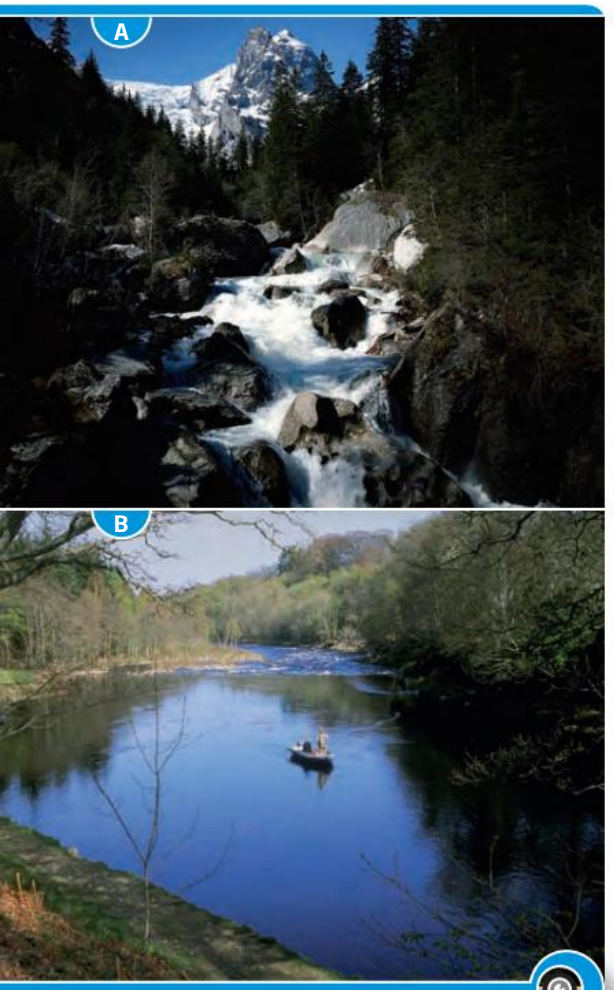


FIGURE 1.7.14

The nature of stream flow is related to the gradient of the land over which it flows. Water in steep mountain rivers (**A**) will flow with greater turbulence than water in a flat landscape (**B**).

FIGURE 1.7.15

The nature of the lithosphere has a major impact on the nature of a river or stream.

River basin morphology

The size, shape and gradient (slope) of the catchment basin will have a considerable bearing on the *discharge rate* of the river. Obviously, large catchments will tend to discharge more water, and over a longer period, than smaller ones. Also a steeper gradient will cause water to drain more rapidly.

The catchment soils and vegetation

Both the nature of the soils and the vegetative cover of catchments will influence the volume and rate of runoff. If soils are sandy, much of the water will infiltrate the soils. The presence of dense ground-cover vegetation will also increase infiltration. In contrast, impermeable clay-rich soils, or

geoskills 16

Measuring the discharge of a river

A simple way to assess the flow of water in a small creek is to measure the rate at which a barely floating object, such as an orange, moves down a measured distance of the channel. Here are the basic steps:

1. Locate a relatively straight section of creek about 10 to 20 m long.
2. Mark the beginning and end of the channel, measure the length and mark the mid-point.
3. By measuring the depth of the cross-section of the channel (at, say, intervals of 1 or 2 m), calculate the area of the cross-section at each end and at the middle. Calculate the average cross-section in square metres.
4. By multiplying the cross-section by the length of the channel being used, calculate the stream volume over that section in cubic metres.
5. Release an orange at, say, five equally spaced points across the stream. Calculate the average time, in seconds, for the orange to pass from the upstream to the downstream limits of the channel.
6. Now, you can calculate the discharge because you know the volume of the water in the channel and the time taken for that water to move downstream. Use the following formula.

$$\text{Discharge} = [\text{volume } (m^3)/\text{time (seconds)}] = m^3/\text{second}$$

Note: This method provides only an approximation because the floating objects may not follow direct paths downstream.

geoskills 17

Investigating river sediment load

1. Should the opportunity arise where rapidly flowing water carrying heavy sediment can be collected safely, collect several 1-L samples of water in a turbulent part of the stream. Also collect several 1-L samples from a more sluggish part of the same stream.
2. Shaking the water first, pour the samples into 1-L measuring cylinders and allow the sediment to settle. Are there differences in the sediment? What would you expect to see?
3. Let the samples stand for a couple of days until most of the sediment has settled.
4. Carefully drain off the water, collect the sediment and let it dry.
5. After weighing the sediment, you are in a position to calculate the mass of suspended sediment per unit volume of water. If you could measure the runoff, you could then estimate the total mass of sediment being removed.

soils saturated from previous rainfall, with little vegetation cover will yield the most runoff and the highest flood peaks.

The water that infiltrates the soil may be added to the **groundwater**, which may slowly flow into the river system. Due to the delay in the passage of this water, it provides a more constant **base flow** in the river. This will be examined in more detail later in this unit.

Depending on soil type and extent of vegetation cover, heavy rains will cause sediment and organic matter to be washed into rivers. Thus, the water quality in the river is dependent on the conditions and land management in the catchment. It is also obvious that runoff can include nutrients and pesticides that have been used in agricultural activities in the catchment.

River channels

As water passes over land, there is a degree of resistance, which slows down the movement of water. This resistance is caused by friction. Water even travels more rapidly in *rills*. These are the smallest component of the drainage system, measuring 2 or 3 cm in width, and are formed by the merging of **sheet flow**. Thus, a well-defined pattern of rills, rivulets and channels will increase the speed of runoff and, again, increase flood peaks. The more developed the drainage network, the more rapid the flow of water.

groundwater water beneath the earth's surface that fills pores between materials, such as sand, soil or gravel.

base flow streamflow originating entirely from ground water discharging to the stream; also known as basal flow.

sheet flow runoff that flows over the ground as a thin, even layer rather than concentrated in a channel.

FIGURE 1.7.16
Flooded urban area, Newcastle, 2007.

FIGURE 1.7.17
A stormwater drain.

geoskills 18

Investigating the relative proportions of sand, silt and clay found in a soil

1 Use three or four soil samples of 200 g each placed in a container. Preferably one of your samples will be rather sandy and one will have more clay.
2 Break down the soil into small clods. Then, to each sample, add a heaped teaspoon of Calgon (or an equivalent water softener) and add about 500 mL of water. Allow the samples to soak for a few minutes.
3 After the samples have soaked for five to 10 minutes, stir them until they have broken down.
4 Pour the samples into 1-L measuring cylinders. Top up the solution to the 1-L mark. Carefully, invert the cylinders a few times and then stand them upright. Note the time each cylinder is left to stand.
5 Measure the depth of sediment that has settled after periods of five minutes, two hours and several days. These measurements will provide a rough indication of the relative proportions of sand, silt and clay in the soil.

Note: More precise methods using hydrometers may be found in good texts on soils.

The most efficient channel shape is deep and almost semicircular, with minimal obstructions and smooth channel beds and banks. Engineers employ these principles in designing stormwater channels. (See figure 1.7.17, p. 185.) This is particularly important in urban areas where there is a lot of impermeable ground cover (concrete and asphalt). In such an area, unless there is a well-designed network of drains and storm-water channels, local flooding will be common. (See figure 1.7.6, p. 185.) Of course, if the drains are efficient and effective in removing local water, the problem of flooding does not disappear. Instead, it is simply transferred downstream where it may become someone else's problem.

geofocus

Aquatic ecosystems

The stream banks and beds are more than just the physical boundaries of the river channel; they are part of the aquatic ecosystem. A simple classification of **riverine** compartments is shown in figure 1.7.18. In many ways there is an interrelationship between the compartments: the *fringing* compartments provide shade and shelter; the *pelagic* compartment provides the area for fish and other organisms to swim or drift; and the **benthic** zone provides a source of food for fish and waterbirds.

The velocity of the river flow has a very strong influence on the characteristics of the aquatic zone. Slower-moving waters, or **lentic** environments, will have greater amounts of debris along the river bed, which will be silty or muddy. By comparison, **lotic** environments, with faster flows, will have less fine sediment on the river bed and be relatively clear of debris. The more turbulent flow will also ensure a greater degree of mixing, giving a more even water temperature and ensuring good *oxygenation* of the river to some depth.

Slow-moving rivers or lagoons and billabongs do not experience similar mixing, unless put in motion by strong winds.

Particularly in the summer, the upper layer of water is heated by the sun. This causes a layering, or thermal **stratification**, to develop. (See figure 1.7.19.) In deeper waters of 5 or 6 m and more, the **epilimnion** (surface layer) becomes less dense through warming. It remains floating over the cooler, dense **hypolimnion**. Even when wind moves the surface, provided the resultant turbulence is not excessive, the epilimnion will continue to circulate independently. The stratification restricts the degree of oxygenation in the hypolimnion. The anaerobic (oxygen-free) conditions can cause the production of elements that are toxic to some living organisms. The problem is greatly exacerbated when there is a large amount of decaying river material with a high **biochemical oxygen demand (BOD)**. Many fish and other marine life cannot exist in these stressed conditions.

Due to the flow velocity, lotic environments are less likely than lentic environments to have a wealth of *benthic* (river-bed dwelling) organisms. Nor will they include the single-celled floating plants, the phytoplankton or **algae**. These are more likely to be found in lentic systems and form the basis of a distinctly different food web. Due to the greater diversity of conditions in a lentic environment, a greater range of organisms will flourish there. Although, as indicated above, some compartments may not be suitable for some biota.

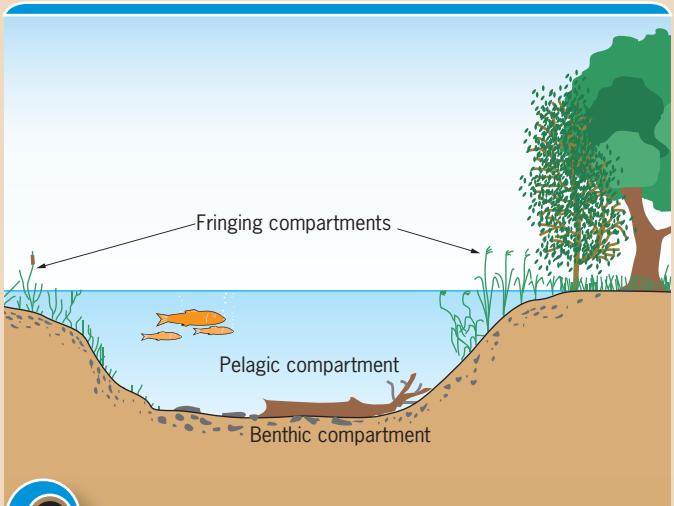


FIGURE 1.7.18

Cross-section of a typical river, showing the major compartments.

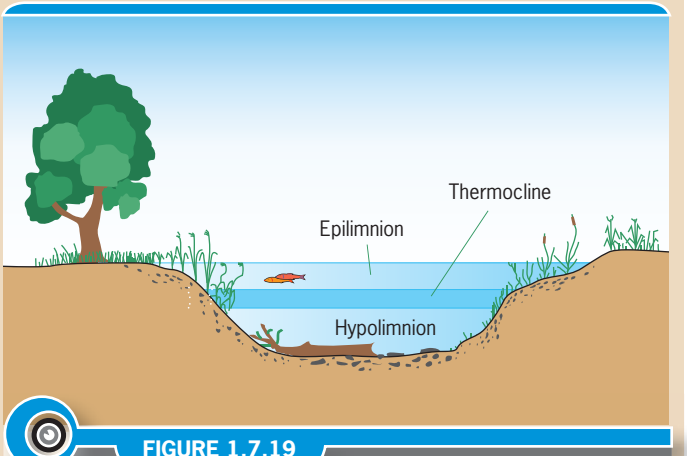


FIGURE 1.7.19

Thermal stratification in a slow-moving river environment.

geofocus

Floods

A *flood* occurs when water overflows its natural banks onto the normally dry land. Floods are caused by extended periods of rain, rapid winter snow thaws or heavy thunderstorms. While floods occur under natural conditions, the activities of people in catchments have led to a sharp rise in the number of deaths caused by flooding. Flash floods are a serious problem in urban areas where drainage systems are unable to cope.

While floods may disrupt plant and animal communities in the short term, their long-term effects are likely to be beneficial. Floods flush out river systems. They break up algal blooms and dilute concentrations of salt, nutrients and other pollutants. They also cover the land with a layer of rich alluvial soil.

understanding the text

1 **Outline** the major factors that influence the nature of rivers.
2 **Explain** the effect of geology on river systems.
3 **Define** the term river discharge.
4 **List** the factors affecting stream velocity.
5 **Describe** the relationship between soils and river flow.
6 **Explain** why land management is important in terms of water quality.
7 **Explain** the link between drainage texture and the flow of water.
8 **Describe** the most efficient channel shape. Explain why this shape is the most efficient.

working geographically

1 **Interpreting diagrams** Study figure 1.7.8 (p. 182). Write a paragraph explaining the concept of stream order.
2 **Writing task** Study figure 1.7.13 (p. 183). Write a brief report describing the impact of tectonic processes on the rivers shown in parts **b** and **c**.
3 **Map/fieldwork study** Using a topographic map or an appropriate local river, identify influences of geology/topography on the path of the channel.
4 **Interpreting diagrams** Study figure 1.7.10 (p. 182). Explain how precipitation that falls in one catchment can be diverted into another.
5 **Constructing diagrams** Draw a diagram representing the losses from precipitation on its path over the catchment to the river.
6 **Interpreting diagrams** Study figures 1.7.11 and 1.7.12 (p. 183). Explain why average stream velocity increases as it approaches its mouth.
7 **Interpreting diagrams** Study figure 1.7.12 (p. 183). Explain the variation in stream velocity in the cross-sectional profile of a river.
8 **Fieldwork** In a relatively natural outdoor setting, trace the path of overland flow via identifiable rills and rivulets. Possibly photograph the path taken by water in several situations for the purposes of comparison.
9 **Writing task** If few signs of the path of water are evident in the previous activity, write a paragraph or two about likely reasons why this may be so.
10 **Fieldwork and fieldsketching** In a natural setting, what evidence is there that sediment is being transported through the catchment? Sketch the settings where sediment is evident.
11 **Fieldwork** Select a suitable river with which you are familiar. Compile a list of the uses of the chosen river. Underline the most essential uses.
12 **Interpreting topographic maps** Using a topographic map, determine the change in the gradient of a river as it moves from its headwaters to its outlet. Divide the river into categories showing the steep, intermediate and gentle gradient sections. Taking care to read the contours and measuring the distances along the river channel, determine the approximate maximum and minimum gradients that you can distinguish.
13 **Interpreting text** Study the Geofocus box 'Aquatic ecosystems'.
   a Describe the functions of the fringing, pelagic and benthic compartments.
   b Distinguish between lentic and lotic environments.
   c Outline the conditions under which toxic elements are produced in slow-moving rivers, lagoons and billabongs. What impact do they have on fish and other marine life?

Fluvial landform features

There are a wide variety of fluvial landform features. This diversity is a product of the interaction between river hydrology, geology, riverine vegetation and topography. High relief is associated with V-shaped valleys and waterfalls. Low relief is associated with floodplains, deltas and levees,

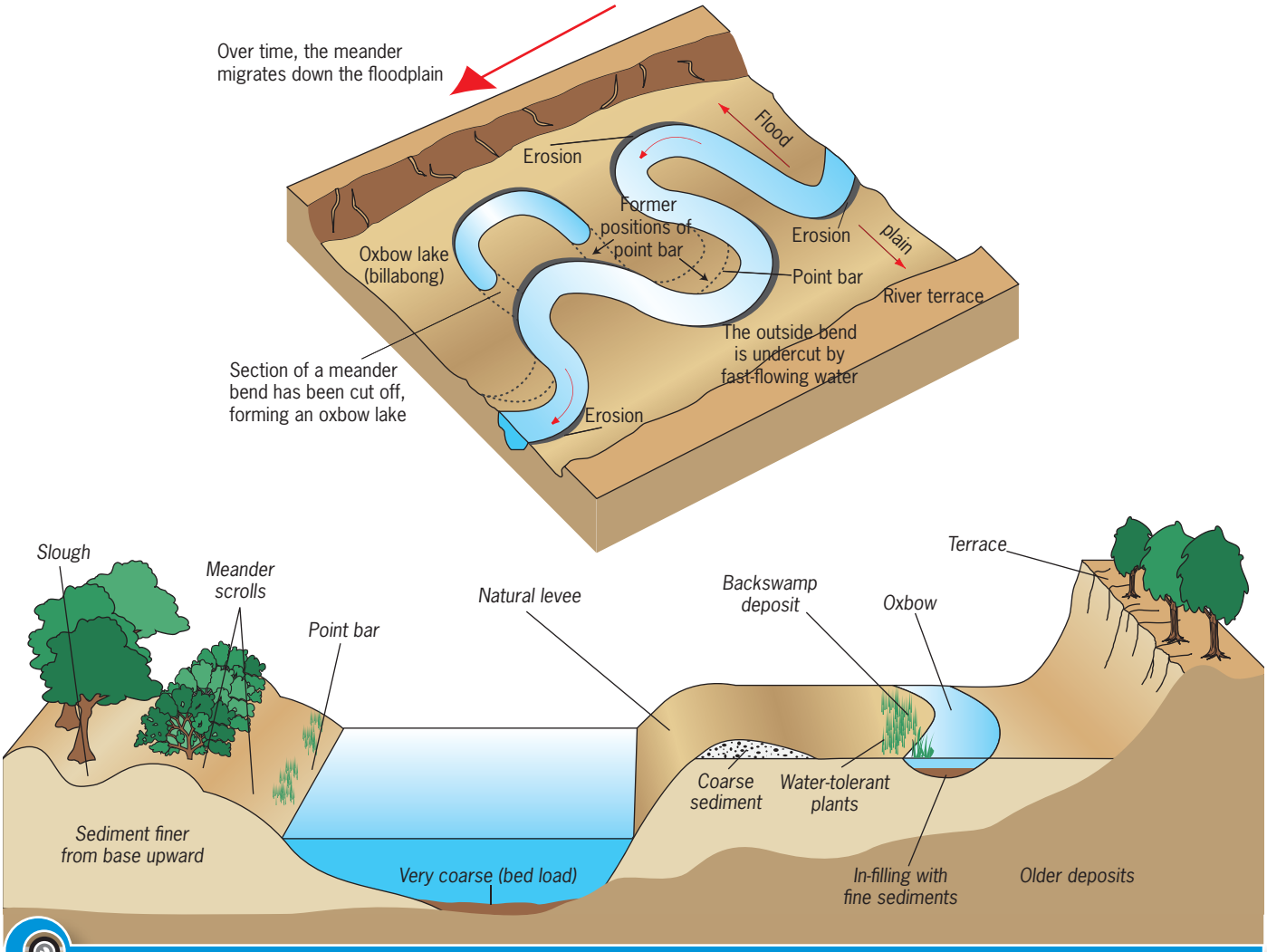


FIGURE 1.7.20

Typical fluvial landform features found along a river valley.

braided stream a network of converging and diverging streams separated from each other by narrow strips of sand and gravel.

FIGURE 1.7.21

A braided river channel.

which are established through the deposition of flood-borne sediments.

The flow rates and the ratio of discharge to sediment load are factors leading to the development of **braided streams** and meanders. Braided streams occur in steeper gradients and where the banks are formed from easily eroded materials. Deposition of sediments followed by flooding may well be the major trigger factors that cause meander patterns to change.

Braiding

When a river becomes choked with sediments it will divide into a series of diverging and converging channels. The 'islands' are known as *eyots* and each channel is referred to as an *anabranch*. Braided channels are common in regions with relatively short periods of high discharge and heavy bedloads, such as alpine and semi-arid areas. (See figure 1.7.21.) Braided rivers are commonly found in high alpine rivers, particularly where glaciers have created considerable debris fields. For example, there are many braided rivers found on the west coast of New Zealand's South Island.

Meanders

A widely recognisable feature of rivers is the development of meanders, which are the repeated curves of the river channel. *Meanders* are best

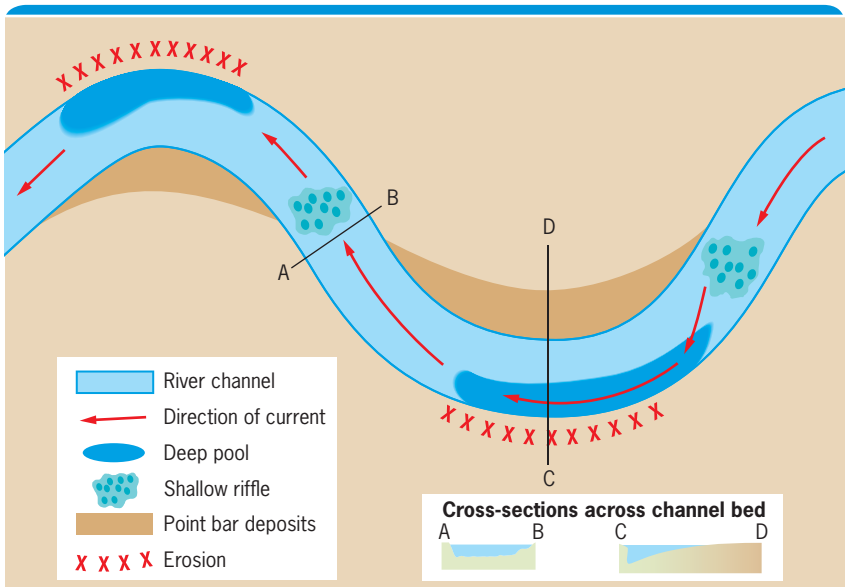


FIGURE 1.7.22

Features of a meandering river.

developed where rivers flow at low gradients through the alluvial deposits in the middle and lower reaches of a river system. It was once thought that obstructions, such as fallen logs and large rocks, diverted the river channel. However, laboratory testing designed to recreate the flow of water in river channels revealed that, even on the smoothest surface, water followed an irregular wave-like pattern of flow. This pattern is shown in figure 1.7.22. The development of an alternating deep *pool* and shallow *riffle* sequence in the river channel is now regarded as being responsible for the deflection of the water within the river channel and for the development of meanders.

It appears that as water travels through a riffle it is deflected onto the outside bank at the next bend by **centrifugal** forces. As the river scours and undercuts the outside bank, the meander migrates outwards. Point bar deposits build up on the inside of the loop on what is known as the slipoff slope.

Oxbow lakes and meander scars

The meander loops in the river channel grow larger and larger until

geojobs

Fluvial geomorphologist

Geomorphologists study the way that landforms are created and changed by natural processes. Fluvial geomorphologists examine the role of water in these changes. Many fluvial geomorphologists work on river systems to examine the behaviour of river processes. They also study the potential for human impact on these processes and therefore on the rivers themselves.

centrifugal moving or directed away from the centre.

laminar flow water moving in smooth layers around an object.

geoskills 19

Investigating river beds

1. Choose a section of a river where you can study one complete meander loop.
2. Study the bed of the river and identify the deep pools and shallow riffles. Describe the nature of the streamflow in the pools and over the riffles. (Is it turbulent or **laminar**?) As energy is lost through friction, what part of the meander loop will experience most erosion?
3. Draw a sketch of the meander loop, labelling the pools and riffles, and the direction of streamflow. Identify sites of erosion and deposition.
4. Observe the bend in the meander loop and draw a profile across the river channel. Label the undercut bank and the point bar deposits.
5. How would you expect the position of the river channel to change in the future?

geoskills 20

Investigating river banks

1 Study the banks of the channels of your local creek.
2 Look for the layers of muds (the deposits of fine material from suspension) and sands and gravels (the deposits of bedload).
3 When there is little evidence of deposition try to identify those parts of the stream profile where some deposition occurs. This would include those parts of the channel where stream velocity decreases and deposition is most likely. Draw an aerial view of the channel, labelling the areas of deposition.
4 Work out the sequence of deposits; that is, the layers of silt. These become progressively finer upwards, often with a sharp break at their base. Such sequences are usually the product of a single storm or a flood. As the flood recedes, the movement of the bedload will cease first. Then the finer suspended material will settle.
5 Draw a profile of the bank, labelling the different layers of deposits.
6 Collect past rainfall data for the catchment. Report on any correlation you can make between these data and recent deposits.

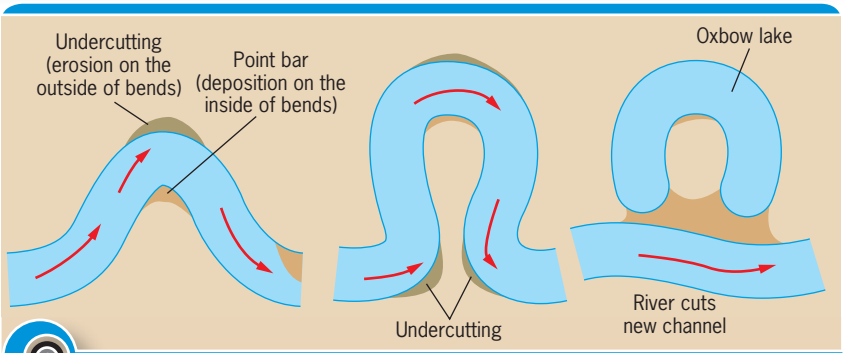


FIGURE 1.7.23
The formation of an oxbow lake.

understanding the text

1 **Outline** how the biophysical environment interacts to produce the diversity of fluvial landform features.
2 **Describe** the conditions that are likely to create a braided river.
3 **Describe** a river meander.
4 **Explain** how natural levees are formed.

working geographically

1 **Writing task** Write a report describing the changes in the form of a river from its upper reaches to the end of its course. Use as a model a river with which you are familiar and/or use a topographic map to provide information.
2 **Writing task** Study figure 1.7.22 (p. 189). With the aid of an annotated sketch, write an explanation outlining why rivers develop meanders in their lower reaches.
3 **Interpreting diagrams** Study figure 1.7.23. Explain the formation of oxbow lakes.
4 **Constructing diagrams** Draw your own annotated block diagram to illustrate the fluvial landform features of the valley floor.

the channels almost meet. During floods, there is an increased volume and velocity of discharge in a river. This may cause the river to cut straight across the narrow neck of land separating two *meander loops*. The old, abandoned sections of the former channel are called *cutoffs* or *oxbow lakes*. These, in time, will fill with sediment, becoming *backswamps* or *billabongs*. Eventually, backswamps dry out and become vegetated depressions known as *meander scars*. (See figure 1.7.23.)

Floodplains

Casual observers of river floodplains often assume that past flooding built the broad, flat areas adjacent to the channel. This is indeed the case within confined river valleys where lateral movement of the river channel is restricted by the nature of the topography or geology of the catchment. In these circumstances, over-bank deposits of sediment during flooding are largely responsible for floodplain development.

In broader valleys, however, closer study has revealed that both erosion and deposition are constantly taking place within the river channel. There is an accumulation of material deposited on the inside of meander curves as the river migrates laterally. It is this buildup that is largely responsible for the development of the floodplain.

Natural levees

A floodplain, as the name implies, is normally inundated in times of peak flows. As the sediment-laden floodwaters spread out across the floodplain they quickly lose velocity. Much of the suspended silt and sand will settle on the ground. The greatest amount of deposition is adjacent to the channel. This causes a natural levee of elevated ground to develop on either side of the main channel.

The river as a system

This section will focus on the river as a system. This approach provides an opportunity to study the inputs and outputs, and how these influence a natural system. It also provides a framework for identifying the nature and extent of human impacts on rivers. Thus, each major component of river systems will be studied and followed by a review of the human impact on that component.

River catchments and runoff

The catchments that collect water for the rivers can be viewed as simple input/output models. The inputs are generally precipitation, but may also include water introduced from other catchments or sources.

The loss of inputs is substantially in the form of *evaporation* from land, vegetation and water surfaces, and transpiration from growing vegetation. Water that infiltrates the ground surface and is not taken up by vegetation may eventually pass through to the river system via groundwater flows. Water that passes deeper into **artesian** beds may be lost from the catchment altogether. The remaining water passes as *overland flow* or runoff to the river. Depending on the nature of the rainfall and land management in the catchment, other inputs arriving at the river include eroded material, nutrients, organic matter and, particularly from some groundwater additions, high levels of salts.

We can express the relationship between the inputs (rainfall) and their pathway in the following form.

inputs = runoff + evaporation + transpiration + groundwater + loss to other catchments + change in soil/surface storage

Alternatively, the relationship can be expressed in the following form.

runoff = inputs – evaporation – transpiration – groundwater – loss to other catchments – change in soil/surface storage

The amount of runoff (and the sediment and other materials carried by it) entering rivers is dependent on the nature of the rainfall, and the soils, vegetation cover, natural processes and land management. The vegetation, for example, causes a degree of ponding (or water retention) over the catchment surface. This impedes the flow of surface water, which helps to increase the infiltration of surface water into the soil.

Human-induced impacts on runoff

Humans still don't have a clear understanding of all the factors that control climate. For example, scientists are still assessing the extent and likely impacts of climate change, which include potential shifts in weather patterns and changes in rainfall and temperature. There is also little understanding of the effects of large-scale deforestation on local climatic modification.

More water can be made available in a catchment by transferring water across its watershed. Water can be harvested from one catchment and diverted to another via pipelines, tunnels and canals. Such diversions are generally undertaken for economic reasons. Apart from the production of hydro-electricity, the purpose of the Snowy Mountains Hydro-Electric Scheme in southern New South Wales was to divert waters to the drier inland areas of south-eastern Australia, where it is used to irrigate crops. (See figure 1.7.24.)

Attention should also be directed towards the rivers that are deprived of water as a result of such diversion. The ecology of the Snowy River,

FIGURE 1.7.24

The Snowy Mountains Scheme diverts eastern-flowing rivers to the western side of the Great Dividing Range. This water is used to support massive irrigation projects, such as the Murrumbidgee Irrigation Area.

geofocus

Human impacts on the Chattahoochee River

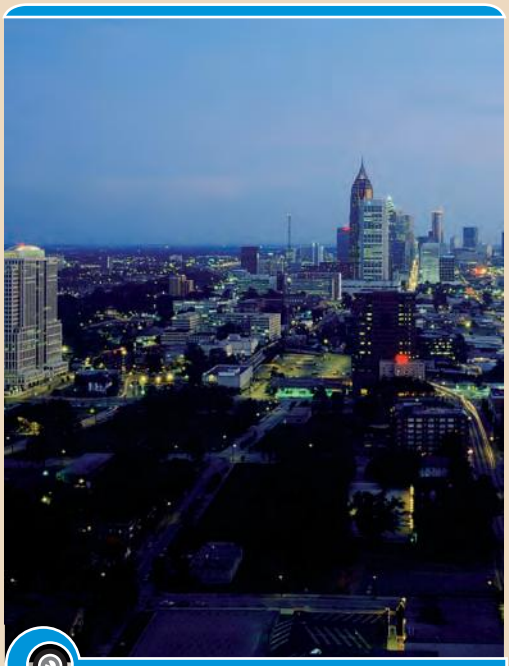


FIGURE 1.7.25

Atlanta is one of the fastest-growing cities in the United States and has had a severe impact on the Chattahoochee River, which flows through it.

The Chattahoochee River flows through the US state of Georgia and past the sprawling city of Atlanta, where it becomes heavily polluted by human activities. Atlanta has a population of more than 5 million and is one of the fastest-growing cities in the United States. It relies on the Chattahoochee River and a nearby lake for its water supply, but the river is fast becoming an environmental disaster.

Urban runoff is a major problem with pesticides, oil and other contaminants entering the river through the many stormwater pipes that flow directly into the river. Another major issue is the disposal of sewage. Between 1.5 million and 3.6 million L of treated sewage and stormwater is discharged into the river every day. This discharge increases nutrients, especially nitrates and ammonia. These nutrients affect aquatic life and increase the growth of algae, which consume oxygen. This reduces the amount of fish, native river plants and other life.

Atlanta faces problems with cracked and leaking sewerage pipes that allow untreated sewage to flow directly into the river. On several occasions local authorities have been fined for breaching federal laws by allowing pollution to enter the river.

Upstream from Atlanta there are major problems with agriculture causing an increase in sediment flows and allowing manure, pesticides and herbicides into the river. Landclearing leading to soil erosion is the main cause of sedimentation. One study estimated that soil erosion is so severe that enough sediment flows down the Chattahoochee River and its tributaries to cover 800 ha of land with mud to a depth of more than 20 cm every day.

The impact of sedimentation on one fish species in the river, the bluestripe shiner, has been widely studied. The fish uses cracks in the rocks along the river bank to lay eggs. As sediment levels have risen, cracks have filled with mud and the fish is now in widespread decline.

for example, has suffered because the majority of its spring flush from melting snow is now directed westwards into the Murray River system. The river now shows the effects of excessive silting. In time, however, the river channels and banks and their vegetation will adjust to the new flow regime.

Sediment and nutrient yield

Weathering, soil formation and erosion are naturally occurring processes that, unless there is further tectonic uplifting, eventually result in a virtually flat landscape. The removal and transportation of the weathered material and some topsoil is part of this natural system in which the rivers play a significant role. In a system that is in equilibrium, the inputs will closely follow the outputs. For example, eroded river banks may often be replaced by newly deposited landforms; although the gradients of the rivers will steadily be reduced.

The biophysical environment will also generate naturally occurring nutrients, both from the soil and biotic material (from plants and animals). Again, apart from exceptional events, river systems find a balance between these inputs (that is, the river ecosystems) and the outputs.

Human-induced impacts on sediment and nutrient yield

Sediment yield rises following disturbance of the soil surface, particularly if the protective vegetation is removed and the runoff is increased. Faster sheet-water flows will ensure that more sediment flows into rivers. If the land is used more intensively and fertilisers are

FIGURE 1.7.26

Urban sewage-treatment works can dramatically increase nutrients levels in rivers.

applied, the chance of higher nutrient loads reaching the river systems also rises. Similarly, intensive stocking, the development of feed lots and urban sewage-treatment works (see figure 1.7.26) all have the potential to contribute to the nutrient load of the river.

The major reservoir supplying Sydney is Warragamba Dam. From its earliest days, restrictions were placed on activity on the slopes draining into the reservoir to ensure that siltation and pollution of the water supply were minimised. This was quite appropriate because the hillsides draining directly to its waters were naturally well-vegetated and needed to be carefully managed. In addition, the waters themselves were strictly policed to ensure nobody trespassed in the area. However, nutrient-rich sediment was already accumulating in the reservoir, and it would seem that the managers were unaware of the problem or simply chose to ignore it.

Lake Burragorang, the water body formed by Warragamba Dam, is receiving millions of tonnes of sediment annually. This in itself is worrisome because the sediment is potentially toxic. Of even greater concern is the volume of nutrients entering the dam. The nutrients, attached to the sediment, are transported into the aquatic system, predisposing the system to eutrophication. *Eutrophication* is the addition of plant nutrients into water. It often causes a rapid increase (bloom) in the growth of algae. (See figure 1.7.27.) The death and eventual decomposition of the algae results in a release of toxins, which can harm animals. It also lowers the oxygen level until the water cannot support aerobic (air-dependent) organisms.

The catchment: factors affecting yield

The factors affecting yield within a catchment include the nature of the vegetation, the extent and type of human activity and the availability of groundwater. These are examined in more detail below.

Vegetation

Vegetation has a multifunctional role in a catchment. Apart from modifying local climatic conditions, it intercepts rainfall, effectively protecting the soil surface from more intense precipitation. It also acts

geojobs

Hydrographer and hydrologist

Hydrographers measure, describe and map the surface waters of the earth, including oceans, seas, rivers, lakes and estuaries. The information obtained is used to design dams, weirs, bridges, irrigation projects, water supply schemes, sewerage systems and flood mitigation works.

Hydrologists evaluate and manage the quantity, quality and sustainability of water resources. They use their knowledge and skills to:

- undertake research into the processes of the hydrological cycle
- develop strategies for the sustainable use of water resources
- study the causes and impacts of, and possible solutions to, water pollution and land degradation
- monitor water quality
- manage water resources
- undertake computer modellings of surface and groundwater.

Courses in earth sciences, geology and natural resources are offered by the University of Technology Sydney and the following universities: Australian National University, Charles Sturt, Macquarie, Canberra, New England, New South Wales, Newcastle and Wollongong.

FIGURE 1.7.27

Eutrophication is the addition of plant nutrients into water. This encourages nutrient-loving algae to multiply.

ponding collection of runoff in depressions where it cannot drain out.

TABLE 1.7.1

Impacts of specific soil types on infiltration under various landuses and slope conditions expressed as a percentage of total precipitation

Topography and vegetation	Open sandy loam	Clay and silt loam	Tight clay
Woodland			
Flat: 0–5% slope	90	70	60
Gentle: 5–10% slope	75	65	50
Hilly: 10–30% slope	70	50	40
Pasture			
Flat	90	70	60
Gentle	84	64	45
Hilly	78	58	40
Cultivated			
Flat	70	50	40
Gentle	60	40	30
Hilly	48	28	18
Urban areas	**30% impervious**	**50% impervious**	**70% impervious**
Flat	60	45	35
Gentle	50	65	80

FIGURE 1.7.28

Ploughing increases the risk of erosion.

FIGURE 1.7.29

The hard surfaces of urban areas greatly increase runoff.

as a barrier to overland flow by:

- reducing the velocity of runoff and thereby reducing surface erosion
- causing **ponding**, which increases the time in which infiltration can occur.

An established stand of vegetation can also assist infiltration by developing a relatively **permeable** layer of organic material. It also assists by providing a network of fissures, or cracks, through the soil profile. These result from the decay of old root systems.

The presence of vegetation and a thick layer of humus provides an ideal habitat for soil fauna. The fauna's presence in the soil enhances its condition and may assist the movement of water into the soil. Earthworms, in particular, establish a tunnel network that can improve infiltration, particularly in heavy clay soils. Table 1.7.1 shows that infiltration is highest in established, well-vegetated pasture paddocks.

Human activity

Table 1.7.1 provides a summary of the way that different soil types, gradients and human activities affect runoff and infiltration. In terms of runoff, it is evident that the act of cultivating or ploughing a field does not, in fact, increase infiltration. To the contrary, such practices appear to increase runoff and the potential for erosion. This is due to two factors.

First, cultivation disturbs any existing soil fauna pathways and closes off other fissures. Probably even more effective in this regard is the second action of turning over the soil, as occurs with some methods of cultivation. This buries any accumulated organic debris, and brings a subsurface **horizon** to the top. The normal process of soil formation involves the removal of finer clay particles from the shallow surface horizon: the A horizon. They accumulate lower in the soil: the B horizon. Should soil be overturned in the process of cultivation, even only to a depth of 10 cm, the more clay-rich soil may be brought to the surface. Despite the rough nature of the cultivated surface, moderate rainfall will 'puddle' on the soil surface, breaking down the soil structure and bringing the clays into solution (that is, suspending the clays in water). Depending upon the clay content in solution, it effectively reduces infiltration by reducing the **porosity** of the soil.

The other important factor in relation to human activity is the effect of urban development on the local hydrology. Widely spaced residential

geofocus

Environmental flows

Environmental flow is the term used to identify the amount of water needed in a watercourse to maintain healthy, natural ecosystems. A reduction in river flows is brought about by the combined effect of **impoundment** by dams and reservoirs and extraction by water users. This places severe stress on the aquatic ecosystems. There have been many management proposals that require the release of minimum environmental flows to ensure the preservation of the natural biota. This would also involve a simulation or recreation of natural seasonal flows.

The allocation of an environmental flow to the Snowy River became a major environmental issue in the 1990s. Environmentalists wanted an allocation equal to 28% of the original flow. This was opposed by water users to the west of the Great Dividing Range, who feared a cut to their water allocations. More recently, during the severe drought that gripped New South Wales until 2007, the State Government faced criticism after it announced that it would reduce and ultimately suspend environmental flows down the Hawkesbury–Nepean River, to stop water being released from the falling Warragamba Dam. This resulted in massive weed fields growing in the slow-moving waters. It was not until huge rains in June 2007 that water flow was restored to much of the river.

development in leafy areas may have minimal effect on runoff. However, most urban development is on relatively small blocks with a high proportion of land covered by impermeable surfaces, including roofs, driveways, patios, paths and roadways. It is easy to see that the natural drainage system in an area that is intensively urbanised will have great difficulty in coping with the higher runoff yields. This will be of even greater significance in areas with sandy soils, which would have experienced very high infiltration under normal circumstances. These areas would not, under natural conditions, have a well-developed drainage system. Thus, an impermeable layer over these soils will vastly increase the runoff. In addition, as mentioned earlier, the incidence and severity of flooding and erosion in river channels is made worse by the use of efficient drainage systems transporting water from rooftop to river.

impoundment a reservoir built from what was once part of a free-flowing river; state of being impounded or captured.

Groundwater

Some of the water that infiltrates into the soil seeps into **aquifers**, where it is stored as groundwater. Groundwater is an important resource, often accessible at considerable distances from rivers. Not all groundwater in Australia is of high quality. Approximately 90% of sources have water that is too saline (salty) for human consumption and not fit for irrigation of salt-sensitive crops.

In some areas, including the Murray Valley, additions to the water table through excessive infiltration from irrigation have caused saline water to rise to the root zone of crops rendering the soil sterile. (This is discussed in greater detail on pages 207–8.) Reports from other areas suggest that pesticides, particularly those used on irrigated crops, have found their way into aquifers. This is a matter of serious concern because in aquifers there is virtually no flushing mechanism to dilute such concentrations. Should serious contamination occur, the aquifers would be virtually destroyed for most purposes.

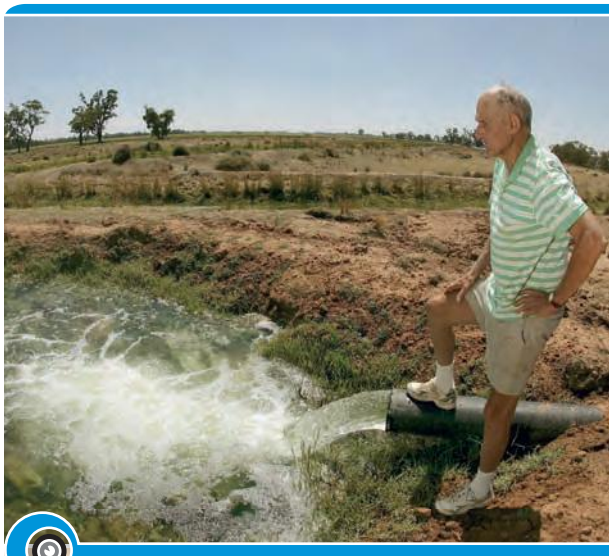


FIGURE 1.7.30

Bores, such as this one in central Australia, draw ground water to the surface. Unsustainable use of this important water resource will have a devastating effect on the environment and the communities that rely on bore water.

Landuse and the riverine environment

The impacts of changes in landuse are readily observable in river ecosystems. Increases in sediment yield will lead to siltation. It will also increase the **turbidity**, or cloudiness, of the river and the level of nutrients in the water. The latter is a major problem where point sources, such as urban sewage outfall and seepage from feedlots, are contributing effluent. If the flow is high, or there is regular flushing of the system, the river is better able to handle higher inputs of sediment and nutrients.

Rivers also provide valuable breeding grounds for fish that migrate up-river for spawning. Fish breeding may be limited by alterations to rivers in terms of water quality and temperature, **regulation** of flows

geofocus

Illegal gold mining in Venezuela threatens river systems

The tropical rainforests of Venezuela are among the most extensive wilderness areas in the world. Illegal gold mining in the state of Bolivar, in the south of the country, is posing a serious threat to several rivers in the region, most notably the Caroni River.

While much of the region is in theory a protected wilderness, large-scale illegal mining is found throughout the region, as are the settlements that go with the mines. Miners clear vast tracts of forest to expose the rich gold-yielding gravels. They also spray river banks with high-powered water cannons to loosen the gravels. These processes have dramatically increased sediment in the river. Another problem is the use of mercury to separate gold from the rest of the gravel. Much of the toxic mercury is simply washed down the river, where it contaminates the food chain. Environmental groups also hold fears for another major river system in the region: the Caura River. It is reported that 600 miners are operating there. World record prices for gold have greatly increased the incentive for miners to search out and exploit new sources of gold-bearing gravel. Protection of the environment is often put aside in the rush for gold.

FIGURE 1.7.31

Illegal mining has greatly increased sedimentation in Venezuela's Caroni River.

understanding the text

1 **Outline** the factors that affect the amount of runoff entering a river system.
2 **Explain** the ways that human activities influence the water inputs in a catchment.
3 **Outline** the main concerns about schemes to divert water inland.
4 **Describe** the impact of human activities on sediment yields.
5 **Outline** the effects of vegetation on catchment runoff.
6 **Define** the term groundwater.
7 **Describe** the impacts that an increase in sediment yield (resulting from a change in landuse) would have on river ecosystems.

working geographically

1 **Constructing diagrams** Construct a flowchart to illustrate the inputs and outputs of a catchment.
2 **Research task** Conduct research into the environmental impacts of the Snowy Mountains Scheme on rivers such as the Snowy River. Describe the nature of these impacts and outline the strategies being adopted to overcome them.
3 **Constructing diagrams** Construct an annotated diagram to illustrate the role of vegetation in a catchment.
4 **Writing task** Prepare a short report to summarise the information contained in table 1.7.1 (p. 194).
5 **Research task** Undertake library and Internet research. Investigate the new techniques of cropping that reduce problems in catchments. The Department of Agriculture and the Department of Land and Water Management are likely sources of information. List the principles that have been adopted and suggest how these will reduce land-degradation problems associated with cropping.
6 **Writing task** Study the Geofocus box 'Illegal gold mining in Venezuela threatens river systems'. Write a short report outlining the problems associated with illegal gold mining in Venezuela.

The river as an ecosystem

Catchments have a variety of aquatic ecosystems. Two of the most significant ecosystems are wetlands and billabongs. These ecosystems are found along many of Australia's river systems.

Wetlands

Wetlands occur in areas where the water table is at or above the land surface for prolonged periods, providing some waterlogged conditions for truly aquatic plants. Wetlands are classified according to their location. They include *montane* (that is, found in mountains), riverine or floodplain, and coastal wetlands.

Like many alpine regions around the world, Australia's Snowy Mountains have numerous small *peatlands*. Here the snow-melt drains into low-lying areas, keeping it saturated for much of the year. These areas are important because they tend to distribute runoff over prolonged periods. They also support unique communities of plants and animals.

Riverine wetlands fulfil several important roles. For example, they provide:

- a filter for the river, which reduces or moderates river flow and allows sediments to settle
- a habitat for fish, birds, reptiles and many vegetation types
- a resting spot for migratory birdlife
- a resource area for fish, timber and recreation.

Depending on the nature of the riverine area, the values of a particular wetland may vary. The role of a delta-based wetland, through which the river runs, will be more that of a water filter and flow moderator. Water bodies cut off from the river channel fulfil more of a role as sheltered habitats. (See figure 1.7.34.)

Billabongs

A *billabong* (an *oxbow* or *cut-off lake*) is one category of wetland. For most of the time, a billabong remains isolated from the river itself. During floods, however, the billabong may become part of the river channel.

Billabongs are of particular interest for their biological rather than

FIGURE 1.7.32

Billabongs are formed when river meanders are cut off from the main river channel. A billabong is shown near the centre of this photograph.

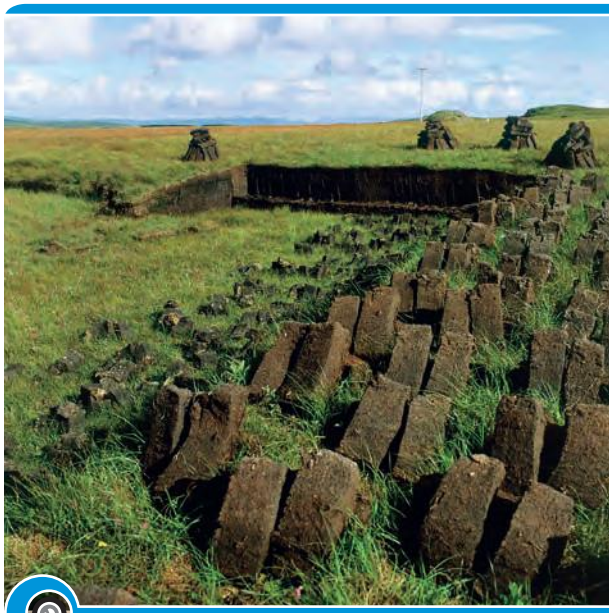


FIGURE 1.7.33

Peatlands, also known as montane wetlands, are found in alpine areas.

FIGURE 1.7.34

Wetlands are waterlogged environments where flora and fauna have become specially adapted to this unique location.

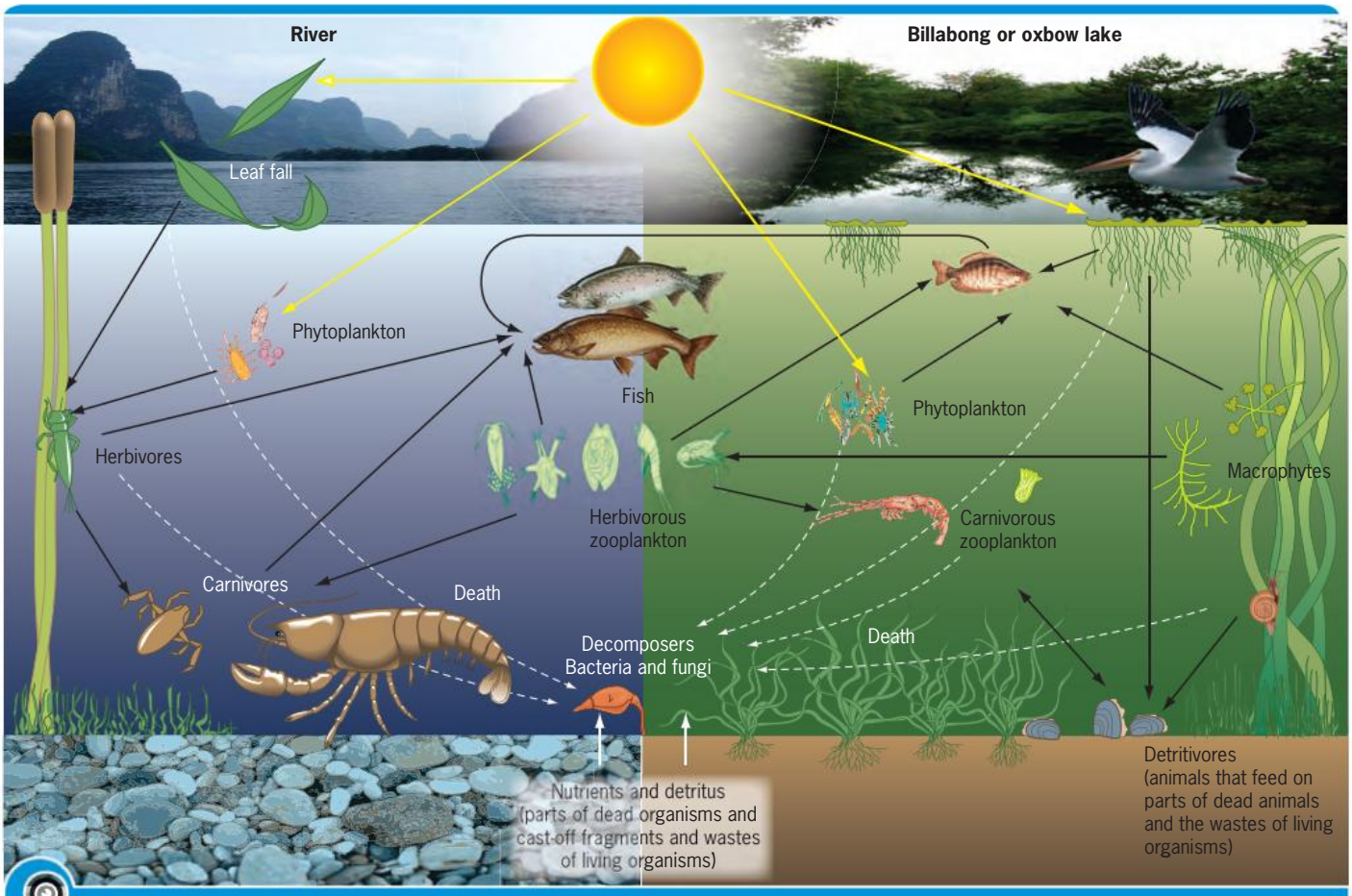


FIGURE 1.7.35

Billabongs have complex, interrelated food webs.

hydrological characteristics; that is, they are generally characterised by the plants and animals contained within them. Isolated from the river flow for most seasons, they are still bodies of water. They are thermally stratified, meaning that water temperatures vary considerably with depth. Due to decaying organic matter, they are often of darkish colour but are not turbid. As an ecosystem, the aquatic community of a billabong is subject to a wide range of extremes in terms of temperature and water quality due to both seasonal and flood regimes. Thus, the organisms present must adapt to changing conditions, leave if they are mobile or suffer the consequences.

Life in the river system

Phytoplankton

The word *phytoplankton* is derived from 'phyte', which means 'a plant' or 'growth', and 'plankton', which means 'floating'. Phytoplankton are small single-celled algae. They are part of the producers, or autotrophs, of the food web. While they are plants, some have the ability to propel themselves through the water. Others, by changing their buoyancy, can float at different levels in the water.

The most notorious of the phytoplankton are the *blue-green algae*. (See figure 1.7.27, p. 193.) They cover the water in a thick film and, as they die off, release a toxin that can kill livestock that drink the affected water. While humans may also die if they drink the water, a more common problem

is skin irritation from contact with the water or the algae themselves. The blue-green algae are very sensitive to their surrounding conditions, particularly sunlight, water temperature and quality (including, of course, turbidity) and the availability of nutrients. They are also sensitive to variations in river flow resulting from seasonal variations and localised rainfall.

Zooplankton

Zooplankton are tiny, single-celled animals, generally less than 0.2 mm in diameter. (See figure 1.7.36.) They play an important role in the aquatic food web. As a group, they eat phytoplankton, other plants and other zooplankton. Some are parasites. Many are *detritivores*. A detritivore is an animal that recycles nutrients within the ecosystem by feeding on parts of dead organisms and the cast-off fragments and wastes of living organisms.

In addition, the zooplankton are food for other, generally larger, animals within the aquatic ecosystem. Thus, a change in the aquatic environment that reduces the amount of zooplankton may have major repercussions for the whole ecosystem; at least in the short term until a new population can be established. Some species are particularly sensitive to changes in water temperature and quality. The impact of river regulation on many river systems has undoubtedly upset the natural balance and affected the progression of plant and animal populations through the annual cycle.

Macroinvertebrates

The *macroinvertebrates* are animals without backbones. In freshwater aquatic systems, such as the Murray River, we find insects, snails, worms, molluscs (such as mussels) and crustaceans (such as yabbies and crayfish, see figure 1.7.37). Macroinvertebrates fill a variety of niches in the food web because they include omnivores, carnivores, detritivores and herbivores, and represent the major food source for animals higher up the food chain, including fish and birds.

Food supply and habitat are both important for the well-being of these animals. They cover a wide range of life forms and their habitats include the benthos (or bottom sediment), rocks, waterplants and alga colonies, tree roots and old logs, branches and debris that have fallen or been washed into the river. Others are mainly free-swimming, but require suitable sites for laying their eggs. In some instances, particularly where a river stretch is to be used for recreation purposes, well-meaning individuals 'clean up' all the old logs and snags to ensure the safety of those in the water. While some limited removal may be appropriate, this material is part of an important habitat for many species of aquatic plants and animals.

Waterplants

Waterplants fulfil a variety of roles within a river system. They protect the river banks and beds, reducing the velocity of the flows and causing sediment to collect. As with the phytoplankton, they add oxygen to the water, play a role in the recycling of nutrients and are a food source. While they also provide shelter for insects and fish and even protection from fast-flowing currents, many smaller river organisms attach themselves to the waterplants. They are also important protective sites for some hatching macroinvertebrates. Without them, species diversity in the river would be significantly reduced. Being at the base of the food web, their absence would reduce or even eliminate some animal populations, from the smaller *zooplankton* to the larger fish.

FIGURE 1.7.36

Zooplankton.

FIGURE 1.7.37

Yabbies are found throughout the Murray system.

FIGURE 1.7.38

Snags, such as fallen trees, have traditionally been removed from rivers because they pose a threat to boats. However, they are very important breeding grounds for many species of aquatic animals.

understanding the text

1 **Describe** the wetland ecosystem.
2 **Explain** the ecological importance of wetlands and billabongs.
3 **Outline** the significance of zooplankton in the wetland ecosystem.
4 **Outline** some of the functions of waterplants.

working geographically

1 **Research task** Using the Internet and other appropriate sources, write an extended response comparing riverine wetlands to the intertidal wetlands found in coastal areas.
2 **Research task** Using library and Internet resources, investigate the characteristics of water hyacinth. Write a report about water hyacinth, where it came from, where it has been spreading in inland rivers, and the consequences of its spread.
3 **Internet research** Visit the South Australian Government's MurrayCare site. Outline the threats to biodiversity in the Murray River. Explain the strategies that have been put in place to deal with these issues.

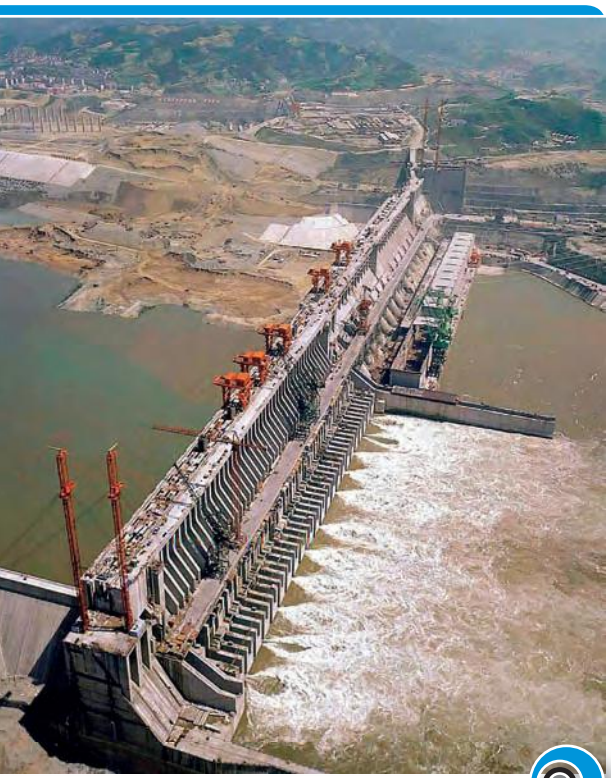


FIGURE 1.7.39

The massive Three Gorges Dam project in China has dramatically impacted on the environment of the Yangtze River. The dams have also seen millions of people forcibly relocated to make way for the project.

River regulation

Most of the world's major river systems have been regulated; that is, they have weirs, diversions and dams to provide a more consistent supply where and when it is needed. Virtually all of Australia's rivers are regulated to some degree. The Paroo River in the far west of New South Wales is the only major river in the state considered to be free of regulation. The regulation of rivers causes many significant changes to the river ecosystem. These include the impact of dams on the flushing of the river system and the various water extractions that reduce river flows.

Dams are the most significant form of river regulation as they dramatically alter the flow, direction and ecosystem of a river. Dams impact on both the upstream area that is submerged and the downstream reaches of the river. As with any large-scale human activity there are both benefits and costs associated with dams.

With the onset of a drought in the first few years of the twenty-first century, there have been many calls for the construction of large-scale dams in many states. In New South Wales, plans are well under way for the construction of a dam on the Shoalhaven River to the south of Sydney in the Nowra region. The construction of this dam has attracted considerable criticism due to the environmental and economic costs associated with its construction. In Queensland, similar concerns have been raised about the construction of a large dam on the Mary River near the town of Gympie in the northern part of the Sunshine Coast.

FIGURE 1.7.40

Proposals for the construction of a dam on the Mary River near Gympie on Queensland's Sunshine Coast have attracted widespread protests.

hypolimnion bottom waters of a thermally stratified lake or waterway.

TABLE 1.7.2

Impact of dams on the area submerged

Costs	Benefits
Area submerged ■ Riverine scenery is submerged ■ Agricultural land is submerged ■ Recreation areas are lost ■ Riverine and wildlife habitats are destroyed ■ Transported sediment is trapped ■ Water temperature is modified ■ Water chemistry, particularly at depth (in the **hypolimnion**), is altered ■ Water quality is changed ■ Food webs are restructured and biota composition is altered ■ The migration of biota is restricted by the dam wall ■ The climate in the vicinity of the reservoir is affected ■ Water levels fluctuate as water is discharged	■ A major water body is created for recreation, such as sailing, swimming and fishing ■ Aquatic environment is enlarged ■ Aesthetic amenity could be enhanced ■ There is some degree of control over the impounded water
Downstream reaches ■ Major changes are made to the natural hydrological regime ■ Peak flows are reduced ■ There is the possibility of increased minimum flows; although, due to associated water extraction, even more serious low flows are possible ■ The viability of species that are dependent on seasonal flows is threatened ■ Floodplains that are deprived of periodic inundation are threatened ■ The replenishment of river beds and banks below the dam is reduced ■ A major adjustment is made to the river ecosystem	■ Flow is regulated for long periods ■ Water quality may be improved ■ There is some flood reduction

Water down the drain: why we don't need more dams

By Dr PAUL SINCLAIR

During a recent fleeting heavy rain shower my five-year-old son woke me late in the night to ask what the noise on the tin roof was. Almost 70 per cent of Australians are living under at least stage 3 water restrictions. And if you think more dams are the answer to this problem, think again. Australia already stores more water per person in dams than any other country.

Pouring more concrete into rivers is not the answer. Building more dams would be a 20th-century response to 21st-century problems. We need solutions that restore river systems, create wealth from conservation and stimulate innovation…

Dams have many benefits, but they also have costs on the environment, communities and treasury. Dams can't change the fact that water is limited and we have to live within a water budget that is getting smaller. Our water budget is getting smaller because of climate change, growing populations and unsustainable irrigation water use—not a lack of dams.

Why don't we just build more dams where it rains? Talk to the dam builders and climate experts and they'll explain that Victoria's dams have already been built in high rainfall areas. In Victoria about 84 per cent of the rain and snowfall evaporates or is transpired by vegetation, 15 per cent runs off land into rivers and about 1 per cent soaks down to recharge groundwater aquifers…

In an average year Victoria's dams can hold almost half the water that would flow in rivers. But in some years the dams can hold nearly every drop of river water—such as 2003–04—when dams could hold 72 per cent of the state's river flow.

Do we have a right to take every drop of water? No. Every living thing relies on water. Freshwater ecosystems worldwide are declining faster than land and marine environments. We've already condemned rivers such as the Moorabool, which supplies Ballarat and Geelong, to a slow death. Last month 100 000 short-finned eels died in a drying and saline Lake Bolac in south-western Victoria…

Existing dams and weirs have to be used better and those we don't need should be removed. Do we really need 3500 weirs in the Murray–Darling Basin? With fewer weirs there'd be more native fish and cleaner water…

Dams have impacts on river systems that send out ripples lasting for generations. The health of the Murray River is today an international embarrassment because of decades of unsustainable water use. Long-term targets to reduce water use in big-drinking industries such as irrigation are needed to mitigate the effects dams have had on the Murray.

We need to get better at using water where it falls. Innovative, small-scale stormwater storage projects, such as the Royal Park Stormwater Reuse System, are already making a difference, according to Dr Grace Mitchell from Monash University's Institute for Sustainable Water Resources.

These systems capture local stormwater, decrease dependence and effects on surrounding catchments and reduce energy use by not having to pump water great distances…

Dr Paul Sinclair is the acting executive director of Environment Victoria

The Age, 5 May 2007

understanding the text

1 **Define** the term river regulation.
2 **Describe** some of the consequences of river regulation.

working geographically

1 **Writing task** Write an extended response outlining the costs and benefits associated with the construction of large regulatory structures, such as dams and weirs. Consider the impact on both the area submerged and the downstream reaches of the river system.
2 **Internet research** Visit the Save the Mary River Coordinating Group site.
   a Outline the nature of the proposed river regulation on the Mary River.
   b Explain what the group states will be the potential impacts of this regulation.
   c Describe the strategies being employed by the group to stop the regulation.
   d Assess the usefulness of this website in terms of meeting the goals of the Save the Mary River Coordinating Group.
3 **Interpreting text** Read the newspaper article 'Water down the drain' (p. 201).
   a Explain why Australia's water budget is shrinking.
   b Outline the nature of dams in Victoria and water storage in Victoria.
   c Explain the effect of dams and weirs on the Murray River.

did you know?

The Murray–Darling Basin is the country's food bowl. It accounts for 41 per cent of Australia's agriculture and $22 billion worth of agricultural exports. The region covers an area the size of France and Spain combined and is home to almost 3 million people.

geofocus

River regulation on the River Murray

The Murray is the most significant river in Australia. It is Australia's largest river and, together with its tributaries, drains an area covering about one-seventh of the continent. Compared with other major river systems around the world, however, the Murray is relatively small. It takes the Amazon River less than one day to discharge water equivalent to the Murray's total annual flow. That said, the Murray holds enormous economic importance to Australia. Often referred to as the food bowl of Australia, the Murray–Darling Basin generates billions of dollars worth of produce annually and is home to several significant inland centres.

The river runs from an augmented, or supplemented, catchment in a high-rainfall area. Its course takes it through a relatively dry inland area where it supports a variety of urban, stock, industrial, irrigation and recreational activities. The dryness of the total catchment is demonstrated by a comparison with other large systems around the world in tables 1.7.3 and 1.7.4.

Another important environmental issue regarding the catchment is the recognition that the Murray drains an area of land that has inherently high levels of salinity; that is, a high level of dissolved salts in the water. This condition predates the European occupation of the area. In 1829–30, the explorer Sturt and his party noted that the waters of the Murray were quite saline.

Over the past century or so, there has been a major increase in the area of the Murray's catchment that shows obvious signs of salinity. Algal blooms in the Murray and its tributary, the Darling River, have periodically reached alarming proportions. However, these phenomena were obviously present at the time of Sturt's exploration. What has changed is the scale and severity of the problems.

To appreciate the characteristics of the river, it is necessary to gain an understanding of the factors that predispose the river to the major threats within the system. This understanding will also provide insight into the problems that have been exacerbated by river regulation and the landuse in the catchment since colonial settlement.

FIGURE 1.7.41
The River Murray is an iconic feature of the Australian landscape.

FIGURE 1.7.42

The mouth of the River Murray. As a result of regulation, the amount of water that flows out of the Murray River mouth into the sea has fallen by more than 60%.

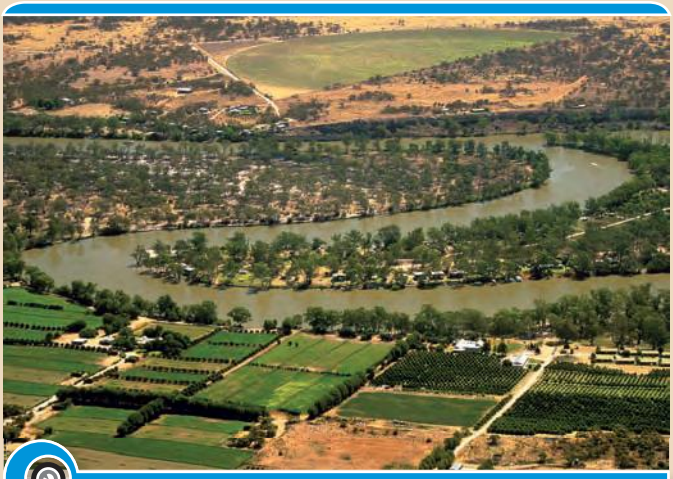


FIGURE 1.7.43

The Murray system contains very significant agricultural industries.

TABLE 1.7.3

Comparison of water yields

Catchment	Yield/km^2 catchment (m^3/year)
Murray–Darling (Australia)	15 000
Yangtze (China)	1 190 000

Source: N. Mackay and D. Eastburn, *The Murray*, Murray–Darling Basin Commission, Canberra

TABLE 1.7.4

Major river systems of the world compared with the Murray River

River	Length	Catchment (1000 km^2)	Discharge (m^3/sec)
Murray (Australia)	3750	1072	470
Amazon (South America)	6516	7180	180 000
Congo (Africa)	4700	3822	42 000
Yangtze (China)	5800	1970	35 000
Mississippi (USA)	6019	3221	17 545
Nile (Africa)	4180	2881	1584

The Murray catchment

Throughout geological time, the Murray catchment has been inundated by a shallow sea, which has provided a legacy of saline conditions. As the most recent inland sea retreated, it deposited the extensive sand sheet that persists over much of the western basin. While the ocean waters retreated, a water body covering about 30 000 km^2 remained. This body was called Lake Bungunnia. Until its disappearance, around 500 000 years ago, the rainfall must have been significantly higher than it is at present to enable rainfall to exceed evaporation from the lake.

This period enabled much of the salt from the inland sea to be removed from the catchment. Little of the original salt water remains trapped in the catchment. The majority of the present salt has been brought in via the atmosphere, largely through rainfall over the last 500 000 years.

As a consequence of its geological legacy of a shallow catchment that does not drain to the sea, the groundwaters of the Murray catchment are trapped in the sedimentary soil that has filled the catchment. Over the years, much of the water has been removed by evaporation in lower areas, where the groundwater is exposed in lakes. The salts have remained, only to find their way back into the groundwater aquifers. If there is a period of extended rainfall, the groundwater level rises, the soil may become salinised and saline water will find its way into the river system. There is, therefore, little wonder that Sturt and his party found the water salty to taste.

In the context of agriculture, the problems of salinity have been recognised for a century. However, 100 years ago the extent of the area affected was limited. Since then, the extent and degree of salinisation of the soils and the river system have increased considerably and the welfare of many agricultural communities is now threatened.

River regulation: historical aspects

Apart from the watering of livestock, the first commercial use of the Murray River centred on its role as a major transport artery. (See p. 177.) The river was used extensively by paddle steamers. These vessels were used to transport export produce, mainly wool, to Goolwa at the mouth of the Murray. From there it was shipped overseas via Port Elliot and Victor Harbor.

There were up to 240 paddle steamers operating on the Murray in the 1870s. While the river was being used extensively for transport, the South Australian Government strongly resisted any proposals to regulate and divert water from the river. The 1870s saw increased irrigation

development in Victoria and a decline in river transport due to increased competition from the railways.

Diversion of water from the unregulated Murray and its tributaries was adequate for two decades. Then, frequent dry years (during 1896–98 and 1901) prompted calls for the development of reservoirs and weirs to regulate the river's flow.

The major problem was that the annual thaw of the highland snows sent a spring flush of water downstream, several months before the peak demand for crops growing through the hot summer months. In addition, in some years, the spring flush yielded reduced flows. As a consequence, an Interstate Royal Commission on the River Murray was established in 1902. As if to highlight the problem, there was no flow passing through the mouth of the Murray for a period of at least six months during the commission's hearings.

Thirteen years of negotiation eventually produced the River Murray Waters Agreement (1915) which created the powerful River Murray Commission. There were three key points of the agreement. First, the flow at Albury was to be shared equally between New South Wales and Victoria. Second, Victoria and New South Wales were to retain control of their tributaries below Albury. Third, Victoria and New South Wales were to supply South Australia with a guaranteed minimum quantity of water, or 'entitlement'.

Under this arrangement, two major projects were proposed: the Hume Weir, upstream of Albury; and Lake Victoria, between Wentworth and Renmark. In addition, many locks and weirs were planned downstream from Echuca. Thus, a major transformation of the river system was instigated, ensuring a reasonably secure irrigation supply. Other schemes were developed on virtually every major tributary of the Murray, effectively providing at least some regulation on all branches of the river system.

Despite this high level of supply management, and again following dry years in the early 1940s, there was a new proposal to further augment the waters of the Murray and Murrumbidgee Rivers. This was the *Snowy Mountains Scheme*, which diverted the upper, high-rainfall portion of the Snowy River catchment into the headwaters of these rivers. This diversion was carried out via a system of hydro-electric power stations. The scheme was a marvel of technology, planning and project management and allowed the further development of irrigation works in these rivers. A consequence of this development has been the unfortunate increase in soil and river salinity.

FIGURE 1.7.44

The location and extent of the catchment of the Murray River. Also shown are the region's major towns and water-related engineering structures (dams, locks, weirs, reservoirs, etc.).

The impact of regulation and changing landuse

The most significant impacts on the seasonal pattern of river flows are associated with the construction of reservoirs. Also significant are the diversion or extraction of water from the river and altered runoff characteristics resulting from changes in landuse.

Reservoirs

The construction of reservoirs has brought about major changes in the river system. They have:

- enabled more water to be diverted for irrigation by impounding high spring/early summer flows
- increased the area being irrigated
- changed the seasonality of the flows (that is, the pattern of flow by season)
- reduced the frequency and intensity of floods
- tended to reduce the minimum flows; although this is really only a by-product of the river management
- caused dramatic changes to the river ecosystem.

The extensive network of regulatory structures along the Murray is represented diagrammatically in figure 1.7.47 (p. 206). The changed seasonality of the river flows at Albury can be determined by comparing current or actual flow with simulated natural flows, as indicated in figure 1.7.46.

Diversions from the river

Around two-thirds of the water that would have originally reached the sea from the Murray–Darling Basin is now diverted out of the river for human activities. Under natural conditions, prior to regulation, around 12 300 GL of water flowed out of the Murray River per year. At present the figure is less than 500 GL per year. However, this does vary considerably depending on rainfall conditions in the catchment.

Research conducted by the Murray–Darling Basin Commission (MDBC) in the late twentieth century found that the basin's river systems are in a state of drought for 61 years per 100 years. Under unregulated conditions, the river systems are in a state of drought for five years per 100 years. The reduction in flows is highly controversial, and severe droughts in recent years have made the situation even more problematic. Table 1.7.5 highlights the severity of the drought. Much of the water extracted from the basin is used for irrigation purposes.

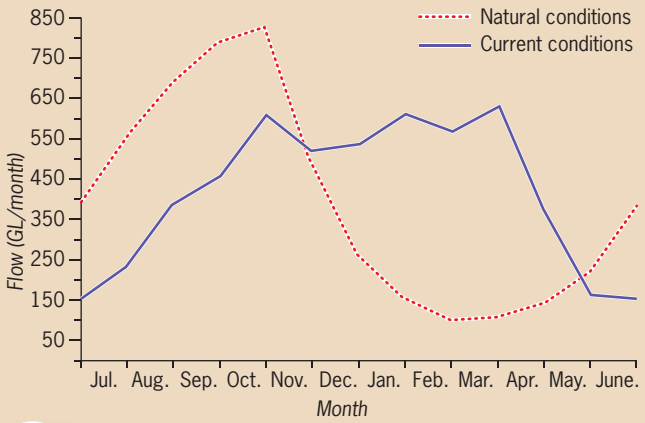


FIGURE 1.7.46

Murray River flows.

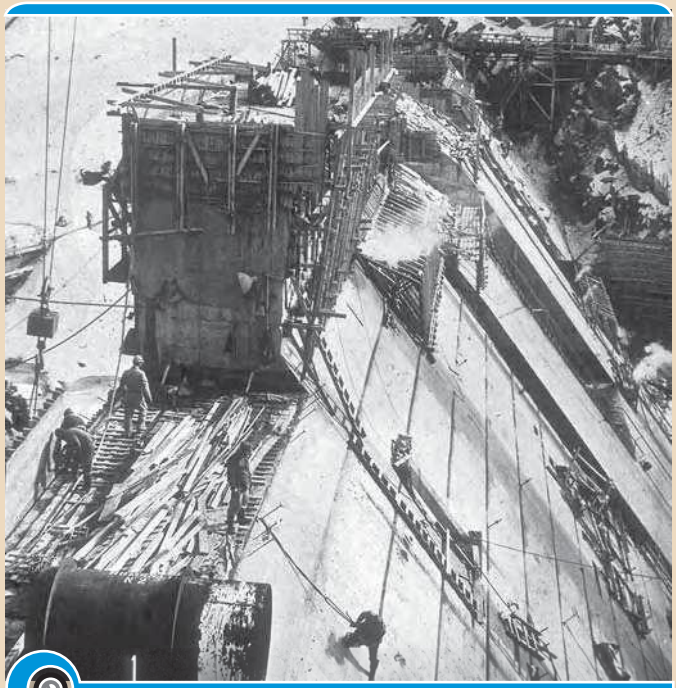


FIGURE 1.7.45

Construction of the Murray 2 Dam, part of the the vast Snowy Mountains Scheme that was built in the years following World War II. The scheme dramatically changed the flow regime of the Murray River and other rivers west of the Great Dividing Range by diverting water that flowed to the east and west and into the Murray catchment.

TABLE 1.7.5

Irrigation dam levels in June 2007 in the NSW section of the Murray–Darling Basin

Dam	Storage as a % of total dam capacity
Blowering	23%
Burrendong	6%
Burrinjuck	27%
Chaffey	19%
Copeton	9%
Glenbawn	31%
Hume	11%
Keepit	4%
Split Rock	3%
Wyangala	6%

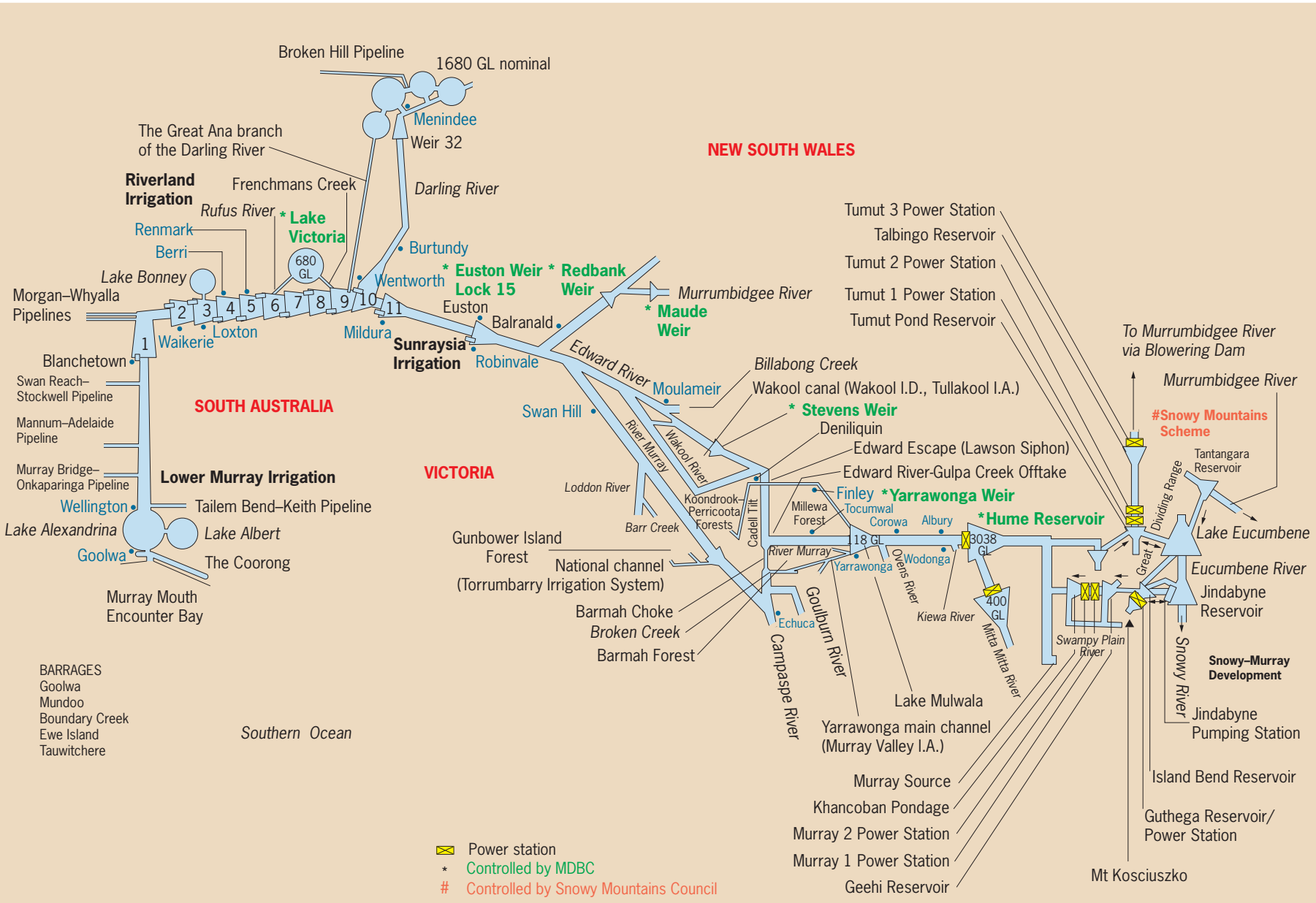


FIGURE 1.7.47

The various structures that regulate flows along the Murray River and its tributaries. Source: *The Murray*, pp. 46–7.

In 2007, farmers in the basin were informed that there would be no water available for irrigation as dam levels had reached critically low levels. This prompted moves from the Federal Government to take control of the basin and the water resources within it, with a $10 billion plan to restore health to the basin. New South Wales, Queensland and the ACT all agreed to cede (hand over) their powers over the basin to the Federal Government in order to centralise control and provide a single policy to water allocations to farmers in the future.

Impacts of river regulation on the hydrosphere, lithosphere and biosphere of the Murray–Darling Basin

River regulation has had a substantial and enduring impact on the hydrosphere, lithosphere and biosphere of the Murray–Darling Basin.

> *The Murray-Darling Basin is geologically and climatically prone to concentrating salt in the landscape.*
>
> Murray–Darling Basin Commission

Salinity

Salinity is one of the key issues currently facing the Murray system. Salinity is essentially a function of rainfall, and the release of salt from groundwater storages and its discharge into the river system. It also results from changes in landuse, especially landclearing and overwatering of irrigated crops. Throughout the basin there is an upward trend in salinity levels.

Salinity affects not only water quality but also the soil and plants that grow in it. Rising salt levels also affect aquatic life. To some extent, land-based animals are also affected due to the loss of vegetation that cannot survive in saline soils.

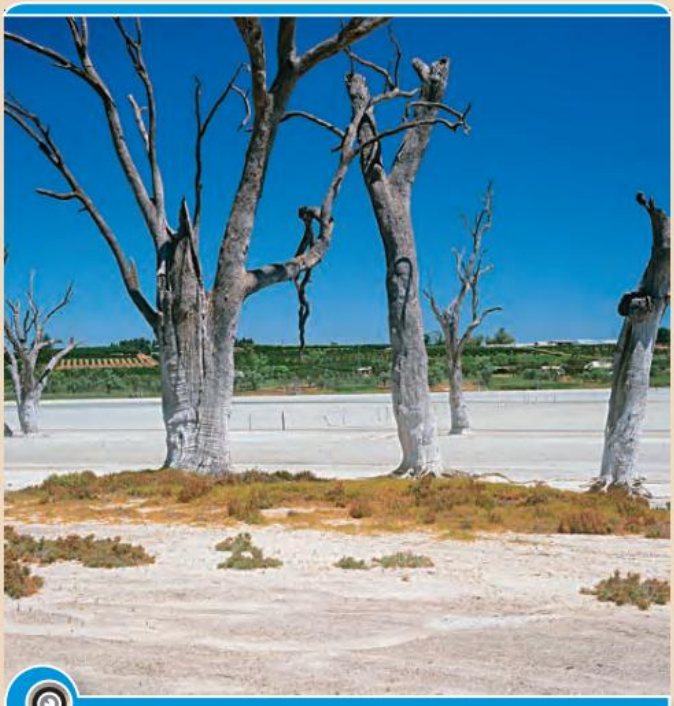


FIGURE 1.7.49

Salt-affected agricultural land.

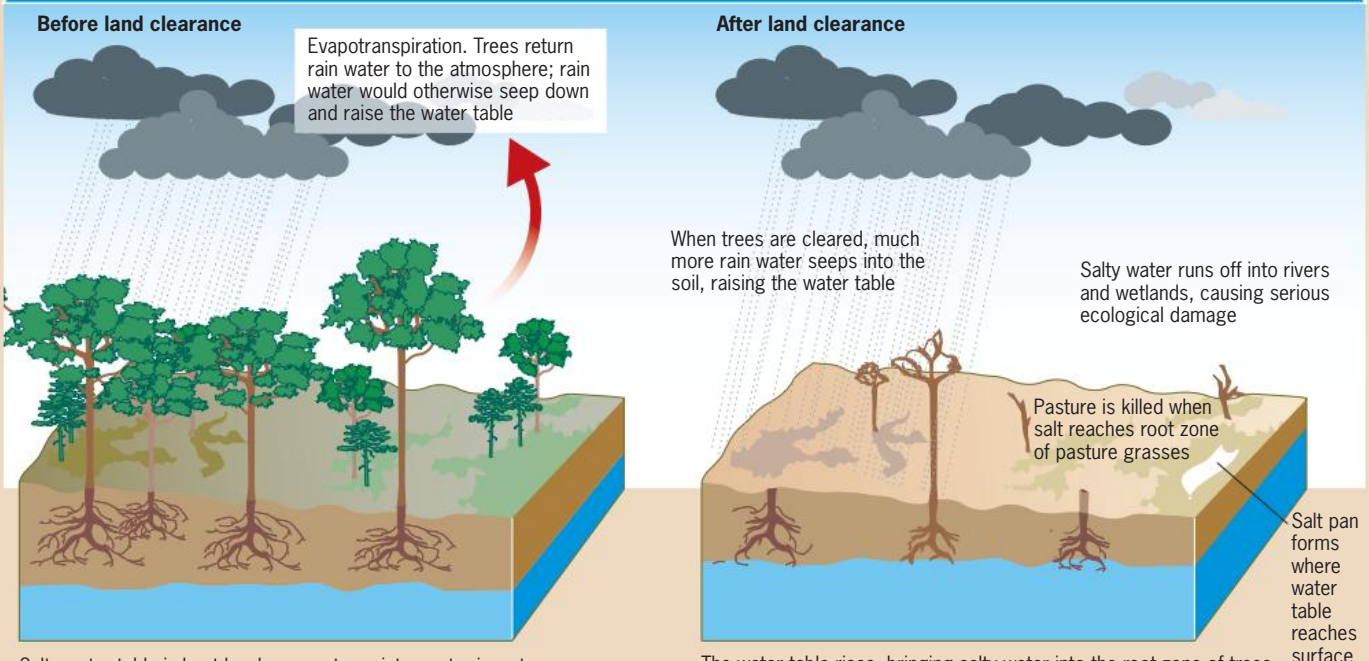


FIGURE 1.7.48

Replacing deep-rooted trees with shallow-rooted crops and pasture results in dryland salinity.

A salinity audit conducted by the MDBC found that by the second half of the twenty-first century, salinity levels in the basin's river systems will have become so great that water will no longer be suitable for human consumption.

There are two major causes of salinity within the system: dryland salinity and irrigation-induced salinity.

Dryland salinity results from the removal of deep-rooted trees. These trees act as pumps by drawing on the groundwater. They evaporate the groundwater, thus keeping it well below the surface. Once the trees have been removed and replaced with shallow-rooted plants, such as cereal crops or pasture, the groundwater rises bringing dissolved salts along with it. (See figures 1.7.48 and 1.7.49, p. 207.)

Areas that are subject to irrigation face the same problems associated with dryland salinity. However, the problem is made worse by the addition of excess water on the surface. The water seeps into the soil, causing the water table to rise further. (See figure 1.7.51.)

Once the salt reaches the surface it forms a scar of white salt on the landscape. Very few plants can survive in these saline soils. The water that flows over the soils and into rivers also becomes saline, creating both a land-based and riverine problem.

Throughout the basin, many strategies are currently in place to reduce the problem of salinity. One common strategy involves sinking bores into the underground aquifer and drawing out the saline water. However, this process is expensive and leaves the problem of disposing of the salt once the water has been evaporated. (See figure 1.7.50.)

Widescale replanting of deep-rooted trees is also taking place in many parts of the basin. In most cases this involves farmers giving over part of their land to tree planting. This has had some success in reducing water levels. The number of trees that have been planted is just a tiny proportion of the original number lost.

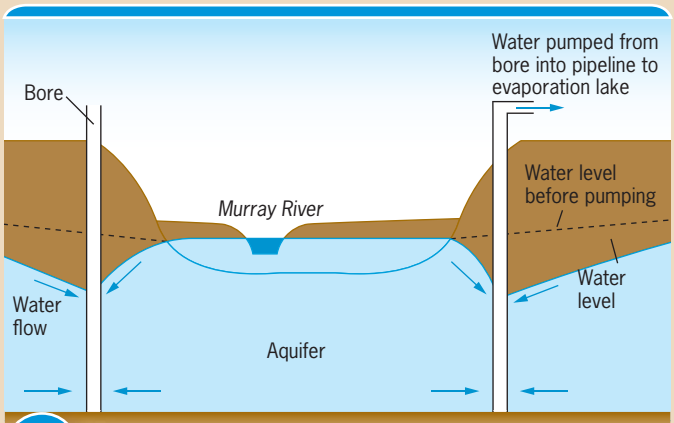


FIGURE 1.7.50

Complex engineering schemes are used in parts of the basin to draw saline groundwater to the surface and evaporate off the salt.

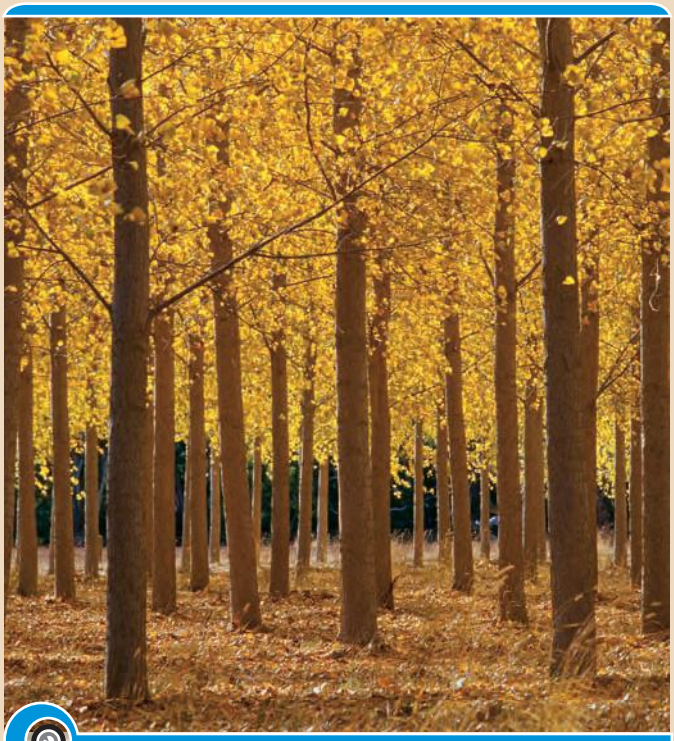


FIGURE 1.7.52

Tree plantations have been planted throughout the basin to provide a timber resource and also to reduce groundwater levels in a bid to deal with salinity.

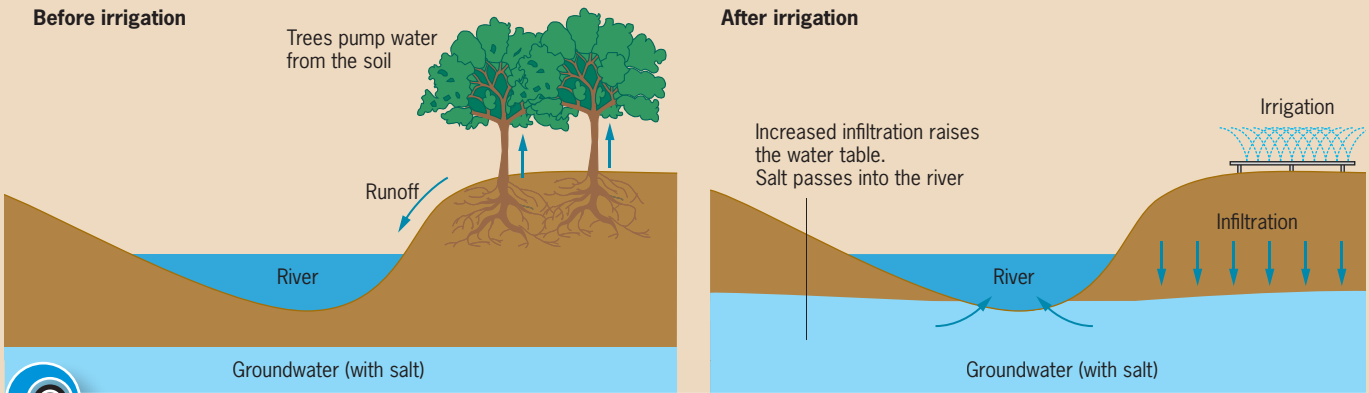


FIGURE 1.7.51

Irrigation salinity. Irrigation water causes the water table to rise, bringing dissolved salts to the surface.

FIGURE 1.7.53

Turbid river water.

Turbidity and nutrient runoff

Turbidity is a measure of opaqueness or cloudiness of water. The natural processes of weathering and erosion contribute clay and silt to rivers. These particles are the major cause of turbidity: the effect of scattered light passing through water. (See figure 1.7.53.)

In addition to suspended sediment, organic matter may also contribute to turbidity. Turbidity is not a direct measure of the volume of suspended sediment in a river because different particles have different reflective characteristics. Nevertheless, it is often used as an indication of the load of suspended sediment. Many of the tributaries to the Murray and especially the Darling are contributing high sediment loads to the river.

The level of turbidity is an important factor in any river ecosystem. The cloudiness of the water results in reduced photosynthesis. The more turbid the water, the less chance for light to penetrate the water and allow the phytoplankton, attached algae and macrophytes to grow. (Macrophytes are large, vascular aquatic plants that grow in shallow water along the shorelines of lakes or in the slow-moving reaches of rivers.) As these are the primary producers at the bottom of the food chain, turbidity can have a major influence on the quantity and diversity of life forms in the river ecosystem. Unsustainable farming practices that expose soil to erosion are the main cause of increased turbidity. Simple strategies for dealing with the problem include improved agricultural techniques, such as minimal tilling that leaves soil relatively undisturbed, and tree planting.

The major nutrients of importance in the river are phosphorus and nitrogen. While these nutrients occur naturally and are essential for the normal functioning of the riverine ecosystem, excessive amounts can result in deterioration in water quality. These excess nutrients are the result of fertilisers, which is used extensively in the basin, and sewage from urban areas and animals. High levels of nutrients encourage algae to bloom, which can poison the water.

The decline of the Murray crayfish

The Murray crayfish (see figure 1.7.54) are the largest macroinvertebrates in the Murray River system. They are slow-growing creatures that do not reach sexual maturity until they are six to nine years old. When fully grown (at around 25 to 30 years of age) they can weigh up to 3 kg. They were once commercially fished in the lower reaches of the river.

The number of Murray crayfish has been declining rapidly since the 1950s. Since present river-water salinity levels and temperatures are within the range tolerated by the crayfish, it is believed other factors are responsible for this decline. These factors include increased nutrient levels and decaying algal blooms. The crayfish are also sensitive to pesticides, which are common in many parts of the basin.

Wetlands

There are more than 7000 wetlands throughout the Murray system, covering over 200 000 ha. These wetlands are critically important habitats for many species of aquatic life as well as waterbirds and land-based animals. The wetlands are also important natural water storage areas for river systems and provide refuges for animals during times of drought.

River regulation has had a major impact on the functioning of wetlands. Regulation has reduced the frequency and severity of flood events. This has reduced the amount of water making its way across floodplains and into the wetlands on their edges. Additionally, many wetlands have become water sources for irrigation and other activities. For example, in 2007 it was revealed that farmers had illegally diverted water out of the internationally protected Macquarie Marshes in the north-west of New South Wales, causing damage to these important waterbird habitats.

River red gums

The most common trees along the Murray–Darling system are the river red gums or *Eucalyptus camaldulensis*. (See figure 1.7.55, p. 210.) They have suffered stresses due to grazing by livestock, logging, insect attack and localised recreational activity. However, the most significant threat to their existence is a reduction in flooding. This occurs when rivers are regulated and when the natural channels that reticulate the water are modified or obstructed. Often flood barrages and levees have been constructed to prevent localised flooding, but they effectively restrict flooding for many kilometres downstream.

FIGURE 1.7.54

Murray crayfish.

Habitat changes resulting from dam construction on the Murray

The features of river regulation, such as dams and weirs, have major impacts on the habitats of many different aquatic animals. For example, dams create large areas of deep, still or slow-moving water. Such water has different temperatures, chemistry and flow characteristics than rivers. Dam and weir walls also impede the movement of fish and other species.

Mussels in the Murray

Mussels are shellfish with two shells up to 10–14 cm long. (See figure 1.7.58.) They live up to 15 years, and are filter feeders, burrowing through the sediment searching for food. Two species are present in the Murray: the floodplain mussel, which lives in lentic environments; and the river mussel, which inhabits the flowing waters of the river channels.

Since the development of water impoundments along the river there has been an increase in the floodplain habitat and a reduction in the river habitat. Of the two species of mussel, the floodplain mussel is more tolerant of being out of water; it can survive for a year or more in such conditions. Thus, reduced flows and droughts have had a greater impact on the river mussel. The mussels, in common with crayfish, are sensitive to changes in the amount of oxygen. This is especially the case for the river mussel, which would normally be well-oxygenated under reasonable flow conditions. Thus, human-induced changes have had a much stronger influence on the river mussel. The floodplain species, which is normally accustomed to considerable environmental change, has suffered relatively little.

> *Over the past 100 years, populations of native fish species in the Murray–Darling Basin have suffered declines in both distribution and abundance.*
>
> Ian Sinclair, President of the Murray–Darling Basin Commission, 2003

FIGURE 1.7.55

River red gums have evolved to deal with regular flooding. Their numbers have diminished because regulation limits flooding.

FIGURE 1.7.57

By limiting flood events, river regulation has significantly affected the functioning of wetlands throughout the Murray–Darling Basin.

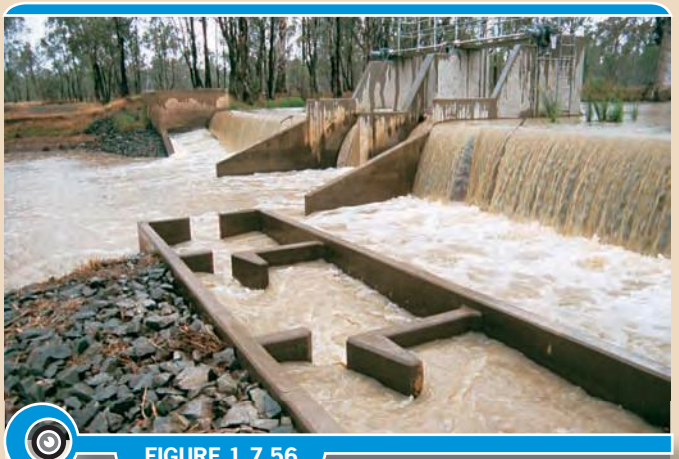


FIGURE 1.7.56

Fish ladders have been installed on some dam and weir walls in the Murray to enable fish to move upstream above the wall.

FIGURE 1.7.58

Some species of mussels have suffered as a result of river regulation.

Fish life

The native fish of the River Murray have not fared well as a result of river regulation. Many of the species, such as golden perch, have evolved to move up and down the river. However, barriers have significantly reduced their ability to do this. A report into the status of native fish in the Murray–Darling Basin released by the MDBC in 2003 found many threats to the native fish species in the River Murray. (See table 1.7.6.)

Several strategies have been adopted to improve the situation of native fish within the basin. This has included a re-snagging program that sees logs and other debris replaced in the main river to recreate the in-stream habitats on which many species rely. There has been restoration of wetland and billabong habitats in different locations along the river. For example, community groups have restored a 17 ha wetland area, Pilby Creek wetland habitat, near Renmark in South Australia. The removal of alien species, such as European carp, has also been undertaken. One company, Charlie Carp, has even developed an organic fertiliser out of the carcasses of carp. In so doing they have turned the pest into a useful resource.

FIGURE 1.7.59

One of the most iconic of the Murray fish species is the Murray cod, which was almost fished into extinction. Cod numbers are slowly recovering due to careful management.

FIGURE 1.7.60

Introduced European carp have caused major stress to native species.

Waterbirds

Many of the changes listed above also affect the waterbird population of the Murray River system. The most important issues for the continued survival of the waterbirds is the loss of suitable habitat and the loss of stimulus for annual breeding. Of particular concern is the condition of the wetlands, as discussed earlier. Changes brought about through modification of the natural cycle of inundation of wetlands (either too little or permanent flooding), reduction of small to medium floods and the altered seasonality of flow have threatened many species that depend on the natural hydrological cycles for their survival. While the obvious solution is to return the flow patterns to normal, this is unlikely to be an acceptable option as it would jeopardise much of the agricultural activity in the region. Other approaches are necessary, but further research and understanding are still required in several areas.

TABLE 1.7.6

Threats to the native fish species in the River Murray

Threat	Threatening process
Flow regulation	Loss of water to other uses, critical low flows, loss of flow variation, loss of flow seasonality, loss of low to medium floods, permanent flooding and high water, increased periods of no flow
Habitat degradation	Damage to riparian zones, removal of in-stream habitats (e.g. snags), sedimentation
Lowered water quality	Increased nutrients, turbidity, sedimentation, salinity, artificial changes in water temperature, pesticides and other contaminants
Barriers	Impediments to fish passage resulting from the construction and operation of dams, weirs, levees, culverts (drainage pipes under roads) etc., and non-physical barriers (such as increased velocities, reduced habitats, reduced water quality and thermal pollution, i.e. changes in water temperature)
Alien species	Competition with and/or predation by carp, gambusia, oriental weatherloach, redfin perch and trout
Exploitation	Recreational and commercial fishing of depleted stocks and illegal fishing
Diseases	Outbreak and spread of Epizootic Haematopoietic Necrosis Virus (EHNV) and other viruses and parasites
Translocation and stocking	The loss of genetic integrity caused by inappropriate relocations and stocking of native species

Source: Adapted from *Native fish strategy for the Murray Darling Basin 2003–2013*, Murray–Darling Basin Commission, May 2003

FIGURE 1.7.61

Charlie Carp is an organic fertiliser produced from European carp, an introduced species.

River Murray crisis: the Federal Government's response

The crisis in the Murray–Darling Basin led the then prime minister, John Howard, to announce a $10 billion package to seize control of the region in early 2007. The thinking behind such a bold initiative was the view that one authority, rather than competing state-based interests, would achieve better management of the region's water resources.

The new Murray–Darling Basin Authority (which will replace the existing Murray–Darling Basin Commission) will enforce a sustainability cap (for example, a limit on water withdrawals) on the river system.

The core function of the new authority will be to oversee the management of the region's river systems and aquifers. The new authority will be an expert-based authority, reporting to the Commonwealth Minister for the Environment and Water Resources. It will have clearly prescribed functions and consultative mechanisms.

The Commonwealth Government will also establish an environmental water manager, separate from the new agency. The manager will have the ability to hold and trade water for environmentally beneficial outcomes. The ACCC will oversee the operation of the 'market' in which water allocations are traded, including charging arrangements.

The Commonwealth environmental manager will consult with other environmental water providers (such as states and public trusts) in preparing a Basin-wide environmental watering plan. This will form a component of the Basin-wide strategic plan.

The National Water Commission (NWC), a Federal Government agency, would perform an audit role upon the new authority. The audit will be a planned, independent and documented assessment to determine whether agreed upon requirements are being met. The commisson also has oversight of current state arrangements for their compliance with the National Water Initiative. The NWC would also audit compliance with catchment water plans and arrangements to regulate the level of water interception (extractions).

Murray–Darling a threatened river: WWF

By DAVID CRAWSHAW

Australia's Murray–Darling river system is among the world's rivers most threatened by human activity alongside the Ganges and Nile, a report says.

An overview by the World Wildlife Fund for Nature (WWF) released today summarises threats to 10 of the world's great rivers—those considered by the WWF to be already suffering 'most grievously under the weight of these threats, or bracing for the heaviest impacts'.

'There are some rivers on the list that are so damaged that without serious restoration efforts they could be lost, and others that are relatively intact but face massive degradation unless action is taken now to conserve them,' it said.

The six main threats to river systems were dams and infrastructure, excessive water extraction, climate change, invasive species, over-fishing and pollution.

The WWF overview, World's Top 10 Rivers at Risk, was based on eight international assessments of river health.

'Focusing analysis on watersheds with high ecological importance and those affecting large human populations … the 10 most endangered rivers emerge as the Salween, La Plata, Danube, Rio Grande, Ganges, Murray–Darling, Indus, Nile, Yangtze and Mekong,' it said.

In the Murray–Darling, which drains 14 per cent of Australia's landmass, invasive species like the European carp were the main threat to the ecosystem.

Other threats included salinity, river regulation and climate change.

The overview, which the WWF hopes will stimulate environmental debate, warns exotic plants and animals are supplanting the native flora and fauna, and harming the river's ecosystem.

'These invasive species reflect an ongoing governance failure common to most countries,' it said.

'While the Australian government has long had some quarantine controls, they have not adequately excluded new introductions of dangerous species.

'Australian governments have failed to adequately screen the many exotic species already in the country—legally and illegally—and undertake incursion management to kill dangerous species while their populations are still low.'

Prime Minister John Howard last month secured the agreement of Queensland, NSW and South Australia to transfer responsibility for water management in the Murray–Darling basin to the commonwealth.

In return, the federal government will spend $10 billion to address the over-allocation of water and restore the river system's health.

Source: AAP General News, 20 March 2007

understanding the text

1 **Describe** the effect of the Snowy Mountains Scheme on the Murray Basin.
2 **Outline** the impact of reservoir construction on the Murray River.
3 **Describe** the effect of water diversions on discharge rates from the Murray.
4 **Define** the term salinity.
5 **Outline** the causes of salinity in the Murray–Darling Basin.
6 **Describe** some of the strategies being used in the basin to reduce the threat of salinity.
7 **Explain** what turbidity is.
8 **Outline** the impact of turbidity on the river system.
9 **Describe** the consequences of excessive nutrients in the river system.
10 **Explain** why wetlands are important features of the riverine environment.
11 **Describe** the effects of human activity on the Murray–Darling Basin wetlands.
12 **Outline** the major threats to native fish species.
13 **Describe** some of the strategies being adopted to improve the status of native fish in the basin.
14 **Outline** the effects of river regulation on water birds in the basin.

working geographically

1 **Interpreting statistics** Use the statistics in tables 1.7.3 and 1.7.4 (p. 203) to compare the Murray River with other major river systems around the world.
2 **Writing task** Prepare a short report outlining the historical development of river regulation along the Murray.
3 **Interpreting diagrams** Using figure 1.7.44 (p. 204), describe the location and extent of the River Murray Basin.
4 **Interpreting diagrams** Study figure 1.7.46 (p. 205). Compare the river flows under natural conditions to the flows under regulated conditions.
5 **Research task** Investigate the current situation regarding the management of the Murray River catchment.
6 **Research task** Using the Internet and library resources, conduct research into the effects of salinity on the Murray–Darling Basin. Outline the extent of the problem and assess at least two of the strategies being adopted to deal with the problem.
7 **Writing task** Using specific examples, write an extended response analysing the impact of river regulation on the flora and fauna of the Murray–Darling Basin.
8 **Writing task** Read the newspaper article 'Murray-Darling a threatened river: WWF'.
   a List the six main threats to river systems identified in the article.
   b Outline the threat to the Murray system according to the article.
   c Describe the author's view on the management of the Murray River to date.
9 **Research task** Investigate the role played by the Murray–Darling Basin Authority in managing the water resources of the Murray–Darling Basin. Evaluate the success of the Federal Government's initiative.

geojobs

Environmental engineer

Environmental engineers assess and manage the effects of human activity on the natural and built environments. They use their knowledge and skills to:

- undertake environmental impact assessments
- prepare environmental impact statements
- manage natural resource exploitation
- assess the impact of wastes on the environment
- develop ecologically sound ways to deal with toxic and hazardous wastes.

Universities offering relevant degrees include the University of New England, University of New South Wales, University of Newcastle, University of Technology Sydney and University of Wollongong.

section two

two

Global Challenges

Today, 6.6 billion people inhabit planet earth. This is well up on the earth's population at the beginning of the last century when there were just 1.6 billion people. This rapid rise in human numbers is unprecedented and threatens the very well-being of the planetary systems on which all life depends. Clearly, we are failing to adequately feed, house, educate and employ many of the earth's people. Billions live in conditions we would find intolerable. Unfortunately, worse is yet to come. Demographers predict that the earth's population will grow to more than 9 billion before a fall in fertility rates initiates a gradual decline in population.

The problem lies not just in the explosion of human numbers. It also rests in the material demands of the population, especially those living in the developed world. Over 1 billion people enjoy lifestyles that impose grossly disproportionate demands on our planetary ecosystems. This consumerism is powered, in turn, by a sudden expansion in our technological capabilities that enable us to use (and sometimes misuse) ever-greater stocks of natural resources. Our insatiable demand for the energy sourced from fossil fuels, for example, is altering the composition of the earth's atmosphere. The resulting climate change endangers whole ecosystems and perhaps humanity itself.

Humanity has, however, confronted such challenges before. In recent times it has successfully addressed the issues of acid rain and ozone depletion. Collectively, we can reduce our environmental footprint by limiting our consumption of fossil fuels and by developing alternative (renewable) sources of energy. Humanity has the capacity to confront such issues. It also has the ability to address the issues of global inequality and geopolitical instability.

In this section of the text we focus on some of the great social, cultural, political, economic and environmental challenges facing humanity.

outcomes

students:

- **P1** differentiate between spatial and ecological dimensions in the study of geography
- **P4** analyse changing demographic patterns and processes
- **P5** examine the geographical nature of global challenges confronting humanity
- **P6** identify the vocational relevance of a geographical perspective
- **P7** formulate a plan for active geographical inquiry
- **P8** select, organise and analyse relevant geographical information from a variety of sources
- **P9** use maps, graphs and statistics, photographs and fieldwork to conduct geographical inquiries
- **P10** apply mathematical ideas and techniques to analyse geographical data
- **P12** communicate geographical information, ideas and issues using appropriate written and/or oral, cartographic and graphic forms

overview

In this section of the text we undertake a geographical investigation of the challenges facing humanity at a global scale.

unit 2.1

> In the last 200 years the population of our planet has grown exponentially, at a rate of 1.9% per year. If it continued at this rate, with the population doubling every 40 years, by 2600 we would all be standing literally shoulder to shoulder.
>
> **Stephen Hawking, British scientist**

> The key problem facing humanity in the coming century is how to bring a better quality of life—for 8 billion or more people—without wrecking the environment entirely in the attempt.
>
> **Edward O. Wilson, US scientist and author**

> Instead of controlling the environment for the benefit of the population, maybe we should control the population to ensure the survival of our environment.
>
> **Sir David Attenborough, British naturalist**

Population Geography

It took 10 000 years for the world's population to reach 1 billion, another 100 years to double to 2 billion and less than another century to more than triple to 6.6 billion today. What will happen to this trend in the twenty-first century and can we cope with it?

The increase in the size of the human population in the last half-century is unprecedented; and nearly all the growth is occurring in the developing countries. Currently, 80 million people are being added every year in developing countries, compared with about 1.6 million in developed countries. While the developing countries will keep growing, the more developed countries may grow slowly or not at all.

Population change is linked to economic development, education, the environment, the status of women, epidemics and other health threats, and access to family planning information and services. All these factors interact with every aspect of our lives, regardless of where we live.

The study of population geography is important because there is a clear connection between population growth and virtually every challenge facing humanity.

In this unit we focus on the changing nature, rate and distribution of the world's population; the factors affecting fertility and mortality; population movements; and issues arising from the changing size and distribution of the population.

The big shift

In 2008, the world reached an important milestone. For the first time in the planet's history, more than half the human population are living in urban areas. There are now 3.3 billion urban dwellers. By 2030, this number is expected to grow to almost 5 billion. Many of the new urban residents will be poor. Their future, the future of cities in developing countries, the future of humanity itself, all depend on how this process is managed. How, for example, do authorities best meet people's basic needs: shelter, access to clean water, sanitation, health care, employment and affordable public transport. Can these needs be met in a way that is environmentally sustainable?

The world's urban population grew very rapidly over the course of the twentieth century: from 220 million to 2.8 billion. The next few decades will see an unprecedented scale of urban growth in the developing world. This will certainly be the case in Africa and Asia where the urban population will have doubled by 2030. In other words, the accumulated urban growth of these two continents during the whole span of history will be duplicated in a single generation. By 2030, the towns and cities of the developing world will make up 80% of the world's urban population.

Managing the process of urbanisation is among the greatest challenges facing humankind.

exam-style questions

extended responses

- Outline the changing nature, rate and distribution of the world's population.
- Account for the spatial variations in the growth of the world's population.
- Explain the spatial variations in the world pattern of fertility and mortality.
- Account for the relatively high rates of urbanisation being experienced by countries in the developing world.
- Outline the types, volumes and directions of population movements.
- Analyse the environmental, economic and social issues arising from the changing size and distribution of the world's population.

glossary

- **age structure** percentage of the population (or number of people of each gender) at each age level in a population.
- **birth rate** the total number of live births in a year for every 1000 people in a population per year.
- **child mortality rate** the annual number of children under the age of five years who die per 1000 live births; also known as the under-5 mortality rate.
- **death rate** the total number of deaths per 1000 people in a population per year.
- **demographic changes** changes in the size, composition, rates of growth, and density of population; changes to fertility and mortality rates; and changes to patterns of migration.
- **demographic transition** the theory that relates the process of industrialisation to declining death rates followed by declines in birth rates.
- **demography** the study of the characteristics and changes in the size and structure of human populations.
- **fertility rate** the average number of children a woman will have during her reproductive years.
- **infant mortality rate** the annual number of deaths of infants under 1 year of age per 1000 live births.
- **life expectancy** the average number of years a newborn infant can expect to live.
- **migration** the act or process of moving from one place to another with the intent of staying at the destination permanently or for a relatively long period of time.
- **overpopulation** the situation where the existing population is too large to be adequately supported by available resources.
- **population density** the number of people per unit area.
- **population distribution** the variation of population density over a specified area.
- **population doubling time** the number of years required for a population to double in size given a constant rate of natural increase.
- **population pyramid** a bar graph showing the distribution by gender and age group of a country's population.
- **population structure** the age and gender composition of a population, usually depicted as a population pyramid.
- **rate of natural increase** the percentage by which a population grows in a year. This is the difference between the birth rate and the natural death rate and excludes migration.
- **replacement-level fertility** the number of children a woman and her reproductive partner must have to replace themselves. The worldwide average is usually just above two children per couple because some children die before they reach their reproductive years.
- **urban growth** the rate of growth of an urban population.
- **urbanisation** the process by which there is an increase in the proportion of a population living in places classified as urban; the movement from rural to urban areas.
- **zero population growth (ZPG)** the situation where the birth rate equals the death rate and the population size remains stable.

World population: changing nature, rate and distribution

World population growth

During the twentieth century the world's population grew at a rate never before experienced. In late 1999, the world's population exceeded 6.0 billion. By 2007, it stood at 6.6 billion and it is projected to rise to 9.1 billion by 2050. This is a dramatic rise from 1900 when there were only 1.6 billion people on earth, and 1950 when there were only 2.5 billion. It took from the dawn of history to the year 1820 for the earth's population to reach 1 billion. It required just 12 years to add the latest billion to the tally. (See figure 2.1.1.)

Every year the world's total population grows by more than 77 million. A continuation of this growth is inevitable because a relatively large proportion (28%) of the world's population is under the age of 15. This provides a built-in momentum for further growth, even as **fertility rates** continue to decline.

did you know?

Note to teachers and students

Students in New South Wales are required to study population geography plus TWO of the following FOUR options: natural resource use, cultural integration, political geography and geographies of development.

FIGURE 2.1.1

The world grows ever more crowded. Hundreds of thousands of Hindu devotees crowd the banks of the Ganges River during the Kumbh Mela festival.

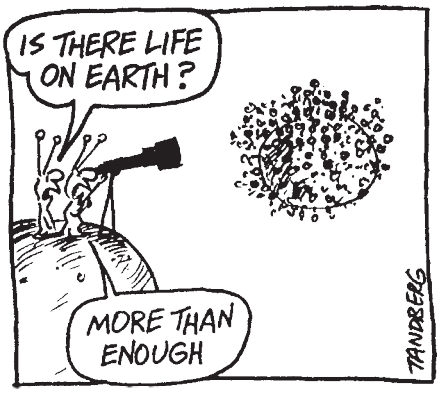


FIGURE 2.1.2

We may have different religions, different languages, different coloured skin, but we all belong to one human race.

Kofi Annan, former Secretary-General of the United Nations

One way of appreciating the rapid rate of population increase is to calculate the number of years required to add each additional billion people to the world's population. Table 2.1.1 shows that it took 2 million years to add the first billion, 130 years for the second billion and only 12 years for the sixth billion.

Can these trends continue? Obviously not. There are now signs that the explosive growth in human numbers will be followed by a significant slowdown in the rate of increase and that the world's population will actually stabilise late in the twenty-first century. Even if the rate of growth stabilises or declines in the years to come, there still may be 9 billion human inhabitants on the planet before the middle of the century; that is, 2050. (See table 2.1.2.)

Many experts are concerned about the size of this increase. They fear that the addition of another 3 billion people will degrade and even overwhelm the earth's biophysical environment: the land's food-producing capacity and the other natural resources on which all life depends. They are also concerned that meeting the energy needs of the

TABLE 2.1.1

Adding billions

World population	When reached	How long did it take?
1 billion	About 1800	All of human history (2 million years)
2 billion	1930	130 years
3 billion	1960	30 years
4 billion	1974	14 years
5 billion	1987	13 years
6 billion	1999	12 years
7 billion	2011*	12 years

*Projection

TABLE 2.1.2

The growth in human numbers

Year (AD)	Population (millions)
1000	275
1100	306
1200	348
1300	384
1400	373
1500	429
1600	486
1700	635
1800	919
1900	1571
2000	6073
2025	7840*
2050	9104*

*UN estimates

geoskills 21

Log-log and semi-logarithmic graphs

At times we need to graph data that have a range of values that are difficult to fit on a standard graph. Log-log and semi-logarithmic graphs are designed to meet this need. They can accommodate data with a huge range of values. They also allow judgements to be made about the rate of change. The steeper the line, the greater the rate of change.

Semi-logarithmic graphs have a vertical scale that is graduated in a logarithmic progression. This means that equal intervals, or cycles, on the vertical scale increase geometrically, for example 1, 10, 100, 1000 and 10000. The horizontal scale has a normal arithmetical progression.

Log-log graphs have both the vertical and horizontal axes graduated in a logarithmic progression.

did you know?

- Unlike many other countries in the developed world, the population of the United States will continue to grow, mainly due to immigration.
- In 1950, India had a population of 350 million people. Fifty years later it exceeded 1 billion.
- Africa has the highest **birth rate** of any continent. The continent's population grew from 470 million people in 1980 to 944 million in 2007. It is expected to exceed 1.95 billion by 2050. Women in the countries of Sub-Saharan Africa have on average 5.5 children each.

birth rate the total number of live births in a year for every 1000 people in a population per year.

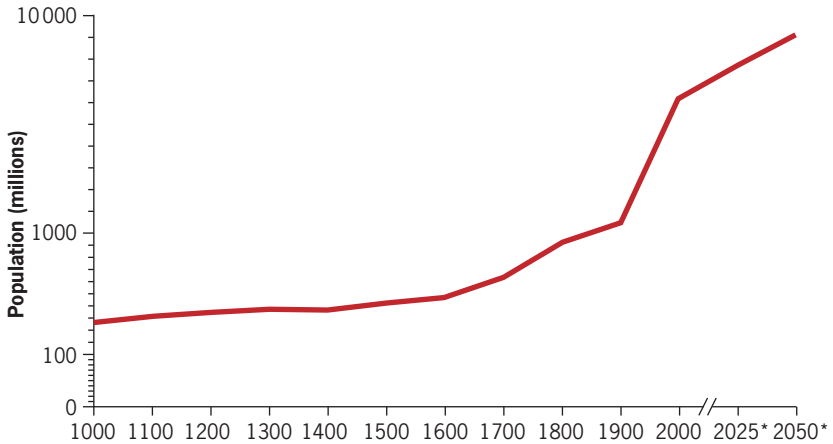


FIGURE 2.1.3

A semi-logarithmic graph showing the growth in the world's population since 1000 AD.

TABLE 2.1.3

World vital events per time unit, 2007

Time unit	Births	Deaths	Natural increase
Year	132639868	55238376	77401492
Month	11053322	4603198	6450124
Day	363397	151338	212059
Hour	15142	6306	8836
Minute	252	105	147
Second	4.2	1.8	2.5

Figures may not add to totals due to rounding. Source: US Census Bureau

growing population will simply accelerate the rate of climate change. This will especially be the case if alternatives to the burning of fossil fuels are not developed.

Others believe that the earth's population should be seen as a valuable resource. They claim that technology will enable humans to cope with the problems that will result from the increase in population.

The global pattern of population increase

The world map of population growth (see figure 2.1.6) reveals the wide range of growth rates in different regions. Population growth rates are highest in those parts of the world that are least able to cope. The

geofocus

Exponential growth

The rapid increase in the human population outlined in the text is an example of exponential growth. Exponential growth occurs when some factor, such as population, grows by a constant percentage of the whole during each unit of time. The failure to understand the nature and implications of exponential growth is one of humankind's greatest shortcomings.

Examples of exponential and arithmetic growth rates
Exponential growth: 1, 2, 4, 8, 16, 32, 64, 128, 256
Arithmetic growth: 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12

Exponential growth starts off slowly, but a few doublings quickly produce very high numbers. This is because after the second doubling each additional doubling amounts to more than the total of all preceding growth.

For the first several million years of human history the world's population grew exponentially at the very slow rate of just 0.002% a year. Since then the average annual exponential growth rate has increased sharply. It reached a peak of 2.06% in 1970, before dropping to 1.68% in the mid-1990s.

The time it takes for a population to double depends on the annual percentage growth rate. Dividing the annual percentage growth rate by 70 gives doubling time. At its current growth rate of 1.68% the world population will double in 37.6 years.

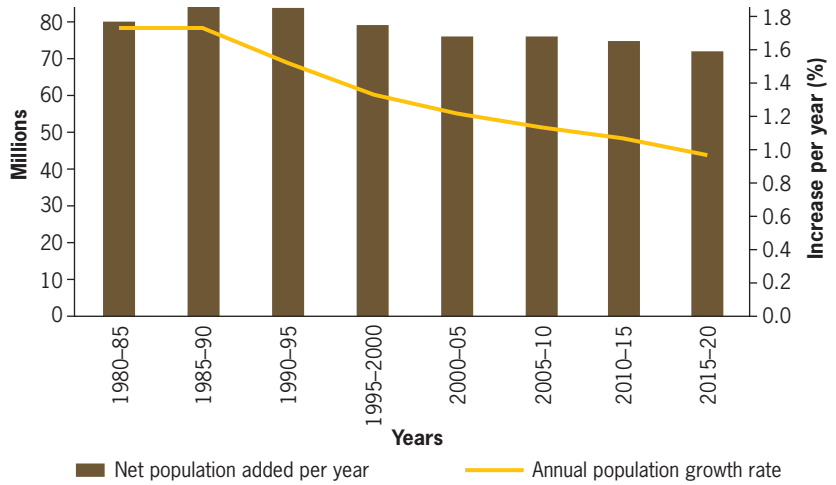


FIGURE 2.1.4

Annual growth rate of human population, 1980–2020. The annual increase in world population peaked at about 87 million in the late 1980s. Since then the rate of annual increase has declined steadily. By 2030 it is expected to have decreased to 0.75% and by 2050 it is projected to be just 0.5%.

countries of the developing world have 80% of the world's population yet they account for 98% of the world's annual population increase. Of the 6.6 billion people who inhabited the earth in the year 2007, 5.4 billion lived in the countries of the developing world. The population of the developed world, now 1.2 billion, will increase to only 1.4 billion by 2050, with virtually all this growth occurring in the United States. Due mainly to immigration, the US population will continue to grow; from 302 million in 2007 to 420 million in 2050.

The greatest proportional increase will occur in Africa. There the population is expected to double between 2007 and 2050 (increasing from 994 million to 1953 million in 2025). With fertility rates of up to seven children per woman and 41% of its population under the age of 15, the source of this growth in Africa is already in place.

geofocus

The language of demography

The study of **demography** examines the characteristics and changes in the size and structure of human populations. Some of demography's key concepts include those discussed below.

Population growth rate

The world's population growth rate increased from about 1.5% per year from 1950–51 to a peak of over 2% in the early 1960s due to reductions in mortality. Growth rates thereafter started to decline because of the rising age at marriage. The decline was also due to the increasing availability and use of effective contraceptive methods.

Poor, underdeveloped regions

The population of poor countries grows six times faster than that of rich countries. This is despite the higher **death rates** in those countries.

Ageing population

The twentieth century will probably be the last when younger people outnumber older ones. By 2050, there will be 2.5 people aged 60 years or older for every child 4 years old or younger. This shift has serious implications for health care spending for the young and old.

Zero population growth

Zero population growth (ZPG) is the situation where the birth rate equals the death rate and the population size remains stable.

Overpopulation

Overpopulation is the situation where the existing population is too large to be adequately supported by available resources.

Fertility rate

The world's **fertility rate** fell from 5 children per woman in her lifetime in 1950 to 2.7 children in 2000, By 2007 the rate had declined to 2.56. These drops in the fertility rate have been the result of worldwide efforts to make contraception and reproductive health services available, as well as other cultural changes. While this is encouraging it is important to remember that if fertility remains at present levels instead of continuing to decline, the population would grow to 12.8 billion by 2050 instead of the projected 9.1 billion.

Urbanisation

In 1800, roughly 2% of people lived in cities; in 1900, 12%; and in 2000, more than 47%. In 1900, not one metropolitan region had 10 million people or more. By 1950, one region did: New York. In 2000, 19 urban regions had 10 million people or more. Of those regions, only four (Tokyo, Osaka, New York and Los Angeles) were in industrialised countries.

Population density

The world's average **population density** is expected to rise from 45 people per square kilometre in the year 2000 to 66 people per square kilometre by 2050. Assuming 10% of land is arable, population densities per unit of arable land will be roughly 10 times higher. This will pose unprecedented problems of landuse and management for the developing world.

demography the study of the characteristics and changes in the size and structure of human populations.

death rate the total number of deaths per 1000 people in a population per year.

fertility rate the average number of children a woman will have during her reproductive years.

population density the number of people per unit area.

In the countries of the developed world the rate of population growth has slowed dramatically. Europe's fertility rate is now only 1.5; too few to replenish the population. Europe's population is expected to shrink by 9% by 2050: down from 733 million in 2007 to 669 million.

South America's population growth is relatively high but uneven. Women in French Guiana, for example, on average have twice as many children (4.0) as those in Chile. In Chile, each woman bears on average 2.0 children, while in Argentina, which is more developed, women have approximately 2.5 children each.

In Asia, growth rates vary significantly. China, the world's most populous country, has experienced a dramatic decline in its fertility rate: from 6.5 in 1968 to just 1.6 in 2007. Even so, China's population, which is 1.3 billion, is greater than that of the entire developed world. India's population of 1.1 billion continues to grow, with an annual rate of just 0.6%. By 2050 India will have overtaken China as the world's most populous country. There will be 1.7 billion people in India compared with 1.4 billion in China. The Philippines, which had only 21 million people in 1950, is expected to grow to 150 million by 2050; more than either Russia or Japan. Russia's population is expected to shrink by 23% between 2007 and 2050: from 142 million down to 109 million. The population of Japan will shrink by 26%.

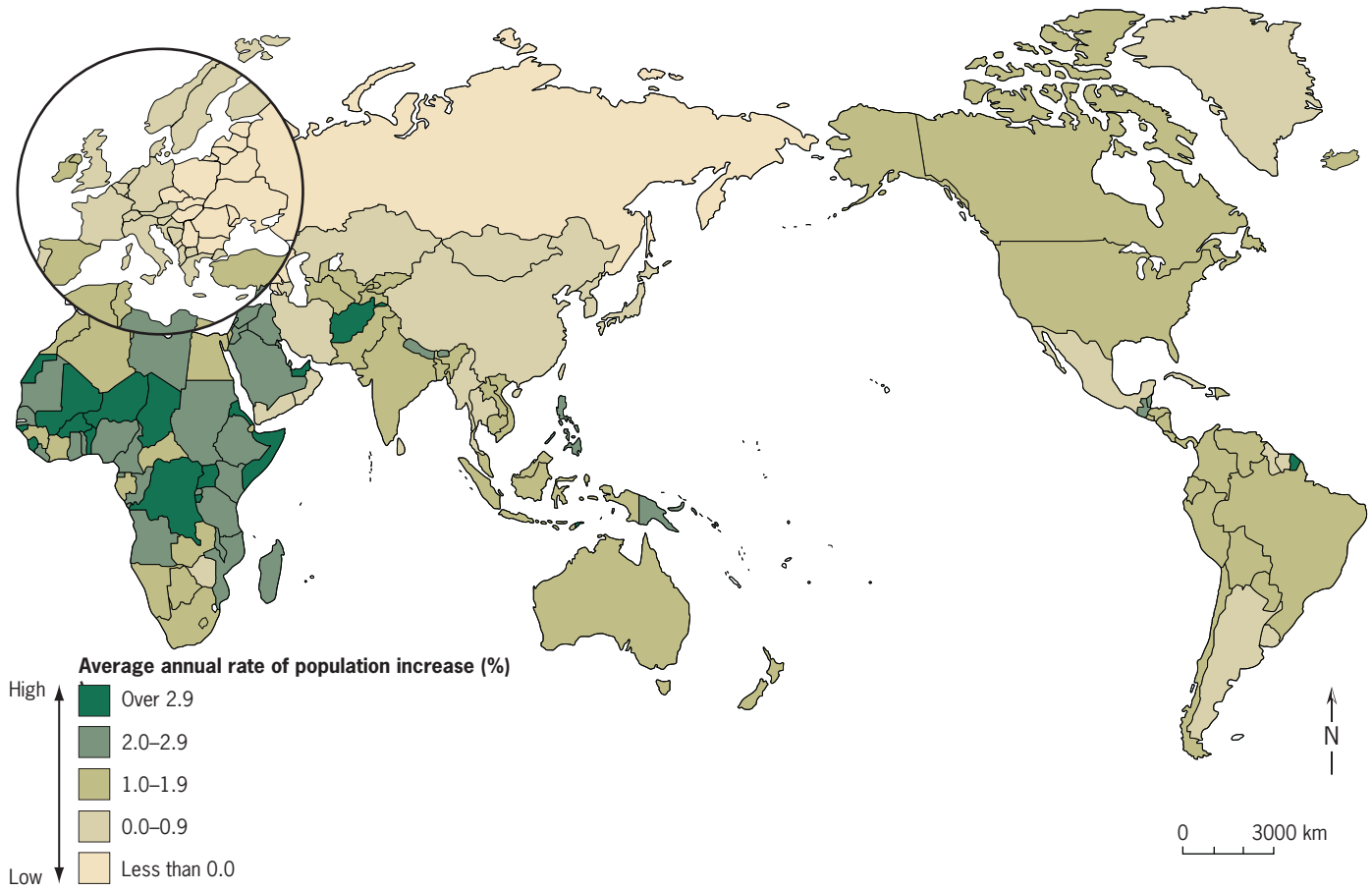


FIGURE 2.1.5

Average annual rate of population increase, 2000–05.

TABLE 2.1.4

World demographic trends by region, 2007

Region	Population mid-2007	Projected population mid-2050	Projected population change 2007–50 (%)	Total fertility rate	Percentage of the population <15 years	Percentage of the population >65 years	Life expectancy
World	6625	9294	45	2.7	28	7	70
Developed	1221	1259	3	1.6	17	16	80
Less developed	5404	8036	49	2.9	31	6	67
Africa	944	1953	107	5.0	41	3	54
North America	335	462	38	2.0	20	12	79
Latin America and Caribbean	569	784	38	2.5	30	6	76
Asia	4010	5378	34	2.4	28	6	70
Europe	733	669	–9	1.5	16	16	72
Oceania	35	49	27	2.1	25	10	72

Source: 2007 World Population Data Sheet, Population Reference Bureau

Figure 2.1.5 shows the spatial variations in the rate of population growth. Figure 2.1.6 (p. 224) shows projected population change during 2005–50. Table 2.1.4 illustrates the world's demographic trends by region.

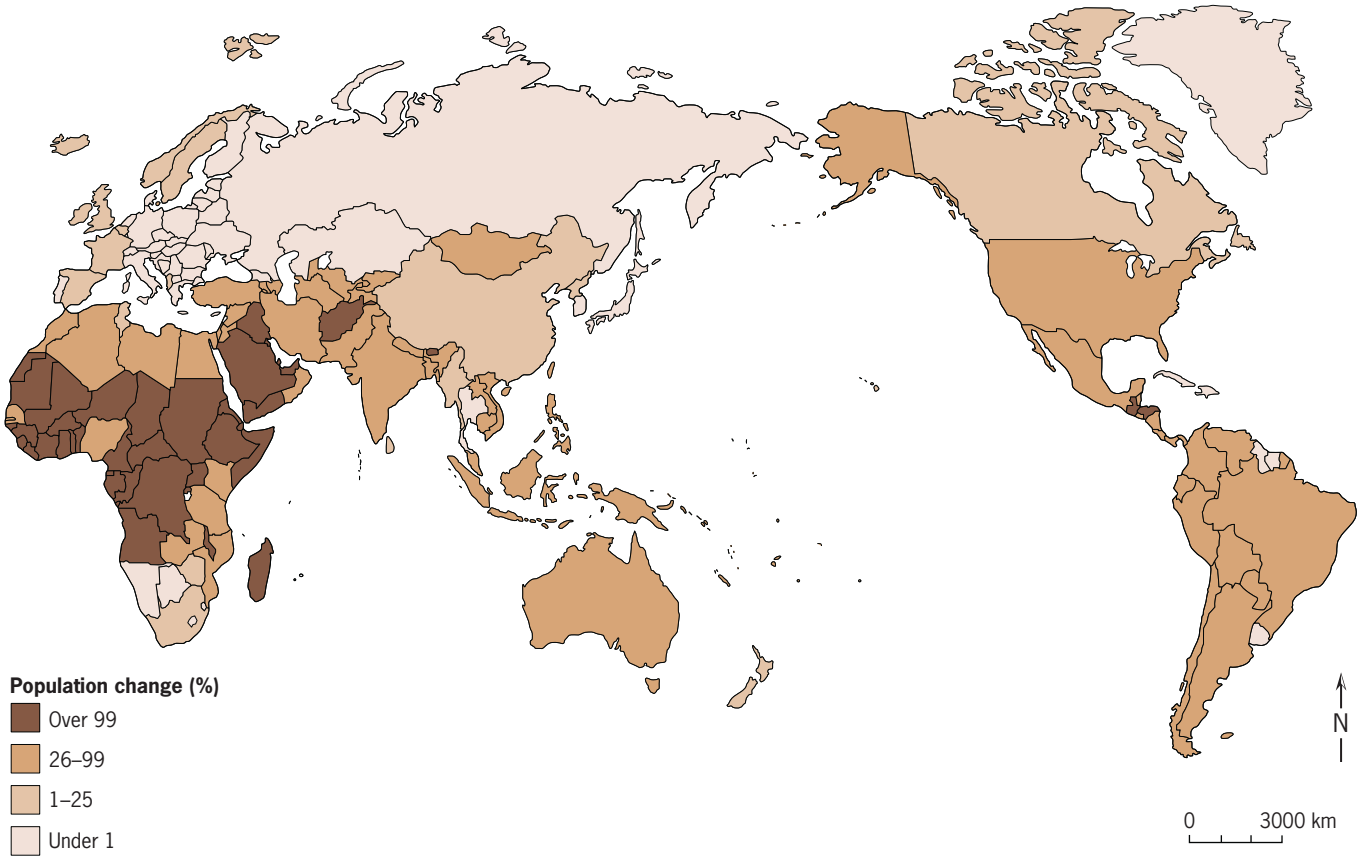


FIGURE 2.1.6

Projected population change, 2005–50.

TABLE 2.1.5

World's 10 largest countries by population, 2007 and 2050

2007		2050	
Country	Population (millions)	Country	Population (millions)
China	1318	India	1747
India	1132	China	1437
USA	302	USA	420
Indonesia	232	Indonesia	297
Brazil	189	Pakistan	295
Pakistan	169	Nigeria	282
Bangladesh	149	Brazil	260
Nigeria	144	Bangladesh	231
Russia	142	Dem. Rep. of Congo	187
Japan	128	Philippines	150

Source: 2007 World Population Data Sheet, Population Reference Bureau

did you know?

Globally, the number of persons aged 60 years or over is expected almost to triple, increasing from 672 million in 2005 to nearly 1.9 billion by 2050. Whereas six out of every 10 of those older persons live today in developing countries, by 2050, eight out of every 10 will do so. An even more marked increase is expected in the number of the oldest-old (persons aged 80 years or over): from 86 million in 2005 to 394 million in 2050. In developing countries, the rise will be from 42 million to 278 million. This indicates that by 2050 most old people will live in the developing world.

The cause of the rapid growth in human numbers

A number of changes have combined to slash **child mortality rates** and increase **life expectancy** without having the same dramatic impact on fertility rates. These include advances in medical science and public

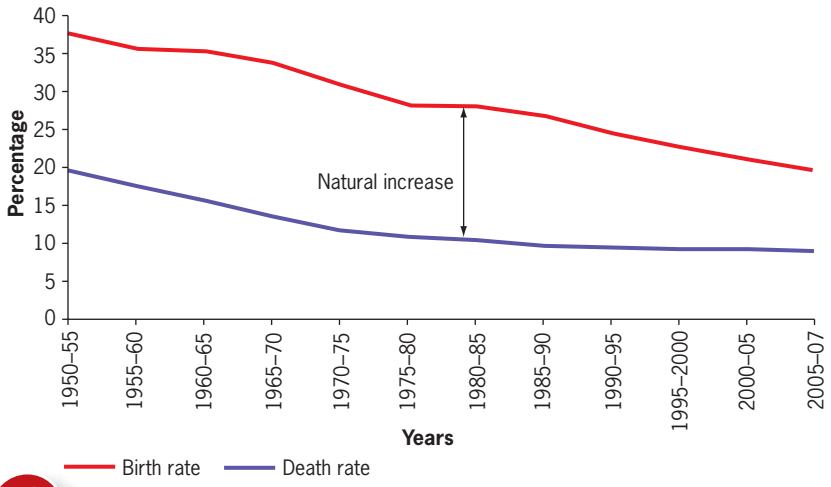


FIGURE 2.1.7

Trends in birth and death rates, worldwide, 1950–55 to 2007.

health, nutritional improvements and greater access to education. This has meant that many more young people have survived to their reproductive years than was the case in the past.

The decline in mortality rates (see figure 2.1.7) is often hailed as one of the great accomplishments of human civilisation. Since the early 1950s the death rate for the world has more than halved: from 19.7 to 9.0 deaths per 1000 population. The mortality rates for the developed and developing worlds are now 10 and 8, respectively. **Infant mortality rates** have declined from 198 per 1000 live births in 1960 to 52 in 2007. (The rate is six per 1000 in developed countries and 57 in developing countries.)

In developed countries the improvements in medical science and public health came about quite slowly and life expectancy increased only gradually. In 1800, life expectancy at birth was about 35 years; by 1900 it had increased to 50 years; by 1950 it had reached 66 years; and today it stands at 80 years. (See table 2.1.4, p. 223.)

In the countries of the developing world the rate of increase began much later but has been more rapid. By 1950 life expectancy had increased to about 50 years. Today it stands at 67 years; an increase of more than half a year every 12 months. Most of this increase came about because of the rapid adoption of the medical technologies that originated in the countries of the developed world.

As a result of these **demographic changes**, fewer children die in infancy and people live longer.

Spatial patterns of fertility and mortality

The *crude birth rate* is the number of births during a specific period. The *crude death rate* is the number of deaths during a specific period. These two measures are usually expressed in terms of the number of births or deaths per 1000 people in a population per year. The **rate of natural increase** of a population is determined by calculating the difference between the crude birth rate and the crude death rate.

The birth rate

There are significant variations in birth rates around the world. The highest birth rates are found in Africa and south-west Asia. For many years, the countries of Africa have had the highest birth rates in the world. Kenya, Tanzania and Uganda all had rates of 50 or more during the 1980s. Demographers regard rates above 30 as high. This places many Central American, African and Asian countries in this category.

The hungry world cannot be fed until and unless the growth of its resources and the growth of its population come into balance. Each man and woman—and each nation—must make decisions of conscience and policy in the face of this great problem.

Lyndon Baines Johnson, 36th president of the United States (1963–69)

did you know?

Urbanisation is the increase in the share of the total population living in urban places. This process is inevitable, and will present humanity with a raft of challenges. Yet it can also be a positive development. The concentration of poverty and social disruption in cities does paint a bleak picture. But no country in the industrial age has ever achieved significant economic growth without urbanisation. While cities may concentrate poverty, they also represent the best hope of escaping it.

Cities also concentrate (and often highlight) the environmental damage done by modern civilisation; yet experts and policymakers increasingly recognise the potential value of cities to long-term sustainability. If cities create environmental problems, they also contain the solutions. The potential benefits of urbanisation far outweigh the disadvantages. The challenge is in learning how to exploit its possibilities.

infant mortality rate the annual number of deaths of infants under 1 year of age per 1000 live births.

demographic changes changes in the size, composition, rates of growth, and density of population; changes to fertility and mortality rates; and changes to patterns of migration.

rate of natural increase the percentage by which a population grows in a year. This is the difference between the birth rate and the natural death rate and excludes migration.

did you know?

In developed countries, 20% of today's population is aged 60 years or over. By 2050 that proportion is projected to be 32%. The elderly population in developed countries has already surpassed the number of children (persons aged 0–14 years). By 2050 there will be two elderly persons for every child. In the developing world, the proportion of the population aged 60 years or over is expected to rise from 8% in 2005 to close to 20% by 2050. Population ageing is becoming a pervasive reality in developed countries. It is also inevitable in the developing world but will occur faster in developing countries.

TABLE 2.1.6

Countries with the highest and lowest life expectancy

Highest		Lowest	
Country	Life expectancy (years)	Country	Life expectancy (years)
Japan	82	Swaziland	33
Australia	81	Botswana	34
France	81	Lesotho	36
Iceland	81	Zimbabwe	37
Italy	81	Zambia	38
Sweden	81	Malawi	40
Switzerland	81	Angola	41
Austria	80	Afghanistan	42
Canada	80	Central African Rep.	43
Israel	80	Mozambique	43
Malta	80		
Netherlands	80		
New Zealand	80		
Norway	80		
Singapore	80		
Spain	80		

Source: 2007 World Population Data Sheet

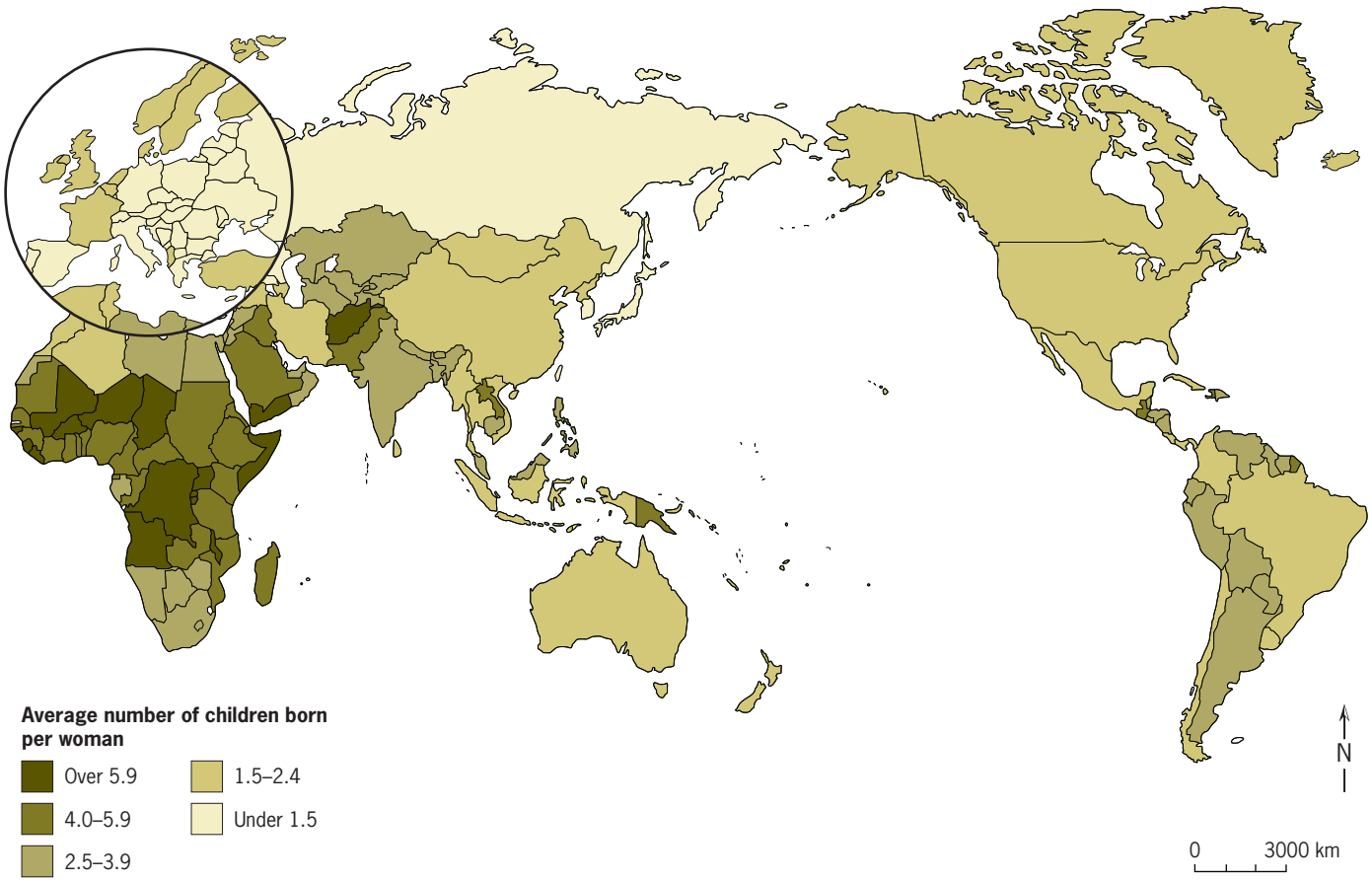


FIGURE 2.1.8

World pattern of fertility, 2007.

geofocus

The demographic transition model

In an attempt to explain the nature of population change experienced by countries, demographers have developed the **demographic transition model**. This model is based on the experiences of several European countries and Canada and the United States. It attempts to identify the different stages of demographic change and to look at their impact on total population. Figure 2.1.9 illustrates these stages.

Future population projections are based on the assumption that we have entered Stage 4 of the demographic transition. Demographers assume, for example, that eventually the birth rate and death rate will reach equilibrium. This will occur several decades after we reach a point where couples average two children each. This two-child average is called **replacement-level fertility** because each couple replaces themselves in the number of people in a population. When the *fertility rate* (the average number of children women are having) is at replacement (or 2.1 children per family), the two children born essentially replace the parents when they die. (The decimal value accounts for child mortality.)

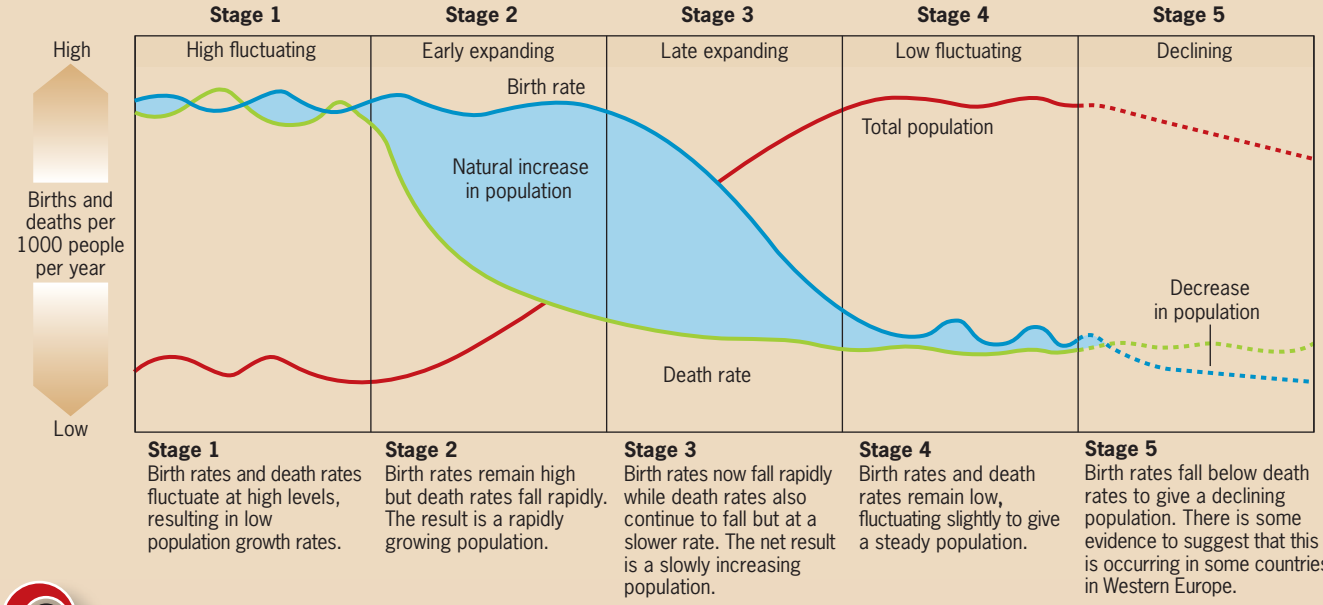


FIGURE 2.1.9

Demographic transition model.

The lowest birth rates are in Europe, where a number of countries have rates below 1.5. Other areas with low birth rates are Australia, New Zealand, Japan, Canada, the United States and China. In some male-dominated cultures, women may be prevented from exercising control over their own fertility. It is clear that low birth rates are associated with higher standards of living. China is the exception to this. It achieved its low birth rate by implementing strict population-control measures.

A number of countries that are moderately wealthy have intermediate birth rates. This would suggest that there is a relationship between a country's birth rate and its level of economic development. However, economic development is not the only factor. Cultural traditions and the status of women also play a role.

The *fertility rate (FR)* is a measure of the average number of children born to a woman of child-bearing age. The FR is a particularly revealing statistic because it provides us with an insight into future demographic trends. For example, at the height of Kenya's population explosion in the 1980s, the average number of children born per woman was 8.1. In 2007, it was still high at 4.9. Thirty years ago China's FR was 6.0. Today it is just 1.6.

demographic transition the theory that relates the process of industrialisation to declining death rates followed by declines in birth rates.

replacement-level fertility the number of children a woman and her reproductive partner must have to replace themselves. The worldwide average is usually just above two children per couple because some children die before they reach their reproductive years.

FIGURE 2.1.10

Infant mortality rates are still high in many African countries. A young, severely malnourished and dehydrated child is cleaned at a hospital in Kenya.

The FR in many countries has experienced a steady decline in recent years. Not only China but also India, Egypt, Brazil and Mexico have lower fertility rates today than they did one generation ago. In a single generation, India's FR has declined from 5.8 to 2.9, Egypt's from 7.2 to 3.1, Brazil's from 6.3 to 2.3, and Mexico's from 7.7 to 2.4. On the other hand, Nigeria's FR (at 5.9) still exceeds 5.0 (the rate for Africa as a whole) and, on average, Afghani women still have 6.8 children each. In East Timor the FR is 7.0, which is only marginally less than Guinea Bissau and Niger in western Africa (7.1).

The overall decline in fertility has been occurring for several decades. This is why the growth rate of the world's population has declined from over 2.1% to 1.2% during the past 30 years. If these reductions are sustained there is some hope that the world's rate of population growth can be slowed. The world pattern of fertility is shown in figure 2.1.8 (p. 226).

The death rate

The *death (or mortality) rate (MR)* is a measure of the number of deaths per 1000 people in a given year. Worldwide the MR is 9, but Africa as a whole has an MR of 14 and some African countries have an MR in excess of 20. These countries include Zimbabwe (with an MR of 21), Zambia (22), Sierra Leone (23), Lesotho (25) Botswana (27) and Swaziland (29).

A high MR usually indicates that infant mortality is high. In some parts of the developing world as many as one in 10 children die before reaching their first birthday. Infant mortality rates are highest

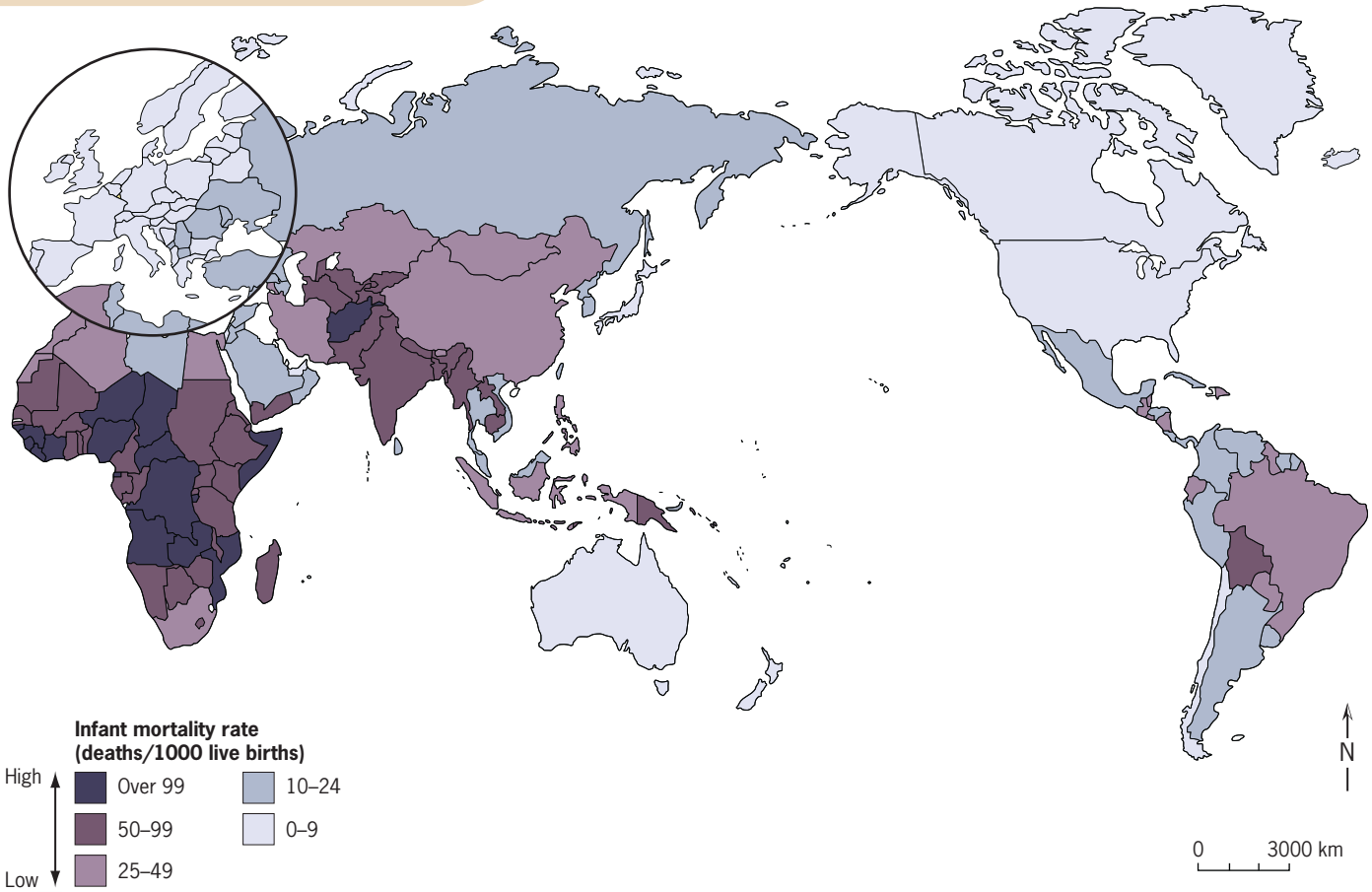


FIGURE 2.1.11

World pattern of infant mortality, 2007.

in Sierra Leone where 158 out of every 1000 children born die before their first birthday. This is well above the whole of Africa rate of 86 and the worldwide rate of 52. Australia's infant mortality rate, by way of comparison, is only 5. The global pattern of infant mortality is shown in figure 2.1.11.

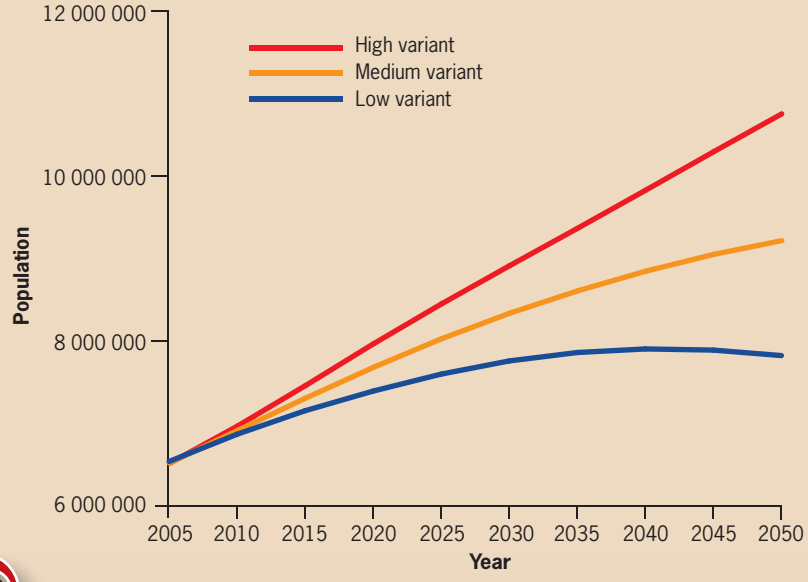
Population projections

Current population projections are based on the assumption that the FR will decline in those countries where they are high today and that life expectancy will rise where rates are low. They are also based on the assumption that the demographic trends of all countries will duplicate the demographic transition experienced by the countries of the developed world.

An important variable in estimating future population levels is the point at which a country's FR drops to the *replacement level* of 2.1 children per woman. In most developed countries the FR is now below replacement level. The situation in the developing countries is not so clear-cut. In the newly industrialised countries, such as South Korea and Singapore, the FR has already dropped below replacement level. In another group of countries that includes Brazil, Argentina, China, Sri

did you know?

In 2007, thousands of people faced starvation due to deepening drought in northern Kenya. The government is distributing food rations to communities in the worst affected areas and is appealing to the international community for urgent aid to save the lives of an estimated 2.5 million people. North-eastern Kenya could take 15 years to recover from the effects of the drought.



High variant: the fertility rate is projected to remain at 2.35 over most of the projection period; that is, 0.5 children above the fertility in the medium variant.

Medium variant: the fertility rate is assumed to converge eventually towards a level of 1.85 children per woman.

Low variant: the fertility rate is projected to remain at 1.35 over most of the projection period; that is, 0.5 children below the fertility rate in the medium variant.

FIGURE 2.1.12

Population projections for 2005–50 based on various assumptions regarding fertility.

geofocus

World population predicted to peak at 9 billion

According to the United Nations, the world's population reached 6.67 billion in mid-2007. Despite projected lower fertility levels, the world's population is expected to reach 9.2 billion in 2050. If, however, the fertility rate remains at the current level of 2.6 children per woman, by 2050 the world will have 10.7 billion inhabitants.

During 2005–50, nine countries are expected to account for half the world's projected population increase. These are India, Pakistan, Nigeria, Democratic Republic of Congo, Bangladesh, Uganda, the United States, Ethiopia and China and are listed according to the size of their contribution to population growth. India is expected to surpass China as the world's most populous country by around 2025.

Figure 2.1.12 shows population projections based on various fertility rate projections.

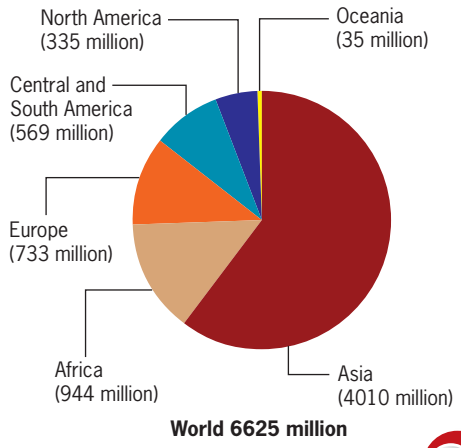


FIGURE 2.1.13

Distribution of the world's population, 2007.

Lanka and Thailand the rate has dropped to less than 3%. A group that includes India, Turkey and the Philippines has experienced a decline in fertility to about 4%, where it has tended to stabilise. A final group that includes most of the countries in Sub-Saharan Africa has experienced little if any decline in fertility. (See figure 2.1.8, p. 226.)

At a global scale, population projections have proved to be quite accurate. At a national level or regional level, projections tend to be less reliable.

We know that future population growth is inevitable, but the range of possible future population sizes varies dramatically. Five plausible projections published by the United Nations led to outcomes ranging from 7.3 billion people to 10.7 billion people in 2050.

While no-one knows exactly when the population will stop growing, the United Nations and other organisations estimate that world population could continue to grow well into the twenty-second century, reaching 9.8 billion by 2150. These outcomes are based on the medium projections. (See figure 2.1.12, p. 229.) These assume (to varying degrees for different countries) that the downward trend of fertility rates will continue and stabilise at 2.1 children per woman. They also assume continued mortality declines. If fertility were to decrease at a much faster pace and stabilise at 1.6 children per women, world population could stop growing much sooner; by 2050 it would be 7.3 billion. Given

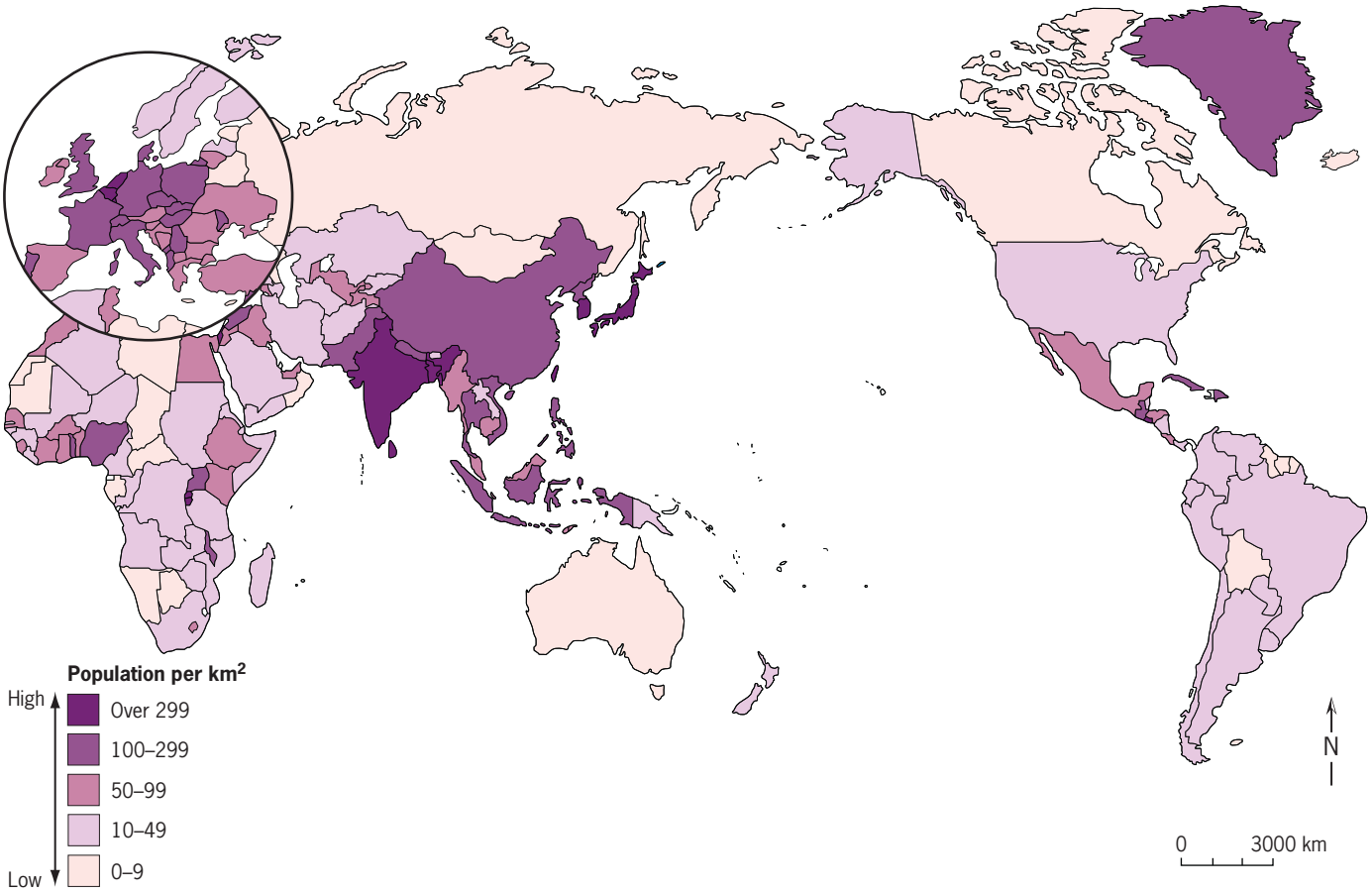


FIGURE 2.1.14

Population density.

that scenario, the population would decline to 5.3 billion by 2150. On the other hand, slower declines in fertility could lead to a global population of 10.7 billion by 2050 and 16.2 billion in 2150, with fertility projecting to stabilise at 2.5 children per woman.

The distribution and density of the world's population

The distribution or spread of the earth's population is uneven and there are substantial differences in *population density*; that is, the number of people per unit area.

Population distribution is best shown by using dot maps while population density is, by convention, normally shown using choropleth maps. (See figure 2.1.14.) Both types of maps reveal those parts of the earth's surface that are sparsely settled and those that are densely settled.

At a global scale, population distribution and density are determined largely by biophysical opportunities and constraints. Land makes up just 30% of the earth's surface. Of this amount, 28% is seriously deficient in water, 22% has soils that are too thin for cultivation, 10% is waterlogged and 6% is affected by permafrost. Only 11% of land offers no serious limitation to settlement and agricultural landuse. At the local or regional scale, economic, political and social factors are likely to be influential in determining landuse.

understanding the text

1 **State** by how much the world's population increased during the twentieth century.
2 **State** the number of people that are added to the world's population each year.
3 **Explain** why continued population growth is inevitable for the foreseeable future.
4 **Explain** why people are concerned about the extent of the projected rate of population increase. Outline the argument used to dismiss these fears.
5 **State** where most of the population growth is occurring.
6 **Identify** the continent that will experience the greatest proportional increase in population. Cite the reasons for this.
7 a **Identify** the demographic trend now apparent throughout the countries of the developed world.
b **Describe** the impact of this trend on Europe's population.
8 **Identify** the demographic pattern that is apparent in Asia.
9 **Outline** the causes of the rapid growth in the human population.
10 **Define** the term natural increase.
11 **Identify** where birth rates are the highest and lowest.
12 **Describe** the relationship between birth rates and economic development.
13 **Explain** what is meant by the term fertility rate (FR). What trends are apparent in the FR?
14 **State** where death rates are the highest and lowest.
15 **Identify** the assumptions on which projections about population growth are based.
16 **Explain** what is meant by the term replacement level.
17 **Identify** the factors that determine the distribution and density of a population.

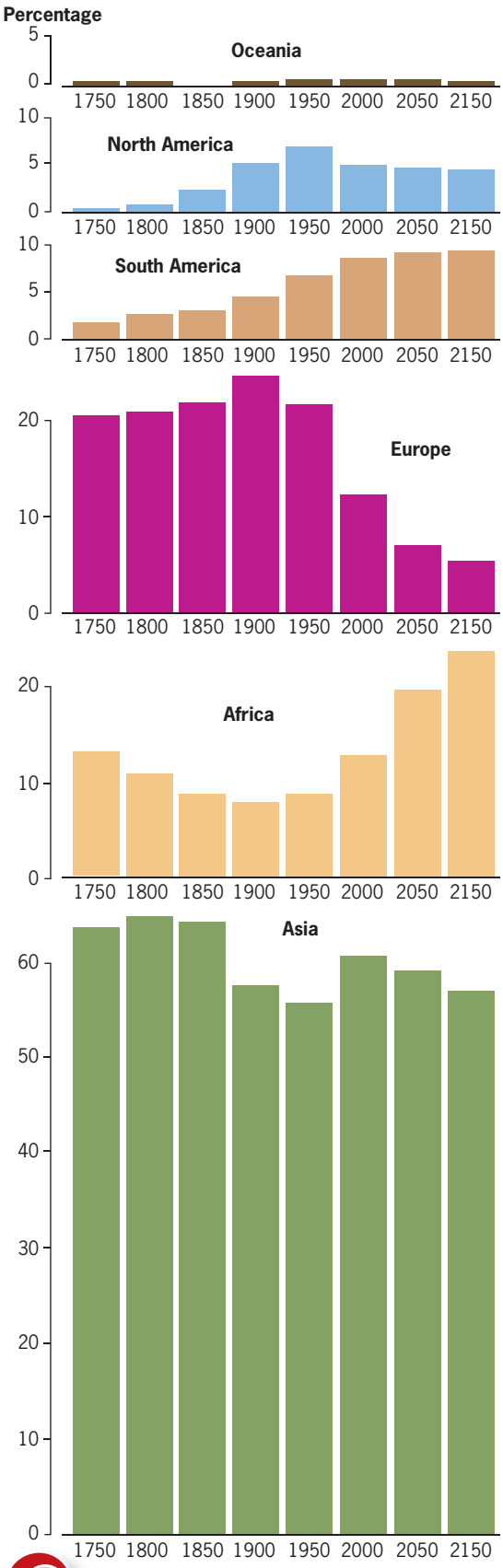


FIGURE 2.1.15
Changing distribution of the world's population, 1750–2150.

1 **Constructing diagrams** Using the information in table 2.1.2 (p. 219), draw a line graph showing the growth in human numbers. Use a scale of 10 mm to 1000 million people on the vertical axis and 10 mm to 100 years on the horizontal axis.

2 **Interpreting diagrams** Study figure 2.1.3 (p. 220).
- a State when the world's population first exceeded 1 billion.
- b Identify the time period in which the world's population expanded most quickly.
- c Explain why figure 2.1.3 is more effective in showing the growth of world population than the graph you constructed in activity 1.

3 **Interpreting diagrams** Study figure 2.1.4 (p. 221). Write a paragraph outlining the trends in population increase and the population growth rate.

4 **Interpreting diagrams** Study figure 2.1.5 (p. 223). With the aid of an atlas, identify those parts of the world with population growth rates greater than 2.9%. Identify those countries experiencing negative population growth rates.

5 **Using ICT** Using the US Census Bureau site, complete the following tasks.
- a Access the World POPClock. What is the population of the world today?
- b Update the key demographic statistics used in this section of the text.
- c Access the International Data Base (IDB). Select a group of countries representative of different stages of the demographic transition.
  - i Print out the population pyramids for the current year, 2010, 2015 and 2020 for each of the countries selected. Compare the graphs and write a report describing the trends evident.
  - ii Use a world map as the basis for a wall display illustrating the demographic trends of the countries selected.
- d Access the IDB Country Summaries. For each of the countries selected in part c of this task, find the estimated population for the current year and for 2015 and 2025.

6 **Interpreting diagrams** Study figure 2.1.6 (p. 224). With the aid of an atlas, identify those parts of the world that are projected to have the highest percentage change in their population in the period 2005–50.

7 **Interpreting diagrams** Study figure 2.1.7 (p. 225). Write a paragraph outlining the trends in birth and death rates since 1950–55.

8 **Interpreting diagrams** Study figure 2.1.8 (p. 226). With the aid of an atlas, identify the parts of the world with the:
- a highest fertility rate
- b lowest fertility rate.

9 **Writing task** Study figures 2.1.5 (p. 223), 2.1.8 (p. 226), 2.1.11 (p. 228) and 2.5.5 (p. 416). Outline the relationship between the rate of population increase, fertility rates, infant mortality rates and GNI per capita.

10 **Writing task** Study figure 2.1.9 (p. 227). Write an explanation of the demographic transition model. Include references to the processes responsible for the trends apparent at each stage of the transition.

11 **Interpreting diagrams** Study figure 2.1.11 (p. 228). With the aid of an atlas, identify those regions of the world where infant mortality rates are the:
- a highest
- b lowest.

12 **Writing task** Study figure 2.1.12 (p. 229). Outline how population projections are affected by the various assumptions made about fertility rates.

13 **Constructing diagrams** Read the third paragraph in the section dealing with the distribution and density of the world's population (p. 231). Use those data to construct a proportional bar graph that illustrates the biophysical constraints on human settlement.

14 **Interpreting diagrams** Study figure 2.1.13 (p. 230). State the proportion of the world's population living in:
- a Asia
- b Africa
- c Europe.

15 **Interpreting diagrams** Study figure 2.1.14 (p. 230), then complete the following tasks. Use an atlas to assist you.
- a Identify the regions of the world that are the most densely settled.
- b Identify the countries with the highest population density.
- c Which regions are the most sparsely settled?
- d Name 10 countries that have low population densities.
- e State the range of population density in each of the following countries: Iceland, New Zealand, Moldova, Belarus, Latvia, France, Cuba, India, Pakistan, Afghanistan and Japan.
- f Compare figure 2.1.14 with a physical map of the world. Describe the relationship between the nature of the biophysical environment and population densities.

16 **Interpreting diagrams** Study figure 2.1.15 (p. 231).
- a Identify those regions of the world that are increasing their share of the world's population.
- b Which regions have a declining share of the world's population?
- c How has Asia's share of the world's population changed since 1750?

Factors affecting fertility and mortality rates

Despite the rapid population growth still being experienced by some of the world's poorest countries there is now some cause for optimism. The world's annual rate of population increase is slowing, from 2.06% in 1965–70 to 1.73% in 1985–90, 1.44% in 1990–95 and 1.31% in 1995–2000.

The average annual growth rate in 2000–05 was 1.2%. (See figure 2.1.16.) This slowing is a result of the lower fertility rates that have accompanied improvements in the quality of people's lives and the increasing use of contraceptives. As people's economic and social well-being improves they tend to have fewer children. (See the Geofocus box 'Fertility rates plummet'.)

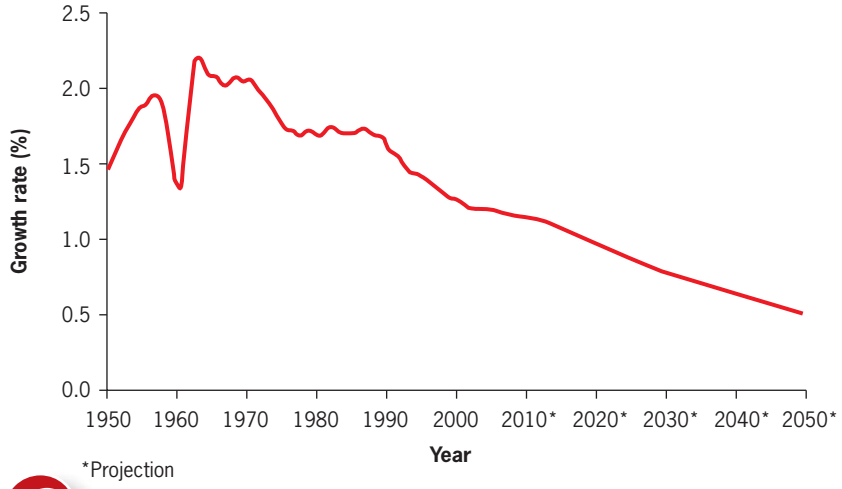


FIGURE 2.1.16

World population growth rates (actual and projected), 1950–2050.

did you know?

Among the least developed countries, where life expectancy today is just under 50 years, it is expected to be 66 years in 2045–50. In the rest of the developing world, life expectancy is projected to rise from just under 66 years today to 76 years by mid-century. Due to the high prevalence of HIV/AIDS in some developing regions, the projected increase in life expectancy in less developed countries is dependent on the implementation of effective programs to prevent and treat HIV infection.

geofocus

Fertility rates plummet

Global birth rates are now at their lowest level in recorded history. The average woman living in the developing world is now having just 2.9 children, down from an average of nearly six babies in the 1970s. UN demographers now predict that fertility rates throughout most of the developing world will fall below the replacement level (2.1 children per woman) before the end of the twenty-first century. Factors contributing to the fall include the increased level of education for women, the use of contraceptives and the process of urbanisation.

Already, 20 countries have fertility rates below that required to maintain their existing population. The United Nations predicts that by 2050, 75% of less developed countries will have below-replacement fertility. China, which implemented a strict one-child per family policy in 1979, has had the largest drop in fertility rates: from 6 in the 1950s to 1.6 in 2007.

About one-third of the world's countries now have fertility rates below replacement level. The lowest rates are found in the world's 44 most developed countries, which together account for 19% of the world's population. All except Albania have fertility rates below replacement level. Fifteen of these countries, mostly located in Southern and Eastern Europe, have achieved fertility rates below 1.3 children per woman. Japan, Italy, Spain, Germany and Russia are among the countries expected to have significantly smaller populations by 2050.

Because of declining fertility rates, the population of developed countries as a whole is expected to remain virtually unchanged between 2005 and 2050, at about 1.2 billion. By contrast, the population of the 50 least developed countries is expected to more than double; growing from 0.8 billion in 2007 to 1.7 billion in 2050. Some of these countries are expected to experience very rapid population growth. For instance, between 2007 and 2050, the population is projected to at least triple in Afghanistan, Burkina Faso, Burundi, Chad, Congo, Democratic Republic of Congo, East Timor, Guinea Bissau, Liberia, Mali, Niger and Uganda. The population of the developing world as a whole is expected to increase; rising from 5.4 billion in 2007 to 8 billion in 2050.

Countries of the developed world

Throughout the countries of the developed world, rates of fertility are now falling below replacement level, with an overall figure of just 1.6. Experts expect fertility rates to remain low and possibly undergo a further decline. They attribute this trend to a range of social and

did you know?

- UN demographers project the average life expectancy of a child born in 2050 will be 75. A child born today is expected to live, on average, until 65, while 50 years ago life expectancy at birth was 46 years. In the more developed regions, the projected increase is from 75 years today to 82 years by mid-century.
- Increasing life expectancy, when combined with declines in fertility, will produce a trend of population ageing, whereby the share of older persons in a population increases relative to that of younger persons.

economic changes taking place within developed countries. These include the following:

- The status and role of women has changed. Women's increased level of participation in the workforce has been brought about by a number of factors, such as
  - the changing structure of the workforce, especially the growth of employment opportunities in the service sector
  - changing social attitudes to the participation of women in the workforce, such as erosion of the once widely held view that, upon marrying, women should relinquish their position in the workforce
  - rising material expectations that have encouraged an increase in the number of two-income families.
- Attitudes to marriage and child-bearing have changed. Women are choosing to marry later, delay the start of their families and concentrate child-bearing within a shorter period of time.
- There is a growing acceptance of alternative lifestyles and family structures. It is, for example, becoming more common for women to remain single and/or childless. There is also a growing acceptance of non-heterosexual relationships in some societies.
- Methods of birth control have improved and are more acceptable and more widely available. These have enabled women to exercise greater control over their own fertility.

Countries of the developing world

In the countries of the developing world the first tentative signs of a decline in fertility rates became apparent towards the end of the 1960s. By the mid-1970s this trend had become more widespread. By 1973 the rate had fallen to 3.6 from a 1950s high of 6.2. By 2007 it had declined to 2.9. Although this decline has been substantial it remains well above replacement level, which is approximately 2.1. If it is sustained, the population of the developing world will double in just 24 years. The average fertility rate for the developing world also masks some substantial differences between regions. In sub-Saharan Africa, for example, the fertility rate is 5.5 children per woman.

FIGURE 2.1.17

Mothers breastfeed newborn babies in a hospital in Manila in the Philippines. Fertility rates remain relatively high in many developing countries.

The most widespread decline has occurred in those countries experiencing the fastest rates of economic development, such as Singapore. The relatively high levels of education and well-organised, government-sponsored family planning programs in such countries have been central to their success. So successful was Singapore's 'Stop at Two' policy (in place from the mid-1960s to 1986) that the government is now encouraging couples to have larger families. The new policy is 'Have Three or More, if You Can Afford It.' This initiative was introduced due to the fear of future labour shortages and the restraints these would place on the country's economic growth.

In countries experiencing slower rates of economic development some success has been achieved through the application of various incentives and penalties designed to encourage couples to have smaller families. Before its current surge in economic growth, China achieved a substantial reduction in its fertility rate by just such an approach.

Factors affecting fertility rates

The factors affecting fertility rates include:

- *Levels of economic and social well-being*. Fertility rates generally decline with increasing levels of development.
- *Infant mortality rates*. High infant mortality rates result in families having larger numbers of children in the expectation that some will not survive infancy.
- *The importance of children as part of a family's labour force*. In many countries of the developing world, children are seen as an asset because of the labour they are able to contribute to subsistence farming practices. Children also assist with the collection of water and fuelwood.
- *Levels of urbanisation*. Urban dwellers tend to have a lower fertility rate than people living in rural areas.
- *Educational and employment opportunities for women*. Fertility rates tend to be high where women have little or no access to education and paid employment.
- *The average age of marriage*. As the average age of marriage increases, fertility rates tend to decrease. If marriage is delayed to the age of 25, a woman cuts her child-bearing years (typically ages 15–44) by 10 years and reduces her prime reproductive years (typically 20–29) by 50%.
- *The cost of raising children*. The high cost of raising and educating children in developed countries has contributed to a reduction in fertility.
- *The availability of reliable methods of birth control*. Access to contraceptives tends to reduce fertility.
- *The availability of aged services and pensions*. These reduce parents' reliance on their children to support them in their old age.
- *Family size preferences*. In some societies, family size is influenced by a range of cultural factors, including religious beliefs and cultural traditions. These, in turn, are often linked to the status of women and the degree of control that women are able to exercise over their own fertility.

Factors affecting mortality rates

The factors affecting mortality rates include:

- nutritional standards
- standards of personal hygiene and effluent disposal (sanitation)
- access to safe drinking water and the incidence of infectious diseases
- access to medical and public health technology, including immunisation, antibiotics and insecticides.

did you know?

- Twenty-eight per cent of the world's population is aged under 15 years. In developing countries, the population under the age of 15 can be as high as 48% (as occurs in Mali, in Africa). In developed countries, the proportion can be as low as 14% (as in Liechtenstein, the Ukraine and Spain) or 15% (as in Austria, the Czech Republic and Hungary).
- In 2007, Niger had the highest fertility rate, at 7.1 children per woman, while South Korea and Taiwan had the lowest, at 1.1.
- In 2007, Burkina Faso, Guinea Bissau, Liberia, Mali, Niger, Sierra Leone, Burundi, Malawi, Rwanda, Somalia, Uganda, Chad, Democratic Republic of Congo, Yemen, Afghanistan and East Timor all had total fertility rates greater than 6.0 per woman.
- In 2007, Afghanistan had the highest infant mortality rate, at 166 deaths per 1000 live births. Iceland had the lowest rate of infant mortality, at just 2.4 deaths per 1000 live births.

geofocus

China's One-child Policy

China's One-child Policy (or Planned Birth Policy, as it is officially known) was introduced in 1979 to limit the country's population growth. Although introduced as a temporary measure, the policy is still in place. Officially, couples are limited to just one child. Second or subsequent pregnancies are met with fines, economic penalties and pressure to have the pregnancies aborted.

The policy is not an all-encompassing rule. It has, in practice, only applied to ethnic Han Chinese living in urban areas. Ethnic minorities and those living in rural areas have not been subject to the policy. Nevertheless, the policy has proved very successful in reducing the rate of China's population growth.

There have, however, been some unplanned demographic and social impacts. Male children are often prized more highly than girls. This has resulted in cases of neglect and abandonment of female children. Female babies are often aborted, and infanticide has been known to occur. As a result, there is now a gender imbalance; there are 114 males for every 100 female babies.

The policy proved very effective at curbing China's population growth rate. In 1979, when it was introduced, the fertility rate (FR) was over 5%. By 2007, the FR had dropped to 1.6, well below the population replacement rate of 2.1. To prevent too dramatic a population decrease a special provision now allows millions of couples to have two children legally. To qualify, both partners must be without siblings (brothers or sisters).

population pyramid a bar graph showing the distribution by gender and age group of a country's population.

population structure the age and gender composition of a population, usually depicted as a population pyramid.

High rates of infant mortality are usually an indication of inadequate food (under-nutrition) and poor diet (malnutrition). They often can also indicate a high incidence of infectious diseases, many of which are contracted from contaminated water.

Population policies

The countries experiencing the most substantial declines in fertility are those that have implemented population-control policies that are well-organised, government-initiated and emphasise birth control and family planning. By themselves, however, such policies are unlikely to achieve a sustained reduction in fertility unless they are associated with programs that promote economic and social development. Coercive policies are rarely successful. An example was the policy implemented in India in the 1970s, where sterilisations conflicted with religious and cultural beliefs and civil liberties.

Family planning programs can be a highly emotive cultural and political issue in many countries. This is particularly true in countries of the Islamic world and those in which the Roman Catholic Church is a major social and political influence. Culturally sensitive family planning programs are central to the achievement of sustained reductions in fertility and population growth rates. Such programs need to be combined with improvements in infant and maternal health care programs.

Population structure

By studying the age and gender structure of a population we can gain some useful insights into the prospects for future population growth and a range of issues related to a population's economic and social needs. The demographic transition model shows only the rate of natural increase (or decrease) resulting from the difference in birth and death rates. On the other hand, **population pyramids** show the impact of migrations, wars, major epidemics and gender imbalances.

Figure 2.1.18 shows the **population structure** of two countries at different stages of the demographic transition. Ethiopia has a population pyramid that shows the impact of high fertility and mortality rates. This is typical of many of the world's poorest countries. The large proportion of the population under the age of 15 will ensure high levels of population growth for the foreseeable future. Italy's population pyramid is typical of an ageing population in the developed world. Both birth rates and death rates are low and life expectancy is high.

The ageing of the world's population

One of the most important demographic changes is the ageing of the world's population. In 1970, there were 291 million people over the age of 60 years. This represented 7.8% of the world's population at that time. By the year 2000 this number had increased to 600 million or 9.8% of the total population. By 2005 this had grown to 690 million or 10.3%. In the more developed regions, the population aged 60 or over is expected to nearly double; from 245 million in 2005 to 406 million in 2050. Meanwhile, the population of persons aged under 60 is likely to decline; from 971 million in 2005 to 839 million in 2050. (See figure 2.1.20, p. 239.)

Another way of observing this method is to note the projected increase in the median age of the world's population. In 1950, the median age of the world's population was 23.9 years. By 2005, this had increased to 28.0 years, and by 2050 it will have increased to 38.1 years. However, these global figures mask significant regional differences. The population of Europe, for example, has the world's oldest median age of nearly 39 years and this is expected to reach 47 years in 2050.

The least developed countries, on the other hand, tend to have young populations. Afghanistan, Angola, Burundi, Democratic Republic of Congo, Guinea Bissau, Liberia, Niger and Uganda are all projected to have a median age under 24 years in 2050.

Population ageing is now increasingly obvious in the developing world. Between 1950 and 2007 the developing world's average life expectancy rose from 40 years to 66 years. The factors contributing to the ageing of the population include increased life expectancy due to improvements in medical science, hygiene and nutrition. (See figure 2.1.22, p. 240.)

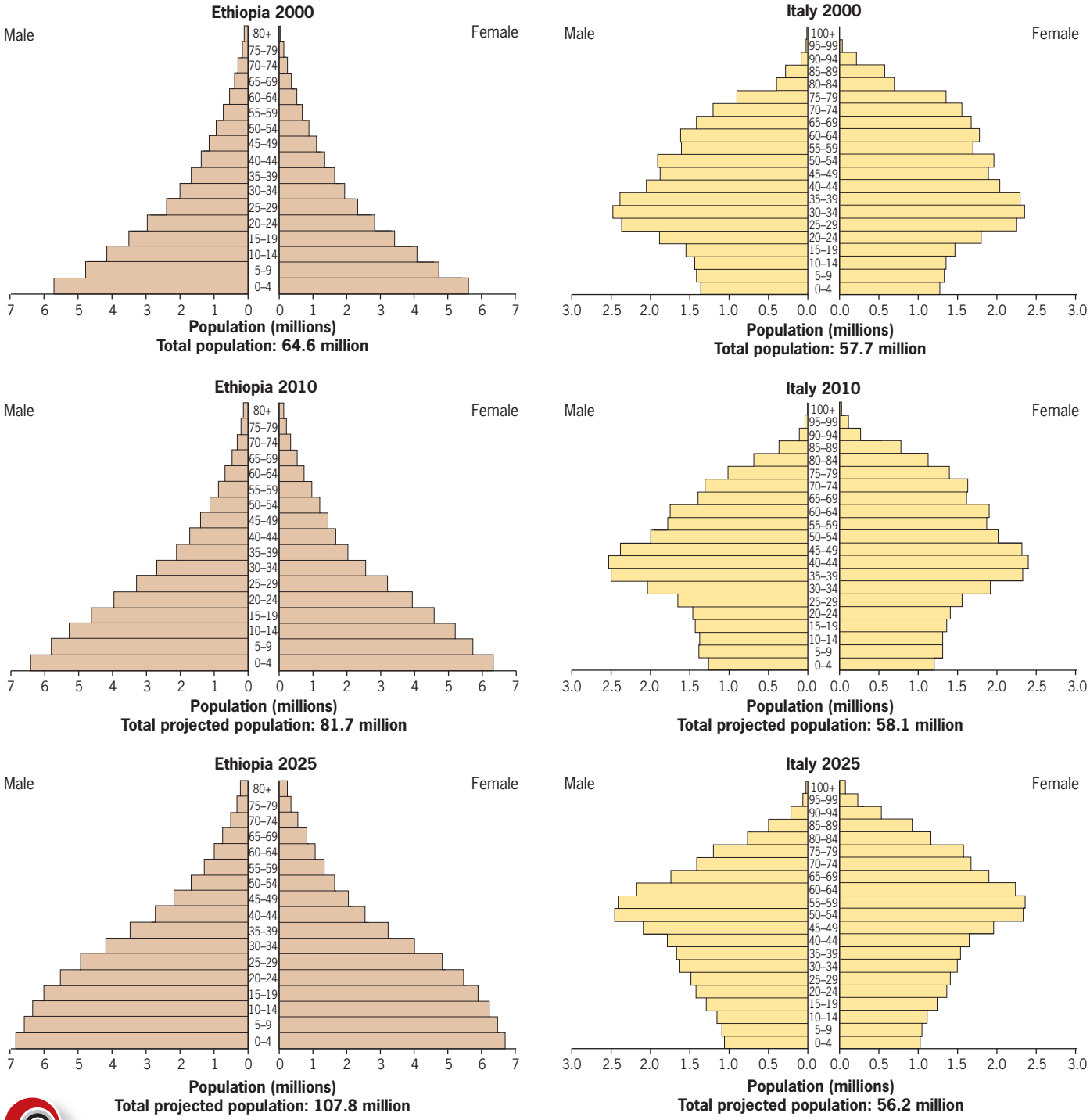


FIGURE 2.1.18

Population pyramids for Ethiopia and Italy, 2000, 2010 and 2025.

geoskills 22

Population pyramids

Population pyramids are bar graphs used to illustrate the age and sex structure of a population. The vertical axis of the graph represents the various age groups of a population. The horizontal axis shows either the actual number or the proportion of the population for both males and females. Because each population pyramid represents 100% of a particular population, comparisons can be readily made with the population pyramids of other populations.

Sometimes the horizontal scale shows the actual number of people in each age group. Before you try to interpret a graph always check the units of measurement used on the horizontal axis.

Populations are often divided into broader age groups based on dependency. The dependent parts of the population are usually defined as the 0–14 age group and the 65 and over age group. The changing proportion of the population in each of the age groups provides us with valuable information about future population trends. For instance, if the proportion of the population 65 years and over is growing, the population is said to be ageing. If the proportion of the population 14 years and under is decreasing, we can conclude that the birth rate is declining, as is the rate of population increase.

The shape of a population pyramid provides us with insights regarding the population shown. It can, for example, tell us whether the population is ageing or has the potential for significant future growth. Figure 2.1.19 shows some of the common population pyramid shapes and the conditions under which they develop.

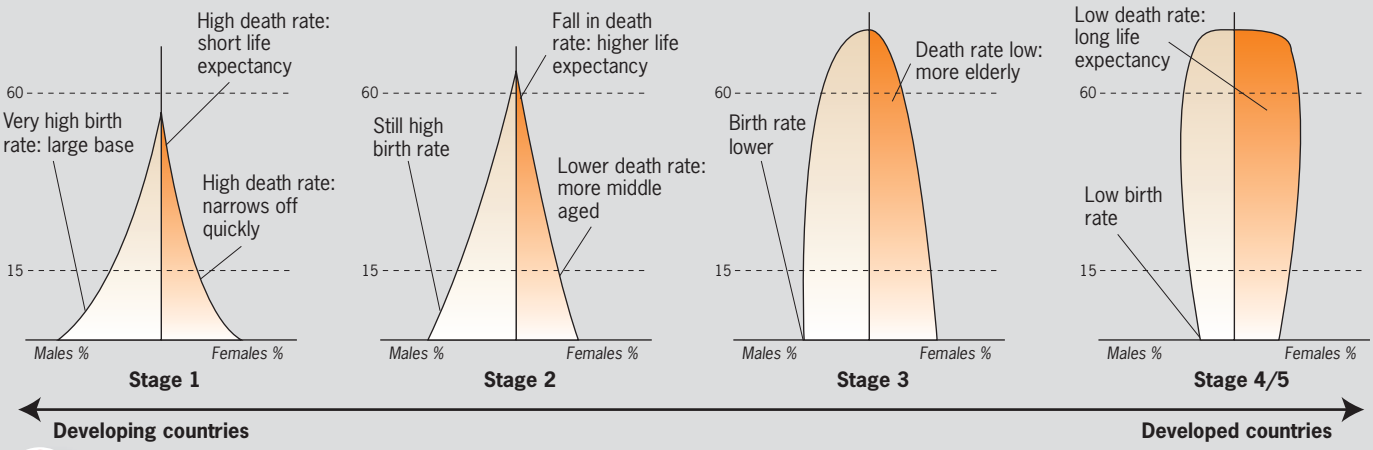


FIGURE 2.1.19

Common population pyramid shapes and the conditions under which they develop.

TABLE 2.1.7

Percentage of persons aged 65 years and over, 2007

	2007	2025	2050
World	7	10	16
Developed countries	16	21	26
Developing countries	6	9	15
Europe	16	21	28
North America	12	18	21
Oceania	10	15	19
Latin America and Caribbean	6	10	19
Asia	6	10	18
Africa	3	4	7

Source: 2007 World Population Data Sheet, Population Reference Bureau

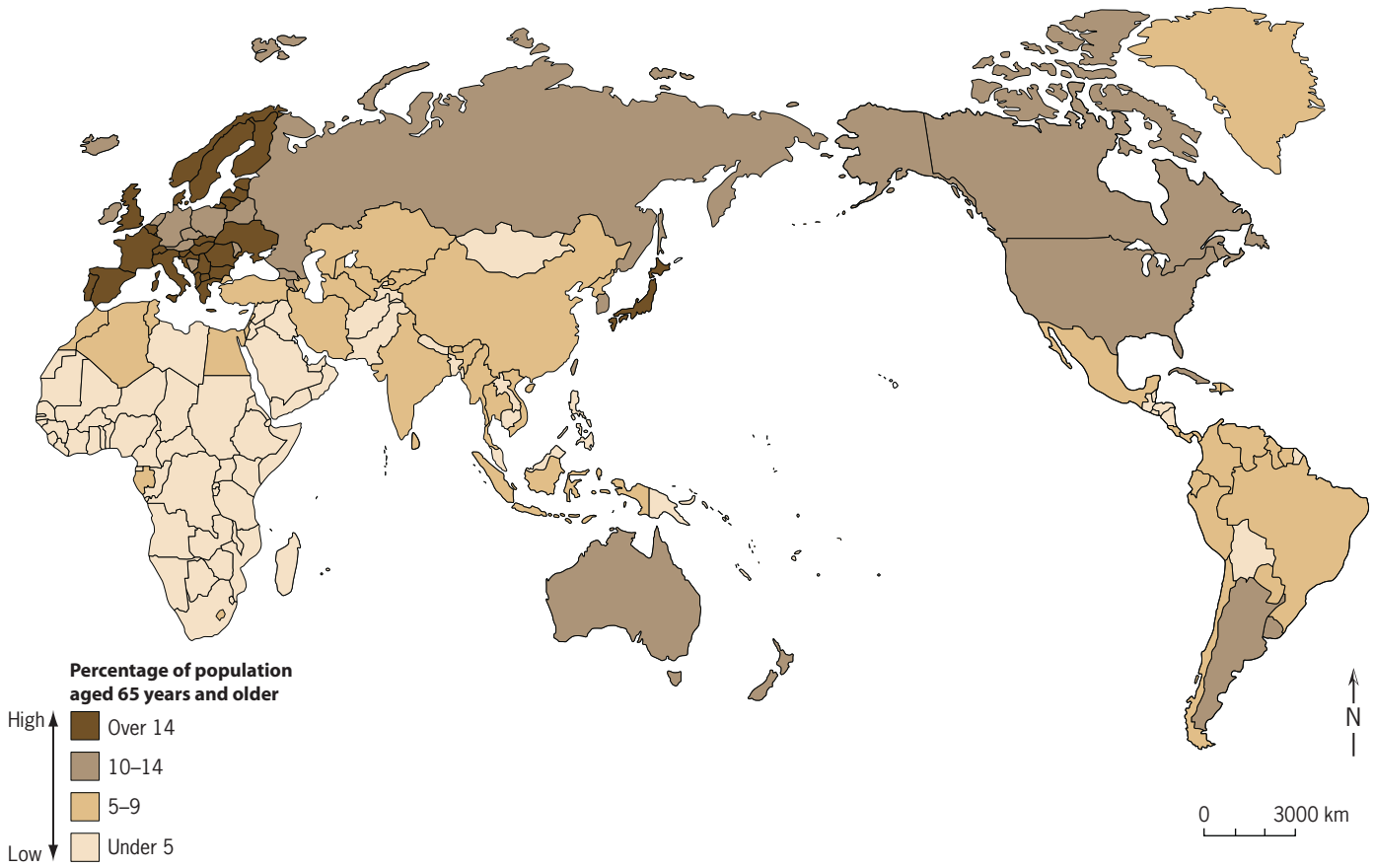


FIGURE 2.1.20

Proportion of the population aged 65 years and older, 2007.

FIGURE 2.1.21

An elder care centre in China. Meeting the needs of a growing population of the aged is presenting the countries of the world with new challenges. China currently has over 140 million elderly citizens, and the figure will keep growing at an annual rate of about 3.2% over the next 50 years.

did you know?

- Egypt has the most highly concentrated population on earth. Ninety-nine per cent of the country's 73.4 million people live on just 4% of the total land area, which is 1 001 449 km^2.
- Despite the surge in population growth in Africa, more than half the world's people will continue to live in Asia. At its projected growth rate, Asia's population will increase from 4010 billion to 5378 billion by 2050. This is an increase of 34%.

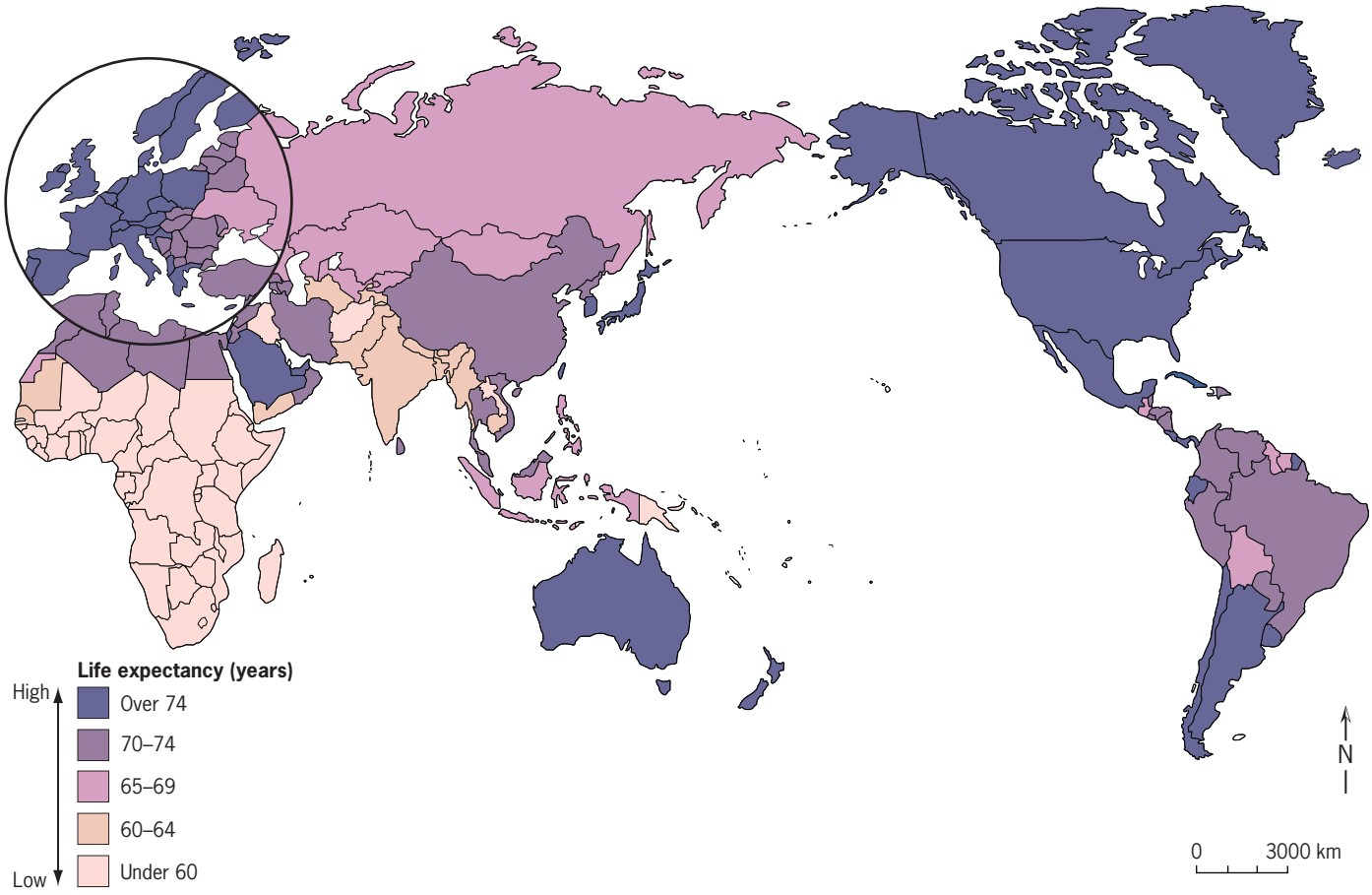


FIGURE 2.1.22

Life expectancy, 2007.

understanding the text

1 **a** **Identify** the trends apparent in global fertility rates.
   b **Explain** why these trends are occurring.
2 **Describe** how the changing status and role of women have affected fertility rates in the countries of the developing world.
3 **Identify** the fertility trends that are now becoming apparent in the countries of the developing world.
4 **List** the factors affecting fertility rates.
5 **List** the factors affecting mortality rates.
6 **Outline** what must accompany family planning policies if they are to achieve sustained reductions in fertility rates.
7 **Outline** the information we can obtain about a population by examining its population pyramid.
8 **Explain** why the world's population is said to be ageing.
9 **Outline** the factors responsible for the ageing of the world's population.

working geographically

1 **Writing task** Write an extended response. Topic: Outline the factors affecting rates of fertility and mortality and account for the differences observed on a global scale.
2 **Interpreting diagrams** Study figure 2.1.16 (p. 233).
   a When did the rate of population growth peak?
   b What trend was apparent between 1975 and 1990?
   c What has been the trend since 1990?
3 **Interpreting text** Study the Geofocus box 'Fertility rates plummet' (p. 233).
   a Outline the extent of the decline in fertility.
   b Explain the consequences of this decline for the countries of both the developed and developing worlds.
4 **Interpreting text** Study the Geofocus box 'China's One-child Policy' (p. 236).
   a Outline China's One-child Policy and explain how it is enforced.
   b Describe the impact of the policy on China's population growth rate.
   c Outline the unplanned demographic and social impacts of the policy.

Population movements

Migration is the act or process of moving from one place to another with the intention of staying at the destination permanently or for a relatively long period of time. The movement of people out of an area is referred to as *emigration* while the movement of people into an area is called *immigration*.

Basic classification systems identify two broad types of migration: internal migration and international migration. *Internal migration* refers to population movements within a country, while *international migration* involves a movement across national boundaries. Migrations can also be defined as being either forced or voluntary. *Voluntary migrations* occur when people move because they wish to improve their economic and social well-being and/or to gain personal freedom. *Forced migrations* are usually the result of circumstances beyond the control of the individual. Natural disasters, wars and civil unrest often initiate large-scale population movements.

The features of contemporary population movements include:

- the globalisation of migration
- an increase in the volume of migration in all regions
- a growing diversity in the type of migration (Most countries with a migrant intake have a mix of immigration categories: labour, refugee, permanent settlement and family reunion.)
- an increasing proportion of women in all types of migration across all regions (This is particularly the case with labour migration and some refugee movements.)
- the increasing international mobility of highly qualified personnel
- the movements associated with economic and social change in the newly industrialised countries.

International movements

The movement of people from one continent to another and from one country to another has been a feature of human history for thousands of years. Today such movements are part of a global process that is reshaping societies and cultures. Many contemporary migrations are closely related to the economic, political and cultural links being formed between countries due to the process of globalisation. The volume of movement is likely to increase because of this factor. Population movements are changing the face of the world: migration and ethnic diversity within countries are powerful forces for social and cultural change. There are now more than 120 million people living outside the country in which they were born.

International population movements have affected regions and countries in different ways. Some countries are largely the product of immigration. Examples are the United States, Canada, Australia and New Zealand. (See figure 2.1.23.) Their populations consist mainly of European immigrants and their descendants. The indigenous populations that once occupied these lands have been dispossessed, and the descendants of those who survived have been marginalised and discriminated against. In the last 25 years these four countries have experienced a change in the source of their immigrants. Many of their immigrants now come from Asia and, in the case of the United States, from Mexico, South America and the Caribbean. Figure 2.1.27 (p. 244) shows the impact that migration has had on specific populations.

Central and South America

Most Central and South American countries have been affected by the movement of refugees and foreign workers. There has, for example, been

working geographically

1 **Interpreting diagrams** Study figure 2.1.18 (p. 237).
   - **a** Estimate the proportion of the population under the age of 15 for each of the populations in 2010.
   - **b** Estimate the proportion of the population over the age of 60 for each of the populations in 2010.
   - **c** Describe how the population structure of Ethiopia is typical of many other developing countries.
   - **d** Describe the future trends in Italy's population.
   - **e** Outline the potential for future population growth in each population.
   - **f** Explain how the future social needs of Ethiopia and Italy will differ.
   - **g** Explain why Italy is concerned about its future labour requirements.

2 **Interpreting diagrams** Study figure 2.1.20 (p. 239). With the aid of an atlas, identify those parts of the world with the oldest and the youngest populations.

3 **Interpreting diagrams** Study figure 2.1.22 (p. 240). With the aid of an atlas, write a report outlining the spatial pattern of life expectancy.

4 **Writing task** Study figures 2.1.22 (p. 240) and 2.5.5 (p. 416). Write a paragraph describing the relationship between life expectancy and GNI per capita.

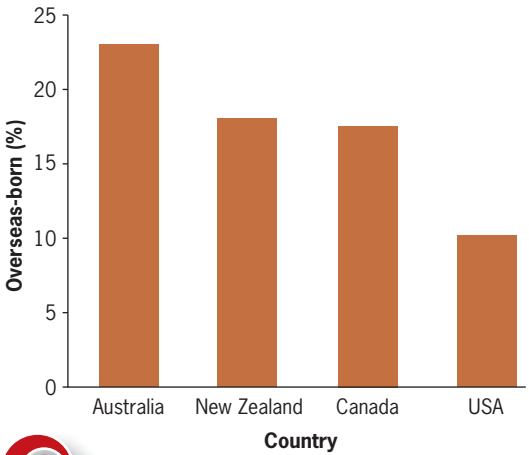


FIGURE 2.1.23

Proportion of overseas-born population for Australia, New Zealand, Canada and the United States, 2005.

exodus the migration of a large group of people from a hostile environment.

an **exodus** of refugees from Cuba and Haiti to the United States. There have also been significant labour migrations (frequently illegal) from Mexico, Jamaica and other countries of the Caribbean to the United States.

Africa

In Africa, large-scale migrations have often been initiated by climatic disasters, military conflict, civil disorder and famine. (See figure 2.1.38, p. 249.) Other population movements are associated with migrant labour systems established to meet the needs of plantations and mines. These movements date from the period of colonialism and white settlement. The largest of these was an international recruitment system operated by South Africa, which continues to function in a modified form. In Sub-Saharan Africa, migration has always been a tradition, although much of it is seasonal.

Asia

In Asia, large-scale international movements are common. Iran and Pakistan play host to millions of Afghan refugees, while India receives thousands of immigrants from Sri Lanka, Nepal and Bangladesh. The emerging economic powers of South-east Asia have also attracted thousands of foreign workers, many of whom arrive illegally.

The Middle East

In the Middle East, oil revenues have created a demand for foreign labour. 'Guest workers' (see pp. 246–7) from other Arab states, India,

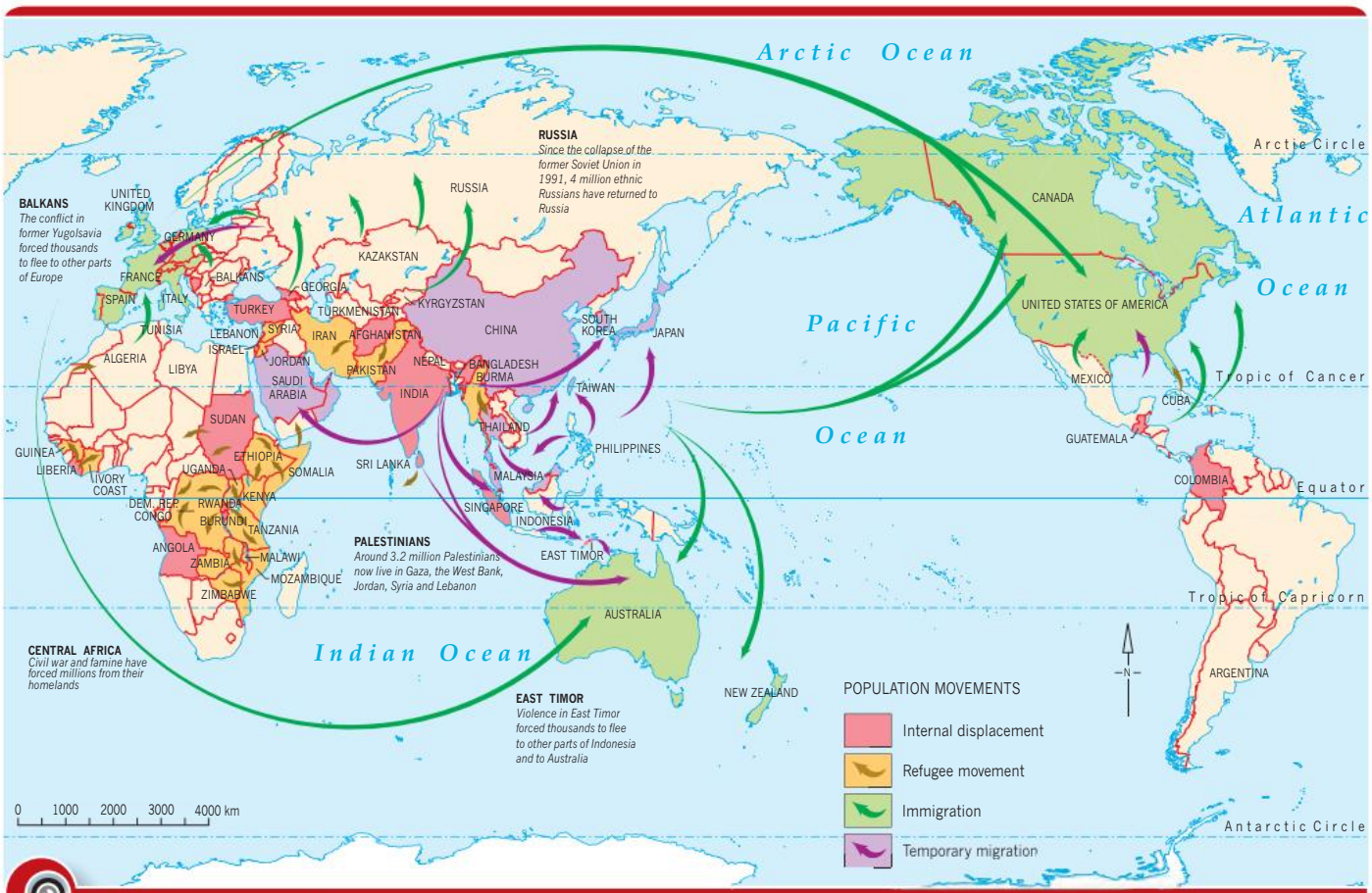


FIGURE 2.1.24

Recent population movements.

Sri Lanka, Bangladesh and the Philippines have been recruited in large numbers. Most are employed on short-term contracts. Elsewhere in the region, population movements can be quite complex. Turkey, for example, is a country of both emigration and immigration. During the 1960s and 1970s millions emigrated, mainly to Germany, as guest workers. When recruitment of workers ceased, family reunion took over as a main motivation for Turks to migrate. Turkey, in turn, has become a favoured destination for Turks and other Muslims escaping religious persecution in Eastern Europe.

Europe

Patterns of movement within Europe have been changed dramatically by the collapse of communism in the late 1980s and the conflict in the former Yugoslavia. (See the Geofocus box 'The collapse of the Yugoslav federation sparks an exodus'.) Germany has been the country most affected by these changes.

geoskills 23

Proportional circles and shapes

Proportional circles, when used on maps, show the relative size of the units being measured by the area of each circle. The size of each circle must be drawn in proportion to the total value it represents.

Proportional shapes are sometimes used instead of circles. They may be, for example, squares, rectangles, cubes, triangles, symbolic representations or the shape of nation-states.

geofocus

The collapse of the Yugoslav federation sparks an exodus

The Yugoslav federation was formed in 1918 out of the debris of World War I, and was supposed to unite all the South Slav peoples: the Serbs, Croats and Slovenes. The major historic tension in Yugoslavia was between the Croats and Serbs, who had vied for control of the Balkans for hundreds of years. Although ethnically and linguistically very closely connected, their religions and historic traditions and experiences have kept them apart and mutually hostile. These historic tensions were greatly increased by the horrific experiences of World War II, when Croatia was led by a fascist puppet government that committed many atrocities.

The Bosnian Moslems are ethnically, linguistically and historically South Slavs. They were despised by the Croats and Serbs because of their historic conversion to the Islamic religion and their alleged collaboration with the Turks during the long occupation by the Islamic Ottoman Turkish Empire from the fourteenth century until 1908.

The Kosovars were another Islamic nation who occupied a large part of Serbia. They spoke Albanian and were closely related ethnically to the people of Albania.

In the 1990s, the Yugoslavian federation fell apart with secession (declaration of independence) by Slovenia, Croatia, Macedonia and the Bosnian Moslems. There were violent attempts by the remaining, Serbian-dominated federal government to prevent the break up. When that failed, Serbia tried to retain as much territory as possible, especially at the expense of Bosnia and Croatia and by denying any autonomy to the Kosovars. The main sources of conflict have been the:

- intermingling (or mixing) and mutual hostility of Croatian, Serbian and Bosnian peoples within the official borders of Croatia and Bosnia
- attempts by the Yugoslav (Serbian-dominated) government to support the Serbs within Croatia and Bosnia
- nationalism of the Kosovars.

As a result of this conflict, as many as 4 million people were displaced or became refugees between 1991 and 2003. Up to 600 000–800 000 people emigrated to other European countries. Others (10 000–20 000) went to North America and Australia.

More recently, Montenegro declared its independence from Serbia in 2006 after a referendum, and Kosovo did so against opposition from Serbia in 2008.

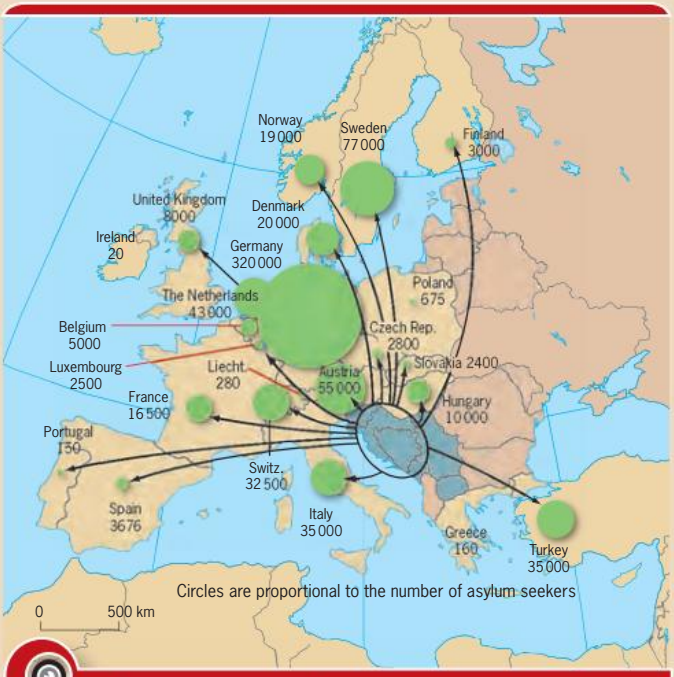


FIGURE 2.1.25

Movement of refugees and displaced people from the former Yugoslavia since 1991.

FIGURE 2.1.26

New Australians celebrating after their Australian citizenship ceremony. Many people make a conscious choice to migrate and settle permanently in another country in the hope that they will achieve a better quality of life for themselves and their children.

resettlement migration permanent movements to another country, usually for employment.

did you know?

The *skilled migration stream* consists of those who migrate permanently and who have skills and qualifications in demand in Australia. The *family migration stream* consists of family members who migrate to Australia in order to join relatives who have already migrated to Australia.

emirate the territory ruled by an emir.

working geographically

1 **Interpreting diagrams** Study figure 2.1.23 (p. 241). Identify the country with the highest proportion of overseas-born residents. What proportion of New Zealand's population was born overseas?

2 **Interpreting diagrams** Study figure 2.1.24 (p. 242).
- **a** List the main flows of migration shown on the map.
- **b** Name the parts of the world that have experienced significant levels of internal displacement.
- **c** **i** Identify the main source regions of temporary migrations.
  ii What are the main destinations of these temporary migrations?
- **d** Describe the main refugee movements shown on the map.

3 **Interpreting diagrams and text** Study the Geofocus box 'The collapse of the Yugoslav federation sparks an exodus' (p. 243).
- **a** Briefly outline the events that resulted in the exodus of more than 800 000 people from the former Yugoslavia.
- **b** Identify the three principal destinations for those fleeing the former Yugoslavia.
- **c** Use the Internet to investigate the current geopolitical situation in the area occupied by the former Yugoslav federation.

4 **Interpreting diagrams** Study figure 2.1.27.
- **a** By how much did the percentage of the foreign-born population in Ireland increase between 1995 and 2005?
- **b** What overall trend is apparent in this graph?

Types of international movements

The main types of international movements are described below.

Resettlement migration

Many people make a conscious choice to migrate and settle permanently in another country in the hope that they will achieve a better quality of life for themselves and their children. Others seek to be reunited with family members who have previously undertaken the move. (See figure 2.1.26.)

A feature of recent **resettlement migration** has been the growth in the number of professionals, technicians and other highly skilled personnel migrating on a permanent basis. For example, Europe, North America and Australia have accepted thousands of doctors and engineers from places such as India and Malaysia, many of whom are unable to find well-paid work in their own countries. Such migrations, however, are a drain on the resources of many poorer countries.

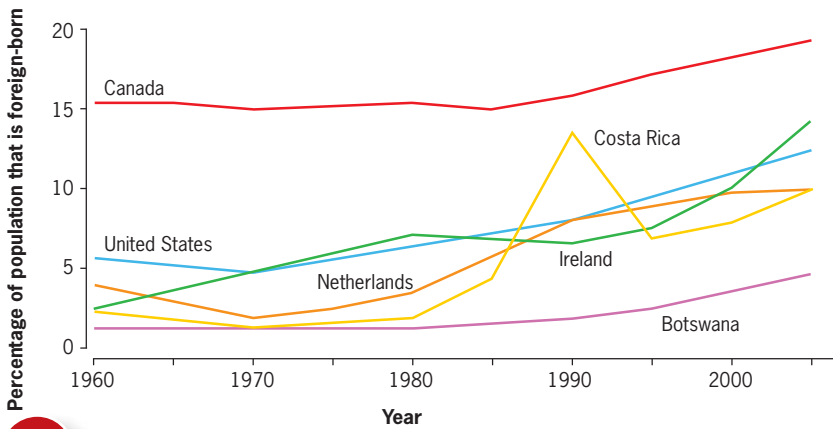


FIGURE 2.1.27

Foreign-born populations in selected countries, 1960–2005. Foreign-born populations are on the rise in both developed and developing countries.

geofocus

Meeting Australia's demand for skilled workers

Australia has a long history of planned migration. Since World War II, it has welcomed more than 6 million migrants. On a per capita basis, Australia has taken more migrants than Canada, New Zealand or the United States in the post-World War II years. (See figure 2.1.28.)

Today, nearly one in four of Australia's current population of 19.6 million people was born overseas. This is much higher than other traditional immigration countries. Our overseas-born population originates from over 170 countries.

In 2005–06, Australia received 142 930 migrants. Of these, more than 97 000 entered via the skill stream, while the family reunion stream accounted for 45 290 places.

The skilled migration program targets people who are not sponsored by an Australian employer but who have skills in particular occupations required in Australia. Applicants must be over 18 and under 45 years of age. They need to have good English language ability, and recent skilled work experience or a recently completed, eligible Australian qualification. The top occupational group of new skilled migrants to Australia continues to be computing professionals, followed by accountants and elementary clerical, sales and service workers.

Australian employers can sponsor and employ skilled foreign workers who have recognised qualifications and skills and/or experience in particular occupations required in Australia. The government issues these workers with a '457' visa.

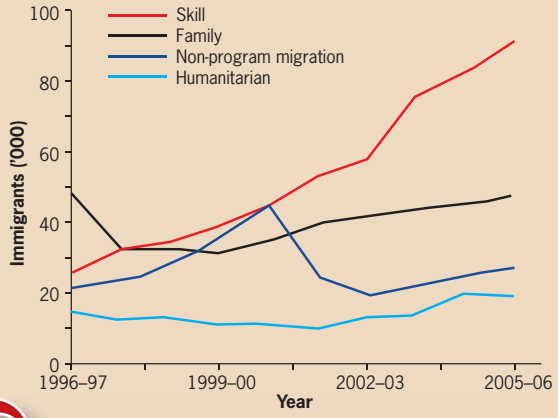


FIGURE 2.1.28

Immigrants to Australia by category, 1996–97 to 2005–06.

geofocus

Population movements to, from and within the Middle East and Northern Africa

Population movements to, from and within the Middle East and Northern Africa are reshaping the populations of the region.

In many of the oil-rich Persian Gulf states, foreigners make up a majority of the labour force, filling service and skilled jobs that native-born workers are unwilling to do. In Bahrain, for example, 47% of workers are foreign-born men and 11% foreign-born women. In Kuwait, 64% of workers are foreign-born men and 17% are foreign-born women. Foreigners make up half the labour force in Saudi Arabia. In the **emirate** of Dubai (population 1.4 million) there are over 400 000 foreign labourers, most of whom work in the construction industry. Currently there are more than 5000 construction sites in the emirate. (See figure 2.1.29.)

These immigrants send home billions of dollars in remittances to help their families. But they often work long hours and have limited ability to challenge their employers, some of whom fail to deliver on promised pay and benefits. The living conditions of the workers in Dubai have, for example, been described by Human Rights Watch (a human rights NGO) as being 'less than human'.

In other parts of the Middle East and Northern Africa, people are leaving to seek economic opportunities or escape violence or political instability. In North Africa, a region of emigration, foreigners make up less than 1% of the population. In 2005, one-third of France's 3.3 million foreigners were from Morocco, Algeria, Turkey and Tunisia. In the same year, one-third of Germany's 6.9 million foreign-born population was from the Middle East and North Africa.

FIGURE 2.1.29

Dubai's massive construction industry depends on the labour of guest workers.

geoskills 24

Flowline maps

Flowline maps (such as figure 2.1.31) show the movement of information, goods and people between places and the quantity of such movements. Movements are shown by lines or arrows that link the place of origin with the destination. The quantity moved between places is indicated by the width of the line or arrow. The map's legend indicates the value of the flowlines.

Contract migrations

Contract migrations are usually undertaken for a specified period and are related to contracted employment. Part of the income earnt is often sent back home to the worker's family. Some 25–30 million of an estimated 125 million people living outside their country of birth are thought to be foreign workers. They are believed to remit (or return) more than US$67 billion annually to their homelands. Contract migrations fall into several categories.

Guest workers

In some parts of the world there are more jobs than there are people willing or able to work. To solve the ensuing labour shortages, governments often permit the entry of guest workers for a specified period of time. These workers are called guest workers. This practice places labour second only to oil in world trade.

geofocus

Major international migrations in the past

The past five centuries have witnessed human migrations on a vast scale. The majority of these migrations have been generated by events in Europe. The most significant of these flows are shown in figure 2.1.30 and include these two internal migrations:

- the eastern United States westwards
- western Russia eastwards.

They also include flows from:

- Europe to North America
- Southern Europe to South and Central America
- the United Kingdom and Ireland to Africa and Australia
- Africa to the Americas (the slave trade)
- India to east Africa, South-east Asia and the Caribbean
- China to South-east Asia and the United States

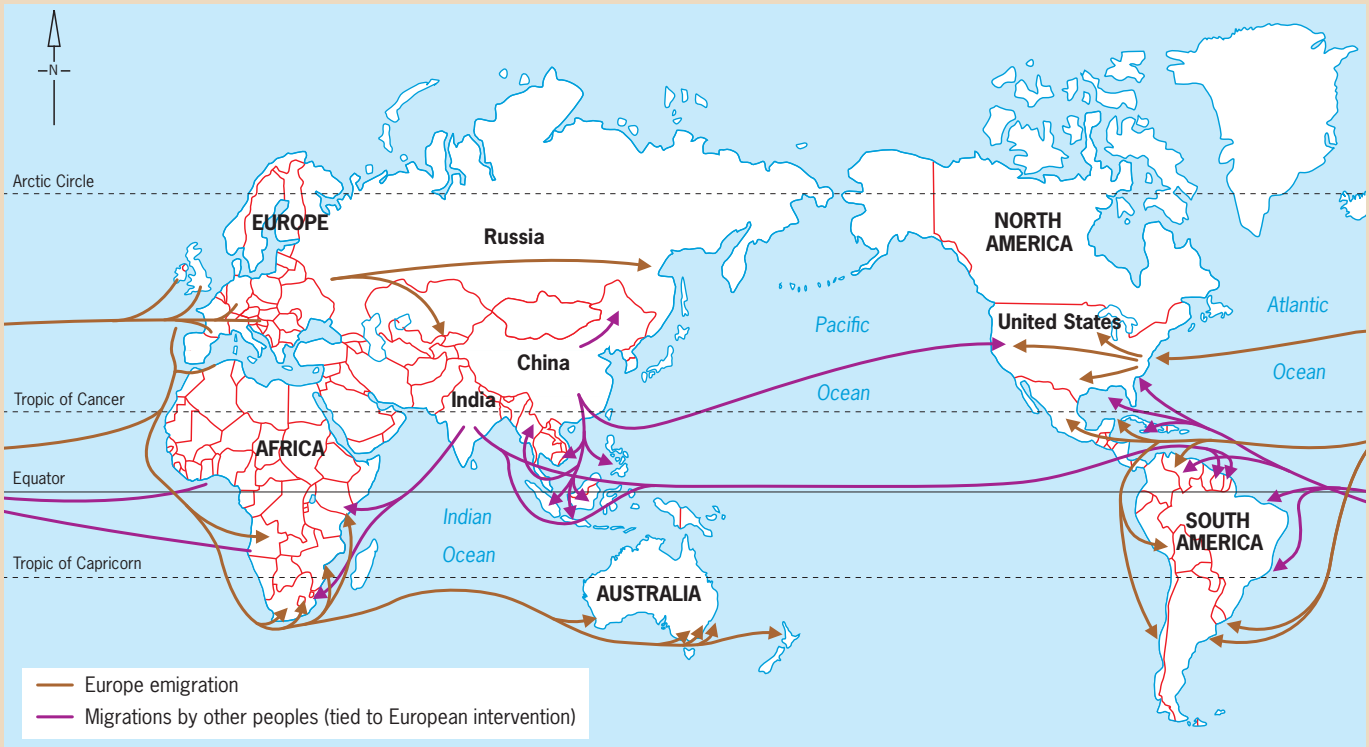


FIGURE 2.1.30

Major human migrations of the past 500 years.

In the oil-rich countries of the Middle East (Saudi Arabia, Libya and Kuwait), for example, there are now more than 4.5 million foreign workers. While most have come from other Arab countries, such as Egypt and Jordan, large numbers have also come from India, Bangladesh, Sri Lanka and the Philippines. Most work within a rigid contractual framework; they are not permitted to settle or be accompanied by

geofocus

Forced migrations

The slave trade

Some of the world's largest migrations have been forced migrations. By far the most significant of these was the transatlantic slave trade. (See figure 2.1.31.) Tens of millions of (mainly male) Africans were transported to the Americas against their will and at a huge loss of life. The actual number of people involved may never be known; estimates vary from 12 million to over 30 million. Most were transported to the plantations of the Caribbean and South America, where they worked as unpaid slave labour. Today the descendants of these people make up the majority of the population of several Caribbean countries.

Despite the relatively large proportion of blacks in the US population, the number of slaves transported to the United States was quite small compared with the number taken to the Caribbean and South America. (See figure 2.1.32.)

The slave trade devastated whole communities in Africa. Families were destroyed, children orphaned and community life disrupted. Communities were raided and most of the younger men seized. Generations passed before the demographic effects of the slave trade were overcome and the long-term balance of population structures in Africa and the Americas was restored.

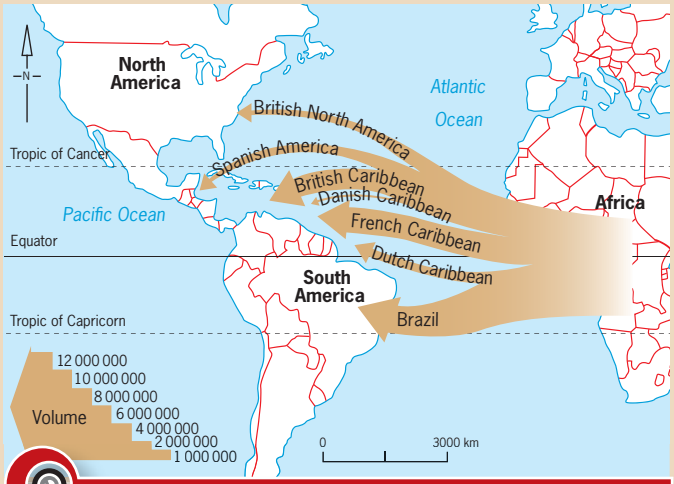


FIGURE 2.1.31

The transatlantic slave trade, volume and destinations, 1701–1810.

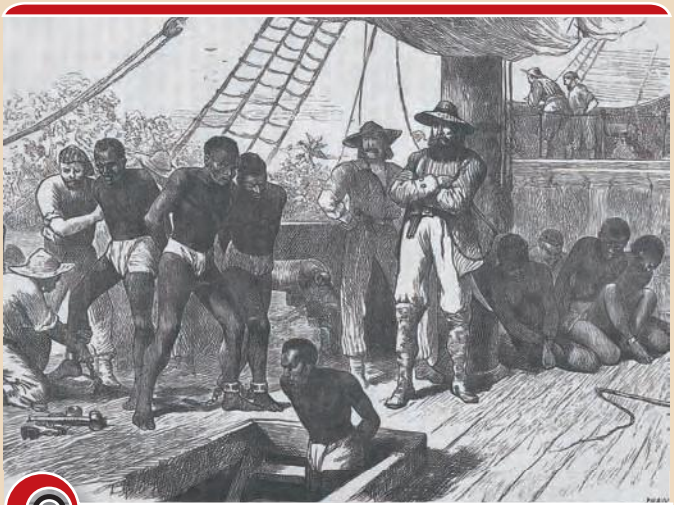


FIGURE 2.1.32

African slaves en route to the Americas.

Nazi slave labour

During World War II, 8 to 12 million Jews, Gypsies, Poles, other Eastern Europeans and people of other nationalities and religions were forced to work under inhuman conditions in Nazi-controlled industries as slave labourers. Many did not survive, and became victims of the Nazi Holocaust. (See figure 2.1.33.)

FIGURE 2.1.33

Displaced slave labour among the ruins of the Saar Valley, Germany, following liberation by allied forces.

FIGURE 2.1.34

Canadian students consider the prospects of studying at Australian universities. Student 'contract' migration has become popular in both the developed and developing world.

dependants and they are denied a range of civil and political rights. Many are required to live in barracks. Women domestic workers are often subjected to exploitation and sexual abuse.

Business migrations

The globalisation of economic activity has been accompanied by the growth in the international movement of highly qualified executives and professionals. An increasing number of firms are sending personnel to work in overseas firms or joint ventures. Japanese firms, for example, have more than 110 000 personnel assigned to overseas branches. An additional 1 million Japanese people go abroad each year on short visits related to business. This type of migration is expected to increase with the growth of transnational corporations.

Student migrations

A third type of 'contract' migration is the international movement of students. Large numbers of students from both developed and developing countries now study at schools and universities throughout the world. (See figure 2.1.34, p. 248.) Another type of student migration is the student-exchange program.

Refugees (forced migrations)

People are often driven from their homeland because of war, famine, natural disasters or religious, political or ethnic persecution. These people are often referred to as 'refugees' or 'displaced persons'.

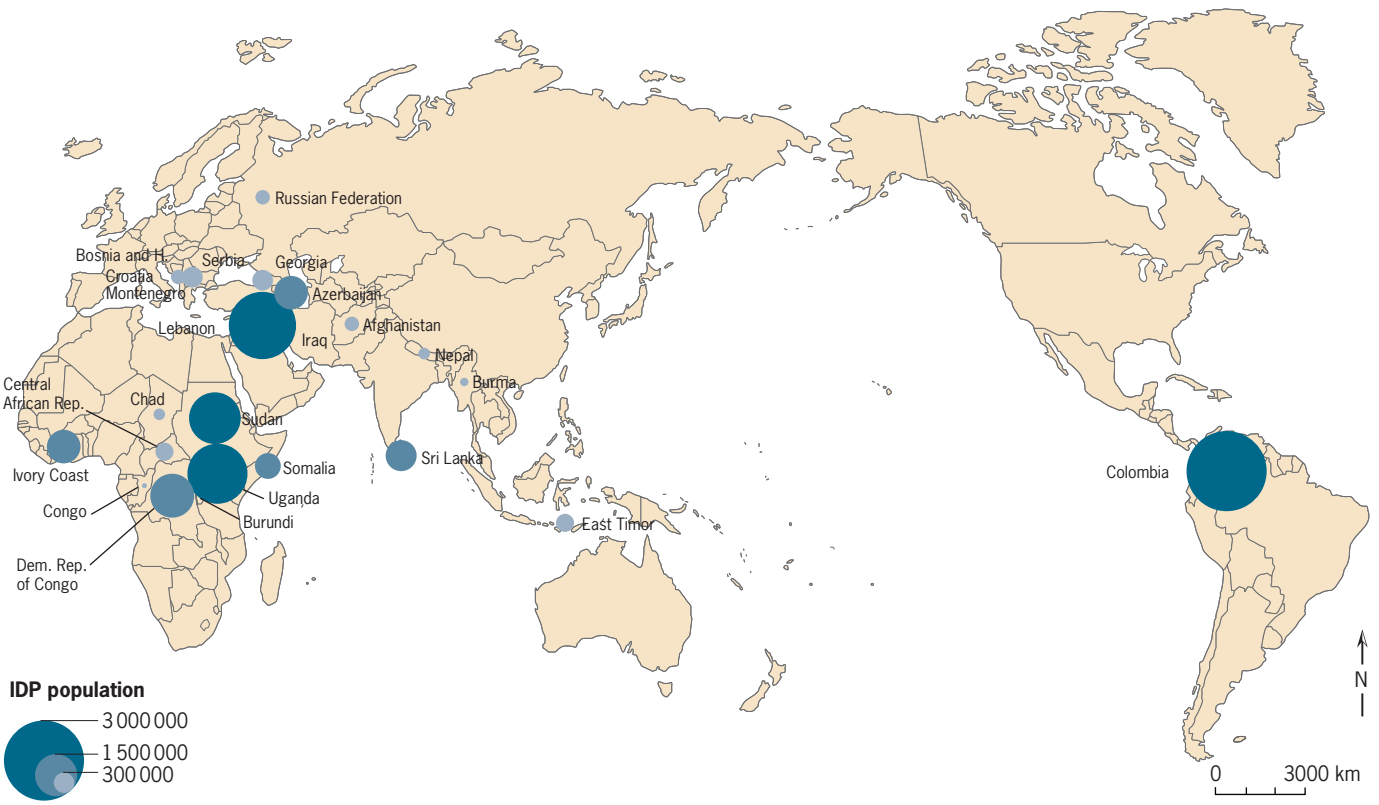


FIGURE 2.1.35

Internally displaced persons protected/assisted by the UNHCR, end of 2006.

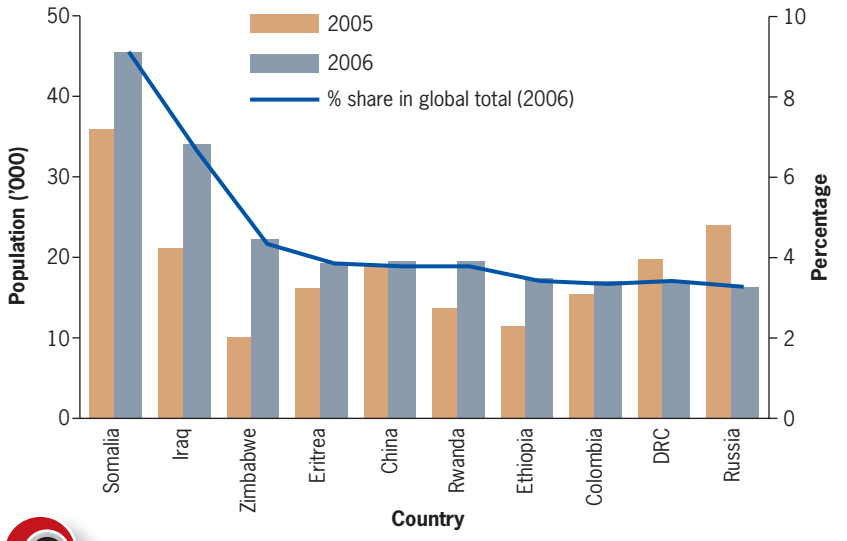


FIGURE 2.1.36

Main countries of origin of new asylum-seekers, 2005–06.

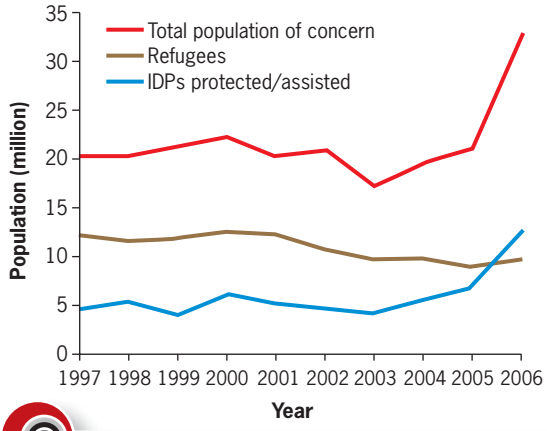


FIGURE 2.1.37

Total population classified as being of concern to the United Nations High Commissioner for Refugees (UNHCR), 1997–2006 (end of year).

The United Nations (UN) officially defines a refugee as being a person who cannot return to their country of origin without risking serious harm because of a well-grounded fear of persecution based on their race, religion, nationality or political views. Many people disagree with this definition and argue that it excludes millions of people who have been displaced within countries. The UN definition, for example, does not take into account those millions of people who because of drought, starvation, land degradation, natural disasters, poverty and political conflict have lost their livelihood and been forced to flee their home but remain within their country of origin. The term 'internally displaced person (IDP)' (see figures 2.1.35 and 2.1.37) is used to avoid the problems associated with the narrow UN definition of a 'refugee'.

Another classification is 'economic' refugees: people who flee their homeland in search of a better standard of living. One of the difficulties that government authorities face is how to differentiate between economic refugees and genuine refugees.

The number of refugees has grown substantially since the mid-1970s. The victory of the communist-led forces in Indo-China led to the departure of more than 2 million people from Vietnam, Cambodia and Laos. More than 1 million have been resettled in the United States. Others have found refuge in Australia, Canada and Western Europe.

During the 1970s and 1980s large numbers also escaped conflicts in Lebanon and Afghanistan. (Since the 1970s 6 million Afghans have fled to neighbouring countries.) In South America, thousands fled repressive military regimes in Argentina and Chile. In Africa, there have been mass exoduses from Zaire, Uganda, Namibia and, most recently, Somalia and Rwanda.

The collapse of the Soviet Union and the Soviet-backed governments in Eastern Europe led to an upsurge in the number of refugees from there seeking asylum in Western Europe. The disintegration of Yugoslavia into a number of warring ethnic groups made the situation worse.

The number of refugees worldwide increased from 8.2 million in 1980 to 15 million in 1990. Current estimates put refugee numbers at well over 22 million. The number of refugees peaked in 1995 at 27 million.

FIGURE 2.1.38

Rwandan refugees.

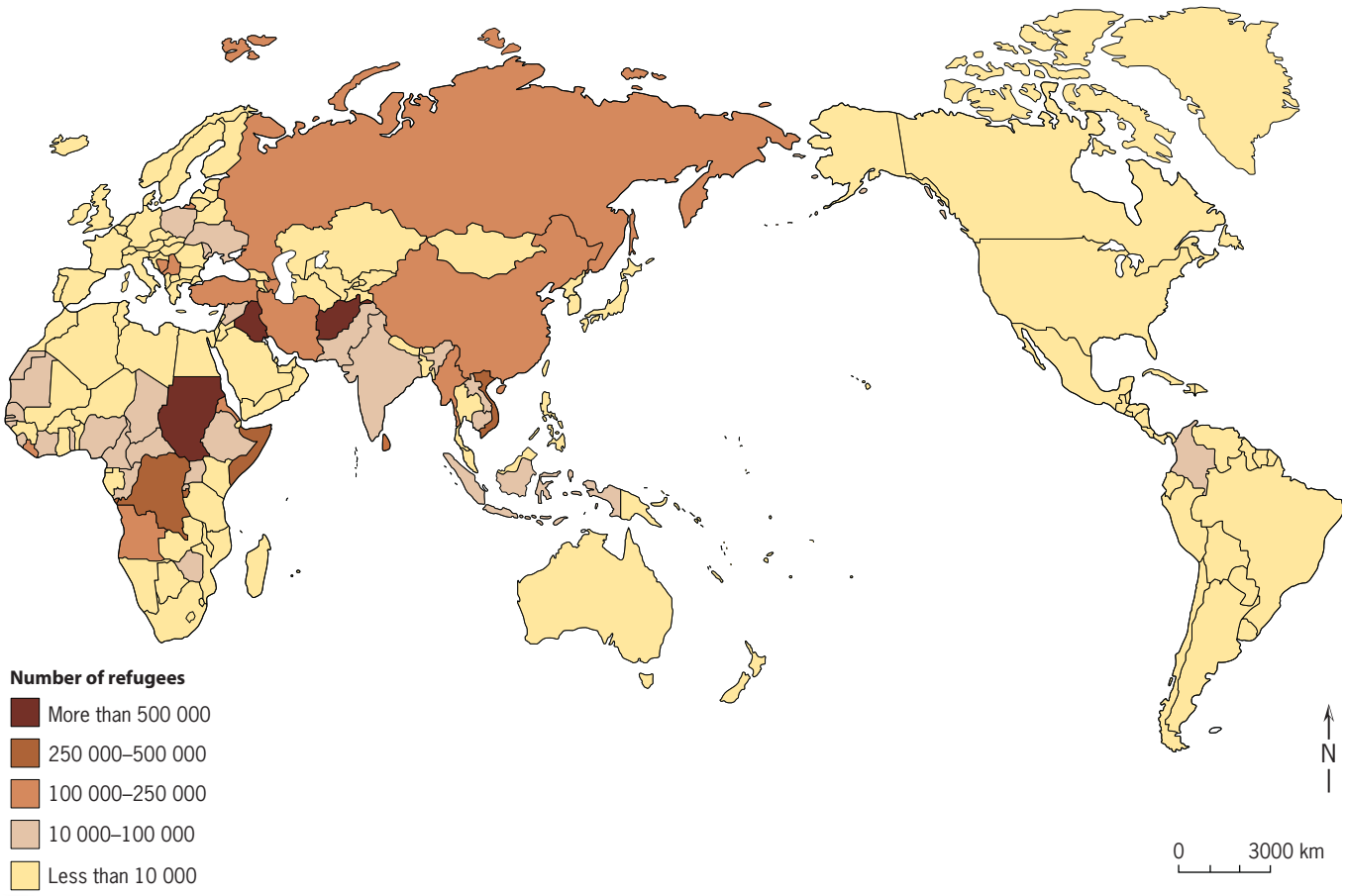


FIGURE 2.1.39

Major source countries of refugees, end of 2006.

At the close of 2006 there were 9.9 million refugees worldwide. This is the highest number for 5 years and up from 8.7 million just a year before. In addition to the refugees, more than 24.5 million IDPs were forcibly relocated within their own country. (See figures 2.1.35, p. 248, and 2.1.37, p. 249.)

The countries of the developed world are the best places to absorb large numbers of refugees. Since 1945, Australia, for example, has accepted more than 500 000 refugees and displaced people. This number includes 170 000 Europeans displaced by World War II and its aftermath. Australia currently accepts refugees from about 40 countries. The United States, Canada and the countries of Northern Europe have also accepted large numbers of refugees.

Internal migrations

Rural–urban migrations

One of the most significant population movements of the twentieth century has been the drift to the cities. This has resulted in a rapid growth in the size of cities and the proportion of the population that lives in them. In recent decades this process has been most marked in the countries of the developing world.

At the beginning of the twentieth century only 14% of the world's population lived in urban places (towns and cities). By 1950 this had increased to 30% and by 2007 it was 50%. By the year 2025 the proportion

understanding the text

1 **Define** migration. How can it be classified?
2 **Outline** the features of contemporary international population movements.
3 **Outline** the main types of international movements.
4 **Distinguish** between resettlement migration and contract migration.
5 **Account** for the expansion of business migration.
6 **Outline** the reasons why people are sometimes forced to flee their homeland.
7 **State** how the United Nations defines a refugee. Why is this definition said to be inadequate?
8 **Outline** some of the significant refugee movements since World War II.

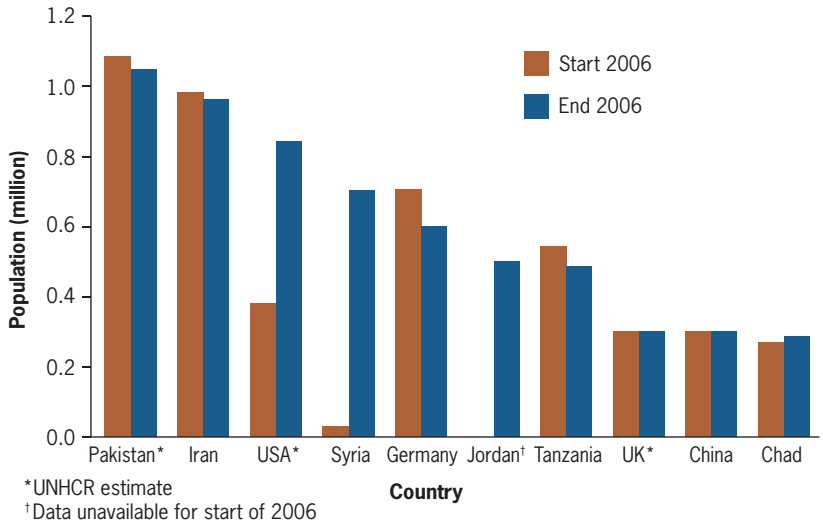


FIGURE 2.1.40

Major refugee-hosting countries, 2006.

working geographically

1 **Interpreting text** Study the Geofocus box 'Meeting Australia's demand for skilled workers' (p. 245). Explain the difference between Australia's skilled migration program and the '457' visa scheme.

2 **Writing task** Study figure 2.1.28 (p. 245). Write a stimulus-based response outlining the trends in Australia's migration program.

3 **Interpreting text** Study the Geofocus box 'Population movements to, from and within the Middle East and Northern Africa' (p. 245).
- **a** Outline the principal population movements in the region.
- **b** Investigate the state of Dubai. What is the basis of its economic growth? Why is there so great a demand for guest workers in Dubai? Outline the scope of the developments taking place in Dubai.

4 **Interpreting diagrams and text** Study the Geofocus box 'Major international migrations in the past' (p. 246). Select one of the migrations listed and investigate the reasons for the migration, the numbers of people involved and the impact on indigenous peoples. Present your findings as a PowerPoint presentation and accompanying oral report.

5 **Interpreting diagrams and text** Study the text and map related to the slave trade (p. 247).
- **a** Why were African slaves shipped to the Americas?
- **b** Where did the majority of slaves go to?
- **c** What impact did the slave trade have on African communities?

6 **Research task** Investigate a past large-scale population movement, such as the transportation of an estimated 15 million slaves from Africa to the Americas or the movement of up to 37 million indentured labourers from places such as India and China to east Africa, Malaysia, Sri Lanka, Fiji and the Caribbean. Present your findings as a written report. Include a map showing the movement discussed.

7 **Research task** Study the text and photograph related to Nazi slave labour (p. 247). Investigate the nature and scope of the Nazi's exploitation of slave labour in Europe immediately before and during World War II. Investigate the international legal instruments aimed at preventing a repeat of such actions.

8 **Interpreting diagrams** Study figure 2.1.35 (p. 248). Identify the major concentrations of internally-displaced persons. Estimate the number of internally-displaced persons in Colombia and Iraq. Undertake research to explain why people have been displaced in these countries.

9 **Interpreting diagrams** Study figures 2.1.36 and 2.1.37 (p. 249).
- **a** Outline the trends in the number of people of concern to the UNHCR between 1997 and 2006.
- **b** Identify the principal sources of asylum-seekers in 2005–06.
- **c** Outline the trends evident in these graphs.

10 **Interpreting diagrams** Study figure 2.1.39. With the aid of an atlas, describe the spatial distribution of refugees by place of origin.

11 **Interpreting diagrams** Study figure 2.1.40.
- **a** Identify the principal refugee-hosting countries at the end of 2006.
- **b** Use research to account for any difference in the major refugee-hosting countries between the beginning and end of 2006.

12 **Research task** Undertake Internet research into a contemporary refugee crisis. Investigate the reasons for the crisis, its historical context, the numbers of refugees involved, the destination of the refugees and the actions taken to meet their needs. Use an oral report to present your findings to the class.

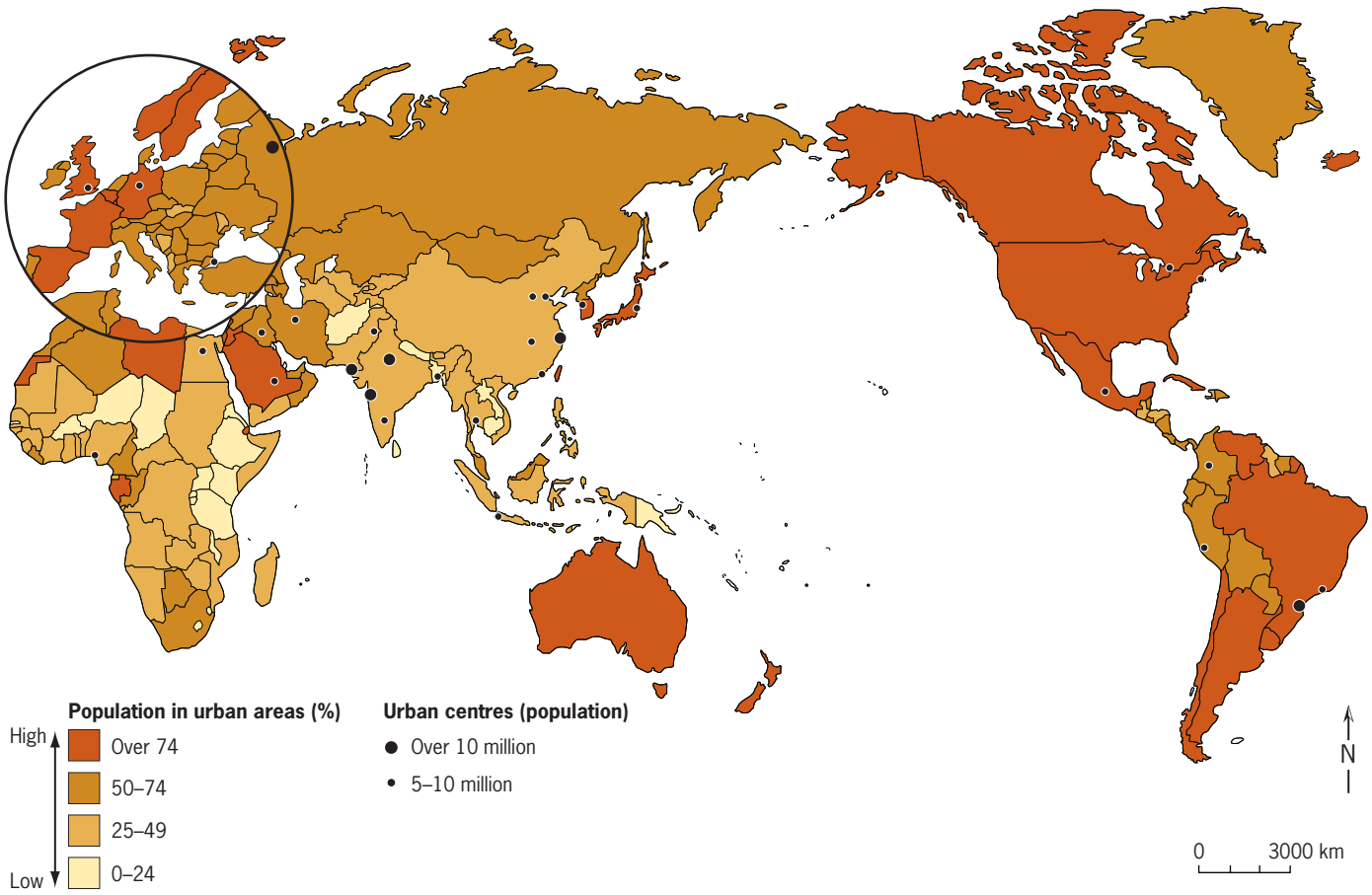


FIGURE 2.1.41

Percentage of the population living in urban areas, 2007.

urban growth the rate of growth of an urban population.

urbanisation the process by which there is an increase in the proportion of a population living in places classified as urban; the movement from rural to urban areas.

of the world's population living in urban places is expected to be more than 60%. In actual human numbers this represents an increase from 733 million in 1950 to 2260 million in 1990 and to 5119 million in 2025. In 1900 there were only 13 cities with more than 1 million people. There are now more than 336. Figure 2.1.41 shows the proportion of the population living in urban areas.

This important demographic change is the result of urban growth and urbanisation. **Urban growth** occurs when the size of a city's population increases due to both natural increase and rural–urban migration. **Urbanisation** is the process by which the proportion of a population living in towns and cities increases due to rural–urban migration.

Since the 1950s most of this growth has occurred in developing countries. (See figures 2.1.42 and 2.1.44.) This trend will almost certainly continue. There is a total projected increase of 3.8 billion for cities of the developing world in the period 1950–2025. Of this growth, approximately 2.6 billion (71%) will have been added after 1990. This can only make worse the enormous problems faced by the cities of the developing world.

The reasons for rural–urban migration are often referred to as *'push' and 'pull' factors*. The factors 'pushing' people include famine, war and civil unrest, rural poverty, landlessness resulting from population pressure, land degradation and mechanisation, and climatic disasters. Factors 'pulling' people towards urban centres include the hope of securing a higher standard of living through greater employment opportunities, better access to health care and education, and access to entertainment and the 'bright lights'. (See figure 2.1.43.)

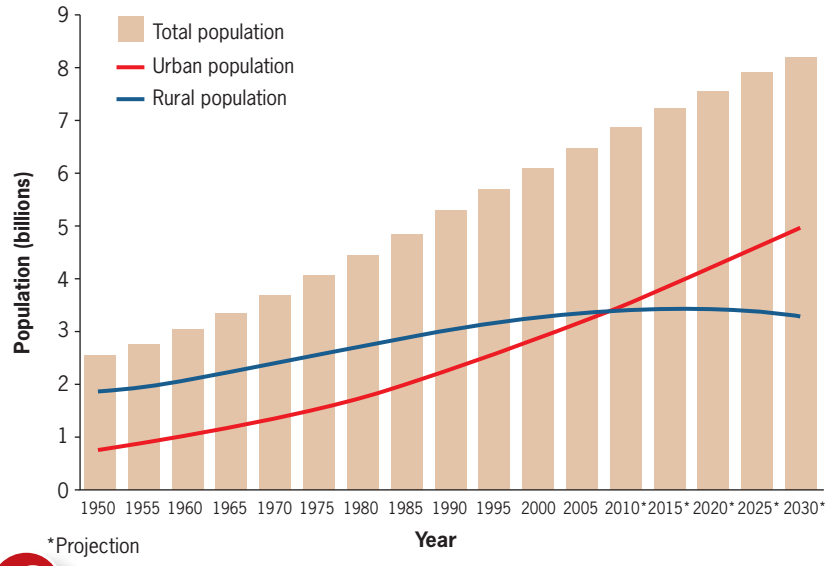


FIGURE 2.1.42

The urban and rural population of the world, 1950–2030.

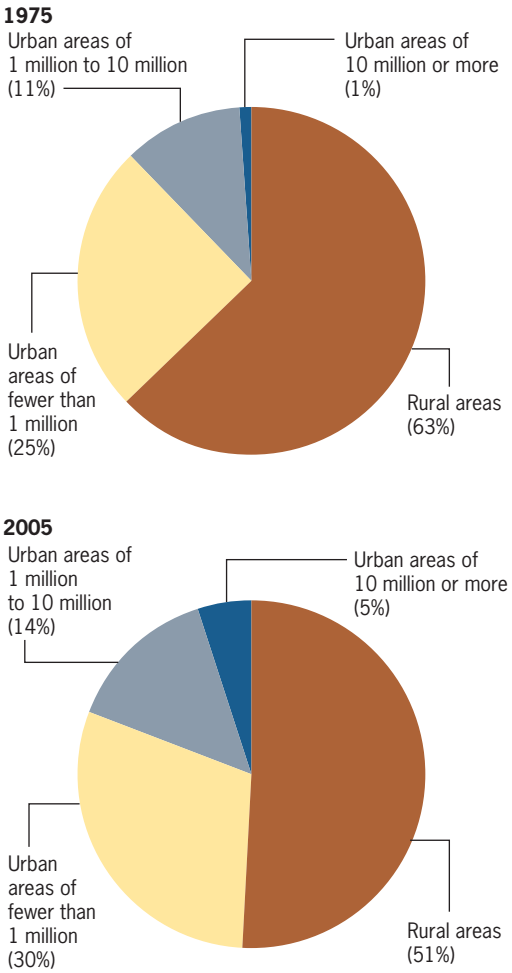


FIGURE 2.1.44

Distribution of the world's population by size of urban area, 1975 and 2005.

Counter-urbanisation

In the countries of the developed world, both the rate of urbanisation and the rate of urban growth have slowed. Also a growing body of evidence suggests that there is a process of counter-urbanisation taking place. People are choosing to leave the large urban centres and move to smaller communities. They are doing so for a variety of reasons, usually associated with the quality of life. This trend has been observed in the United States and in parts of Western Europe. It can be explained, in part, by the development of economic activities not tied to urban areas. These include high-tech manufacturing and service industries, such as tourism. Advances in communication and computer technology now make it possible for some people to work from home. Improvements in transport enable others to commute to work over long distances.

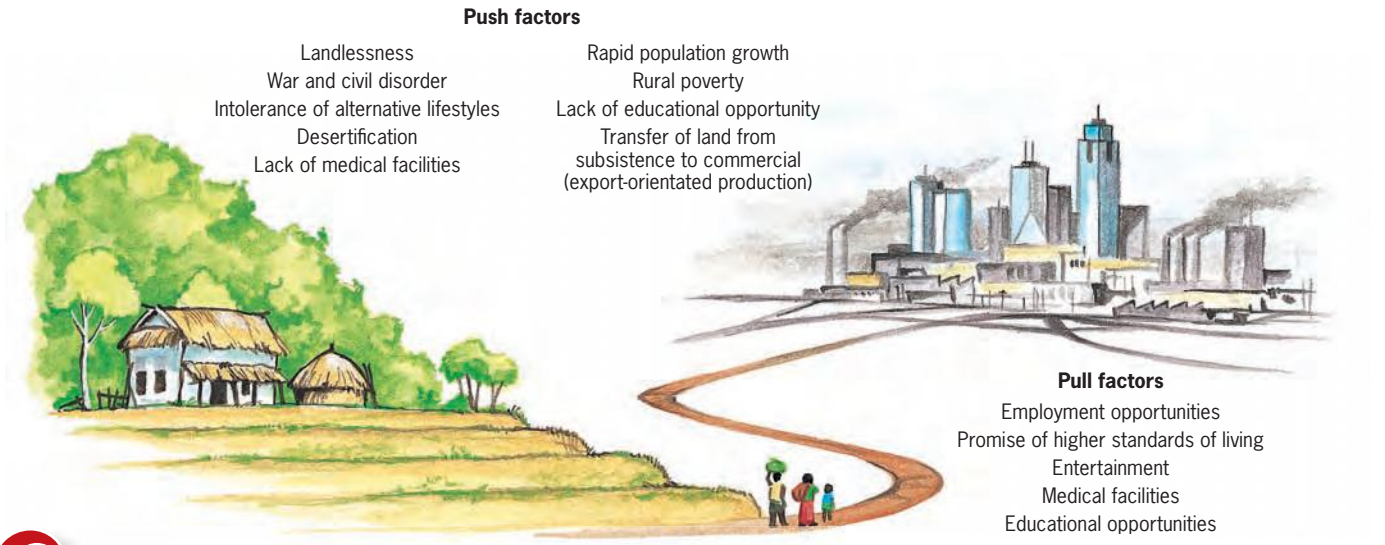


FIGURE 2.1.43

The process of urbanisation.

geofocus

Internal migration in the United States

The people of the United States are the most mobile on earth. The two most significant movements are those towards the west (and more recently the south) and the northward migration of Black Americans from the rural south to the urban north.

The westward movement of people continues to this day. People continue to leave the older industrial centres of the north-east and the farming states of the mid-west in search of employment opportunities in the rapidly growing 'sun belt', especially the states of California, Texas, Georgia and Florida. Many of the older industrial cities have experienced a decline in population. In addition, there has been a decrease in the population of states that depend on farming and mining, which are two economic activities that suffered during the 1980s.

This trend may also be related to the longer period of the life cycle now spent in retirement. With the prospect of spending 25–30 years in retirement, a growing number of retirees are opting for a change in lifestyle. This may involve a move away from large urban centres to resort communities, such as those scattered along the east coast of Australia, in Florida and along the west coast of the United States. In these communities, retirees can take advantage of a more relaxed lifestyle and a better climate.

Population movements related to changing patterns of work

Population movements within countries are also initiated by changes in the pattern of economic activity. If sustained, these movements can bring about quite significant changes in population distribution.

Within the developed countries the relative decline in manufacturing employment and the growth of employment in the service sector have led to changes in the distribution of the workforce. Older industrial areas often have outmoded methods of production, ageing plant and equipment, a highly unionised workforce and congested urban infrastructure. These areas have found it increasingly difficult to compete with the newer industrial centres developing elsewhere in the industrialised countries and in the rapidly growing economies of East Asia.

Areas such as the industrial north-east of the United States and the Midlands of Great Britain have experienced a sharp decline in employment as factories have either closed or been relocated to new sites, including those in the developing world. Some displaced workers have moved to where work is more readily available. Usually it is the younger, more mobile workers who decide to move. In Australia there has been a net movement of people from Australia's southern states (especially Victoria and South Australia) to the Australian Capital Territory and Queensland where the growth in service-sector employment has been strongest.

Movements within cities

Similar processes can also be seen to operate within cities. Manufacturing firms are abandoning the older and more congested industrial sites close to the city centre and relocating in the new industrial estates on the periphery (outer edge) of the urban area. This has resulted in a transfer of jobs from the urban centre to the outer suburbs. This is one of the factors contributing to the process of *suburbanisation* whereby people move from inner-urban locations to the expanding suburbs at the city's outskirts. People are now willing to commute to work over quite long distances, and many opt for lower-cost housing in areas far from the city centre.

Countering this trend are the processes of gentrification and urban consolidation. *Gentrification* is the process whereby rundown inner-urban homes are purchased and refurbished by young middle-income and high-income earners. The process is driven by a desire for accessibility to employment, recreation and entertainment in and near the central business district. *Urban consolidation* is a process that increases population densities in older inner-city areas where the existing infrastructure is under-utilised. Such policies are designed to slow the growth of urban sprawl.

Seasonal movements

Some movements that are related to work and leisure are seasonal. Fruit pickers and seasonal workers in areas dependent on tourism are obvious examples. Ski resorts take on large numbers of additional staff during the winter months; in coastal areas hotels and resorts add to their staff in summer. People often move to take advantage of these employment opportunities. Tourism itself is often seasonal. For example, in many parts of the world large numbers of people move to coastal resorts for their summer vacations.

understanding the text

1 **Explain** the difference between urban growth and urbanisation.
2 **Outline** the reasons for rural–urban migrations.
3 What is counter-urbanisation? Why are people choosing to leave cities?
4 How have changes in the pattern of economic activity affected population movements? Give examples.
5 **Describe** the movements taking place within cities.
6 **Distinguish** between gentrification and urban consolidation.

working geographically

1 **Interpreting diagrams** Study figure 2.1.41 (p. 252). With the aid of an atlas:
   a name the countries with at least 75% of their population living in urban centres
   b name five African and five Asian countries with less than 24% of their population living in urban centres.
2 **Writing task** Study figure 2.1.42 (p. 253). Write a stimulus-based response outlining the trends apparent in the graph.
3 **Writing task** Study figure 2.1.43 (p. 253). Write a report outlining the factors responsible for the process of urbanisation.
4 **Writing task** Study figure 2.1.44 (p. 253). Write a stimulus-based response outlining the distribution of the world's population by size of urban area.
5 **Fieldwork task** Observe examples of gentrification and urban consolidation in your local community.
6 **Research task** Investigate the internal movements of people in Australia. Draw a sketch map to illustrate the flow of people.
7 **Research task** Access the Australian Bureau of Statistics website or text-based publications. Locate information highlighting population movements within Australia. Write a report describing the trends apparent. Suggest reasons for this pattern of movement.
8 **Research task** Investigate population movements in Australia. In undertaking your research try to answer the following questions.
   a What has happened to Australia's small towns?
   b Where have people been moving to in recent decades?
   c Which small towns have been growing? What is fuelling their growth?
   d What has happened to small inland towns? Which towns have been affected?
   e What is meant by the term 'sponge city'? Give examples.
   f What is fuelling the growth of sponge cities?
   g Why are farms getting larger?
   h What are the factors causing the population shifts apparent in Australia?

Issues arising from the changing size and distribution of population

The implications of rapid population growth are becoming increasingly apparent as the world's population exceeds 6 billion and heads towards 9 billion by 2050. How will the environment and humankind respond to this population explosion? Expert opinion is divided into two camps.

Environmentalists and ecologists regard the situation as a catastrophe in the making. They argue that in order to feed the growing population, farmers will need to intensify the agricultural practices that are already the cause of serious environmental damage. They also contend that the earth's natural resources and the biophysical environment, already burdened by past population growth, will simply collapse under the weight of future demand.

The optimists, on the other hand, who include many economists and some agricultural scientists, argue that the earth can produce more than enough food to meet the needs of a rapidly expanding human population. They assert that technological innovations will help us meet the challenges associated with the rapid population growth and deliver higher standards of living to most people.

Global inequalities

The countries of the developed world have just one-fifth of the world's population but consume 70% of the world's energy, 75% of its metals and 85% of its wood. They also account for 80% of the world output of goods and services. The poorest one-fifth of the world's population produces and struggles to survive on just 1.4% of the world's goods and services.

geolinks

Using the Internet

Listed below are sources of up-to-date information about population.

Data
- Population Reference Bureau
- United States Census Bureau
- Australian Bureau of Statistics
- United Nations Population Fund

Journals
- UNFPA: State of World Population
- Migration News

did you know?

Quality of life refers to an individual's overall sense of well-being and the degree of well-being enjoyed by a people, as measured by income levels, quality of housing and food, medical care, educational opportunities, transportation, communications and other measures. The standard of living in different countries is frequently compared based on annual per capita income.

FIGURE 2.1.45

Rapid urbanisation and poverty result in the development of vast squatter settlements in the cities of the developing world. The lack of urban infrastructure results in high levels of environmental degradation, especially water pollution.

TABLE 2.1.8

A divided world, 2007

Indicator	World	Developed	Developing
Population mid-2007	6625	1221	5404
Births per 1000 population	21	11	23
Deaths per 1000 population	9	10	8
Natural increase (annual %)	1.2	0.1	1.5
'Doubling time' in years	58	693	47
Projected population, 2025	7965	1254	6711
Projected population, 2050	9294	1259	8036
Projected population change, 2007–50 (%)	40	3	49
Infant mortality rate	52	6	57
Total fertility rate	2.7	1.6	2.9
Population aged under 15 (%)	28	17	31
Population aged over 65 (%)	7	16	5
Life expectancy at birth (total)	68	77	66
Life expectancy at birth (male)	66	73	64
Life expectancy at birth (female)	70	80	67
Population in urban areas (%)	49	75	43
Children dying before the age of 5 (%)	76	6	83
Women with access to contraception (%)	62	68	60
Per capita GNP (US$), 2006	$9940	$29680	$5480

Source: 2007 World Population Data Sheet, Population Reference Bureau

A good deal of the environmental degradation (see figure 2.1.45) that has accompanied population growth can be traced to the environmental interactions of two groups of people:

- the affluent, who live in the developed world and who degrade the environment through their ability to consume resources and generate vast amounts of waste
- the world's poorest people, who are forced to degrade their own resource base out of necessity and lack of alternatives.

Table 2.1.8 contrasts the quality of life experienced by those living in the developed and developing worlds.

World food supply

Central to any discussion about the implications of future population growth is an assessment of the earth's food-producing capacity. As we have seen, opinion is divided on this issue. There is, however, some cause for optimism. Agricultural production has kept pace with population growth. However, the increases in agricultural production required to meet the needs of an expanded population might be achieved at an unacceptably high cost to the environment. Also, the distribution of food remains an issue that must be addressed if all people are to have an adequate supply of food.

Impacts on the environment

Population growth can affect the biophysical environment in a number of ways. In societies that continue to pursue a **subsistence lifestyle**, population pressure contributes to an intensification of landuse. This ultimately contributes to the deterioration and depletion of important natural resources. Increasing population densities and the growing demand for food have resulted in an expansion of cultivation and grazing into increasingly **marginal lands** and led to shortened periods of **fallow**. These, in turn, have led to accelerated rates of erosion and a decline in soil fertility. The increased demand for **fodder**, fuelwood and land suitable for agriculture has accelerated the rate of deforestation. This has contributed to a range of ecological and socioeconomic problems. These include an acceleration in the rates of erosion, an intensification of seasonal flooding, an increase in the incidence of droughts, the silting of rivers and coastal waters, and the loss of countless species of plants and animals.

subsistence lifestyle growing just enough food for your own needs with nothing left over to sell.

fallow method of allowing land to lie idle for a growing season.

marginal land land that, in its natural state, is not well suited for a particular purpose, such as raising crops.

fodder plant matter used to feed grazing animals.

Attempts to make existing agricultural lands more productive have also contributed to a range of ecological problems. These include increased rates of erosion and runoff as well as problems associated with the use of irrigation and agricultural fertilisers and pesticides, such as salinity, algal blooms and chemical residues. These impacts are most apparent in the world's fragile environments: its semi-arid lands, mountains, wetlands, tropical rainforests and coral reefs.

The processes of urbanisation and industrialisation have also contributed to environmental degradation. The concentration of large numbers of people in relatively small areas overwhelms the ability of biophysical processes to cope. Severe atmospheric, water and noise pollution are common to most large cities. The safe disposal of industrial and domestic waste has become a major issue in urban areas in both the developed and developing worlds. It is most acute in the developing world where rapid rates of urbanisation have exceeded the ability of government authorities to provide the necessary infrastructure.

Other implications

Landlessness

Landlessness is now a major problem throughout the developing world. There is simply not enough land to go around because of population

geofocus

The Philippines: impacts of rapid population growth

High annual population growth rates have resulted in the Philippines having a population that now exceeds 88.7 million and a population density in excess of 296 people per km^2, or six times the world average. (In 2007, the population growth rate in the Philippines was 1.76%, which is down from 2.07% in 2000.) The magnitude of this growth has outstripped the capacity of the land to absorb the additional rural population and of the economy to absorb the expanding urban-based population. The solution for many Filipinos has been to move to upland areas or to migrate overseas.

Internal migrations

The pressure of population growth on agricultural land has been particularly intense. While more and more land has had to be brought into production, serious land shortages still exist in many regions. The only choice for many people has been to move to less densely settled areas. The population of the less densely settled upland areas has been growing by about 4% annually. This is primarily due to migration. More than one-third of the entire population now live in these areas. One of the most significant of these rural–rural migrations has been to the island of Mindanao.

The environmental and social impacts of these migrations have been considerable. The male-dominated migration to Mindanao has, for example, disrupted the livelihood and social stability of the existing Muslim or indigenous groups and has embroiled parts of the island in an ongoing and bitter political conflict.

The environmental costs of population growth and the associated intensification of landuse relate largely to the expansion of agriculture into areas previously forested and/or with a slope greater than 18°. Cultivated upland areas increased from 582 000 ha in the 1960s to over 5 million ha in 2005. As a result, the country lost one-third of its forest cover between 1990 and 2005. Rates of water runoff and soil erosion have increased greatly as the protective forest cover has been removed. Soil erosion is estimated to remove about 122–210 tonnes per ha annually from newly established pasture, compared with less than 2 tonnes per ha from land under forest. Other, related, consequences include the loss of habitat for wildlife, microclimatic change and the siltation of downstream rice-growing areas. As a result of elevated levels of runoff there has been an increase in the incidence of flooding. This has led to the devastation of communities and the loss of life. Major mudslides are increasingly common. (See figure 2.1.46).

International migrations

The Philippines has 4.8 million of its citizens working temporarily in more than 160 countries. Most take up short-term contracts in the Middle East and South-east Asia. Significant numbers also go to the United States (where there are now almost 1.5 million Filipinos) and to Canada, Australia, Japan and Europe. Perhaps as many as another 100 000 leave to 'illegally' seek work or residence in Europe, the United States and East Asia.

Population pressure undoubtedly plays a significant role in the escalating numbers leaving the Philippines. However, it is not the only factor to take into account. Pressure to migrate is particularly strong among well-educated Filipinos. Professionals (such as doctors, engineers, teachers and nurses) find that they can secure much higher standards of living by accepting permanent or temporary contracts overseas. Strong family ties and mutual support structures have also fostered the development of 'chain migration'. Filipinos often sponsor other family members to join them as either short-term or permanent migrants. Another contributing factor is the demand for Filipino labour. Since 1970 there has been a demand for all types of labour in the oil-rich states of the Middle East, for domestic servants in Hong Kong and Singapore, and for service workers in Europe.

FIGURE 2.1.46

In the Philippines, rescue workers recover the body of a villager killed by a mudslide caused by illegal logging on a nearby hillside.

FIGURE 2.1.47

Philippine soldier guards logs seized from illegal loggers.

pressure, the nature of land ownership and the alienation of land by commercial agricultural interests. This has resulted in a range of socio-economic problems. Without access to land on which to grow food, people become increasingly dependent on a cash income with which to buy food. Starvation and malnutrition, therefore, become more directly linked to poverty. Another outcome of landlessness is the drift to the cities.

Employment

Because of the **age structure** of their populations and their high rates of urbanisation, the countries of the developing world are facing an employment crisis. On average, 30 million new jobs will need to be created annually just to prevent an increase in the present high rates of unemployment and underemployment (currently more than half a billion).

geoskills 25

Mindmaps

A mindmap is a creative pattern of connected ideas that provides a concise 'picture' of the topic. As a study technique, mindmaps assist us to clarify and recall information. They can encourage creativity and make revision more enjoyable and effective.

To create a mindmap for a whole topic or part of a topic follow the steps below:

1. Write the topic in the centre of a page and put a box around it.
2. Add branches that radiate out from the central topic box.
3. Add detail to your mindmap. Key words and concepts should be highlighted. Add symbols and even small sketches to assist recall or enhance the effectiveness of the mindmap as a form of geographical communication.
4. Draw in the linkages between related concepts.

Use different-coloured pens or pencils for each branch of the mindmap. Use sketches, symbols and abbreviations, and change the size of the words: the more important the word, the bigger it might be.

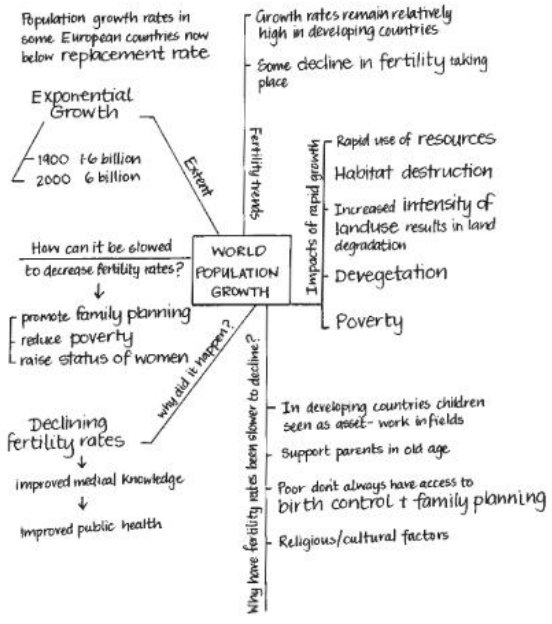


FIGURE 2.1.48

A sample mindmap.

understanding the text

1. **Outline** the main arguments put forward by the two 'camps' in the population debate.
2. **Explain** why the very affluent and the very poor together contribute disproportionately to environmental degradation.
3. **Outline** the various ways in which rapid population growth can have an adverse effect on the environment.
4. **Identify** the issues that have been linked to increased landlessness.
5. **Explain** why the countries of the developing world are facing an employment crisis.

working geographically

1. **Group work** Study figure 2.1.45 (p. 256). Working in groups, brainstorm the problems faced by cities in the developing world that are experiencing rapid population growth. Share your group's points with the rest of the class.
2. **Research task**
   - **a** Undertake research into the arguments of the two 'camps' in the population debate. Working in groups, brainstorm other arguments and supporting examples that you could use in a debate about the issue. Report your group's findings to the class.
   - **b** Conduct a class debate. Topic: Technological developments will enable humankind to cope with the rapid escalation in human numbers.
3. **Research task** Undertake Internet-based research into one of the implications of rapid population growth mentioned in this section of the text. Present your findings as either a written report or an oral presentation.
4. **Interpreting text** Study the Geofocus box 'The Philippines: impacts of rapid population growth'.
   - **a** Use an atlas to locate the island of Mindanao. Describe its location relative to the rest of the Philippines.
   - **b** Write a report outlining how population pressure in the Philippines has led to environmental degradation.
   - **c** Write a paragraph describing the international migrations from the Philippines.

unit 2.2

> The nation behaves well if it treats the natural resources as assets that it must turn over to the next generation increased, and not impaired, in value.
>
> **Theodore Roosevelt, former US president (1901–09)**

> The earth we abuse and the living things we kill will, in the end, take their revenge; for in exploiting their presence we are diminishing our future.
>
> **Marya Mannes, US writer and critic**

> We do not inherit the earth from our ancestors; we borrow it from our children.
>
> **Native American proverb**

> Nature provides a free lunch, but only if we control our appetites.
>
> **William Ruckelshaus, US attorney and civil servant**

Natural Resource Use

This unit develops an understanding of the characteristics of natural resources, as well as their distribution and management. An important concept in this unit is the changing appreciation of what constitutes a resource. Resources are used to meet a society's needs. As a society's needs change, the value of any one resource will change over time. The unit also focuses on the distribution, management and consumption of natural resources around the globe and the associated economic and political issues.

The final issues addressed are environmental and social. Particular attention is given to resource use by developing countries. Such countries often lack natural resources or have inadequate funding and expertise to develop the resources they do have. Trade barriers may restrict their economic growth and limit their standard of living.

exam-style questions

extended responses

- What are natural resources? How are they classified? Give examples of each.
- Examine the renewable, recyclable and exhaustible nature of natural resources.
- With the aid of examples, explain the spatial variation in the distribution and consumption of natural resources on a global scale.
- Outline the economic, political and social issues related to the use of natural resources.
- Examine the economic and political issues related to the ownership and management of natural resources.
- Examine the environmental issues related to the use of natural resources.
- Outline the impact on, and responses of, indigenous peoples to the use of natural resources.
- Explain what needs to be done to achieve the ecologically sustainable use of natural resources.

Going gangbusters: Australia's resources boom

Australia is in the midst of a resources boom. The country has never before experienced anything like the rate at which minerals are being dug up and exported. Revenue from coal exports increased by a staggering 43% between 2004–05 and 2005–06 to generate export earnings of $24.5 billion. Iron ore sales surged by 24% over the same period, up to $14.5 billion in 2006. Then there was crude petroleum, whose overseas revenue grew to $6.7 billion in 2005–06, and natural gas, which rose by 38% to $5.0 billion in the same period.

Australia now ranks as the world's leading producer of lead, bauxite, diamonds, rutile, zircon and tantalum. It is the second largest supplier of uranium, zinc and nickel; the third biggest provider of iron ore, lignite, silver, manganese and gold; and the fourth largest producer of black coal and copper.

Of course, not all Australia's exports are dug from the ground. The country's manufacturing sector increased its export earnings to $42.0 billion in 2006 (a 13.5% increase over 2005). While exports of services did not grow as quickly, they did generate export earnings of $37.0 billion in 2006 (up 4% over 2005).

In the services sector, tourism and education are the biggest export earners. In 2006, tourism generated 11% of Australia's export earnings while the 400 000 foreign students studying in Australia contributed $5 billion.

Australia's exports are booming in response to rapid economic growth in China and India.

glossary

- **anthropocentric** centred on human beings.
- **benchmark** a reference point against which performance can be measured.
- **biocentric** centred on the worldwide system of all life functions.
- **bloc** a group of states or countries united by some common factor.
- **cartel** a group of producers of a single commodity that mutually agree to fix prices.
- **clearfelling** logging operation involving the cutting of all standing timber in an area.
- **environmental audit** an account of environmental attributes.
- **equity** the quality of fairness and impartiality.
- **gross national product (GNP)** the total value of goods and services produced in a country together with income earned from investments and other earnings overseas.
- **host country** the country that provides the location and resources for a foreign company's project.
- **infrastructure** the buildings and other permanent structures associated with a project or other human acitivity.
- **integrated resource management** the management of resources to achieve mutually beneficial goals in two or more projects.
- **natural resource** a natural item that, after processing or manufacture, meets the needs of society.
- **natural resource base** the earth-based materials from which potential resources are to be drawn.
- **non-renewable resources** resources that have finite stocks and, once used, are not replaced or recycled.
- **qualitative** relating to characteristics, properties and attributes.
- **quantitative** relating to measurements.
- **recyclable resources** those materials that can be processed for reuse.
- **renewable resources** those resources that, if carefully managed, will be replenished after use; also known as exhaustible resources.
- **resource** an item that meets a need.
- **subsistence agriculture** the growing of crops and/or the raising of livestock to support the members of a household rather than producing food for sale.
- **tariffs** duties imposed by governments, particularly on imports.
- **total catchment management (TCM)** the coordinated and sustainable use and management of land, water, vegetation and other natural resources on a catchment basis.
- **'user-pays' principle** an economic rationalist approach whereby those who need a service pay for it directly without subsidy. Economic rationalists tend to favour deregulation, a free market economy, privatisation of state-owned industries, lower direct taxation and higher indirect taxation, and a reduction of the size of the 'welfare state'.

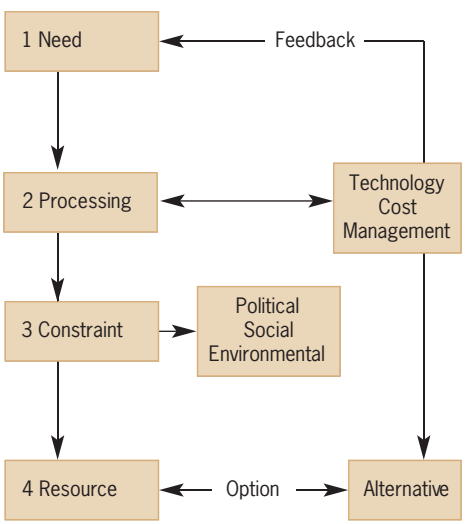


FIGURE 2.2.1

Defining the nature of natural resources.

The nature of natural resources

The appreciation of **natural resources** varies from one culture to another, and even from one individual to another. When studying this section of the text it is important to understand that other people may think very differently than you do about **resources**, such as farmlands and mineral deposits. To a hungry family in a developing country, for example, the land on which to grow essential food crops may seem more immediately important than a possible wealth of minerals found under that land. (See figure 2.2.3.) Thus, any value judgement about resources, including their conservation or management, must be viewed through the eyes of the people dealing with them. Their expectations and experiences must be taken into account. There will rarely be simple, 'correct' answers to many of the questions concerning resources.

From our perspective a resource is something from the natural environment (water, air, trees, mineral ores and fuels) that are used to meet one's needs and wants. The Australian economy, and therefore our standard of living, is largely based on the exploitation of the natural resources bestowed by nature. The discovery, extraction, transport and processing of these resources is, however, dependent on the country's human resources: the skills and abilities of its people.

FIGURE 2.2.2

Any value judgement about resources, including their conservation or management, must be viewed through the eyes of the people dealing with them.

What is a natural resource?

For a naturally occurring item to become a resource, several conditions must be met:

- An item must be recognised as having a use, either directly or as an input into a process that will produce a needed product or outcome.
- There must exist the skills, the equipment and, in some instances, the degree of social organisation necessary to transform the item from its natural state into the required product.
- The transformation of a naturally occurring item into a resource must be achieved at a cost, and with the convenience, that makes it more appropriate than seeking alternatives.
- Any adverse impacts (social, environmental or economic) generated by the whole activity must be acceptable to society. This is especially the case where society has an input into the decision-making processes relating to resources, their processing and utilisation.

Research and/or experience leads to additional knowledge about resources and the development of new production techniques and patterns of consumption. These developments, together with society's changing needs, may cause previously unappreciated items to become valued resources. Sometimes, the same resource may have several different uses through time. It is therefore important to acknowledge the dynamic, or changing, nature of natural resources. (See figure 2.2.1.)

Economic factors

Regardless of the system in which the transfer of goods takes place, there is generally a mechanism that assigns the relative value to an item. The most common mechanism is price, in either monetary terms or some other form of currency. A trade takes place if the price offered by the seller is acceptable by the purchaser. The price of resources rarely stays constant for long and is determined largely by availability and need. Assuming that there is a demand for a particular good, its price will be largely dependent on the level of supply. If the supply increases and the market is free to respond, the price of the item will drop. If the demand increases and supply becomes limited, the price will rise. (See figures 2.2.4 and 2.2.5, p. 264.)

FIGURE 2.2.3

An appreciation of what constitutes a resource varies between cultures and individuals.

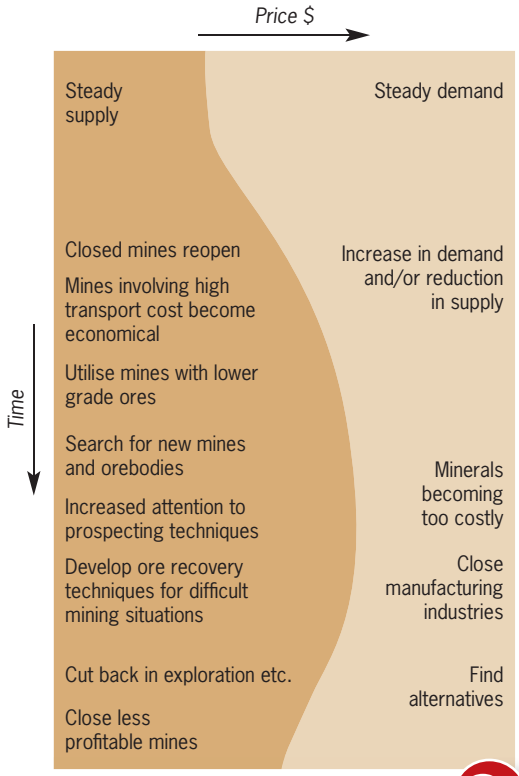


FIGURE 2.2.4

Changes resulting from increased price of a mineral.

FIGURE 2.2.5

The price the grower receives for wheat is determined by the price mechanism. As supply increases or demand drops, the price of wheat drops. As supply declines or demand increases, the price increases.

Technology

The word 'technology' brings to mind items such as computers (see figure 2.2.7), electronic communications, satellites and other products of science and engineering. It may be the latest or most recent phase of a very long line of developments dating back to the harnessing of fire, the intentional cultivation of crops and the domestication of animals.

The ability of Aboriginal Australians to fashion spear tips and other artefacts from quartz represented a major technological achievement at that particular stage of human history. Similarly significant advances were their carefully designed fish traps and their design and use of the boomerang and woomera.

Most technology is developed by building upon prior experience and understanding. It advances through the processes of communicating, questioning and observing.

Technology can impact on natural resources by creating or stimulating demand. In addition, it may improve the supply of materials by developing extraction and processing techniques and reducing production costs. (See figure 2.2.8.) Chilean nitrate deposits provide an example of technological developments reducing the demand for natural resources. These deposits accumulated naturally over many years and were once crucial to the global fertiliser trade. When developments in processing allowed nitrogen to be 'fixed' artificially through the use of electricity, the Chilean deposits became less important.

Cultural factors

As societies evolve, they develop a variety of cultural characteristics. This is even more apparent when a society evolves in isolation. Aspects of culture may range from formal religions to traditional myths and legends, and from appreciation of landscape to appreciation of the qualities of certain woods or minerals for production of an artefact. To indigenous Tasmanians, for example, the eating of fish with scales was taboo, yet they ate vast amounts of shellfish. To them, fish, fishnets or traps had no resource value. In some societies, such as those of Papua New Guinea, the eating of pork has special celebratory significance, whereas it is forbidden to Jews and Muslims.

Other differences between cultures are evident in the way colonists attempted to exploit the Australian lands. Although directed towards meeting economic objectives, traditional farming practices appear to attempt to defy natural systems, particularly in times of drought. One Western Australian wheat farmer recently questioned the culture that had been transplanted from Britain and Europe to this arid landscape:

> *Why is it that I spend all my working days cutting down native trees and shrubs that proliferate, and chasing away and shooting native animals to try and, at the same time, maintain stock that do not do well for half the year and grow crops that provide little profit if any.*

Kangaroo meat was used by some colonists for food, particularly in Tasmania. Yet it is only recently that the meat, which has been used extensively for pet food, has been approved for human consumption. Australian resources that have received more immediate acceptance are our native flowers and plants. There has been increasing interest in these and they now fill an important export role.

Environment and health

Since the days of Thomas Malthus, many individuals have urged restraint in the growth of population and consumption of natural resources. In recent decades the prophets of impending doom have been more numerous. They are particularly concerned about the mismanagement

did you know?

Thomas Malthus (1766–1834) was an English demographer and political economist. He is best known for his influential views on population growth.

FIGURE 2.2.6

Cultural factors impact on people's perceptions of what constitutes a resource.

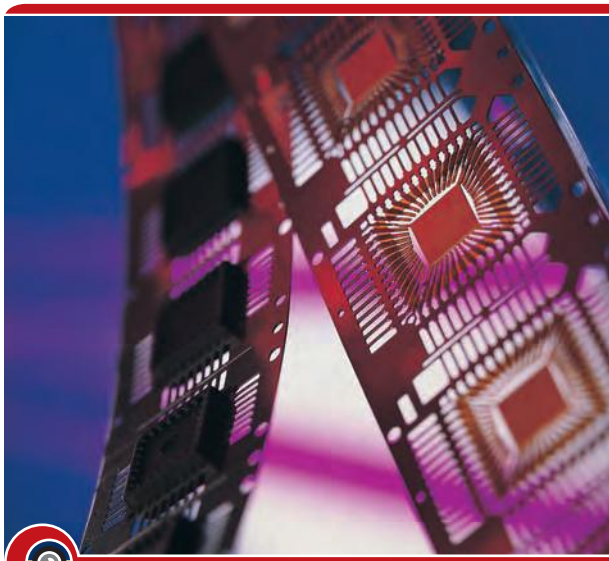


FIGURE 2.2.7

The computer chip is the most recent phase of a long line of technological innovations.

of resources. If the atmosphere, for example, ceases to buffer us from the effects of worsening pollution and significant climate change appears imminent, a responsible society may be convinced to drastically reduce the consumption of fossil fuels. (See figure 2.2.9.) There may well be a trade-off in favour of the environment against the use of coal. Similarly, unless the long-term, safe disposal of nuclear waste can be proven possible, nuclear fuel may lose its resource value. This will especially be the case if renewable sources of energy become more efficient and reliable.

Over the last century, there has been a growing reliance on the use of pesticides, particularly in agriculture. Livestock are particularly vulnerable to various internal and external parasites, and preventative treatment is required. Crops are susceptible to insect attack, and crop production also suffers due to weeds, fungal diseases and plagues of mice and rats. The role of pesticides in maintaining production is crucial, but often it is at a cost to the environment. Insecticides such as dieldrin and DDT have been banned in many countries because of their threats to fauna. (See figure 2.2.10, p. 266.)

FIGURE 2.2.8

Technological developments in resource extraction have increased production and reduced costs.

Policy and politics

For strategic, economic and/or political reasons, governments may actively promote the exploitation of natural resources. Incentives, such as tax rebates, are often used to encourage the development of a mine or new agricultural enterprise in an unpopulated area or in an area with high levels of unemployment. For example, partly in order to reduce Australia's reliance on imported cotton, the Federal Government in the 1960s offered a bounty on locally produced cotton. This policy led to the construction of large dams and the eventual transformation of large grazing holdings into intensively irrigated cotton-farming land. Primarily the cotton farms were established in northern New South Wales and in southern and central Queensland. During the prolonged drought of the early 2000s many people questioned the wisdom of this government intervention.

The most recent example of a controversial government intervention is the support given by the Australian and Tasmanian governments for the construction of a pulp mill at Tasmania's Bell Bay. Environmentalists

FIGURE 2.2.9

A coal-fired power station. Will coal remain a resource if its use is judged to be a threat to the earth's atmosphere?

FIGURE 2.2.10

Insecticides such as dieldrin and DDT have been banned because of the threats they pose to fauna.

FIGURE 2.2.11

The disposal of chemical wastes is a major environmental problem.

claim that the mill will result in the devastation of vast tracts of old growth forest. Gunn's, the company building the plant, argues that the mill will be chlorine free, incorporate the best available technology and set new global standards for mill design. In other words, it will be environmentally friendly. Only time will tell if its claims are true.

geofocus

Conservation

Few people would ever admit to being opposed to the conservation of natural resources. Yet people disagree on what the term actually means. Some believe that it means limited or non-use of certain resources. Such a person may maintain that no air pollution is acceptable, and that wilderness cannot be wilderness if people change it or use it in any way. Others feel that conservation means efficient resource use. They argue that a resource should be used to produce the greatest human good. To these people, resources are beneficial, but only if they are used; non-use of resources is seen as a waste.

The disagreement, however, is even more complex than this. There are many definitions of the meaning of 'efficient', and few can agree on what is truly beneficial. Is profit the highest benefit? Is the spiritual renewal experienced in wilderness the best use of that land? If a beautiful valley is filled with four houses per hectare, each resident has a home and a quarter hectare of land. Is this a more efficient and beneficial use of the land than making the valley into a park, so that more people can enjoy it, albeit less often?

Adapted from S. Cutter et al., *Exploitation, Conservation, Preservation*, Wiley and Sons, New York, 1991

FIGURE 2.2.12

Clear-felling, Derwent Valley, Tasmania.

did you know?

In the view of many, logging is having a devastating impact on the Tasmanian landscape. Each year approximately 15 000 ha of native forest is destroyed in Tasmania. In 2007, a total of 155 distinct areas, totalling 57 km^2, of native forest was cleared of vegetation and converted to plantations. This land clearing is devastating the region's biodiversity and the quality of water catchments.

geofocus

Asbestos

A dramatic deterioration in resource value was experienced by the mineral asbestos. With its effective insulating ability and its high strength-to-weight ratio, asbestos was used extensively in industry to provide heat protection, and in building. It has caused numerous fatalities through mesothelioma (a lethal lung cancer) and the lung disease asbestosis. The most tragic aspect of its production and use, particularly associated with mining, was that it has been widely known for more than half a century that it was a carcinogen (cancer-causing agent). For a number of reasons, restrictions on its use and research into suitable alternatives were delayed. The delay can be attributed to industry wanting to profit from the use of asbestos; the workforce and those exposed to the end-product being ignorant of its health impacts; and governments not being prepared to tackle the problem. In Australia, the major manufacturer of asbestos sheeting ('fibro') only ceased production in 1982. Worldwide, many hundreds of thousands of people have already died, and many more will die from the mining and use of asbestos as mesothelioma can take 20 to 40 years to develop.

Australia's trade union movement has campaigned on behalf of mesothelioma sufferers. In 2007 it was successful in getting James Hardie Industries (a major Australian producer of asbestos-based products) to agree to compensate the victims of the disease. (See figure 2.2.13.)

FIGURE 2.2.13

Asbestosis victim Bernie Banton (left) along with former Midnight Oil frontman and member of the Australian federal opposition Peter Garrett (right) take part in a protest in Sydney, 21 November 2005.

FIGURE 2.2.14

Asbestos, because of its horrific health impacts, has experienced a dramatic deterioration in resource value.

Natural resources: renewable, recyclable and exhaustible

The nature of resources varies greatly. Some appear to be continuously available, while others are in limited supply and could be exhausted. To help make sense of these differences, resources are usually grouped into four categories. These are:

- renewable resources
- non-renewable, or exhaustible, resources
- recyclable resources
- continuous resources.

FIGURE 2.2.15

A forest, if used sustainably, can regenerate. It is, therefore, a renewable resource.

Renewable resources

If used, **renewable resources** will eventually be replenished. This group includes, for example, forests, groundwater, wildlife and fish. (See figure 2.2.15 on p. 267 and figure 2.2.16 below.) It is assumed that after a forest is used for timber, given time, a very similar ecosystem would be reproduced in its place. The word 'ecosystem' is used here for an important reason. Timber production (see figure 2.2.17) involves far more than harvesting a given quantity of wood per unit area on a regular basis. In the timber production process, key timber values need to be maintained. These include the quality of the timber produced (growth of good **sawlogs**, for example) and the species of trees grown. If the timber cannot be reproduced at a similar or better standard than is available from old growth native forests, then the forest is not truly being renewed.

sawlog a log large enough to be sawed economically on a sawmill.

Forests are not, however, only timber-producing areas; they are also ecosystems fulfilling other important non-timber functions. For example, they:

- provide a variety of habitats for native fauna
- contain complex vegetation systems, including many non-commercial species
- consume carbon dioxide (CO_2), making them a key element in the global carbon cycle
- contain water catchments
- are often important recreation areas.

If forestry activity causes a reduction in either plant or animal populations, especially to the point of possible extinction, the harvested timber is not a truly renewable resource. This is because the harvesting process threatens the long-term survival of other life forms. Also, if soil erosion caused by this activity is such that natural soil-forming processes cannot balance the net loss of soil, the timber cannot always be replaced in the long term. Similarly, if water catchments and rivers are degraded as a result of logging, then the forestry cannot be correctly described as renewable.

FIGURE 2.2.16

Fish stocks, if managed carefully, are a renewable resource.

Non-renewable resources

The quantity of **non-renewable** (exaustible) **resources** is finite. This means that once they are used there is no possibility of reuse. A number of the world's energy sources are examples of non-renewable resources.

FIGURE 2.2.17

If forestry activity causes a reduction in either plant or animal populations, especially to the point of possible extinction, the harvested timber is not a truly renewable resource. This is because the harvesting process threatens the long-term survival of other life forms.

geofocus

Peak oil

Peak oil is the point in time at which the maximum global petroleum production rate is achieved. After this time, the rate of production will enter a slow period of decline. If global consumption is not reduced significantly before the peak is reached, the availability of cheap, conventional oil-based products will drop and prices will rise, perhaps dramatically.

The more optimistic predictions claim a peak in production will not occur until around the 2020s or 2030s and assume major investments in alternatives will occur before a crisis point is reached. These predictions show the oil price at first escalating and then retreating as other types of fuel sources are used as transport fuels and as fuel substitution in general occurs. More pessimistic predictions operate on the premise that the production peak has already occurred and that the recent rise in oil prices reflects this situation.

FIGURE 2.2.18

Coal is an example of a non-renewable (exhaustible) resource.

geofocus

Sustainable development

The term 'sustainable development' has become a popular concept in environmental literature and in debates about the nature of economic development. It can be applied to any economic system but is generally used in reference to developing countries. Achieving sustainable development has replaced maximising economic growth as the stated goal of many development assistance agencies, such as the World Bank. Yet, it is more talked about than actually applied.

The term 'sustainable development' does not have the same meaning for all who use it. *Our Common Future* (the Brundtland Commission report) defines sustainable development as 'development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs'. But some regard the primary focus on meeting 'human needs' as being too **anthropocentric** (human-centred) and argue for 'global sustainability' that includes all the components of the biosphere, even those with no apparent benefit to humanity.

Adapted from R. Mikesell and L. Williams, *International Banks and the Environment*, Sierra Club Books, San Francisco, 1992

In particular these are oil, natural gas, coal and uranium. Petroleum-based resources and coal (see figure 2.2.18), the so-called 'fossil fuels', are products of the carboniferous geological age. The climatic conditions under which they were formed are very different from those of today. They are being used in just a fraction of the time span over which they accumulated and they are not presently being replaced.

Of particular concern is the future availability of these energy sources, particularly for transport and electricity generation. While more sophisticated exploration tends to uncover new reserves, the resources will inevitably dwindle. Unless cheap alternatives can be used, the cost of fuel will rise. In addition, the standard of living in resource-poor developing countries may fall even further behind the richer, high-energy consuming developed countries.

FIGURE 2.2.19

Used products ready for recycling. **A** Bales of paper. **B** Crushed aluminium cans.

geofocus

Managing the waste of the technological age

Electronic waste (e-waste) consists of any broken or obsolete electrical equipment (for example, computers, TVs and mobile phones). (See figure 2.2.20.) The safe disposal of such waste is a growing concern because many components of such equipment are toxic and are not biodegradable.

In most cases, e-waste consists of electronic products that were used for data processing, telecommunications or entertainment in private households and businesses. The products are now considered obsolete, broken or irreparable.

Despite being classified as waste, discarded electronic components are best regarded as a secondary resource because many parts can be refurbished and/or reused. For example, many fully functional computers and components are discarded during upgrades. Material recycling of constituent raw materials is also possible. Treating e-waste as a resource is much better than having to deal with its potentially hazardous qualities. The toxic substances typically found in electronic equipment include lead, mercury and cadmium. Carcinogenic (cancer-causing) substances in e-waste include polychlorinated biphenyls (PCBs).

As a result of lower environmental standards and working conditions in countries such as China, India and Kenya, e-waste is being sent to these countries for processing, in some cases illegally. Delhi and Bangalore in India and Guiya in the Shantou region of China have large e-waste processing areas. Uncontrolled burning, dismantling and disposal are causing environmental and health problems, including occupational safety and health impacts among those involved in the industry. The trade in e-waste is controlled by the **Basel Convention**.

Done correctly and with the appropriate regulatory, public and commercial scrutiny, component reuse can divert e-waste from energy-intensive, down-cycling processes. These processes, which include conventional recycling, involve converting the equipment to the raw material form from which they were originally made. The environmental and social benefits of reuse are:

- decreased demand for new products and the raw materials from which they are made
- increased availability of technology to more people due to greater affordability of products
- reduced amounts of waste going to landfills.

FIGURE 2.2.20

Electronic waste in Guangdong, China. Globally, as much as 4000 tonnes of toxic e-waste are discarded every hour. Vast amounts are routinely and often illegally shipped as waste from Europe, the United States and Japan to places where unprotected workers recover parts and materials.

Basel Convention an international treaty designed to reduce the movements of hazardous waste between countries, and specifically to prevent transfer of hazardous waste from developed countries to developing countries; the full title is the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (1992).

Recyclable resources

While there is a limit to most of the world's mineral resources, many of them, as well as some plastic and rubber products, can be recycled after use. These resources are referred to as **recyclable resources**. Scrap iron and steel, for example, can be recycled repeatedly into a wide range of metal products.

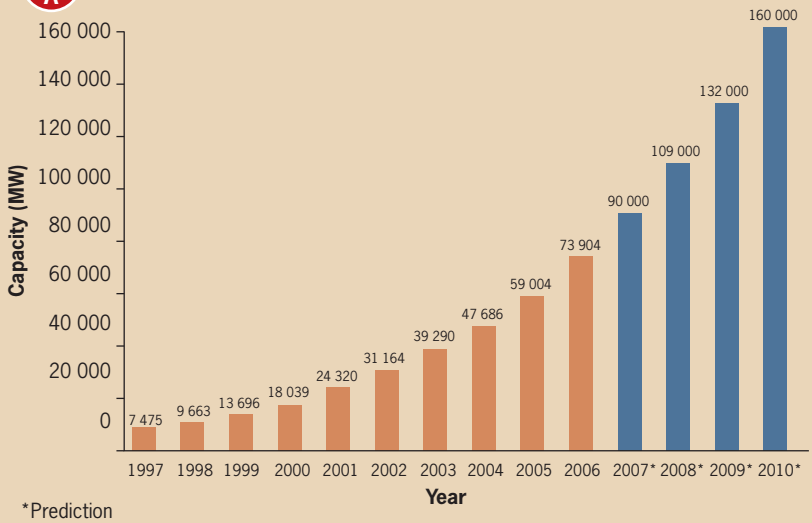
Paper recycling is well known. Yet many other materials are, or can be, recycled. (See figure 2.2.19, p. 269.) These include aluminium cans, glass bottles, plastic bottles, copper wire, silicon, gold and lead from car batteries.

Continuous resources

Continuous (perpetual) resources are those that will virtually always exist. They include solar energy and rainfall.

We can be sure that solar energy will reach the earth for the foreseeable future. However, modification of the earth's atmosphere means there is no guarantee that current levels of solar energy will continue to reach

A



*Prediction

B

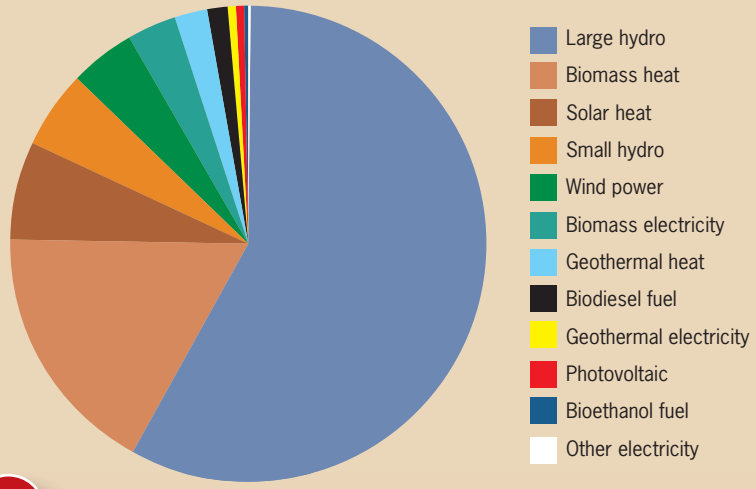


FIGURE 2.2.21

A World wind energy: total installed capacity and production, 1997–2010.
B World renewable energy, 2005.

the earth's surface. In addition, alterations to the landscape (for example, the shrinking of the polar ice caps) may have an impact on the albedo (reflectivity) from land surfaces, and this could alter the climate.

Factors such as changes to the landscape and atmosphere are likely to have a major impact on the pattern of precipitation around the globe. Therefore, it may not be totally accurate to describe rainfall as a continuous resource.

Several other resources may be defined as continuous. They include wind energy, hydro-electricity, tidal power and geothermal power. However, the utilisation of each of these resources has its own impact on the environment.

Figure 2.2.21A shows the growth in the use of wind generation. At the end of 2006, worldwide capacity of wind-powered generators was 73.9 GW. Just over 1% of the electricity used worldwide is produced by wind-powered generators. However, it accounts for approximately 20% of electricity production in Denmark, 9% in Spain, and 7% in Germany. Globally, wind power generation more than quadrupled between 2000 and 2006.

geofocus

Renewed interest in renewable energy

The drop in oil prices in the mid and late 1980s led to a decline in investment in renewable energy sources. An interest in alternatives has since been rekindled by rising oil prices, which have resulted from the supply shortages caused by the rapid economic growth of China and India and global political instability. An additional reason for the interest in alternatives is a growing concern for the state of the environment, particularly the threat of global climate change, which is the product of increased levels of CO_2 resulting from the burning of fossil fuels and forests. Estimates of the future growth of continuous energy sources range from a 33% to 50% share of the world's total energy consumption by the year 2020. This will be a significant increase on the 2007 level, which was approximately 4% (not including traditional wood burning). Australia has a target of 20% for the year 2020. (See figure 2.2.21.)

To promote new and renewable energy sources, governments could:

- encourage research into energy-efficient technologies
- provide tax breaks, rebates and other incentives for households to install energy-saving technologies, such as solar hot water systems and energy-efficient lighting
- use tax incentives to reward corporations that demonstrate ecologically responsible behaviour and to establish a 'level playing field' for all energy sources.

understanding the text

1 **Explain** how naturally occurring items become resources.
2 Cite examples of resources whose uses have changed through time.
3 **Outline** the economic factors that can cause the value of a resource to change.
4 **State** whether Aboriginal Australians were technologically advanced at the time of European settlement. Give reasons for your answer.
5 **Describe** how people from different cultures may view resources differently.
6 Cite examples of materials, other than asbestos, that have lost their resource value because of environmental concerns.
7 If the media influence the public, explain who directs the media.
8 **Define** the term conservation. Provide three examples of conservation practices.
9 **Indicate**, using two examples, how not all renewable resources are necessarily renewable.
10 **Outline** the factors that can influence the availability of continuous resources.

working geographically

1 **Interpreting diagrams** Study figure 2.2.1 (p. 262). Using the diagram as a guide, write a paragraph outlining the dynamic nature of natural resources.
2 **Interpreting photographs** Study figure 2.2.3 (p. 263).
   a In groups, discuss the context in which each of the features shown could be regarded as a resource.
   b Write a report outlining the different views of resources drawn from the scenes shown in the photographs.
   c Discuss the role of the media in shaping society's attitudes. Draw up a code of responsibility for the media to consider in relation to reporting on resources and their use.
3 **Interpreting diagrams** Study figure 2.2.4 (p. 264). Write a paragraph outlining the changes that take place when the price of a mineral increases.
4 **Interpreting text** Study the Geofocus box 'Conservation' (p. 266).
   a Write your own definition of the term conservation.
   b Use the Internet to define the terms anthropocentric and biocentric as they relate to people's world view.
   c In your definition of conservation, did you emphasise human benefits or was your viewpoint more biocentric? Justify your answer.
5 **Interpreting photographs** Study figures 2.2.15 to 2.2.17 (pp. 267–8).
   a How can one establish what should be preserved and what should be utilised? Can you establish a list of criteria?
   b Who should decide what to utilise? Give reasons for your answer.
6 **Writing task** Write several paragraphs to answer the following questions.
   a What is your idea of environmental sustainability?
   b Is there a conflict between the continuation of current human activity and environmental sustainability?
7 **Class discussion** As a class, discuss whether the impact and significance of the term 'sustainability' has weakened our resolve to address the causes of pollution. Is it possible, for example, to have sustainable levels of river pollution or sustainable canal estate residential development?
8 **Class discussion** Answer the following questions and then share your responses with other students in the class.
   a Do you agree that individuals may well regard the concept of sustainability in very different terms depending on their education and value system?
   b What influences do you believe are responsible for your value system?
   c How important is the role of TV and other media in this regard?
9 **Interpreting photographs** Figures 2.2.15 (p.267) and 2.2.16 (p. 268) show two renewable resources. Is their future guaranteed because they are renewable? Write down your reasons for each case.
10 **Critical thinking** There is more to be sustained in forests than timber production. Write a set of guidelines indicating what logging operations must achieve if harvested forests are to be appropriately 'renewed'.
11 **Class discussion and writing task** Discuss the future of fossil fuel use.
   a Write a paragraph about the factors that could eventually cause fossil fuels to be displaced as a major energy source.
   b Write a paragraph about the role of governments in this process.
12 **Interpreting diagrams** Study figure 2.2.21A (p. 271).
   a By how much did the world wind energy capacity increase between 2000 and 2006?
   b How many times greater is the predicted installed capacity of world wind energy in 2010 than the actual capacity in 2000.
   c Brainstorm the advantages and disadvantages of producing energy using wind farms.
13 **Interpreting diagrams** Study figure 2.2.21B (p. 271).
   a What proportion of renewable energy was sourced from large hydro facilities in 2005?
   b Where is wind energy ranked as a source of renewable energy?
14 **Writing task** Is hydro-electricity a truly environmentally acceptable form of energy generation? Write a short exposition to substantiate your point of view.
15 **Using ICT** Using Internet sources, write a series of paragraphs explaining how wind energy, water, the tides and geothermal energy sources are used to produce electricity.

Patterns of natural resources

There are huge **disparities** between, and even within, countries in terms of access to resources. However, it is too simplistic to simply identify the areas with either a great deal or none of a particular resource. Consider rainfall, for example. Some countries have good rainfall (in terms of amount, seasonality and reliability) or potentially good supplies of irrigation water, whereas others have not. Yet, even if a country has low rainfall, this may not be the major constraint on agricultural production, particularly if the topography is such that there are no appropriate agricultural lands. In other areas, low temperatures or presence of permafrost (a permanently frozen layer of soil) may be a major constraint on farming.

Thus, care must be taken when drawing conclusions about people's relative well-being from resource distribution. Often a more meaningful picture can be achieved by studying the consequences of a lack of effective resources. This may be evident in low levels of income, **gross national product (GNP)**, education and energy consumption; high dependency on aid; severe environmental degradation; negligible exports; and possibly poor health, high infant mortality and short life expectancy.

Whatever the indicators used, there is a danger in making generalisations, and care must be taken when interpreting information. Average data for an individual country may suggest that few resource problems exist. However, within that country, there may be a vast gap between the rich and the poor, and there may be serious localised food shortages.

The uneven global distribution of natural resources

The physical processes that created the earth have left a very uneven distribution of resources around the globe. Rich basalt soils, for example, are a result of volcanic activity. Rainfall is largely a function of topography and prevailing winds, position relative to the sea and the local nature of ocean currents. Coal deposits are related to the position of swamplands dating back to the Carboniferous era, about 345 million years ago. Other minerals have been concentrated in particular regions through deposition or other processes.

Land resources

Land resources often involve a trade-off. Clearing forested land for cropping or grazing may be at the expense of both important timber resources and habitats, for people as well as other biota. Large-scale clearing can destroy the society of forest-dwelling indigenous peoples. (See figure 2.2.22.)

The responsibility for clearing forests for agriculture is often not in the hands of the resource-poor farmers. In the Amazon Basin, for example, much of the worst devastation has been caused by wealthier landowners from São Paulo or other cities, for whom landclearing for development of agricultural land brings taxation advantages.

Land and productivity

Land is a fundamentally important resource, and is at a premium in economic entities such as Hong Kong (see figure 2.2.24, p. 274) and Singapore, which are both relatively small. The land's ability to produce food is of particular significance in most developing countries. Consequently, while the area of land per unit of population offers a crude estimate of the potential of a country to feed itself, the areas of **arable** and irrigated land will provide some indication of the level of intensive production. Other information that helps to determine land productivity includes the soil type and topography; the amount, seasonality and reliability of rainfall; moisture loss due to evaporation; and pesticides and fertilisers used in agricultural production. (See figure 2.2.23, p. 274.)

disparity inequality or difference in some respect.

did you know?

In Mata Grosso, clearing began with road expansion in the 1980s that brought in loggers and mining operations. This was coupled with government programs to alleviate poverty by encouraging poor farmers to migrate and colonise the new frontier. In recent years, industrial-scale agriculture, particularly cattle ranching and soybean farming, have become increasingly important causes of deforestation.

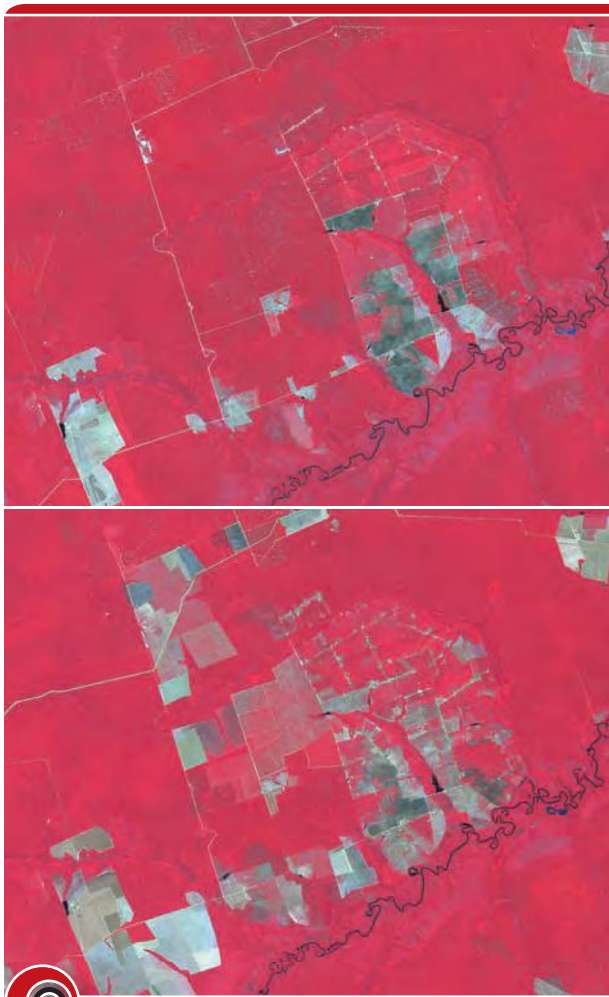


FIGURE 2.2.22

This pair of images shows large clearings made in the Amazon rainforest in the state of Mato Grosso, Brazil, between 2001 (top) and 2006 (bottom).

arable land an agricultural term, meaning land that can be used for growing crops.

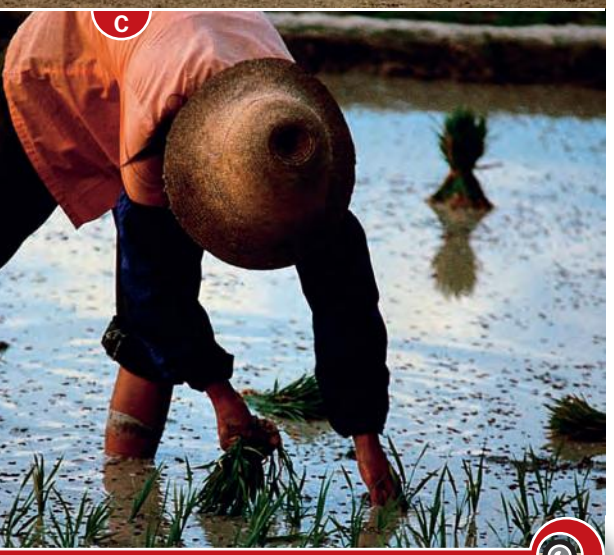


FIGURE 2.2.23

The nature of the biophysical environment ultimately determines the land's ability to produce food. **A** Dry, harsh inland unsuitable for food production. **B** Extensive agriculture: cattle grazing. **C** Intensive agriculture: rice cultivation.

reafforestation the process of restoring and recreating areas of woodlands or forests that once existed but were deforested or otherwise removed or destroyed at some point in the past.

FIGURE 2.2.24

In Hong Kong there is a shortage of residential land. This makes land a very valuable resource there.

TABLE 2.2.1

Population and population land resources

Region	Estimated population 2004 (million)	Land area (km^2 × 1000)	Arable land (% of total)	Irrigated land (% of total)
Developing countries	5094	78110	9.8	22
Least developed countries	241	19330	6.1	12
Developed countries	1221	56620	12.9	9
World	6556	131730	10.7	18

Adapted from UNDP Human Development Report 2000, and updated

Selected basic indicators of agricultural resources are shown in table 2.2.1.

Forests

Forests are a particularly important resource for the rural populations of developing countries. They provide fuel and building materials, and are a source of food. Apart from their significance in maintaining biodiversity, they also have potential for wildlife tourism and ecotourism. Deforestation may have a major impact on the local climate. Some countries are well endowed with forests while others have only limited resources remaining. This resource is particularly limited in countries with harsher climates where there has also been a long history of livestock domestication.

Given appropriate climate, management and financial resources, **reafforestation** is practical, either through planned activities or natural regeneration. Unfortunately, the rate of intentional clearing and over-cutting of forests heavily outweighs any reafforestation and regeneration. The highest rate of deforestation is occurring mainly in the developing countries that still have reasonable forest cover. Forests are cleared to create additional land for agriculture or to generate timber-based export income. (See figures 2.2.28, p. 276, and 2.2.29, p. 277.)

geofocus

Deforestation in Democratic Republic of Congo

Approximately 40 million people in Africa's Democratic Republic of Congo (DRC) depend on rainforests for their basic needs, such as medicine, food and shelter. Despite being rich in natural resources, the DRC is one of the poorest countries in the world. Logging is seen by the World Bank and other donors to DRC as a way to alleviate poverty and promote economic development.

Unfortunately, DRC's forests are one of the world's most threatened ecosystems. Commercial logging and clearing for **subsistence agriculture** has devastated forests and displaced forest dwellers. Another contributing factor is the widespread civil strife in DRC, which during 1996–2003 resulted in the deaths of some 3.8 million people from violence and disease.

FIGURE 2.2.25

Forest-based products are particularly important for rural populations in developing countries.

Logging in the Congo Basin increased significantly as peace returned to the region in 2003. In 2004, encouraged by the World Bank, DRC announced its plans to step up the commercial logging of its rainforests. The timber industry is a major employer in DRC, and thousands of workers rely on logging companies for basic health care and other services. Illegal logging is a significant problem as underpaid bureaucrats look to supplement their incomes by opening restricted areas to cutting. Since the end of the war in DRC, concessions have been granted and the pace of logging in Africa's largest remaining rainforest has accelerated.

Most of the deforestation in DRC is caused by the subsistence activities of poor farmers and villagers who rely on the forests for agriculture and fuelwood collection. (See figure 2.2.25.) Slash-and-burn is commonly used by poor farmers and villagers for clearing the forest.

Typically, poor farmers and colonists gain access to forest lands by following newly built logging roads. During the civil war many people were driven deep into the rainforest to escape the widespread violence. This accelerated the rate of clearance in previously isolated regions.

Traditional fuelwood gathering is a serious source of tree removal around the city of Kinshasa. The forest has already receded by hundreds of kilometres from Kinshasa, thus making worse the overall problem of deforestation in DRC.

The rate of deforestation has also been affected by increases in charcoal production. Charcoal plays an important role in most African countries. However, the inefficiencies inherent in the production and use of charcoal, rapid urbanisation and the preference of urban dwellers for charcoal (rather than fuelwood) place a heavy strain on local forest resources. This has severe environmental consequences.

Charcoal production harms the environment in two ways: deforestation and release of CO_2 gases. In order to produce charcoal, trees must be removed from the forest; hence the deforestation effect. In order to make charcoal, the wood must be burned in kilns, slowly, for long periods of time. During this process, CO_2 is released into the air.

did you know?

The UN Food and Agriculture Organisation (FAO) estimates that globally 10.40 million ha of tropical forest were permanently destroyed each year during 2000–05. This is an increase since the 1990–2000 period, when around 10.16 million ha of forest were lost. (See figure 2.2.27, p. 276.) Annual deforestation has also risen in primary forests, which are relatively intact natural forests that have not been disturbed or modified by human activity. In these forests, annual deforestation rose to 6.26 million ha from 5.41 million ha in the same period.

On a broader scale, FAO data show that primary forests are being replaced by less biodiverse plantations and secondary forests. Secondary forests are natural forests that have regrown after some major disturbance, such as logging. Due to a marked increase in plantation forests, forest cover has generally been expanding in North America, Europe and China while diminishing in the tropics. (See figure 2.2.26, p. 276.) Industrial logging; conversion of forested land for agriculture (commercial and subsistence); and forest fires (often purposely lit) are responsible for the bulk of global deforestation today.

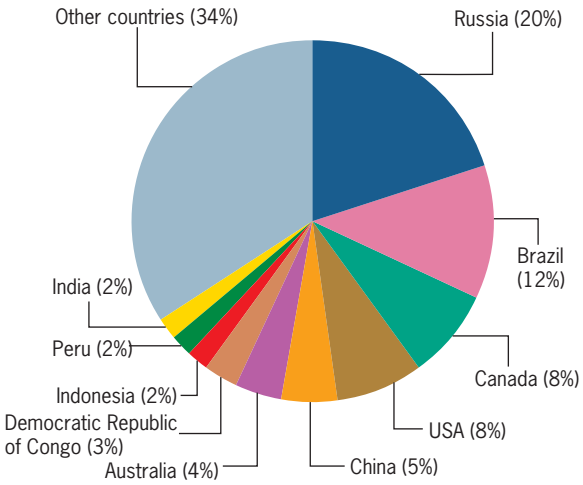


FIGURE 2.2.26

Global forest cover, 2005.

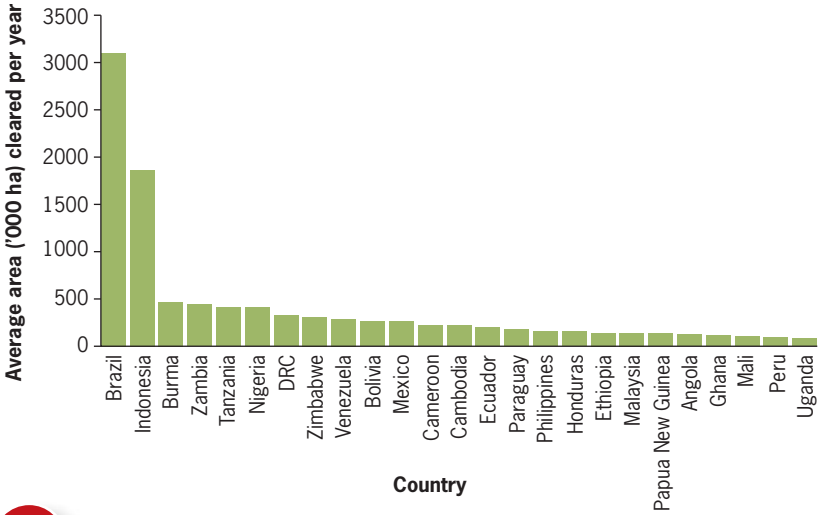


FIGURE 2.2.27

Tropical deforestation rates, 2000–05.

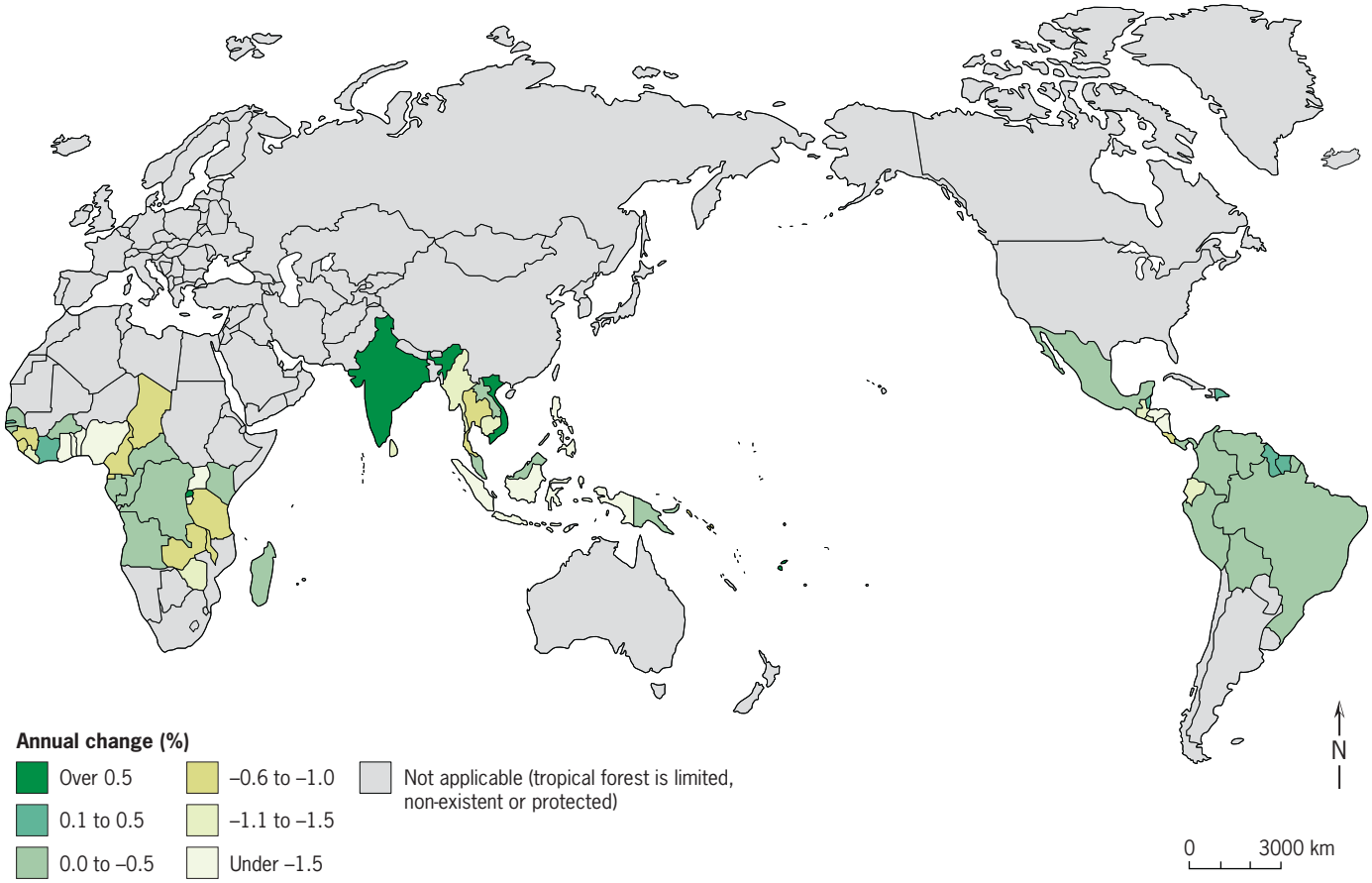


FIGURE 2.2.28

Change in tropical forest cover, 1990–2005.

geofocus

South America: saving the Yanomami

By far the most serious environmental catastrophe to have befallen indigenous people is the ongoing destruction of the world's tropical rainforests. This threatens not only their livelihoods and social fabric, but their very existence. Home to 50 million indigenous people, rainforests are being logged to feed a lucrative export market and burned to clear new land for crops and grazing. (See figure 2.2.29.)

The results have been devastating: flooding; loss of biological diversity; desertification; destruction of sacred sites; disruption of traditional economic activities, such as fishing and hunting; and the forced relocation and displacement of people. The costs of this dispossession include poverty, mental anguish, alcoholism, prostitution and high suicide rates, especially among the young.

Perhaps nowhere is the siege more evident or well-publicised than in the Amazon region of South America.

FIGURE 2.2.29

Fire has been used to clear vast tracts of forest.

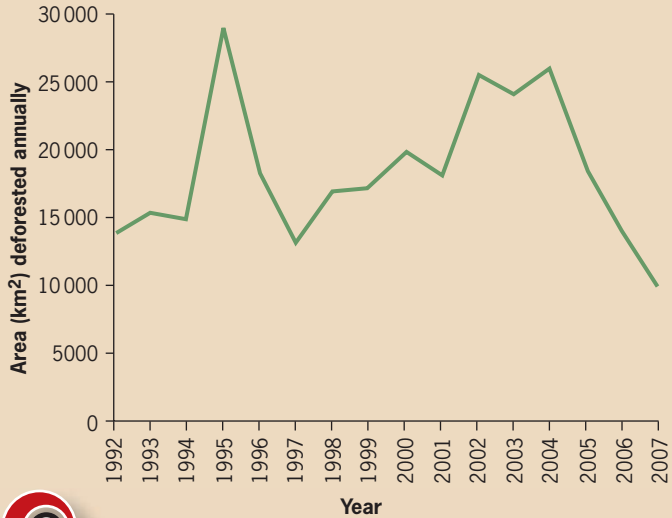


FIGURE 2.2.30

Trends in deforestation in the Brazilian Amazon, 1992–2007.

This majestic basin covers 7% of the earth's surface and is home to more than half the world's biological heritage. Just 1 ha of the Amazon's lush forests contains more tree species than all of North America. Yet, of the 6 million to 9 million indigenous people who once inhabited this paradise, only a few dispersed groups remain. In the twentieth century alone, as many as 90 entire tribes ceased to exist.

The Amazon forests of Brazil are home to the Yanomami Indians. (See figure 2.2.31.) Although they number fewer than 10 000, they are the largest single Indian tribe on the planet still practising their traditional way of life. Not only have the Yanomami seen their homelands disappear through deforestation, they have also had their health devastated by pollution and disease.

Prospectors invaded Yanomami lands in the mid-1980s in search of gold and diamonds. The mercury that the prospectors used poisoned nearly 1500 km of the Amazonian river system, while the miners themselves brought in diseases unknown to forest dwellers. As a result, more than half the Yanomami population has been afflicted with measles, malaria, syphilis or other diseases.

The Yanomami's plight sparked a global outcry. The resulting international campaign to save the Amazon rainforests and their inhabitants has had some success. On 15 November 1991, the then Brazilian president Fernando Collor de Mello declared 9.4 million ha of the Amazon forests—an area comprising 11% of Brazil's territory—as a permanent reserve for the Yanomami.

Such policies are the key to the continuing survival of the 400 ethnic groups who survive in the Amazon. These groups have a population of about 1 million. The policies are also essential to sustainable management of this valuable region.

From 2002 to 2006, the conserved land in the Amazon rainforest has almost tripled and deforestation rates have dropped by up to 60%. About 100 million ha have been declared as protected areas. Together with previously declared areas, this gives a total protected area of 173 million ha.

The original area of the Amazon rainforest was 4 100 000 km^2. By 2005, deforestation had reduced its area by 17.1% to 3 403 000 km^2.

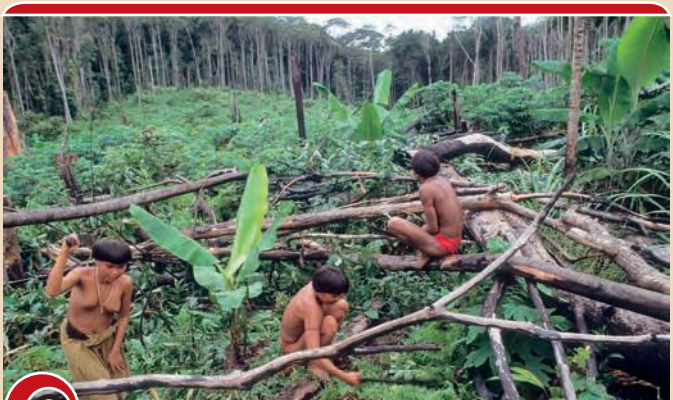


FIGURE 2.2.31

Yanomami practising sustainable shifting agriculture.

did you know?

More than one-third of all species in the world live in the Amazon rainforest. This represents the largest collection of living plants and animal species in the world. The region is home to about 2.5 million insect species, tens of thousands of plants, and some 2000 birds and mammals. To date, at least 40000 plant species, 3000 fish, 1294 birds, 427 mammals, 427 amphibians and 378 reptiles have been scientifically classified in the region. Scientists have described between 96660 and 128843 invertebrate species in Brazil alone. One in five of all the birds in the world live in the rainforests of the Amazon.

The diversity of plant species is the highest on earth with some experts estimating that 1 km^2 may contain over 75000 types of trees and 150000 species of higher plants. To date, an estimated 438000 species of plants of economic and social interest have been registered in the region, with many more remaining to be discovered or catalogued.

Water

Rainfall varies widely around the globe, even at a continental scale. Many factors have a bearing on the effectiveness of the rainfall received. Two such factors are water lost through evaporation and effective radiation, which is solar radiation that reaches the earth's surface at any particular point. Table 2.2.2 indicates the pattern of rainfall, evaporation and radiation around the globe.

TABLE 2.2.2

Global annual rainfall and evaporation and effective radiation

Continent	Precipitation (mm)	Evaporation (mm)	Effective radiation index
South America	1630	700	1190
Africa	690	430	1156
North America	660	320	679
Asia	600	310	723
Australia	470	420	1190

geofocus

Fresh water: a vital resource

The world's supply of clean fresh water is threatened by growing levels of pollution. It is becoming so scarce that, if current trends continue, two-thirds of humanity will suffer 'moderate to severe water stress' within 20 years. This situation not only imperils human health and development on a vast scale, but also the aquatic and terrestrial ecosystems on which much of the earth's life depends. There is clear and convincing evidence that the world faces a worsening series of local and regional water quantity and quality problems. These are largely the result of poor water allocation, wasteful use of the resource, lack of adequate management resources and climate change.

One-third of the world's population already suffers from moderate to high stress as a result of over-demand and pollution of water supplies. By 2025, if all humanity is to have access to safe drinking water and sanitation, the needs of an additional 1 billion people will have to be met.

The growing scarcity of water is also hampering the expansion of agricultural production at a time when demand for food is rising with steady population growth. Efforts to deal with the water crisis need to be made in tandem with an international drive towards global food security. In some countries, there will be a need to move from food self-sufficiency to greater reliance on food purchases from world markets.

Current levels of water shortages and pollution are causing widespread public health problems, limiting economic and agricultural development and harming a wide range of ecosystems. They put global food supplies in jeopardy and lead to economic stagnation in many areas of the world. This is triggering a series of local and regional water crises with global implications.

FIGURE 2.2.32

Access to clean water is a major issue for millions of the world's poor.

There are some bright spots. Some countries, particularly in the developed world, have achieved significant improvements in water quality. They have also secured impressive reductions in agricultural, industrial and domestic water use. On balance, however, these gains have not reversed either the general trend towards water shortages or widespread decline in water quality.

Adapted from *United Nations Chronicle*, 1997, no. 2, p. 24

Minerals

There is no consistent natural distribution of mineral wealth around the globe. Some countries are well endowed; others are not. Some minerals are mainly produced by just a few countries. While many important minerals (including copper, lead and zinc) are not dominated to any great extent by just a few producers.

Iron ore is a mineral of fundamental industrial importance. In excess of 90% of the world's total production is provided by just four countries: Australia, China, Brazil and India. So great is China's requirement for iron ore that, in 2006, its own massive production of 520 million tonnes accounted for only 43% of its needs. (See figure 2.2.33A.) So, while it is one of the world's largest producers of iron ore, it is also a net importer.

Another key mineral, nickel, tends to be dominated by just five countries: Canada, Russia, New Caledonia, Australia and Indonesia. Together, they mined 64% of the world's total production in 2006.

Refining

There are two phases in the production of many minerals before they enter the manufacturing process. The first is the mining of the ore body and the second is the refining of the ore into a usable form.

Aluminium metal, for example, does not occur naturally. Aluminium is mined in the form of bauxite, which contains hydrated oxides of aluminium, some silicon and other elements. Over three-quarters of global exports of bauxite come from just four countries: Australia, Guinea, Jamaica and Brazil. It is refined to alumina (aluminium oxide) and then into the metal aluminium. The last stage requires high inputs of electricity. Thus, while some countries with bauxite deposits will also refine the bauxite to alumina and then to aluminium, some countries with large amounts of cheap electricity will import either bauxite or alumina, **smelt** it, and export the aluminium.

Energy

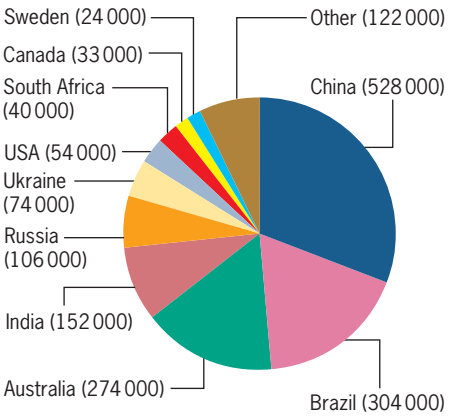
Energy is required for three basic purposes:

- electricity generation; for example, from coal, oil, uranium, solar and hydro-power (see figures 2.2.41 and 2.2.42, p. 282)
- industry; for example, coal for steel production
- fuel for transportation—mainly petroleum-based products but also electricity and nuclear fuel.

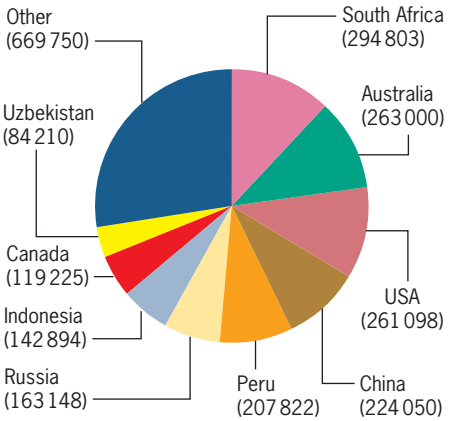
Again, energy resources are unevenly distributed around the world. For electricity generation, the major fuels are coal and uranium.

The burning of coal is a major environmental issue. It releases CO_2 into the atmosphere. This, in turn, is responsible for the enhanced greenhouse effect and climate change. (See figures 2.2.42 and 2.2.43, p. 282.)

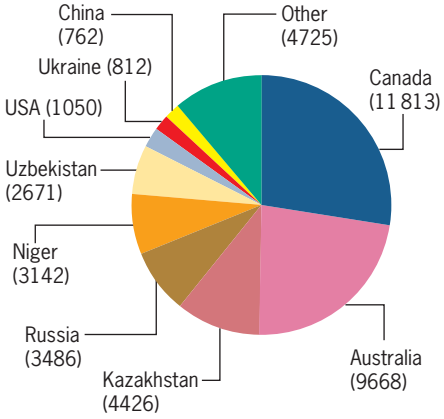
For transportation, the major energy sources are oil (petroleum) and, to a lesser extent, liquid petroleum gas. In some countries, ethanol produced from sugar or cereal crops is an important fuel. **OPEC** is the major **bloc** of oil-producing countries. The former Soviet Union, Western Europe and North America are also major producers of oil. Due to their high levels of consumption, Western Europe and North America are still net importers of oil; that is, they consume more oil than they produce. Other, smaller oilfields exist outside these areas. In Australia there are a number of smaller fields but additional imports are increasingly necessary.



a Top iron ore producers, 2006 (tonnes)



b Top gold producers, 2005 (kilograms)



c Top uranium producers, 2005 (tonnes)

FIGURE 2.2.33

Major producers of selected minerals.

smelt the process of melting aluminium oxides to take out the aluminium metal; also known as refine.

OPEC Organisation of Petroleum Exporting Countries. Founded in 1960, its current members are Algeria, Angola, Indonesia, Iran, Iraq, Kuwait, Libya, Nigeria, Qatar, Saudi Arabia, United Arab Emirates and Venezuela.

did you know?

While it is often economically desirable to add value to the raw minerals through the smelting processes, this may come at a serious environmental cost. Ores that are high in sulfates produce high levels of sulfur dioxide during smelting, which can lead to acid rain. (See Unit 1.2, p. 38.)

Coal

Coal is a fossil fuel formed in wetland ecosystems where water and mud protected the plant remains from oxidation and biodegradation. Coal is principally used as a fuel to produce electricity and heat through combustion. World coal consumption now exceeds 5.3 billion tonnes a year, of which approximately 75% is used for the production of electricity. China and India together use about 1.7 billion tonnes annually, and this is expected to exceed 2.7 billion tonnes by 2025. The United States consumes about 1.0 billion tonnes of coal each year, with 90% consumed generating electricity.

When coal is used to generate electricity it is usually crushed and then burned in a furnace attached to a boiler. The heat this generates converts the water in the boiler into steam, which is then used to turn turbines that generate electricity. Approximately 40% of the world's electricity generation comes from coal-powered facilities. The total known deposits of coal recoverable by current technologies is sufficient for 300 years of use at current consumption levels.

The combustion of coal is a major contributor to human-induced climate change and so the race is on to develop 'clean coal' technologies. These involve building more-efficient power plants (ones that burn less coal) and capturing, separating and storing the CO_2 emitted. The other option is to develop renewable energy alternatives or substitutes. Over time, coal might lose its resource value as the environmental cost of exploiting the resource becomes too great.

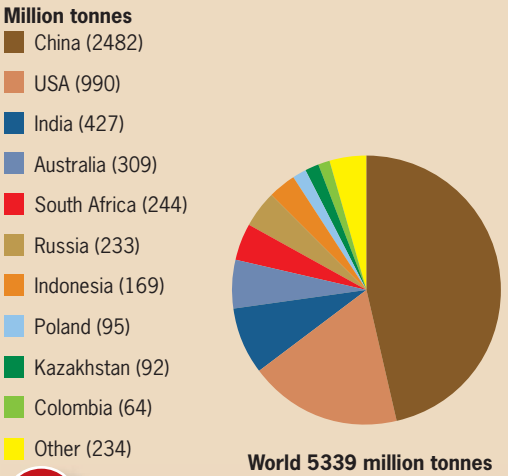


FIGURE 2.2.34

Top **hard coal** producers, 2006. (Note: Total world production figures vary because of source.)

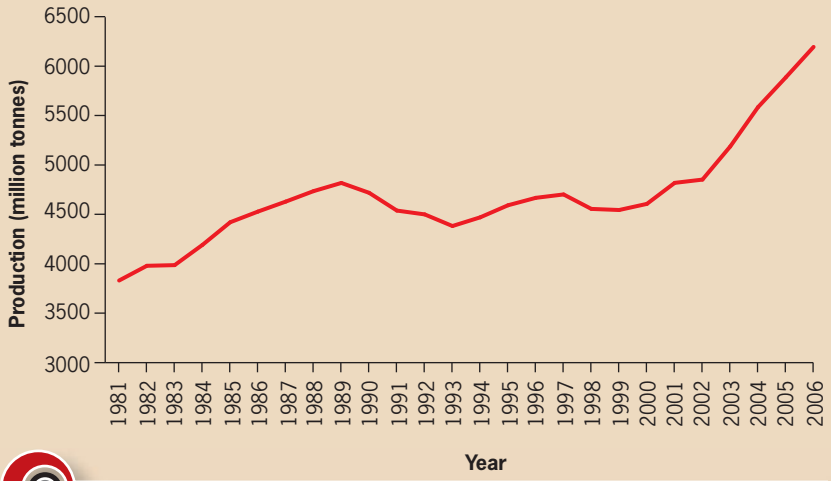


FIGURE 2.2.35

Growth in global coal production, 1981–2006.

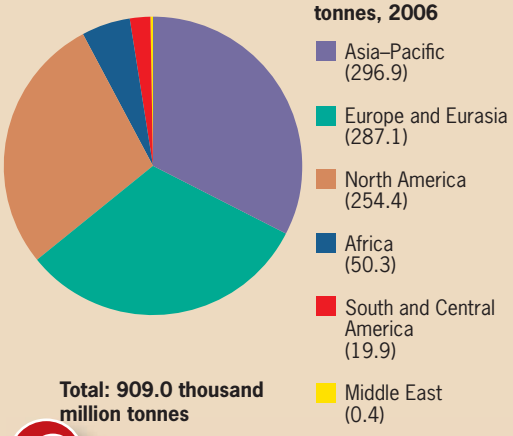


FIGURE 2.2.36

Distribution of proven coal reserves.

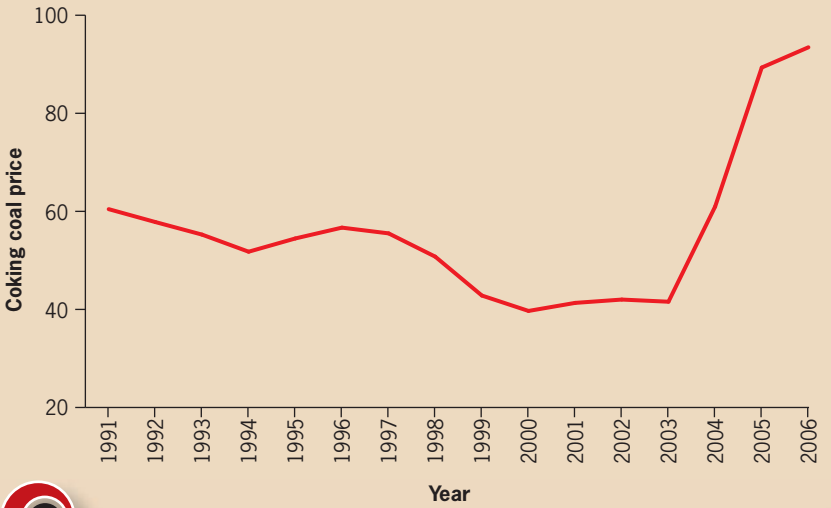


FIGURE 2.2.37

Price of **coking coal**, 1991–2006 (US$ per tonne).

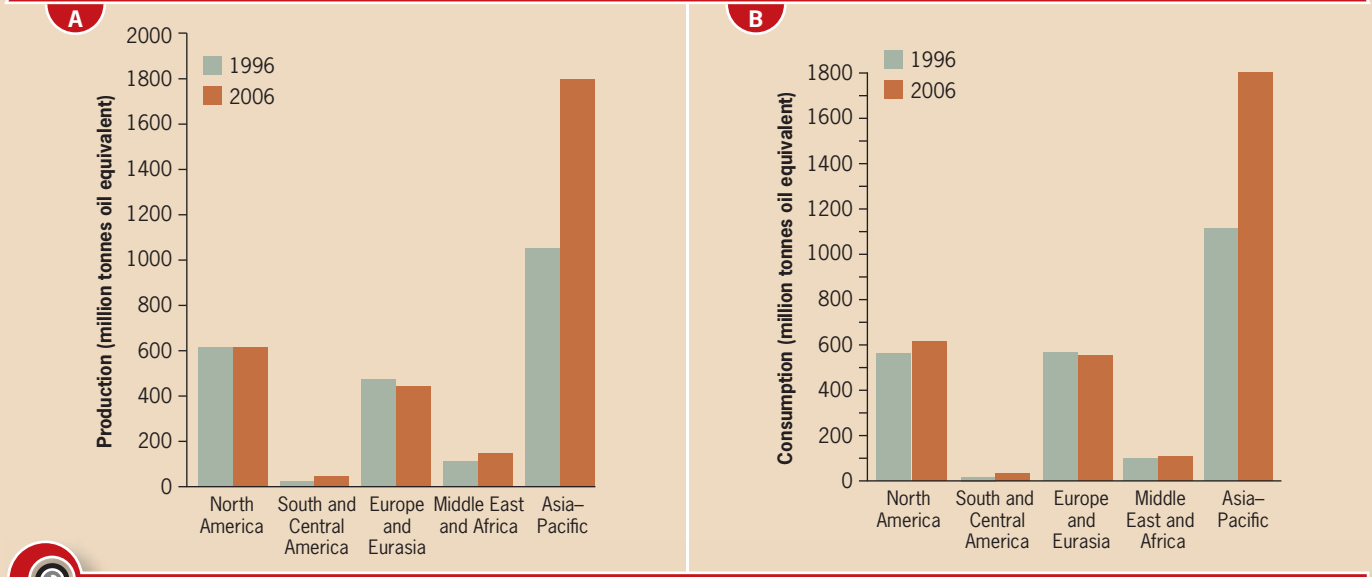


FIGURE 2.2.38

Production and consumption of coal, 1996–2006.

geofocus

China's economic boom

China's economy was once a centrally planned system based on the principle of state (or collective) ownership. The economy was largely closed to international trade. During the last quarter century, it has changed to a more market-oriented economy that has a rapidly growing private sector. China's economy has expanded at an annual rate greater than 8% since the beginning of the twenty-first century. (See figure 2.2.40.)

These changes have resulted in China's emergence as a major economic power. This, in turn, has resulted in a rapid increase in the country's consumption of natural resources. (See figure 2.2.39.) The rising demand for mineral ores has forced up commodity prices (the price of raw materials and primary products). Because of Australia's large reserves of mineral ores, the Australian economy has benefited greatly from the growth in the Chinese economy.

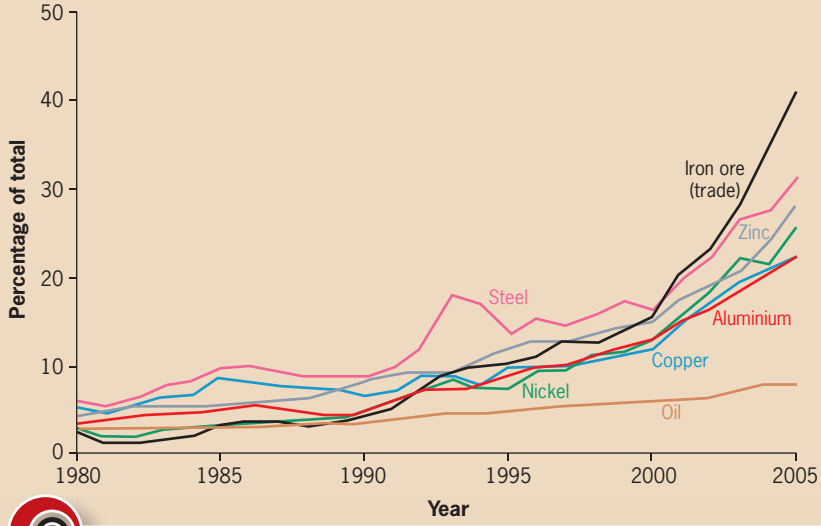


FIGURE 2.2.39

China's share of world mineral demand, 1980–2005.

FIGURE 2.2.40

Growth in the Chinese economy, 2001–05.

hard coal coal with a high proportion of carbon to oxygen.

coking coal coal with a quality that allows the production of a coke suitable to support a blast furnace charge.

understanding the text

1 **Outline** the threat to the Yanomami people of Brazil. What has been done to ease their plight?
2 **Explain** what arable land is and state why it is important.
3 **Identify** the roles of forests.
4 **Explain** how a wealth of resources can present a problem, especially for people in developing countries.

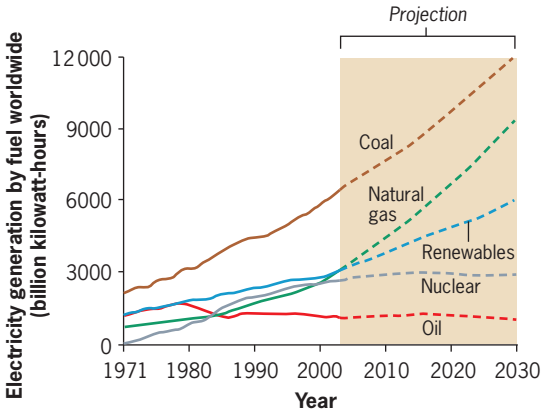


FIGURE 2.2.41
Electricity generation (actual and projected) by fuel type worldwide, 1971–2030.

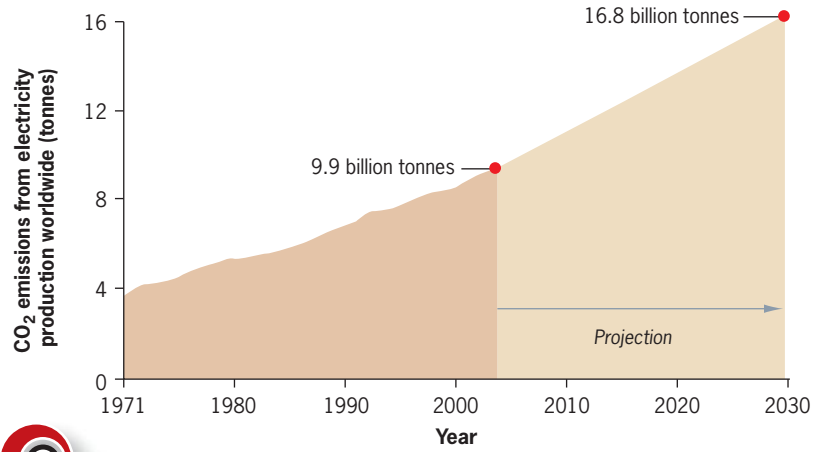
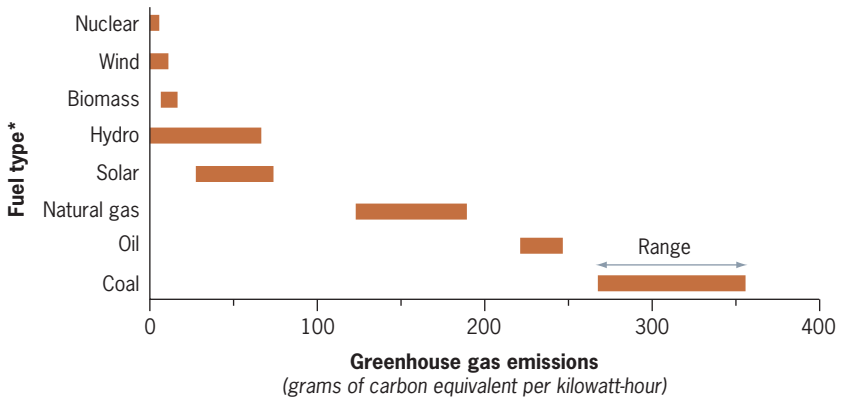


FIGURE 2.2.42
CO_2 emissions (actual and projected) from electricity production worldwide, 1971–2030.



*Includes fuel mining, preparation and transport; plant construction; power production

FIGURE 2.2.43
Greenhouse gas emissions by fuel type.

geofocus

Petroleum

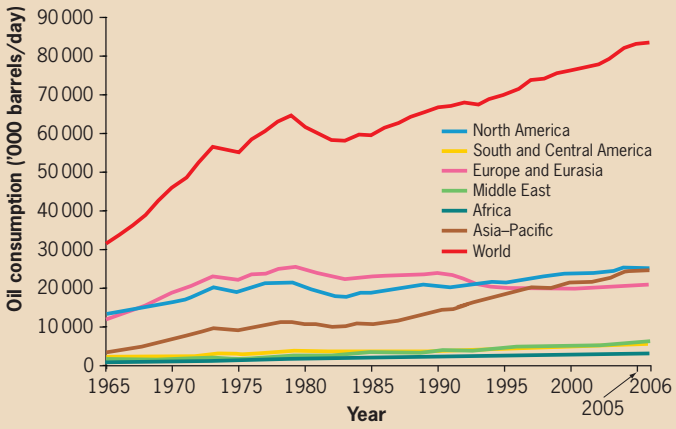
A number of factors have led to substantial increases in the price of oil (petroleum) in recent years (see figure 2.2.45):

- the rapid growth in the global economy (driven, at least in part, by the rapidly expanding economies of China and India)
- geopolitical uncertainty (especially tensions in the Middle East)
- a reluctance by the major oil companies to expand refining capacity.

There are also a range of environmental factors that are encouraging the search for alternative (non-CO_2 producing) energy sources. A significant environmental factor is the contribution that the burning of fossil fuels makes to climate change.

The world's petroleum resources are finite (see figure 2.2.46) and global production will soon peak and then start to decline. Just how much oil remains is unknown. In part, this is because higher oil prices will stimulate further exploration and make it feasible to recover deposits that are now marginal. As a result, there is a vigorous debate among petroleum geologists, energy economists, oil companies and other interested parties about the extent of the total resource and, more importantly, when production may peak.

To further complicate such assessments, the bulk of the world's petroleum resources are heavily concentrated in just a few countries, most of which are located in politically unstable regions. Regional conflicts that could cause short-term interruptions to petroleum supplies cannot be ruled out. Nor can a more gradual impact on the world's oil supplies. This could result from under-investment in production facilities in key oil-producing countries, particularly when petroleum production decisions reflect national policy and not just the demands of the market. New wells, pipelines and tanker platforms require massive amounts of capital, for which most major oil-exporting countries have other, competing demands.



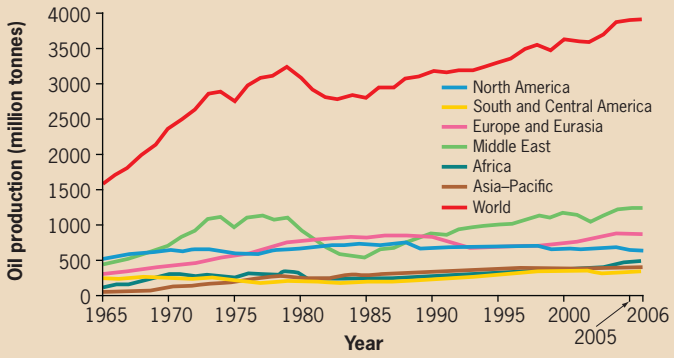


FIGURE 2.2.44

Trends in the global production and consumption of oil, 1965–2006.

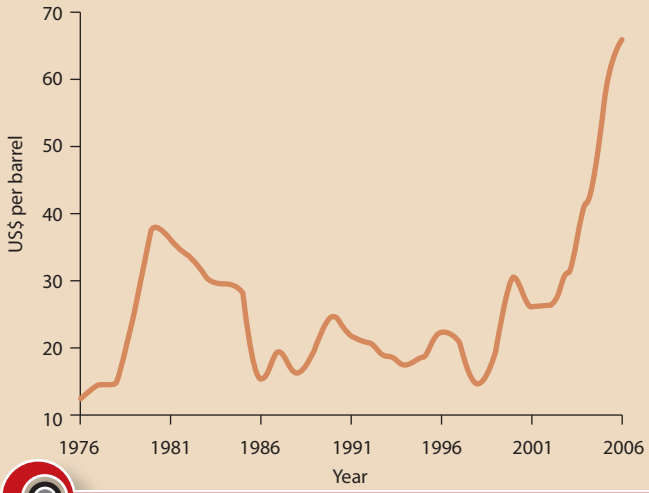


FIGURE 2.2.45

Crude oil prices, 1976–2006.

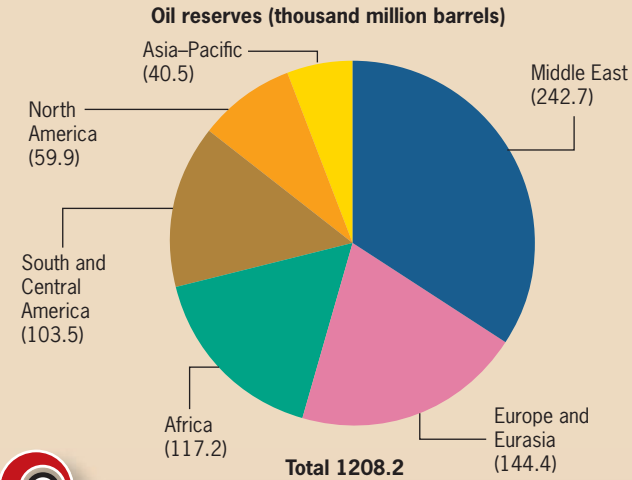


FIGURE 2.2.46

Distribution of global oil reserves, 2006.

1 **Class discussion** The division between the well-endowed and the less fortunate countries of the world is sometimes described as 'developed' versus 'developing'. As a class, discuss the appropriateness of such a division.

2 **Internet research** Using data from the World Bank website, select a very poor country, a developing country and a developed country. For each of these, identify the income levels, GNP, levels of education, and energy consumption. List the resource-related indicators you can identify.

3 **Writing task** Write an explanation outlining the reasons why a country's land area, on its own, is not a good indicator of that country's ability to feed its people.

4 **Research task** Identify an indigenous group, other than the Yanomami, that has been displaced by the destruction of their livelihood in the name of 'development'. Write an extended response on these people, the resources they used and how these have been lost, and what, if anything, can be done to address the problem.

5 **Interpreting statistics** Study table 2.2.1 (p. 274).
   - a Which group of countries has the highest proportion of arable land?
   - b Calculate the population per square kilometre for each category listed in table 2.2.1.

6 **Writing task** The least developed countries have more land per person than the average of all developing countries. Write a paragraph outlining what the other indicators in table 2.2.1 (p. 274) suggest in relation to the agricultural production of the least developed countries.

7 **Interpreting diagrams** Study figure 2.2.27 (p. 276). State the total tropical deforestation rate for Brazil and Indonesia during 2000–05.

8 **Interpreting diagrams** Study figure 2.2.26 (p. 276).
   - a Approximately what proportion of the world's forest cover is in Canada?
   - b How much of the world's forest cover is found in North America?

9 **Interpreting diagrams** Study figure 2.2.28 (p. 276). With the aid of an atlas, identify the countries with the greatest change in total forest cover in the period 1990–2005.

10 **Interpreting diagrams** Study figure 2.2.30 (p. 277). Write a paragraph describing the trend in deforestation in the Brazilian Amazon since 2000.

11 **Interpreting statistics** Study table 2.2.2 (p. 278). Determine which continent has the highest aridity index (effective radiation divided by precipitation).

12 **Interpreting diagrams** Study figure 2.2.33 (p. 279). Outline what the graphs tell us about the global distribution of these mineral ores.

13 **Writing task** Study figures 2.2.34, 2.2.35, 2.2.37 (p. 280) and 2.2.38 (p. 281). Write a report outlining the global pattern of, and trends in, coal production and consumption.

14 **Interpreting diagrams** Study figure 2.2.39 (p. 281). Write a stimulus-based response outlining the impact of China's economic growth on the trends in the world demand for mineral ores.

15 **Interpreting diagrams** Study figure 2.2.40 (p. 281). Calculate the average growth of the Chinese economy in the period 2001–05. Speculate on the consequences of this growth for the demand of mineral ores.

16 **Interpreting diagrams** Study figures 2.2.41 to 2.2.43 (p. 282).
   - a From what is most of the world's electrical energy produced?
   - b By how much is coal-based electricity generation expected to increase between 2005 and 2030?
   - c What is the projected trend in the production of electricity using oil and nuclear energy between 2005 and 2030?
   - d How much electricity will be generated by renewable sources in 2030?
   - e By how much are CO_2 emissions from electricity production expected to grow between 2004 and 2030?
   - f Which fuel type produces the greatest amount of greenhouse gas emissions?
   - g What is the range of greenhouse gas emissions generated by natural gas?
   - h What fuel types generate less than 75 grams of carbon equivalent per kilowatt-hour?

Lack of coincidence between areas of production and consumption of natural resources

Truly subsistence agriculture probably represents the only authentic example of 'coincidence' between place of production and consumption. As soon as a subsistence unit begins to engage in exchange (for example, exchanging decorative feathers with a neighbouring group) the resulting trade breaks the closed loop between the point of origin and the point of use of the goods.

Global trade has grown due to improvements in transport, some dismantling of trade barriers and greater competition for resources. Growth in global trade has led to fewer matches between areas of production and areas of consumption. Thus, although Australia produces vast quantities of different foods, many imported food items are available in our supermarkets, including hams from Canada and fruit juices from South

America. Imports meet shortages of locally available natural resources. The cost of imports is often offset by trade in other raw materials, other products or services (such as finance, expertise and tourism).

Dependence on resource extraction

Countries that are well endowed with natural resources should have a trading advantage over many other countries. This is provided the returns to the country are significant and are invested in other enterprises with long-term benefits for the community.

Historically, Australia has suffered in this respect. In the colonial days it was in Britain's interests to receive the raw materials for its own manufacturing enterprises from Australia. The colony also became, until the 1950s, a major export market for Britain. Due partly to this influence, and the success of its resource-based industries (such as gold, coal and wool), until the 1980s Australia had little encouragement to develop other competitive secondary (manufacturing) industries.

Australia still depends heavily on providing raw materials for the global industrial machine. So, to a large extent, it is highly vulnerable to international economic fluctuations in the value of minerals. Figure 2.2.48 illustrates Australia's dependence on its rural and resource exports (still 52%). Importantly, however, over the past decade there has been a growth in the contribution of manufacturing and services, including tourism.

This issue is not restricted to Australia. For example, countries that have valuable forest resources and offer **timber concessions** to overseas companies find that they become increasingly dependent on the logging activities. Not only do timber companies employ local people, but the government may become reliant on the royalties and taxes generated by the forestry industry. This situation is made worse if the government embarks on major construction developments, such as grandiose government buildings, that are not generating income to meet the debts incurred. Thus, developing countries have expanding forestry industries, which will probably not cease operations until there is little of commercial value remaining. Conservationists around the world are alarmed at the loss of ecologically important forests. However, there is little that can be done about this unless the debts of developing countries are removed through international intervention and other, sustainable, industries are developed to replace the exploitation of forest resources.

Economic and political issues concerning natural resources

Rates of use

Despite the concerns of conservationists, there is some economic rationale for increased rates of resource extraction while an item is in demand, provided environmental standards are not threatened as a consequence. It is possible that demand for that item may diminish over time. As a result, a country, especially a developing country, may be left with little more than unused stocks. The country would have missed an opportunity to benefit from the exploitation of the resource. However, with renewable resources in particular, uncontrolled exploitation may threaten long-term production levels. In addition, it could destroy an ecological balance and threaten other resources.

A good example of this is fishing. Overfishing may cause stocks to be reduced to such a level that, in addition to the threat to the preservation of the fish species, industry jobs would be lost. In addition, boat owners

FIGURE 2.2.47

World trade is the result of the lack of coincidence between areas of production and areas of consumption of natural resources.

timber concession the authority to log a specific area of forest.

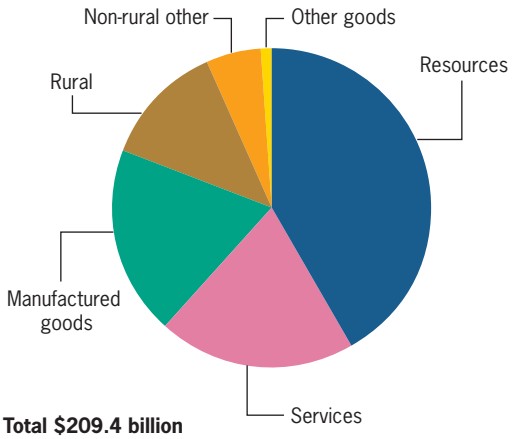


FIGURE 2.2.48

Australia's exports, 2006: share of exports by sector.

FIGURE 2.2.49

Overfishing can undermine the future viability of the resource-dependent fishing industry. **A** Traditional fishing techniques, such as these at Kompong Cham in Cambodia, are more likely to be sustainable than modern techniques. **B** Modern commercial fishing practices can result in the overexploitation of fish stocks.

would incur increasing debts, and food supplies would be threatened by high prices and limited availability. Thus, strategies are required to control fishing. These include imposing taxes or fees, controlling the number of boats and/or people per boat or allocating a quota of fish per individual or boat. A combination of strategies that involves the payment of a tax or fee to the controlling government is ideal, as it allows some wealth accruing from resource utilisation to be distributed to those not involved in the fishing industry. (See figure 2.2.49.)

The dilemma faced by developing countries

Due to the economic circumstances faced by many developing countries, maximising the long-term value of resources presents a considerable challenge. Often valuable assets, such as timber, represent only short-term opportunities. This provides limited benefit to the countries concerned, particularly when they are competing on unregulated markets. The following points demonstrate this:

- Due to low profit margins, emphasis is often placed on the volume of production. In the case of forests, this provides little prospect for planned reafforestation.
- Because returns are depressed, there is the tendency for a high degree of mechanisation, with limited chances of local employment.
- High levels of mechanisation result in the need for more specialised, qualified staff, further restricting the opportunities for unskilled local people.
- Limited funding is available for erosion control and the monitoring of degradation.
- If a transnational corporation (TNC) is involved, further concessions on royalties and environmental controls may be demanded. These demands are often accompanied by a threat to close down operations completely, thereby upsetting the local economy.

International trade barriers

Countries that have a heavy reliance on natural resource extraction often find it difficult to develop manufacturing industries. Australia is one such country. In the colonial era, which did not end until the 1950s, there was little encouragement for the development of manufacturing and the export of finished products. Industrialising countries, such as Japan, relied on imports of resources. Over time, they built up industries and developed markets for their products.

When the original commodity producers, such as Australia, attempted to develop a manufacturing capacity using their natural resources, they encountered two problems. First, because of a limited scale of production (a result of small domestic markets), they were unable to compete with cheaper imported goods. Second, when they sought to improve the size of their markets and develop economies of scale, their exports had heavy **tariffs** imposed on them by countries wishing to protect their own manufacturing industries. This led to numerous international trade barriers.

Developing countries with limited natural resources face a slightly different set of problems. While they may also be obliged to impose tariffs on competing imports, developing countries suffer more through the imposition of tariffs on their exports; their exports are often dependent on a high labour component. They have an abundance of cheap labour and need free market access if their exports are to stimulate employment and improve their standard of living. Thus, export-oriented, value-adding industries are disadvantaged. Unless the domestic (local) market is large, **diseconomies** of small-scale production may mean the natural resource provider is still dependent on imports.

diseconomies forces or factors that cause larger firms to produce goods and services at increased per-unit costs.

Sovereignty

The issue of **sovereignty** over natural resources has long been a cause of confrontation and aggression. Sometimes claims of sovereignty on the basis of historical ownership are created to substantiate a political agenda. Two outcomes of such claims were Iraq's justification for invading Kuwait in 1990 and Argentina's attempted capture of the British-controlled Falkland Islands in the South Atlantic in 1982. Some claim that the US invasion of Iraq in 2003 was just as much about securing access to Middle East oil supplies as toppling Saddam Hussein or eliminating the threat of weapons of mass destruction. Water resources represent a potential source of conflict. (See the Geofocus box 'Africa's potential water wars', p. 289.)

Contests about claims for sovereignty over natural resources range from the peaceful to the militant. Possibly the most subtle form of control is achieved through the financial strategies of TNCs. For peasant farmers tempted to move from subsistence agriculture to **cash cropping**, the opportunities offered may appear attractive. A well-developed TNC operating an **agribusiness** can provide:

- specialised advice and training
- tractors and other machinery
- seeds, fertilisers, fuels and pesticides
- contracts for produce
- financial loans to make it all possible.

In return, the TNC gains access to a reliable supply of agricultural products at a cost well below that available in developed countries.

Quite apart from the problems of social dislocation and food shortages that result from such a transformation, the TNC is in a position to manage the cost of inputs and the price of outputs. Whether the peasant farmers continue to maintain tenure of their land or forfeit it to the TNC through indebtedness, effective sovereignty over agricultural land is virtually surrendered.

Sovereignty over offshore fishing grounds has consistently proved to be a contentious issue worldwide. In recent times, Australian authorities have endeavoured to manage their commercial fisheries in a manner that promotes sustainability but have often been thwarted by illegal operations by overseas fishing fleets.

FIGURE 2.2.50

sovereignty the principle that the state exercises absolute power over its territory, system of government, and population.

cash crop a crop grown for cash.

agribusiness large-scale, organised production of food, farm machinery and supplies as well as the storage, sale and distribution of farm commodities, for profit.

did you know?

Non-tariff barriers

Non-tariff barriers are barriers to trade other than tariffs. These include:

- import and export quotas
- various customs regulations that may target specific goods or countries of origin
- anti-dumping regulations, which prohibit the export of goods at a lower price than they are sold in the country of origin
- subsidies to domestic industries
- technical standards, such as motor vehicle safety requirements
- health standards, such as those relating to chemical residue levels.

All these barriers may be just as effective as, if not more effective than, the imposition of tariffs on imports.

geofocus

Blood diamonds

In recent years, there has been a growing awareness of the issue of 'conflict' or 'blood' diamonds. Diamonds mined in countries such as Sierra Leone, Angola, Liberia and Democratic Republic of Congo have been used to fund both rebel and government combatants, whose main targets are often civilians. The civil wars during the 1990s in Sierra Leone left 50 000 dead, and 500 000 died in Angola. In Sierra Leone and Angola, both government and rebel soldiers committed atrocities and used amputations as a way to coerce and terrorise the population. Diamonds played a key role in funding the food, clothing, transport and, most significantly, weapons needed by combatants.

The reasons why diamonds became such an important issue include the limited supply of the resource and the wealth generated by diamond production (US$13.5 billion globally in 2005). The diamonds found in Sierra Leone are also of very high quality (as opposed to industrial diamonds, which cannot be used for jewellery) and they are readily mined. They are alluvial (that is, they are found on the earth's surface, usually in riverbeds), making them accessible to anyone with a few basic hand tools and skills. With governments essentially acting as organised crime syndicates, these resources quickly became the property of whoever was able to exercise power in an area.

The issue of conflict diamonds first came to the public's attention in 1998 when a small, London-based non-governmental organisation (NGO) named Global Witness issued a report entitled *A Rough Trade*. This report detailed the way in which Angolan rebels were smuggling diamonds into the international markets. The revenues generated during this wartime economy were in excess of US$250 million per year. Implicated in the report was the South African diamond **cartel** De Beers, which at that point marketed approximately 80% of the world's rough diamonds.

The publication of the Global Witness report placed significant pressure on the diamond industry, which feared that their product would attract the sort of negative publicity associated with another luxury item, fur coats. The UN Security Council responded to the report by placing sanctions on the export of diamonds from Angola. These sanctions, however, did little to stop the flow of diamonds. 'Sanction busting' was widespread. The sanctions were finally lifted after the death of rebel leader Jonas Savimbi in 2002. His passing led to a lasting peace agreement between government forces and the rebel forces.

In 2000, another NGO, Partnership Africa Canada, issued a report titled *Heart of the Matter*, which exposed the corrupt diamond economy of Sierra Leone. The United Nations banned the import of diamonds from Sierra Leone. Again, the sanctions proved largely ineffective but fighting in Sierra Leone ceased in 2001.

Governments, industry bodies and NGOs worked together to devise a system for excluding conflict diamonds from the international trade in gems. This system, known as the Kimberley process, was developed in response to the international outcry over the role of diamonds in sustaining armed conflict. Under the agreement, 70 countries agreed on a certification scheme that tracks diamonds from the mine to the retail counter by using a certificate system.

FIGURE 2.2.51

Diamond production was used to finance conflict in Africa.

speculation trading with the purpose of making profits.

Trade agreements

There are many developing countries whose economies are highly dependent on the export of one or more raw materials, often with little further processing or manufacturing undertaken to add value to the raw materials. This makes their economies highly vulnerable to currency exchange rate changes, market trends and **speculation**. During the 1990s the price of most commodities fell as production increased. During the early 2000s, however, commodity prices grew strongly as producers struggled to meet the demand created by the growth of China and India.

Regional trade agreements provide some protection from these fluctuations and, if they foster internal trade, should be mutually beneficial. Another approach to the problem is the Common Fund for Raw Materials, established in 1989 under the umbrella of the UN Conference on Trade and Development (UNCTAD). UNCTAD is the permanent intergovernmental

body and principal organ of the United Nations General Assembly that deals with trade, investment and development issues. This fund attempts to create a buffer in the global stocks of raw materials on the one hand, and to develop new methods of production and marketing on the other. However, there is yet to be established a global agreement on raw materials that effectively provides a reasonable return for mineral production and guarantees developing countries access to supplies.

International treaties

Attempts to liberalise world trade have met with some success but progress has been relatively slow. Factors affecting the rate of progress include the diverse range of objectives and cultures of the many countries, their varied **natural resource bases**, and their differing stages of economic and educational development. These difficulties are sometimes made more complex by occasional armed conflicts.

The General Agreement on Tariffs and Trade (GATT) represented a significant step in the direction of reducing, if not totally eliminating, trade barriers, including non-tariff barriers. It was more broadly based than UNCTAD. In 1947, GATT was agreed upon. It provided a generally acceptable approach for the reduction of tariffs and other trade barriers. In 1995, the World Trade Organisation (WTO) was established to carry out GATT's objectives, which also includes a consideration of environmental issues in relation to trade. However, with many countries facing strong internal political pressure for maintaining industry protection, it is yet to be determined just how effective the agreement will be when it is fully implemented.

Union action

There have been occasions where unions have acted on matters concerning resources, especially if exploiting the resource has health-related implications. In Australia there have been instances, for example, when unionists have refused to handle yellowcake, which is unprocessed uranium ore. In addition, unionists have been involved in attempts to halt the shipping of nuclear fuel for reprocessing in either France or Japan.

Green politics

Worldwide, Green groups have reacted vigorously against a wide range of resource-based activities, particularly when these have had an impact on environmental quality. While protesting has achieved results, it has become increasingly apparent that a direct contribution to political decision-making can achieve sound resource and environmental management. In Germany, concern about the deterioration of forests due to acid rain was so great that several Green politicians campaigning on this issue were elected to parliament in the early 1980s. They are still making a significant impact and until 2008 formed part of the governing coalition government.

did you know?

Not all electoral systems provide for representation of minority groups, particularly in the lower houses of parliament. The Tasmanian system allows for five members (previously seven) to be elected from each of five large electorates. Despite receiving only a relatively small proportion of the total vote, this enables the Greens to have one member elected in each electorate. Other voting systems, particularly those for the upper houses of parliament, provide opportunities for minority groups to be elected and, on occasions when their support is critical, they have the opportunity to influence public policy.

geofocus

Africa's potential water wars

The principal conflicts in Africa during the next 25–30 years could be over the most precious of all resources—water—as countries fight for access to scarce supplies. Potential 'water wars' are likely in areas where rivers and lakes are shared by more than one country. Possible flashpoints are the Nile, Niger, Volta and Zambezi basins.

Within 25 years, nearly one in two people in Africa will live in countries facing water scarcity or what is known as 'water stress'. Water scarcity means that less than 1000 m^3 of water is available per person per year, while water stress means less than 1500 m^3 of water is available per person per year. By 2025, 12 more African countries will join the 13 that already suffer from water stress or water scarcity.

The Nile runs through three countries: Ethiopia, Sudan and Egypt. If the combined population of these three countries rises as predicted, from 150 million today to 340 million in 2050, then there could be intense competition for increasingly limited water resources. Already there is little water left when the Nile reaches the sea. Egypt is unlikely to take kindly to losing out to Ethiopia: a country with one-tenth of the income of Egypt.

Water is already a cause of regional conflict. In the late 1990s, tensions between the Ethiopian and Egyptian governments increased rapidly when the rulers in the Ethiopian capital of Addis Ababa considered a plan to construct dams on the Nile.

There is also another potential water war in Southern Africa involving Botswana, Namibia and Angola. The River Cuito begins in Angola before heading through the Caprivi strip in Namibia (see the Did you know? box on p. 290) and ending in the marshlands of the Okavango Delta in Botswana. This river runs through an area that is no stranger to tensions and conflict between neighbours.

Fresh water is also becoming increasingly unusable because of pollution. This, in turn, impacts on the health of people (and other life forms) who rely on the water of the delta for their wellbeing.

African agriculture is by far the biggest user of water in Africa, accounting for 88% of water use. It takes about 1000 tonnes of water to produce every tonne of grain. One way of reducing the demand on water resources is by importing grain, but for poorer countries in Africa this may not be an option.

did you know?

The Caprivi strip is a narrow protrusion of land in Namibia that extends eastwards about 450 km. It is located between Botswana on the south, Angola and Zambia to the north.

understanding the text

1 **Explain** why is it difficult to establish the optimal rate of resource use.
2 Cite examples of non-tariff trade barriers.
3 **Explain** what is meant by sovereignty.
4 **Explain** how TNCs can gain actual or virtual sovereignty in a developing country.
5 **Explain** why barriers to trade are established.
6 **Outline** why developing countries experience difficulty in establishing their own resource-processing industries.
7 **Outline** how minority politicians, such as the Greens, can achieve representation and control in government.

geofocus

Green politics in Tasmania

Tasmania has a long history of environmental activism dating back to the flooding of Lake Pedder in the early 1970s. (See figure 2.2.52.) This led to the formation of the world's first 'green' political party, the United Tasmania Group, in 1972.

In 1989, concern about the environment and the major resource-based Wesley Vale pulp mill was so great that five Green politicians, led by Dr Bob Brown, were elected to state parliament. Because they held the balance of power, they were able to exert considerable influence over the development of public policy.

The Tasmanian Greens have since broadened their policy agenda to include many other social and economic reforms. A number of Greens have been elected to the Australian Senate and their preferences often play an important role in determining the outcome of elections in Australia.

FIGURE 2.2.52

Lake Pedder prior to flooding.

working geographically

1 **Interpreting diagrams** Study figure 2.2.48 (p. 285). Calculate the proportion of value of Australia's exports derived from the export of resources in 2006.
2 **Interpreting cartoons** Study figure 2.2.50 (p. 287). Using figure 2.2.62 (p. 307), analyse the Nicholson cartoon. As a class discuss the implications of protectionism on Australia's ability to export commodities.
3 **Interpreting text** Study the Geofocus box 'Blood diamonds' (p. 288).
   a Explain what is mean by the term 'blood diamonds'.
   b Outline the reasons why blood diamonds became central to conflicts affecting parts of Central Africa.
   c Outline the actions that have been taken to address the issue.
4 **Research task** Additional information about the trade in conflict diamonds and the campaign against them can be found at the Global Witness website. Using this site, write a report outlining the nature of the organisation's natural resource related campaigns.
5 **Interpreting text** Study the Geofocus box 'Africa's potential water wars' (p. 289).
   a Explain why conflicts over access to water are likely to increase in the next 25–30 years.
   b Give examples of geographical contexts where water is already a source of political conflict.

Natural resource ownership

The four main categories of ownership associated with natural resources are public, private, cooperative and TNC.

Within the public arena, scales of ownership vary considerably, ranging from local community to a global level. Resources that have the potential to be owned and managed at a global scale include the global commons: the atmosphere, the open oceans and the polar lands. The managing of such resources is:

- intentionally long term in its thinking and cautious in its approach
- concerned about **equity** for all countries/people
- not interested in short-term profits
- likely to take some time to reach a consensus
- probably less responsive to change than the private sector.

Many of these characteristics will also apply to the actions of government in an individual country. However, one difference is that governments will tend to develop biases. Also, in democracies facing frequent elections, governments will respond to public opinion or the lobbying of interest groups rather than apply sound long-term planning principles.

Cooperatives involve decision-making by grassroots members who are effectively part owners. They provide some balance between the advantages of the private and public sectors.

TNCs (normally a form of private ownership) have the pursuit of profits as their sole justification for existence.

Table 2.2.3 provides a simple matrix of the attributes of various ownership types. Care must be taken when using this information because many variables will influence individual situations. Also, this table does not provide an exhaustive list of the types of ownership. For example, another type is a joint venture between a government and a TNC. The degree of economic control in such cases can vary considerably. It will depend on the effectiveness of the government and its determination to follow its own agenda. Elected governments need to respond to changing priorities of the voting public and so there is still no guarantee of a long-term benefit for the country.

As information and business expertise flow around the globe, many developing countries are becoming stronger negotiators. There is a wider realisation of the importance and value of resources. Also, many developing countries, particularly those that have witnessed the failings of previous agreements, are not prepared to sacrifice their assets. Regional groupings of countries have more bargaining power than individual countries, and receive more favourable treatment.

geofocus

The Law of the Sea

The 1982 UN Convention on the Law of the Sea established a set of rules for the use of the world's oceans, which cover 70% of the earth's surface. In the decade following its adoption, fishing on the high seas became a source of international conflict. The convention gave all countries the freedom to fish without regulation on the high seas. It also gave all countries exclusive economic rights, including the right to fish within 320 km of their shoreline. Local operators began to complain that the large fishing fleets operating on the high seas were reducing catches in their domestic waters. Violent clashes between the operators of coastal fleets and those from more distant places became increasingly frequent.

In December 1995 a further agreement was drafted. To manage fish stocks sustainably and settle disputes peacefully, the agreement established the basis for the sustainable management and conservation of the world's fisheries. It also:

- addressed the problem of inadequate data on fish stocks
- provided for the establishment of quotas
- called for the setting up of further regional fishing organisations
- tackled the problem of unauthorised fishing
- outlined options for peaceful settlement of disputes.

TABLE 2.2.3

Attributes of resource projects by category of ownership

Attribute	Public	Cooperative	Private	TNC
Long-term planning	High	Medium	Low/medium	Low/medium
Efficiency	Low	Medium	Medium/high	Medium/high
Profit	Low	High	High	High
Equity concern	High	High	Low/medium	Negligible
Income distribution	Medium	High	Low/medium	Negligible
Skills training	Long term	Short/medium term	Short/medium term	Immediate needs only
Environmental concern	High	Medium	Low/medium	Negligible

geofocus

High-seas fishing

Commercial fishing operations are exceeding the ocean's ecological limits, with serious impacts on the intricate web of marine life that makes the sea a vital part of the earth's support system. Almost 70% of all fish stocks have been heavily exploited or brought close to extinction. In one-third of the earth's major fishing regions, the annual catch is down 20% or more from peak years. Without sweeping changes in current fishing practices and remedial action to allow endangered fish stocks to regenerate, the world's fisheries face possible collapse.

FIGURE 2.2.54

The bluefin tuna is an endangered species. These Greenpeace activists are highlighting the unsustainable nature of current commercial fishing practices.

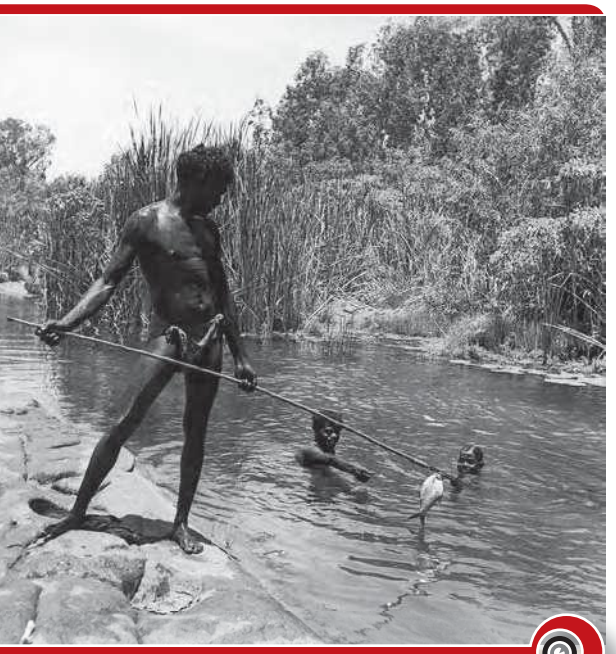


FIGURE 2.2.53

Traditional fishing technique. Aboriginal people were skilled resource managers.

Resource management by indigenous people

Indigenous people living in hunter-gatherer societies must rank among the most skilful of resource managers. This is proven by the fact that so many of these peoples have existed, apparently in balance with their environment, for thousands of years. Some of these groups, including Australia's Aboriginal people, worked actively to develop specific resources. However, most indigenous hunter-gatherer management policies have been directed at ensuring the conservation of species.

Many forms of resource conservation have been adopted and the following list represents, as an example, just some of the techniques used to preserve fish stocks:

- direction by wise people (those knowledgeable about the local ecology)
- designated fishing areas for individuals and/or groups
- restrictions on species caught
- closed seasons
- specified methods of fishing
- various taboos concerning fishing
- total avoidance of fishing
- sacred pools.

The last approach was adopted by Aboriginal people in parts of inland Australia. The sacred pools, where fishing was prohibited, ensured that stocks would remain to build up supplies in a river system once droughts had ended.

Resource management in developing countries

The scale and complexity of some projects is often too vast for the expertise of a developing country. In a mineral development project, for example, exploration using remote sensing, drilling, assaying (assessing) the mineral and costing the project for feasibility are all sophisticated, but essential, preliminary activities. Often, developing countries lack the necessary expertise, equipment and finance to undertake these tasks.

Thus, an alliance with a TNC or even a consortium (group) of TNCs may be necessary in order to undertake a large and/or complex resource development. There is little guarantee that such alliances will proceed smoothly and this may be the fault of either party. Sometimes the most appropriate strategy is for a government to contract a TNC to take advantage of its technical know-how and business expertise. The TNC would be contracted to initiate the project and train local people to assume key operational and management positions. This can ensure that the **host country** receives an equitable (fair) share of profits from the exploitation of its own resources.

Another option is the establishment of an alliance with an industrial country that is in need of an assured supply of raw materials. The industrial country will provide expertise and finance in return for access to resources. It may also restrict the expansion of some of its own manufacturing industries to enable the developing countries to diversify their economic base in those areas.

The remaining alternative for developing countries is to join either a resource production group or a regional trading bloc. While these have their shortcomings, as discussed elsewhere, they still offer some prospect of success if properly organised.

The water is not good in this pond. We collect it because we have no alternative. All the animals drink from the pond, and so does the community. Because of the water we are also getting different diseases.

Ethopian village dweller

The conditions here are terrible. There is sewage everywhere. It pollutes our water. Most people use buckets and plastic bags for toilets. Our children suffer all the time from diarrhoea and other diseases because it is so filthy.

Nairobi squatter settlement dweller

The factories use so much water while we barely have enough for the basic needs, let alone to water our crops.

Indian farmer

Resource management in developed countries

Effective resource management by governments in developed countries has evolved, although erratically, with their industrial growth. In colonial Australia, for example, environmental controls were placed on landuse in the areas adjacent to Sydney's Tank Stream when it was threatened by pollution. The last few decades have focused even greater attention on resource management. This was due to several major factors, including the oil crisis of the 1970s, the impact of acid rain on the forests and ecosystems of Europe and North America, and a growing appreciation that misuse of resources was increasingly placing the whole biosphere at risk.

A country may wish to develop a natural resource base for a variety of reasons: to reduce dependence on imports, meet strategic goals or foster

geofocus

Integrated resource management

Resource management in many developing countries depends on a high degree of integration with, and mutual benefits from, related activities. This is particularly true of traditional Chinese agriculture. Where such integration occurs it is referred to as **integrated resource management**. For example, Chinese villagers spread human and animal effluent on their fields instead of having to depend on costly commercial fertilisers. However, the drive for economic development in many developed countries tends to ignore the importance of an integrated planning approach. To ensure economic viability and to maximise the benefit achieved from available resources, advantages to related industries need to be realised. Thus, the broad integrated approach evident in planning and **total catchment management (TCM)** is increasingly being considered when resource-based projects are being planned.

FIGURE 2.2.55

The surge in world oil prices in the late 2000s resulted from a growth in global demand (especially from China and India) and a decline in the number of new oilfield discoveries.

local economic development. When establishing a natural resource base, various options are available. The following policies, although more applicable to developed countries, also have some relevance to the developing world:

- provision of a bounty (payment of reward) on new discoveries of minerals
- granting of a 'tax holiday' (temporary reduction or elimination of a tax) on new resource-based commercial undertakings
- stimulus of resource-related developments/technologies through support of research conducted and/or funded by the government
- provision of **infrastructure**; for example, railways and port facilities
- supply of cheap power
- training of staff.

Developed countries have several options to control resource use. The option chosen will depend, in part, on the country's objective. If the aim is to increase efficiency of use, then a project to provide, for example, a national power grid to distribute electricity from low-cost energy sources will be attractive economically and optimise resource use.

Another approach is the **'user pays' principle**. This economic rationalist approach, if implemented rigorously, will ensure that all costs are passed on to the consumer. The costs include pollution as well as provision for infrastructure. In the case of irrigation, for example, the cost of dams, the value of submerged land and the environmental costs of river degradation would be factored into the actual fee charged for the water used.

Governments also have the option to tax resources to restrict their consumption. As Australia's oil reserves dwindle, we will need to import more petroleum products. A further increase in fuel taxes may be inflationary, but it can meet several worthwhile objectives. Both the amount of fuel consumed and the resulting pollution will be reduced. It will also reduce the number of vehicles using roads in the cities, especially if a parallel policy of improving public transport is introduced. This could then reduce the resources directed towards freeway construction.

At a national level, recycling has been increasing steadily. A central, related issue is finding space for waste and garbage disposal. This is especially true of solid waste disposal. Recycling is a positive way to foster appreciation of the environment. Unfortunately, however, often the economics of collecting and reprocessing recyclable waste does not make it commercially attractive. Through subsidies, tax concessions or other forms of assistance, governments can stimulate recycling industries, provided society sees merit in the idea. However, in Australia, for example, the producers of non-recycled goods often claim that unfair competition results from such government assistance.

Resource concerns and Australia

Australia has at times played a leading role in focusing international attention on global resource issues, including whaling and resource management in the Antarctic. It has also enacted legislation enabling it to bring about the implementation of international treaties or to address global concerns.

The Federal Government passed the *Great Barrier Reef Marine Park Act* in 1975 to safeguard the reef from oil drilling. The act was passed in response to the reef's growing national and international significance and the importance of the related tourism and fishing industries. Careful management codes have been developed to ensure the protection of this unique natural wonder. The reef was inscribed on the World Heritage list within the decade in which the act was passed.

In 1983 the Federal Government passed the *World Heritage Properties Conservation Act*. In some instances, the act may place restrictions on resource use, particularly where a World Heritage area's natural attributes are endangered by human activity. For example, the proposed Gordon-below-Franklin power scheme in Tasmania was rejected because it threatened Aboriginal sites, relics and artefacts. The area has since been granted World Heritage status. Several other natural sites, including much of the south-west of Tasmania, have also been included on the World Heritage listing.

Global resource management

With improvements in transport and communication, it is becoming increasingly possible to develop a global resource-management structure. In an ideal world, it could lead to efficient resource use and equitable distribution. It would also allow environmental safeguards to be put in place.

While we don't live in an ideal world, it is important to acknowledge what has been achieved globally in terms of resource-management strategies. Several global treaties on aspects of the biosphere have been negotiated; in terms of effectiveness, some have been more successful than others. Recent agreements include initiatives on:

- chlorofluorocarbons (CFCs)—Montreal Protocol, 1987
- biodiversity—International Environmental Summit, Rio de Janeiro, 1992
- CO_2 emissions—Kyoto Protocol, 1997.

To improve and maintain access to essential natural resources for all people and preserve the global environment, a range of strategies must collectively be advocated. There is a need to:

- continue to develop dialogue between and within countries—in particular the potential for hostilities needs to be reduced
- ensure adequate access to food and water, shelter, fuel and health care for all people—unless basic needs are met, there is little chance to focus on further achievements
- provide widespread education and training to enable people to accept responsibility for their actions and to embrace opportunities
- curb population growth
- accept that life forms that have no significance to humans have the right to exist on the planet
- curb reliance on non-renewable resources and research and use more environmentally sustainable technologies
- ensure that renewable resources remain so—forests, for example, are only renewable if managed carefully
- facilitate fair trading—particularly providing developing countries with access to markets in developed countries
- develop a mechanism to reduce debt among developing countries
- assist governments in developing countries—enabling them, for example, to negotiate equitable arrangements with TNCs
- accept the right of individuals, communities or countries that may not wish to depart from their traditional lives to remain as they are—while development may mean more material wealth, it may also mean a surrendering of culture and social networks.

While there is progress towards many of these objectives, there is little room for encouragement in many areas. In the context of renewable resources, for example, there are at least a dozen major international fisheries commissions. Despite the existence of these commissions, fish stocks continue to decline.

> *To waste, to destroy, our natural resources, to skin and exhaust the land instead of using it so as to increase its usefulness, will result in undermining in the days of our children the very prosperity which we ought by right to hand down to them amplified…*
>
> Theodore Roosevelt, former US president (1901–09)

understanding the text

1. **List** the four main categories of ownership associated with natural resources.
2. **Outline** the proof that shows that most indigenous peoples have been effective resource managers.
3. **Outline** the strategies used by indigenous peoples to conserve food sources.
4. **Outline** the nature of resource management in developing countries.
5. **Outline** the ways in which resource management is conducted in developed countries, such as Australia.
6. **Explain** how Australia has responded to specific global resource management issues.

1 **Writing task** Study table 2.2.3 (p. 291). Write a series of paragraphs outlining the nature of the resource projects based on the type of ownership.

2 **Interpreting text** Study the Geofocus boxes 'The Law of the Sea' (p. 291) and 'High-seas fishing' (p. 292).
   - **a** State why better management of the earth's fish resources is considered essential.
   - **b** Outline the extent to which the Law of the Sea has addressed these concerns.

3 **Writing task** Study the Geofocus box 'Integrated resource management' (p. 293). Write a paragraph explaining, in your own words, the concept of integrated resource management.

4 **Class discussion** Australia must be one of the better-resourced countries on earth, yet we sometimes import more food (by value) than we export. As a class, discuss why this is so, whether it really matters and what, if anything, can be done about it.

5 **Class debate** Debate which categories of resources are probably more in need of controls over utilisation rates. Compile your own inventory and rank them in order of priority. Are your decisions based on the issue of limited stocks, possible alternatives, long-term sustainability or environmental criteria?

6 **Class-based activity** Identify the resources that are globally owned. Compile an inventory and indicate who, if anybody, is responsible for looking after them.

7 **Class discussion and debate** Discuss how realistic the concept of global ownership is. If its characteristics are considered too idealistic, does the concept still have value? Debate how the ownership should be managed and just how realistic the expectation is that it might work.

8 **Group work** Why can't democratically elected governments always act as responsible resource managers? Working in groups, devise a list of reasons. Share your group's list with the rest of the class. Discuss possible ways to promote responsible resource management.

9 **Class discussion** From alternative sources, identify some foreign-owned resource companies that are operating in Australia. Discuss what you consider to be equitable operating conditions in relation to how Australia is and/or should be benefiting.

10 **Group work** Do Australian companies operate in resource-based activities in other countries? Devise a 'code of conduct' that lists the principles they should adopt in these circumstances. Do you feel that their approach if operating in developing countries should differ from their approach in developed countries?

11 **Thinking critically** Australia provides millions of dollars of aid each year to support economic development in developing countries. Would it be better to give preferential treatment to imports from those countries? Write down the reasons for your answers and then share your thoughts with the rest of the class.

12 **Class-based activity**
   - **a** In a global context, what concerns result from resource-exporting countries being forced to accept lower commodity prices? As a class, make a list of the consequences.
   - **b** Do you have any suggestions as to what arrangements could minimise this chain reaction?

13 **Research task** Carry out a short research project into a resource-management technique as practised by an indigenous population. Present your findings as an oral report.

14 **Research task** Undertake a short library or Internet-based study of a transnational resource-based project in either a developing country or in Australia.
   - **a** Identify the objectives of the TNC and why it appeared that the host country was keen to permit its operations.
   - **b** As far as available material permits, document the progress of the activity, identifying any major problems encountered by the environment or community. Write a report outlining the findings of your research.

Environmental and social issues concerning natural resources

Environmental issues

Growth has enormously increased man's capacity to do irreparable harm to the environment. Such harm, the unintentional by-product of modern technology, is increasingly international or global in impact, thus contrasting sharply with the much more local pollution problems of the Middle Ages.

R. Lecomber, *The Economics of Natural Resources*, Macmillan, London, 1979

World War II was a period when technology became increasingly more sophisticated, in fields ranging from communications to nuclear physics. The economic development that followed was matched by the increasing conviction that this technology could solve all global problems, from diseases to world food shortages. In Australia, as in other countries, schemes such as the Snowy Mountains Hydro-electric Scheme were considered proof of people's ability to modify nature in order to meet society's needs.

By the 1960s, an increasing number of people were becoming concerned about the rate of development and associated environmental degradation, and the apparent unawareness, indifference or inability to control the mushrooming problems effectively. Certainly, following World War II there was widespread anxiety about the possibility of nuclear war destroying the planet. Interestingly, during the period around 1970 it was believed that a new Ice Age was developing.

Not until the mid-1980s did the cumulative impact of technology and the associated increased consumption of fossil fuels and build up of atmospheric contaminants become a matter of growing global concern. The Montreal Protocol was an agreement made in 1987 to phase out the production of CFCs, which is the main class of chemicals that destroy the ultraviolet-screening ozone in the atmosphere. It represented one of the first global environmental agreements. The extract adapted in the Geofocus box 'Global resource management', written in 1992, summarised the dismay of not just environmentalists, but of many individuals gravely concerned about global resource mismanagement.

As indicated in the Geofocus box below, there is grave concern regarding the impact of CO_2 on the atmosphere. Other gases, such as methane, may also lead to global warming. However, the rise in CO_2 levels is directly linked to increases in the consumption of coal, particularly for power generation and industry, and oil for transport. While many uncertainties surround the precise extent of global warming, there is a growing consensus that the earth's ecosystem is becoming more precariously balanced. Any additional major disruption, either through additional atmospheric load or in the form of a major natural hazard (such as volcanic activity), may upset that balance.

FIGURE 2.2.56

Large-scale protests about climate change are an example of people's growing awareness of environmental issues related to resource exploitation.

Tackling environmental degradation

In recent years, people's awareness of environmental issues has grown and there has been a greater focus on the need to tackle environmental degradation in all its forms. Of particular concern has been the

geofocus

Global resource management: linking economics to environmental issues

The global spread of industrial economic policies and lifestyles is exhausting the basic ecological wealth of our planet faster than it can be replenished. The natural resources on which the growing world population depends are in peril.

Every year the earth's deserts increase by 6 million ha. Year after year, areas of productive agricultural land almost as large as Tasmania are devastated. Each year three times as much land is so eroded that it is no longer commercially useful.

Almost every country in the world is confronted with water contamination or shortages and at least 1.5 billion people do not have clean drinking water. Surface and ground water is poisoned by nitrates and pesticides from agribusiness and public and industrial waste water.

Then there is the problem of the 'treatment and disposal' of highly poisonous wastes produced by the industrial states. Some states take advantage of foreign currency shortages and insufficient legal requirements in developing and Eastern European countries to rid themselves of these problems cheaply.

Meanwhile, the forests disappear. In Europe they are victims of environmental poisoning (acid rain); in the tropics they are cut for commercial purposes. Their **clearfelling** is causing the largest loss of species of all time.

Nearly 6.6 billion people now inhabit the planet. It is estimated that by the year 2025 this population will almost double. Eighty per cent of the 10 billion people will live in developing countries, in regions already experiencing massive hunger and suffering because of misdirected development aid, environmental degradation and debts.

With only one-quarter of the world's population, the industrial countries consume far more energy, food and resources than so-called developing countries. Industrial states consume three-fourths of all energy produced and almost 80% of all commercial fuels. The energy consumption of one citizen of the United States equals that of more than 160 Tanzanians or 900 Nepalese.

Paralleling this unequal consumption, the lion's share of climate-threatening gaseous emissions comes from the industrial countries. This is especially clear in the case of CFCs, which destroy the ozone layer and make up some 17% of the climate-changing 'greenhouse gases'.

Worldwide, less than 8% of CFCs are produced by developing countries. The pollution balance for CO_2 produced by burning fossil fuels is similar. The entire African continent is responsible for only 2.8% of energy-related CO_2 emissions. The North American continent produces 28%, Western Europe 15%, and the former USSR and Eastern European countries together 21.5%.

Adapted from Group of Green Economists, *Ecological Economics*, Zed Books, London, 1992

increasingly apparent evidence that the earth's climate is changing. The refusal of the Howard Government to sign the Kyoto Protocol (see the Geofocus box opposite) became a major political issue and is credited with being a major vote-changing issue in the 2007 Federal Election.

Five important issues are raised by the Kyoto Protocol process:

- Some developed countries, including Australia and the United States, who rely heavily on coal-fired power, did not want to fix firm targets for reducing CO_2 emissions.
- It is a global problem, but it needs commitment, not simply cooperation, from the industrialised countries.
- The developing countries will be pushed even further behind the more advanced, wealthier countries because they will be less able to meet the additional costs associated with CO_2 reduction.
- Countries more reliant on nuclear fuel are in a better position to call for greenhouse gas reduction.
- It would seem that, unless reduced coal firing and oil consumption is achieved, greater dependence will fall on nuclear fuel, which is itself a major risk to the planet, as was shown by the Chernobyl disaster.

The problems of pollution and degradation are always magnified for developing countries. Often these countries have been exploited by colonial powers and they inherit a legacy of degradation. They are poor, have limited profitable resources and, with growing populations, they need to produce more food and create new employment. Despite these massive responsibilities, they are still expected to meet the extra costs imposed by reductions in CFC use and CO_2 emission. Industrial countries have promoted growth without being constrained by these matters. They have done so partly through ignorance and partly through not wishing to acknowledge the problem. Meanwhile, the developing countries are to be further handicapped. This situation is inequitable and morally unacceptable.

Consequently, while acknowledging that the problem of global pollution needs fully global solutions, it is important that the developed countries effectively assist the less wealthy countries in reducing pollution. It is possible to achieve this. First, developed countries would need to lay down their own targets and set about achieving them. Second, they would need to assist the developing countries with training, technology and finance to enable them to meet the global standards without being further disadvantaged. In addition there needs to be a persistent awareness and action campaign to:

- foster the notion that human action can and does cause pollution or degradation
- ensure everybody accepts that the cumulative effect of small contributions will have a significant global impact
- have every individual understand that they may be part of the cause
- ensure that all individuals will accept responsibility for the problem
- ensure that all will know what to do to combat pollution and its effects
- locate financial resources and commit them to control pollution and rehabilitate affected areas.

In summary, the scale of human actions and the cumulative impact of many small activities are increasing the potential for severe disruptions to the global environment, with major consequences for all living things. Many have tried to estimate the likelihood and effect of such a disruption, as well as when and how it will occur. However, nobody can be certain of the likelihood or potential for some critical, irreparable change. We have learnt that, in many instances, we cannot rely on technology as a form of global insurance against the impacts of large-scale environmental

did you know?

Chernobyl disaster

The Chernobyl disaster of 1986 was the worst nuclear power plant accident in history. The reactor meltdown and resulting fire sent a plume of highly radioactive fallout into the atmosphere. The contamination extended across a wide geographical area.

degradation. The only environmemtally safe path is to ensure that human activity takes place with no further net environmental damage; and, ideally, reduces the present level of damage. For example, if forest is to be cleared for one activity, it should be replaced in another area.

geofocus

Kyoto Protocol: tackling CO_2 emissions

How can the international community strike the necessary balance between expanding the pace of economic development (and resultant higher energy use) and responding adequately to concerns about climate change? How can countries gradually but substantially reduce their emissions of greenhouse gases without stalling their economies? And how can we ensure that the burden of protecting the climate is shared most equitably among countries? These are the questions the 169 countries that ratified the 1992 Framework Convention on Climate Change have been grappling with since before they first initialled the treaty at the 1992 Rio Earth Summit.

In December 1997, these countries began to address these questions by forging the Kyoto Protocol. This protocol is a follow-on to the original climate treaty, and marks the first international attempt to place legally binding limits on greenhouse gas emissions from developed countries. Specifically, the protocol aims to cut the combined emissions of greenhouse gases from developed countries by roughly 5% from their 1990 levels by the 2012 time frame, and it specifies the amount each industrialised country must contribute towards that reduction goal.

In late 2007 the newly elected Australian Labor Government ratified the Kyoto Protocol, leaving the United States as the only developed country refusing to ratify the treaty. Negotiations are now under way for an international agreement to replace the Kyoto Protocol.

TABLE 2.2.4

Percentage changes in CO_2 emissions for selected countries agreed to at the Kyoto conference

Country	2012 Kyoto target (change from 1990 emissions, %)	Country	2012 Kyoto target (change from 1990 emissions, %)
Australia	+8	Lithuania	–8
Bulgaria	–8	Monaco	–8
Canada	–6	New Zealand	0
Croatia	–5	Norway	–1
Estonia	–8	Poland	–6
European Union	–8	Romania	–8
Hungary	–6	Russian Federation	0
Iceland	+10	Slovakia	–8
Japan	–6	United States	–7
Latvia	–8		

Adapted from *World Resources*, 1998–99, pp. 174–5

geofocus

Transnational corporations and the environment

Many of the processes that refine ore into usable minerals involve considerable amounts of pollution. Similarly, some industrial processes, although not normally a major threat to the environment and the health of people in the vicinity, can be catastrophic if an accident occurs. The accident at the Union Carbide pesticide plant at Bhopal, India, in December 1984 is indicative of these dangers. The release of toxic methyl isocyanate (MIC) from the plant killed 2500 people, seriously injured a further 10000 and partially disabled 20000.

The TNC concerned, Union Carbide, had many plants in its home country of the United States. The equipment there was much more modern, well maintained and computer controlled. In Bhopal, to keep production costs down, a cheaper manufacturing process was used, despite its greater potential risks. In addition, there had been frequent warnings about the dangers of the systems at the plant.

The Bhopal plant was not directly involved with resource processing, but it is indicative of a double standard that has existed between the developed countries and the developing countries. Despite continuing outrage on such issues, there remain instances where there appears to be less concern about environmental damage and potential hazards in developing countries.

Such cases are not limited to developing countries. Movies such as *Erin Brockovich* highlight the issue of corporate environmental responsibility in a developed country context. In the case on which that movie was based, a legal clerk (Erin Brockovich) was instrumental in mounting a case against the US$28 billion Pacific and Electric Company (PG&E) of California in 1993. The case focused on the contamination of drinking water with hexavalent, also known as chromium (VI), in the southern California town of Hinkley. Chromium (VI) is known to be toxic and carcinogenic. The case was settled in 1996 for US$333 million, the largest settlement ever paid in a direct action lawsuit in US history.

geofocus

Debt-for-nature swaps

As the world's debtor countries struggle to meet their financial obligations and are forced to cut back government spending, environment protection programs are often the first to go. Debt-for-nature swaps are designed to free up resources in debtor countries for much needed conservation activities. A debt swap involves purchasing foreign debt at a discount, converting the debt into local currency, and using the proceeds to finance local conservation initiatives.

The World Wide Fund for Nature (WWF) was one of the pioneers of debt-for-nature swaps and successfully facilitated its first swap in Ecuador in 1987. Since then, WWF has played an important role in the implementation of debt-for-nature swaps around the world.

did you know?

Greenpeace wants a moratorium on new coal mines and coal expansion and for the NSW State Government to develop clean-energy industries to ensure a just transition for coal communities.

Concessions will need to be made by the industrially developed countries to ensure that developing countries have the opportunity to reach a secure standard of living. This may also involve changes in traditional culture and a reduction in population growth in the developing world. It also requires changes in the consumer culture of the developed world and its disproportionate use and abuse of resources.

Social issues

How the impact of natural resource use is viewed depends very much upon the circumstances of each society. In a developed country, such as Australia, most concern is focused on environmental aspects of resource use and the political ramifications of misuse. There is some concern about resource allocation, but the division is predominantly between jobs and the environment. This is demonstrated by the battle over the logging of old growth forests in Tasmania. (See figure 2.2.12, p. 266.)

Apart from the dedication of committed individuals and interest groups, public interest in issues of resource use in the developed world often follows a cyclical pattern. A catastrophic event or protest about an issue may trigger media interest, if the matter is newsworthy. A major

geofocus

Environmental interest groups

Apart from the actions of the few minority Green politicians around the globe, much of the public conscience is pricked on global environmental issues by groups such as the World Wide Fund for Nature and Greenpeace. (See figure 2.2.57.) These and similar organisations keep environmental issues prominent in the media and can be effective in some instances. In 1985, in response to Greenpeace's vigorous protests against nuclear testing by France at their Pacific island of Mururoa, French secret agents sabotaged Greenpeace's vessel, the *Rainbow Warrior*. This international terrorist action in Auckland Harbour, which killed a Greenpeace crew member, further mounted pressure against the French nuclear-testing program.

FIGURE 2.2.57

The beached coal carrier *Pasha Bulker* provides an opportunity for Greenpeace to protest against coal power stations and their contribution to climate change. The ship ran aground in severe weather off the coast of New South Wales in 2007.

geofocus

Ecologically sustainable development in Australia

The National Strategy for Ecologically Sustainable Development was published in 1992 to provide guidelines for the future of Australian economic expansion. The strategy aims to enhance individual and community well-being and welfare by requiring economic development to safeguard the interests of future generations. It also endeavours to ensure equitable distribution within and between generations and to protect biological diversity and maintain ecosystems. The elements of sustainable development are shown in figure 2.2.58.

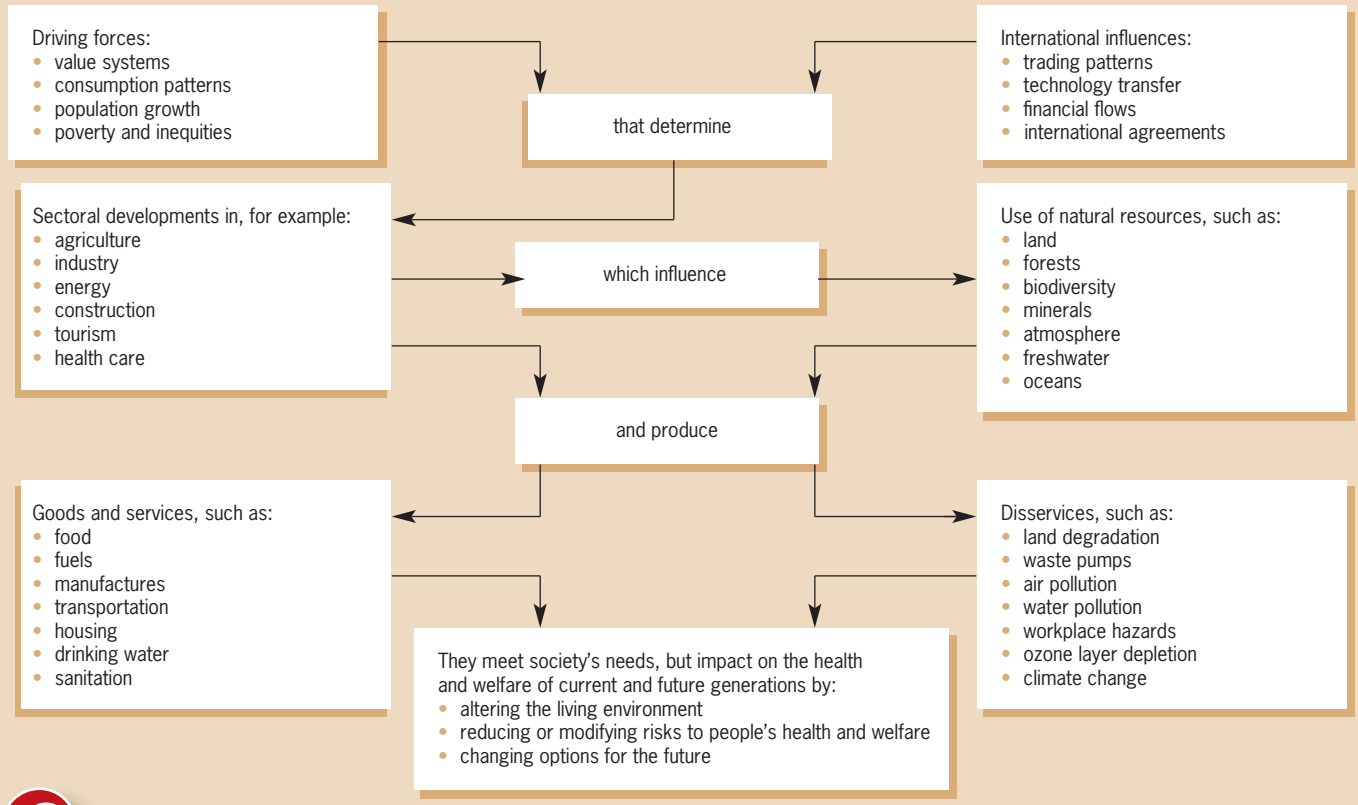


FIGURE 2.2.58

Elements of ecologically sustainable development.

campaign can result and, depending on the issue, legislative action may be taken by government. Legislative action can ensure that appropriate long-term regulatory controls are developed and implemented. However, once other matters become more prominent in the media, or economic circumstances become more pressing, interest in the issue fades or compromises are made.

In developing countries, the issues of greatest concern are those that have a direct impact on an individual. Shortages of food, of fuel to cook it with and of clean water will remain the most important issues until they are addressed. In many societies, political or ethnic oppression, lack of education and training, and absence of both physical and financial resources mean there is little opportunity for altering the existing circumstances. The need for essentials persists, as does a certain amount of resigned acceptance that environmental degradation is inevitable.

There are many critical resource-based problems in the developing countries, but the fundamental issue is the provision of food, shelter

TABLE 2.2.5

Desertification: the symptoms, causes, solutions and outcomes

Symptoms	Causes	Solutions	Outcome
Loss of vegetation	Grazing pressure	Education and training	Other occupations
Loss of soil	Over-cultivation	Environmental education	Reduced, but sustainable agriculture
Loss of farmland	Climatic modification	Alternative fuel sources	Preserve vegetation
Catchment degradation	Fuelwood collection	Reafforestation	Environmental rehabilitation
Nutrition	Over-population	Family planning	Reduced population pressure
Morbidity		Outmigration	
Poverty		Provide more land	

and health care rather than environmental problems. In many cases, major social changes are an integral factor in the solutions to the problems. Take, for example, the issue of natural resource loss through desertification (see figure 2.2.59), and possible approaches to solving the problem. (See table 2.2.5.)

Taking the single problem of desertification as an example, it can be seen that resource-based problems have many causes. The solutions for these may well require changes in society rather than modification of the physical environment. Unfortunately, what is often lacking is the institutional resolve and support necessary to lead and sustain the social change. Resources for education and post-school training, or funds for tree planting, are typical needs.

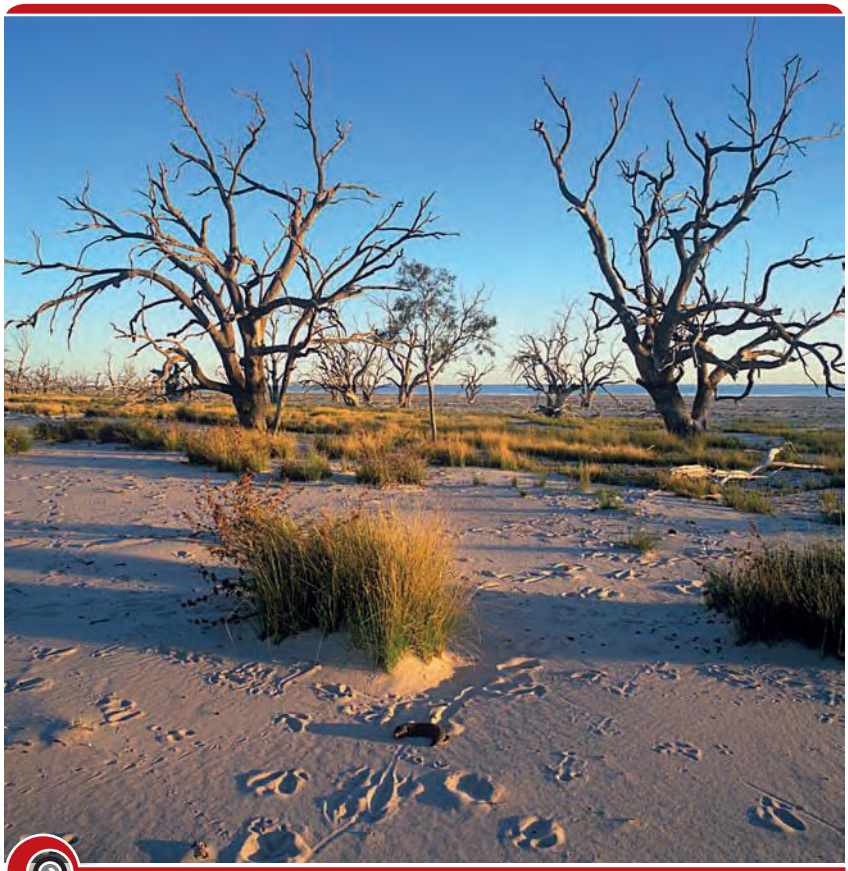


FIGURE 2.2.59

Desertification often results from unsustainable human landuse practices.

On occasions where local entrepreneurs or, probably more typically, TNCs have exploited natural resources, indigenous societies have suffered. (See the Geofocus box 'South America: saving the Yanomami', p. 277.) Responsibility for this normally lies in the hands of the country's government. The many reasons for inaction may include:

- a lack of effective control at a government level
- no laws to protect the environment
- indigenous people having no effective voice in their government
- inadequate official communication channels
- laws being bypassed due to a corrupt system
- inadequate monitoring of regulations, making it difficult to pinpoint responsibility
- inadequate penalties, especially if the potential rewards are high by comparison.

To local indigenous peoples, particularly those living at a subsistence level, an environmentally degrading project may be devastating. However, they may be helpless to alter the circumstances. This helplessness may be due to the following:

- Small groups or tribes are politically insignificant on their own.
- Tribal disputes, cultural differences, geography and poor communications may impede the establishment of a united pressure group.
- Their sentiments may consequently be ignored or they may be swayed by articulate politicians—with empty promises.
- Sometimes key local leaders are 'bought' (that is, are given inducements to act in support of a particular vested interest).

Should the project proceed, it is likely that several of the local people will pick up relatively well-paid employment. Acquiring the material trappings of a cash economy, they may attract others to a dependency on a very different way of life. Thus, the local economy moves away from a subsistence base and relies increasingly on food purchased from

geofocus

Women: bearing the costs of environmental degradation

In developing countries, women are doubly affected by environmental deterioration; first because of poverty and second because of their gender. Environmental degradation places a disproportionate burden on women largely because of their social and economic roles, which expose them to greater numbers of environmental hazards.

Apart from suffering from smoke inhalation from their indoor cooking, they take primary responsibility for obtaining water and washing the family's clothes. These activities can be hazardous where sanitation is poor, washing facilities inadequate and water supplies contaminated.

The kind of employment that women have access to often puts them at risk as well. In rural areas many women work in agricultural fields, where they are exposed to toxic chemicals from fertilisers and pesticides.

In poor households, women have the responsibility for food preparation and collecting fuelwood and cow dung to meet the family's energy requirements. In an environment depleted of forests this may mean many hours of walking every day. Girls often help their mothers to fetch water and fuelwood, depriving them of an education.

FIGURE 2.2.60

Women threshing rice.

outside the area. This may well lead to a weakening of interest in the management of local food-growing areas and lessen concern about degradation. Sometimes the passage towards degradation in developing countries is very subtle but the consequences may be serious, far-reaching and irreversible.

Evaluating resource management strategies

Evaluation of resource management strategies should not simply involve appraising a scheme at its conclusion. Evaluation should begin at the project-planning stage to ensure that goals are met. If the determination of **benchmarks** (targets) is left until a later stage, there is a distinct possibility that there will be bias in response to how circumstances evolve during project establishment. Unambiguous, **quantitative** measures are desirable wherever appropriate to minimise distortion, but most projects will include a number of **qualitative** benchmarks. It must be possible to clearly define and replicate these benchmarks and have them reliably assessed by other persons.

The project's proponents will pay most attention to production and economic indicators. The government or its project-approval mechanism will also have imposed a range of environmental targets that need to be considered. Increasingly there is greater emphasis placed on social consequences of large projects, such as the availability of schooling for family members and adequate hospital facilities. Other social impacts that need to be monitored could include unemployment, crime and supply of goods and services.

Even for projects that have a relatively short operational lifespan, it is desirable to have a set of intermediate benchmarks. They provide a ready indication of the shortcomings of projects as they develop and may well indicate where improvements can be made in techniques or management. Providing feedback about a process is highly desirable and works most effectively if it is provided for in the management structure at the outset.

In large-scale operations, the evaluation process should involve project staff and independent assessors from the initial stages, particularly where the proponents may be loath to enforce rigorous environmental monitoring. The lack of adequate long-term monitoring has been a weakness of many past operations.

Over the last decade or two increased attention has been given to **environmental auditing**. Using a mine site as an example, this process involves measuring key aspects of the site to ensure that subsequent operations do not cause levels of pollution above generally acceptable levels. Measurements also need to ensure that, after mining has ceased, rehabilitation returns the mine site to predetermined environmental standards. Specifications may range from water and sediment yield to the leakage of toxic material. Establishing the standards at the start of the project is crucial to evaluating the net environmental impact.

Unfortunately, evaluations of resource management strategies are rarely as open as they should be. The corporations involved may be concerned about investor confidence, share market fluctuations, industrial espionage from competitors, more stringent conditions from the authorities, debate over working conditions, and union confrontation. Governments may distort or conceal unsatisfactory outcomes arising from its mismanagement if they are concerned about electorate dissatisfaction.

geolinks

Useful Internet sites

Data related to natural resources and the responses to climate change can be found at the following sites.

- The World Bank
- The World Bank: Data and Statistics
- Department of Climate Change.

understanding the text

1 **Outline** the developments in environmental awareness since World War II.
2 **Explain** what the Montreal Protocol is.
3 **Outline** the steps people can take to address issues of environmental degradation.
4 **Outline** the reasons why governments of developing countries often find it difficult to manage the impacts of resource exploitation.
5 **Outline** why indigenous people find it difficult to resist TNCs and environmentally damaging projects they promote.
6 **Explain** why some people advocate the use of nuclear fuel instead of coal to generate electricity.
7 **Outline** why global pollution controls are seen as representing a threat to developing countries, especially if they have few industries. What is the fairest way to deal with this issue?
8 **Define** the term 'desertification'. What are its causes and the solutions to this problem?
9 **Outline** the ways in which women in resource-poor countries bear an above-average burden.
10 **Explain** what is meant by an environmental audit.

working geographically

1 **Interpreting text** Study the Geofocus box 'Global resource management' (p. 297). List the environmental issues highlighted in that text.
2 **Interpreting text** Study the Geofocus box 'Ecologically sustainable development in Australia' (p. 301). Outline the aims of the National Strategy for Ecologically Sustainable Development.
3 **Writing task** Study table 2.2.5 (p. 302). Write an extended response outlining the symptoms, causes, solutions and outcomes of desertification.
4 **Research task** Contact a non-governmental organisation, such as World Vision, and learn of its activities in relation to providing food, shelter, water and possibly education to communities in developing countries. How does the organisation promote effective management of natural resources? Share your thoughts with the rest of the class.
5 **Using the media** Study past and current resource-related events reported in newspapers and journals and identify items relating to:
   a resource planning or decision-making
   b other items on resource issues
   c resource policies of Green politicians.
   Keep a media file on these issues.
6 **Research task** Undertake Internet-based research into a major resource-related controversy. Explain how the groups opposed to the development used the Internet to conduct their campaign.
7 **Class discussion** As a class, discuss the rationale behind Lecomber's statement (p. 296).
8 **Research task** Investigate the objectives of the Snowy Mountains Hydro-electric Scheme. What have been the environmental consequences of the scheme? Debate whether you think this scheme would be approved if it was proposed today.
9 **Writing task** Write a report outlining why developing countries are vulnerable to disasters such as the Union Carbide accident at Bhopal. Consider what must be done to ensure that the frequency of such crises is minimised.
10 **Research task** List the major contributors of CO_2 to the atmosphere in your area. List any other significant greenhouse gas contributions.
11 **Class-based activity** As a class, compile a list of what can be achieved locally to reduce the net emissions of CO_2. Critically evaluate these possible initiatives in terms of their practicality and effectiveness.
12 **Class-based activity** List other major local pollutants in your area and indicate what could be done to reduce them.
13 **Class discussion** As a class, discuss whether you feel that it is reasonable to allow developing countries to produce high levels of pollutants over the next decade or so. What steps could be put in place to achieve this without the global environment being threatened further?
14 **Class discussion** While the aims of ecologically sustainable development are desirable, discuss whether you think it is realistic to gauge what the needs of future generations might be. Consider a range of future scenarios.
15 **Thinking task** Study table 2.2.5 (p. 302).
   a Write a report outlining how physical problems can require social solutions.
   b List the resources that you consider would be required in order to provide an effective solution to the problem of desertification.
16 **Research task** From your nearest Department of Planning office, or from its website, obtain details of the environmental impact assessment procedure. Identify directions that relate to resources and the environment. Note that an Environmental Impact Study (EIS) is required for certain proposed projects. These are made available for public criticism and are often modified as a consequence.
17 **Research task** Obtain a copy of an EIS, preferably from a nearby area, that is related to the use of resources. Study the EIS and identify the resources involved; why it is appropriate that they should be used; and the economic, environmental and social consequences of their use.
18 **Class discussion** Why do we appear never to run out of petroleum? As a class, discuss whether society should actively curtail its consumption of petroleum products and what initiatives are necessary to bring about a change in their use. Develop a table indicating which of your policies represent 'carrots' and which are 'sticks' that may bring about a change in consumption.

Interpreting cartoons

Geographers use a variety of visual text (cartoons, maps, photographs, illustrations, flow charts, diagrams, maps, graphs and webpages) to communicate geographical information. Interpreting such visual texts requires the reader to move beyond simple descriptions of the images or representations to engage critically with the issue being addressed. It also requires the reader to analyse the ways in which such images are constructed and their intended purpose.

To be be able to interpret cartoons, the reader needs to understand the signs and symbols that are used to construct meaning. The reader also needs to appreciate that these symbols make us understand things and react in particular ways. Figure 2.2.61 summarises the tools used by cartoonists to communicate an idea or opinion. These tools are discussed below.

Elements of cartoons

Context

The context is the circumstances that 'surround' the issue being addressed in the cartoon. The context might include the political, social, cultural, historical and institutional factors that influence the way we understand an issue. (Institutions are structures and mechanisms of social order and cooperation governing the behaviour of people.)

Symbolism

Symbols have the ability to communicate often complex, emotionally rich ideas in a concise manner. The use of symbolism involves the inclusion of representational forms or images that have meaning beyond what is obvious and immediate; in other words, a sign or object used by the cartoonist to stand for something other than itself. The effectiveness of such references depends on the presumption that its meaning can be understood by the reader.

Commonly used examples of symbolism include the dove or olive branch (to symbolise peace); the Statue of Liberty (freedom and democracy); a heart, cupid or Venus (love); Uncle Sam and the 'Stars and Stripes' (the United States); a bear (Russia); and a dragon (China).

Stereotyping

Creating an oversimplified image of a particular group of people while suppressing anything uniquely individual is known as stereotyping. Cartoonists often use stereotyping when seeking to highlight the dangers of generalising. In other instances they use it as a 'shorthand' way of communicating generalisations.

Cartoonists must be careful when using stereotypical symbols. They have the potential to reinforce and perhaps inflame harmful prejudices.

Caricatures

Caricatures are humorous illustrations that exaggerate or distort the prominent physical features of a subject to create an easily identifiable visual likeness. This helps us to identify public figures quickly. The best caricatures provide an insight into the character of the person being drawn.

Examples of features that are subject to exaggeration in caricatures include New Zealand Prime Minister Helen Clark's teeth, lips, nose and hairstyle and Australian Prime Minister Kevin Rudd's round face, glasses and boyishness.

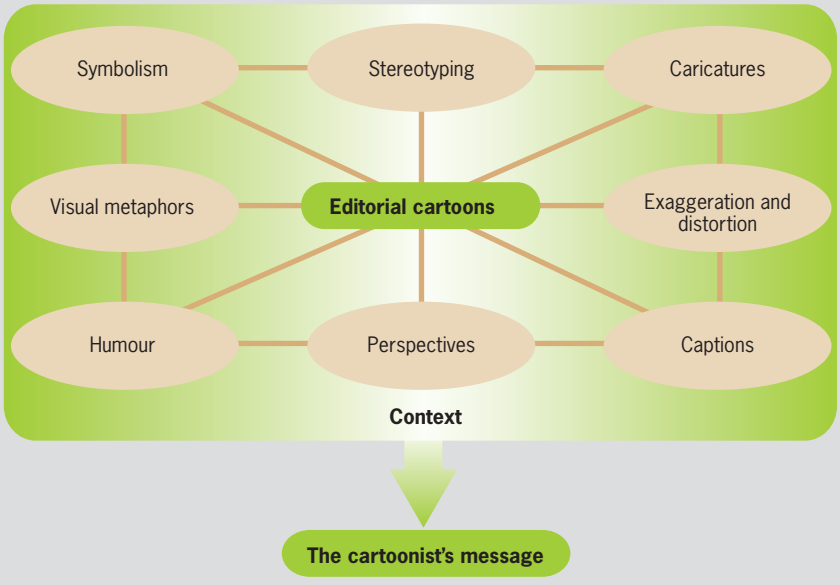


FIGURE 2.2.61

Elements of editorial cartoons.

Exaggeration and distortion

Cartoonists often exaggerate or understate the size of people and objects they draw. They do so to emphasise the relative power, importance and vulnerability of an individual, group or social force. It can also be used to draw attention to aspects of an issue being addressed.

Captions

Captions are text-based statements that are sometimes used to reinforce and put in context a cartoon's non-verbal elements. They complement, rather than make obsolete, the other elements of a cartoon. When taken together, all the elements communicate a social or political opinion.

Perspectives

The cartoonist's perspective is the position, stance or point of view they adopt. The cartoonist might take the opportunity to advance their own view on a particular issue or topic or they might seek to portray (often in a satirical way) the perspective associated with a key player.

The mood or tone created by a cartoon provides important insights into the cartoonist's attitude towards the subject and the audience.

Humour

Cartoonists often employ irony and satire to give a cartoon a humorous edge. Irony is an expression in which the true meaning is the opposite of the literal meaning. Satire involves the use of ridicule or scorn, often in a humorous or exaggerated way, to expose vices and follies. These devices can be used to poke fun at public figures or create a dynamic that draws the reader into a more active engagement with the issue addressed in the cartoon.

Visual metaphors

Visual metaphors are artistic devices used to help our minds come to grips with complex ideas by relating them to something more familiar and readily understood.

Examples of visual metaphors include the use of a sinking ship, wilderness (desert) setting or circled wagons to suggest that a government or political party is experiencing a downturn in its electoral fortunes; a storm as a metaphor for chaos, confusion, fear and destruction; and the grim reaper, vulture, shroud or skull and crossbones as a metaphor for evil, disease and death.

Newspaper, magazine or URL: _____

Cartoonist: _____

Visual elements
Identify any symbols or visual metaphors by the cartoonist. What do these symbols and visual metaphors represent?

paste the cartoon here

Has the cartoonist used caricature? If so, identify the people featured in the cartoon. What physical features has the cartoonist deliberately exaggerated? What is the impact of this exaggeration? What does it suggest about the people shown?

Is there evidence of stereotyping in the cartoon? If so, describe it.

Text-based elements
Does the cartoon have a caption and/or title? If so, write it in the space below.

List any words or phrases used by the cartoonist to identify objects or people in the cartoon.

Which words or phrases in the cartoon appear to be the most important? Justify your selection.

General
Identify the issue addressed in the cartoon.

Explain, in your own words, the opinion or perspective being advanced by the cartoonist.

What interest groups would agree/disagree with the point of view advanced by the cartoonist?

FIGURE 2.2.62

Cartoon interpretation worksheet.

> Global culture doesn't mean just more TV sets and Nike shoes. Linking is humanity's natural impulse, its common destiny. But the ties that bind people around the world are not merely technological or commercial; they are the powerful cords of the heart.
>
> **E. Zwingle, *National Geographic*, August 1999**

> No culture can live if it attempts to be exclusive.
>
> **Mahatma Gandhi, Indian independence leader**

> Culture is the sum of all forms of art, of love and thought, which, in the course of centuries, have enabled humanity to be less enslaved.
>
> **André Malraux, French historian, novelist and statesman**

unit 2.3

Cultural Integration

Not so long ago, it was thought that the process of globalisation and the revolution in information and communications technologies would bring the peoples of the world closer together in a process known as *cultural integration*. But the opposite appears to be happening. While global economies are converging, cultures appear to be diverging, and the widening cultural differences are leading us into a period of heightened social conflict, growing inequality and increased segregation. This is nowhere more apparent than in the divisions emerging between the democracies of the Western world and the wave of religious fundamentalism sweeping the Islamic world.

At a global scale, old national identities are proving surprisingly durable, and, in some instances, have been radicalised by the process of globalisation. Even the most superficial analysis of contemporary geopolitical events draws attention to the role played by groups that both fear and reject the intrusion of outside cultural influences.

In this unit we look at the process of cultural integration and the aspects of global culture where the impact has been greatest. In Unit 2.4 we examine the extent to which the spread of Western cultural influences has provoked a backlash from those who fear that Western culture threatens to overwhelm their own cultural traditions and beliefs.

exam-style questions

extended responses

- What is cultural integration? Outline the factors affecting the nature and rate of this process.
- Explain how the diffusion, adoption and adaptation of mass consumer culture is reflected in THREE of the following: media, fashion, brand images, sport, music and religion.
- Analyse the role played by the media in the process of cultural integration.
- Examine the role of government in the process of cultural integration.
- Explain the contribution of technological change and TNCs to the process of cultural integration.
- Analyse the view that cultural integration increases economic dominance and dependence.
- Explain how cultural integration has contributed to the development of homogenised landscapes.

Dubai: cultural crossroads

Over the last decade or so, oil-rich Dubai has emerged as one of the world's most fascinating examples of cultural integration. Money has transformed this small desert emirate into the world's largest construction site, major international airline hub and tourist destination.

Dubai offers the tourist an amazing range of attractions. In a single day, the tourist can experience everything from rugged mountains and vast sand dunes to sandy beaches and man-made islands, lush green parks, luxurious residential districts and ultra-modern shopping malls selling the world's most fashionable brands. You can even go skiing on one of the world's largest indoor ski slopes, measuring 400 metres and using 6000 tonnes of snow. A second indoor ski slope in the new Dubailand complex opened in 2008. It provides a great attraction, featuring a revolving ski slope, an artificial mountain range, an ice bridge, a cable lift, a snow maze, an ice slide, polar bears, cold water-aquaria and special sound and light effects.

Indoor ski slope in Dubai.

glossary

- **deregulation** the process by which governments remove, reduce or simplify restrictions on the movement of goods and people.
- **economic restructuring** the significant and enduring changes in the nature and structure of the economy brought about, primarily, by the emergence of the global economy.
- **global village** a term used to describe how the world appears to be getting smaller through the accessibility of technology, especially those that facilitate the transfer of information. Thus, the actions that occur in one corner of the globe can rapidly and significantly affect people elsewhere.
- **globalisation** the integration of the world's economy through the mass consumption of mainly Western culture, technology and trade. Globalisation affects economic, political, social, cultural and environmental decision-making.
- **high culture** incorporates elements of lasting value, such as art, literature, theatre, ballet, opera and classical music. Some critics consider its content to be 'high brow' or 'intellectual' when compared with 'popular culture'.
- **homogenised** in relation to culture, a state where one culture becomes similar to another.
- **intellectual capital** using ideas, knowledge or inventions as a means of gaining material wealth through a business enterprise. Specialised knowledge of how a product works creates jobs in areas such as information technology (IT) support.
- **multiculturalism** the official Australian Government policy of encouraging immigration from diverse ethnic backgrounds. It also refers to the promotion and encouragement of the retention of ethnic languages and cultures within Australian society.
- **popular culture** considered to be more mainstream than 'high culture'. It is associated with 'lighter' forms of entertainment, such as sporting events, TV programs, comic strips and rock concerts.
- **rationalisation** to eliminate what is considered unnecessary, in order to make it more efficient.
- **secular** non-religious.
- **sovereignty** the supreme, unrestricted power to govern a state.
- **transnational corporations (TNCs)** large international companies whose operations take place in both developed and less developed countries. Their headquarters are usually located in developed countries.
- **World Bank** an international organisation made up of three United Nations agencies. It provides less developed countries (LDCs) with technical assistance and reconstruction and development finance.

What is globalisation?

No culture is static. Ideas, technologies, products, and people move from one place to another. When cultures come into contact through migration, trade, or the latest telecommunications devices, they influence each other. Sometimes cultures cross-pollinate, exchange foods, music, sports. At other times, say critics of globalisation, a culture swamps another like an invasive, fast-reproducing weed.

Cultures have evolved in response to contact for thousands of years. But the pace has changed. In the past the influences of distant cultures came slowly, delayed by long journeys. Today, because of the telephone, the television, the Internet, telecommunications satellites, world trade, and long-distance travel, cultural influences can spread across the planet as fast as the click of a mouse.

National Geographic, August 1999

Defining cultural integration

Cultural integration is difficult to define because it is made up of many concepts. The idea of a **multicultural** society reflects cultural integration at work; so too does the idea of the '**global village**', where, through technology and trade, a seemingly borderless world is created. Cultural integration also concerns the adoption of a mass consumer culture where everything from fashion to sport, music to TV, becomes integrated into a country's culture, often without challenge. This may be viewed by some as a positive step towards unifying the world. To others, however, cultural integration is seen as a threat to national **sovereignty** and *cultural diversity*. Geographically, where a person lives in the world often determines what part, if any, they can play in this **globalisation** process.

What is culture?

Even experts struggle to define the word 'culture'. In a very general sense, it can be defined as the 'way of life' of a group of people. More specifically, culture can be described as those elements of human existence that are passed down from one generation to the next; the product of humanity's collective intellect and memory. These elements include the traditions, customs, languages, belief systems, art, architecture, music, food and institutions shared by a particular group of people. It includes the material goods the group creates and uses, and the skills it has developed. Culture

geofocus

Globalisation: the human dimension

Globalisation is what happens when you lose your job in Brunswick, Bankstown or Elizabeth because the company for which you work has been bought out by the Australian subsidiary of a Dallas-based transnational company that has decided to relocate its production of T-shirts to Mexico because of cheaper wage costs and lower health and safety standards. It is what happens when you finally get a new job in Brisbane under a new employment contract that lowers your wages and conditions and your boss explains that this is essential to compete with Mexican, or Indonesian, or Chinese, workers.

It is what happens when your sister is sacked from her hospital job because of budget cuts by a State Government that defends its actions by saying it must meet the demands of international credit-rating agencies for balanced budgets and lower taxes. And it is what happens when you get skin cancer because of the hole in the ozone layer created by chemicals released by refrigerators and aerosol cans all over the world.

But globalisation is also what happens when you use the computer at your local library to connect to the Internet and find pages of information from unions and community organisations in England, Mexico or Indonesia, which are trying to link up with workers around the world to stop the driving down of wages and the repression of trade-union activists. Globalisation is what happens when young London musicians of English, Caribbean and Indian descent begin to create new cross-rhythms of black reggae, white trance and Hindi rap. And globalisation is also what happens when a child sees photographs of this planet taken from space and realises that the Earth is indeed finite.

John Wiseman, *Global Nation? Australia and the Politics of Globalisation*, Cambridge University Press, Melbourne, 1998, pp. 13–14

Innovation in education is the key to ongoing success

By ALLAN MOSS*

A lot has changed in the world in the past 40 years. Today, China and India, which were mostly separate from the West economically and culturally, are not only part of the global economy, society and culture, they have become the most important drivers of change. They are generating most of the growth, most of the progress and most of the challenges.

Forty years ago it would never have been anticipated that factory workers and engineers in the west of Sydney would compete directly with factory workers and engineers in Shanghai. And who could have imagined that radiologists in the northern suburbs of Sydney would compete with their counterparts in Los Angeles and New Delhi to interpret X-ray scans taken just a few minutes before in New York. Or that investment bankers based in Sydney … would compete with investment bankers in New York and London for deals in Europe and Asia.

But that is the new reality. Not only are product markets global, but increasingly services and labour markets are, too.

Forty years ago, the key determinant of lifestyle was the country in which you were living. If you lived in the United States, Britain or Australia, you lived reasonably well. Most people who lived in Asia were struggling to survive. Australian assembly-line workers lived much better than most Chinese factory managers.

Today, that may not be the case and tomorrow it certainly will not be so. In the future, what you do will be much more important than where you do it. Globalisation offers tremendous opportunities but there will be losers as well as winners.

Australia is indeed a lucky country. We are blessed by natural resources, an excellent system of government, a wealthy economy and a high degree of social cohesion. However, even these wonderful advantages do not assure our success over the long haul.

The quality of our education system will be vital. It is education and the supply of skilled talent that will determine how much of our economy and how many of our people will be able to participate in high-margin professional services such as health, financial services and education, as well as specialised knowledge-intensive manufacturing such as medical technology. It will also determine how many Australians are forced to depend on commodity manufacturing, routine clerical services and other poorly rewarded activities.

*Allan Moss [now former] Managing Director and Chief Executive Officer of Macquarie Bank

Sydney Morning Herald, 19 July 2007

is expressed in many ways: through the creative and performing arts and the ways people communicate, use resources and utilise space.

Some people fear that the earth's cultural diversity is under threat. They are concerned that cultures are being swamped by Western (mainly US) cultural influences. Others see this development as part of the ongoing process by which a particular culture evolves and is enriched by the cultures with which it interacts. Advanced communication

Goods move. People move. Ideas move. And cultures change. The difference now is the speed and scope of these changes. It took television 13 years to acquire 50 million viewers; it took the Internet only five.

Not everyone is happy about this. Some Western social scientists and anthropologists believe that a sort of cultural cloning will result from what they regard as the 'cultural assault' of McDonald's, Coca-Cola, Disney, Nike, MTV and the English language itself… critics are convinced that Western—often equated with American—influences will flatten every cultural crease, producing, as one observer terms it, one big 'McWorld'.

E. Zwingle, *National Geographic*, August 1999

cultural diffusion the dispersion, or spread, of different cultural elements between countries.

cultural adaptation the modification of a culture to incorporate aspects of another culture.

cultural adoption the acceptance and integration of different cultural elements as if they were your own.

FIGURE 2.3.1

The influence of a mass consumer culture is clearly evident in the streetscape of downtown Niagara, Canada.

understanding the text

1 **Explain** what is meant by the term 'cultural integration'. Why do some people regard it as a threat? What positive benefits may it have?
2 **Define** the term 'culture'. What are its main elements? How is it expressed?
3 **Define** the term 'popular culture'. Give examples of the types of popular culture you interact with.
4 **Outline** the impact of advanced communication technologies on culture.

technologies make it inevitable that cultures, of all types, will become more interrelated and interdependent.

There are many measures of cultural diversity, but one of the best indicators is the state of the world's languages. Some languages are growing. English, for example, is now spoken by more than one-fifth of the world's people. It is an essential element of the new global culture: the language of science, commerce, diplomacy and **popular culture**. Other languages, however, are fading. More than half the 6000 or so languages currently spoken are unlikely to survive the twenty-first century. About half the world's languages have fewer than 10 000 speakers. One-quarter have fewer than 1000. Many blame globalisation: a growing uniformity fuelled by technological advances in telecommunications and the emergence of the global economy. (See pp. 327–32.)

geofocus

A clash of civilisations?

The point of view expressed in the introduction to this unit (p. 308) are consistent with those advanced by Samuel P. Huntington. In his influential essay 'The clash of civilisations', Huntington argued that post-Cold War conflict would occur most frequently and violently along cultural, not ideological, lines:

It is my hypothesis that the fundamental source of conflict in the new world will not be primarily ideological or primarily economic. The great divisions among humankind and the dominating source of conflict will be cultural. Nation states will remain the principal actors in world affairs, but the principal conflicts of global politics will occur between nations and groups of different civilisations. The clash of civilisations will dominate global politics. The fault lines between civilisations will be the battle lines of the future.

Samuel P. Huntington (1993), *Foreign Affairs* 72(3), p. 22

The rise of Islamic fundamentalism can, at least in part, be explained as a reaction to the spread of Western (and especially US) cultural influences. (See figure 2.3.2.) Fundamentalists see these as a threat to their religion and way of life. Some extremists have resorted to the use of terror to achieve their political objectives.

FIGURE 2.3.2

The rise of Islamic fundamentalism can, at least in part, be explained as a reaction to the spread of Western (and especially US) cultural influences.

working geographically

1 **Group work** Working in groups, brainstorm the elements of Australian culture that have their origins in other parts of the world. Compare your group's list with other groups. Compile a class list. What conclusions can you draw from this activity?

2 **Interpreting text** Study the extracts on pages 311–12. Explain, in your own words, the point being made in each extract.

3 **Using the media** Collect photographs that help to illustrate the process of cultural integration. Mount a wall display. Add to the display over the course of the year.

4 **Interpreting text** Study the Geofocus box 'Globalisation: the human dimension' (p. 311). Using your own examples, write a paragraph similar to those written by John Wiseman to illustrate the process of globalisation.

5 **Interpreting text** Read the newspaper extract 'Innovation in education is the key to ongoing success' (p. 311). Write a paragraph highlighting the point Allan Moss is seeking to make.

The diffusion, adoption and adaptation of mass consumer culture

Cultural integration is about accepting or rejecting the process of change described as 'globalisation'. At its simplest level, it is a process where the issues of class, gender, race and ethnicity are denoted simply by what brand of clothing we wear, by where we live, by what music we listen to and by what cultural events we attend. It is about keeping up with the latest trends and allowing them to define our identity, rather than preserving an identity that is uniquely our own.

The following examples of food, fashion, advertising, sport, music and religion demonstrate the nature and extent of cultural integration.

Fast-food going global

One of the most obvious examples of globalisation has been the proliferation of fast-food retailers, such as McDonald's, Burger King, KFC, Pizza Hut and Starbucks. Today, these giants of the fast-food industry are a ubiquitous feature of streetscapes around the world. (See figure 2.3.5, p. 315.) Their proliferation has helped to transform the dietary habits of people in many countries and helped shape (through advertising) the lifestyle aspirations of people, especially the young. Vendors of traditional foods have responded by adapting the fast-food industry's approach to the promotion, production and sale of food. In some cases, the fast-food giants have adapted their products to the cultural context in which they operate.

did you know?

Examples of menu adaptation by McDonald's include:

- the Maharaja Mac in India, which includes 'two all *lamb* patties, special sauce, lettuce, cheese, pickles, onions on a sesame seed bun'.
- the Kiwiburger in New Zealand, which contains fried egg and a slice of beetroot
- the kosher, halal menu in Muslim countries
- the inclusion of frankurters, beer and a cold four-course meal in Germany
- the Ebi Filet-O shrimp burger in Japan
- the McArabia, which is a flatbread, spicy chicken fillet, onion and garlic mayonnaise sandwich. It was launched in the Middle East and is now popular in Malaysia and South Africa.

geofocus

Starbucks

Starbucks is a multinational coffeehouse chain with its corporate base in Seattle, the capital of Washington State in the United States. Named after the first mate in the novel *Moby Dick*, Starbucks is now the largest coffeehouse company in the world. By early in 2007 there were 7521 company-owned and 5647 licensed Starbucks stores in 40 countries, making a total of 13168 stores worldwide. (See figure 2.3.3, p. 314.)

Starbucks has expanded rapidly. In the 1990s, the company was opening a new store in the United States and Canada every workday, a pace that continued into the 2000s. Domestic growth has since slowed, but the company continues to expand internationally and continues to open, on average, seven new outlets a day worldwide. The first outlet outside North America opened in 1996. Almost one-third of all outlets are now outside the United States and Canada.

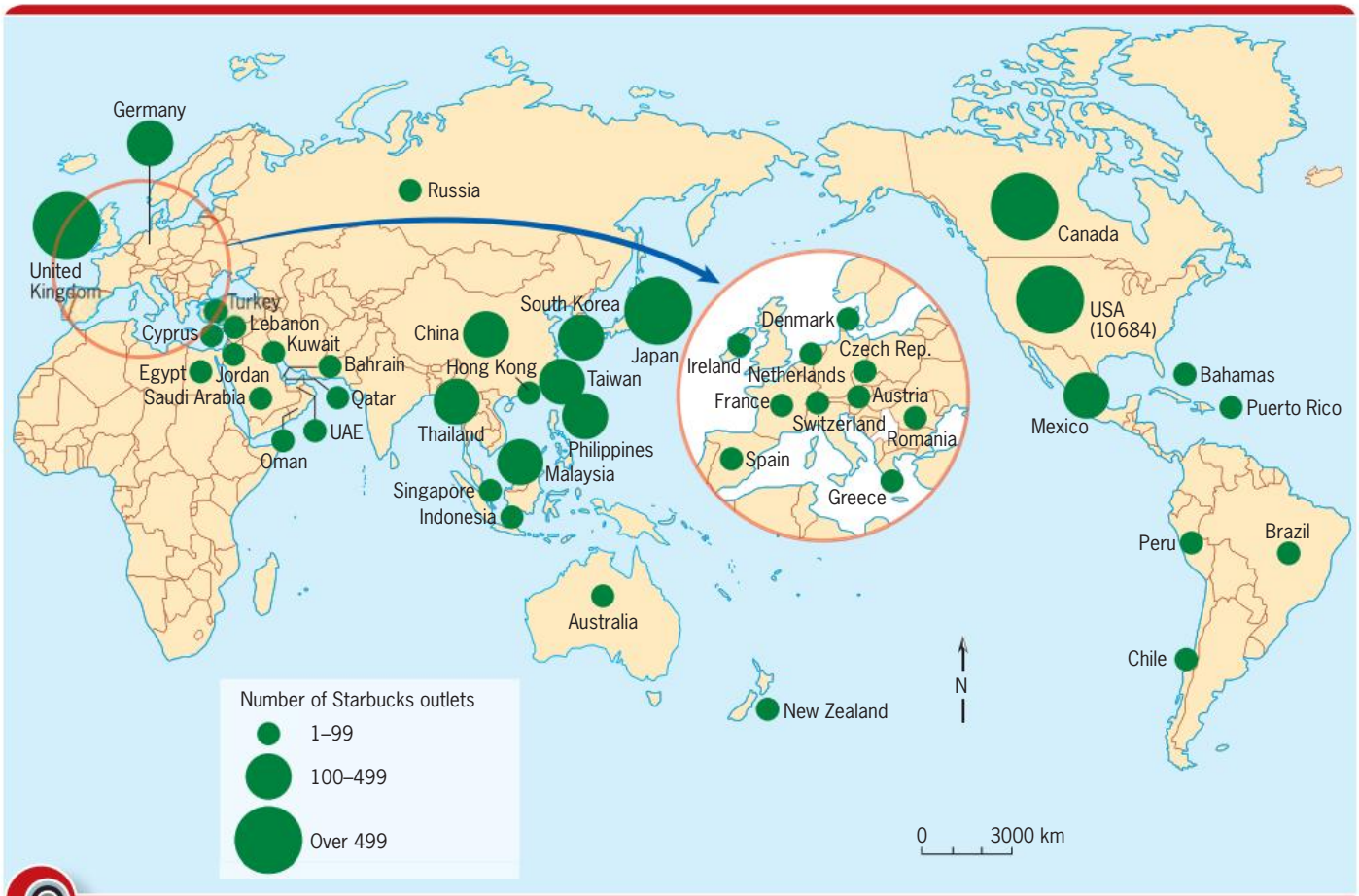


FIGURE 2.3.3

Starbucks: the global reach of US fast-food culture.

China seeks known brands to go global

By DAVID BARBOZA

Never heard of brand names like Great Wall, Hisense, Konka, Amoi and Panda? Outside China, few have. That may change some day, but in the meantime, some Chinese companies are taking a shortcut and adopting widely known names to make their presence felt abroad. China's leaders have been quietly encouraging Chinese companies for years to set up overseas operations, acquire foreign assets and transform themselves into multinational corporations: in other words, to make themselves more competitive in a world increasingly dominated by Wal-Mart, Microsoft and Coca-Cola.

Now, it seems, Chinese companies have gotten the message. This year, the Chinese computer maker Lenovo acquired IBM's personal computer business. Haier, one of China's biggest companies, made a bid last week for Maytag. And in the same week, in the biggest move of all, one of China's state-owned oil giants made a hostile US$18.5 billion bid for Unocal, one of the world's largest oil companies.

Yet many of the companies seem to be acting partly out of desperation, as more foreign brands line shelves of retailers in China. 'Chinese companies are now facing serious foreign competition at home,' said Marshall Meyers, a professor of management at the Wharton School at the University of Pennsylvania. 'So they have to do something. They've got to grow to global scale.' The fact is, despite restrictions on foreign competition here, few powerful brands have emerged in China over the past two decades. And now that some of those restrictions are being lifted as part of China's admission into the World Trade Organisation, some of China's biggest companies are being forced to adopt global strategies.

With its purchase of IBM, Lenovo, a major computer maker in China but virtually unknown outside it, is suddenly the world's third-largest computer maker, after Dell and Hewlett-Packard. TCL, another Chinese company, became the world's biggest television set maker last year after it acquired the television-set business of Thomson of France, which also owned the old RCA brand…

Experts say that whether these deals succeed or not, they are symbolic of China's rapid economic rise and its global ambitions …

geofocus

The golden arches: spanning the globe

When we think of the process of cultural integration the first image that often comes to mind is the ubiquitous golden arches of McDonald's. No other company so graphically demonstrates the diffusion, adoption and adaptation of mass consumer culture.

The McDonald's Corporation had its beginnings in 1955. Ray Kroc, a Multi-Mixer milkshake-maker salesman, received an order for eight Multi-Mixer machines from the McDonald brothers, the owners of a takeaway food outlet.

Ray Kroc was fascinated by the way the McDonald brothers operated their business. The menu was short, simple and cheap and the hamburgers were very popular. Ray convinced the brothers to allow him to open new McDonald's stores. In return, Ray agreed to pay the brothers 0.5% of the gross sales of the new stores. Ray opened the first of the new stores in Des Plaines, Illinois. He expanded his business by granting franchises to local entrepreneurs, all of whom had to adhere to the same principles that made the original McDonald's so successful. By 1960 Ray Kroc had opened 200 outlets across the United States. In 1961 he bought out the McDonald brothers for US$3 million.

Today, McDonald's has more than 30000 restaurants in over 119 countries on six continents (See figures 2.3.4 and 2.3.5.) Every day, McDonald's serves 50 million people worldwide. A new store is opened somewhere in the world every 15 hours. On opening day in Kuwait City, the line for the McDonald's drive-through was over 10 km long. McDonald's is one of the 200 biggest corporations in the United States.

McDonald's promotes its products via extensive worldwide marketing campaigns. In developing countries these campaigns target the young and the elite. It promotes Western-branded fast food as a fashionable alternative to traditional foods. It also promotes the perception that their restaurants are more hygienic and appealing than the local alternative.

In some developing countries, governments have resisted the spread of Western-based fast-food retailers, such as McDonald's. India, for example, imposes tough rules on foreign entrants to its markets. Nevertheless, McDonald's established its first two outlets in India in 1996: one in Delhi, the other in Mumbai (Bombay). To accommodate local religious beliefs, vegetarian and lamb burgers are on the menu, and a special sauce has been mixed using an egg-free base. McDonald's also uses separate kitchen space and utensils to prepare vegetarian and non-vegetarian meals; a highly sensitive issue with traditional Hindus.

Elsewhere, local entrepreneurs are using the reputations established by US-based multinational firms to gain a foothold in international markets. (See the article opposite.)

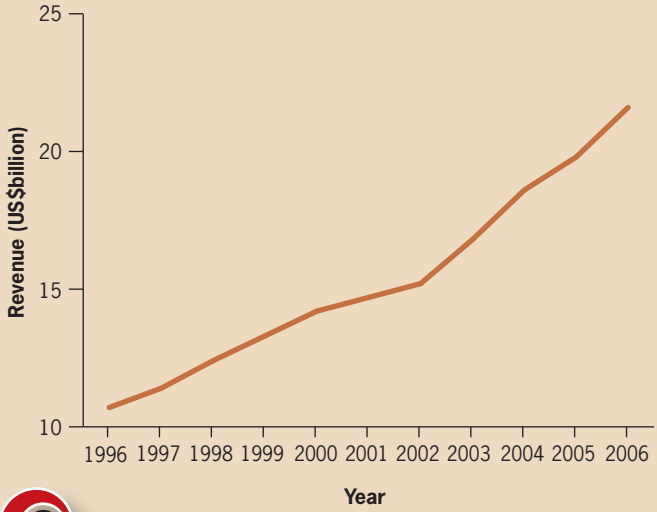


FIGURE 2.3.4

McDonald's revenue, 1996–2006.

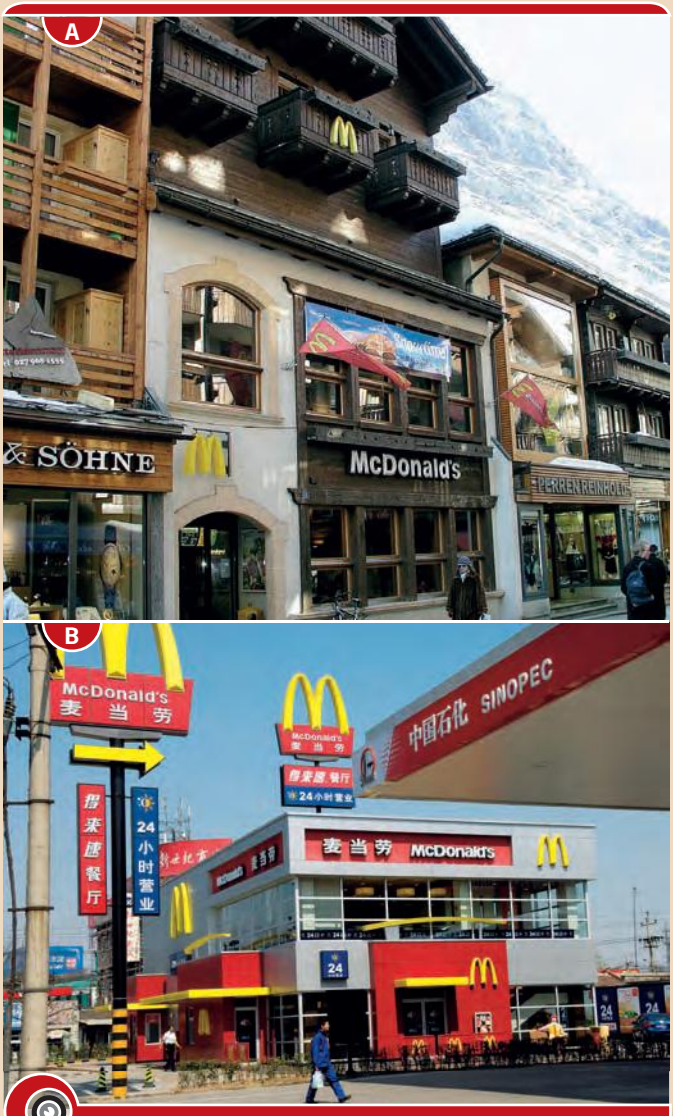


FIGURE 2.3.5

McDonald's outlets span the globe. **A** Zermatt, Switzerland. **B** Beijing, China.

Coca-Cola: the real global thing

Coca-Cola's first non-US bottling plants were built in Panama, Cuba and Canada in 1906. During, and immediately after World War II, the company spread to Europe, Africa and the Pacific. Eastern Europe has been the target of the most recent period of expansion. When the Berlin Wall was demolished in 1989, Coca-Cola rushed trucks of Coke into East Germany to claim the market ahead of its rival Pepsi.

When the first red and white Coca-Cola truck rolled into Warsaw, the capital of Poland, in the early 1990s, some of the locals stood by the side of the highway and applauded. They were not necessarily applauding Coca-Cola per se, but rather what the trademark represented to them: the life, colour and energy of Western commerce that could now be found in their rather drab environment.

Today Coca-Cola sells more than 400 products in over 200 countries. In 2006, Coca-Cola had global revenues of US$24 billion and a gross profit of US$15.9 billion. Coca-Cola is the best known of all the global brands.

Australia's Coca-Cola-Amatil is one of the world's largest bottlers of Coca-Cola.

FIGURE 2.3.7

The Coca-Cola logo is found all around the world. Here it can be seen in the streets of Belgrade, Serbia.

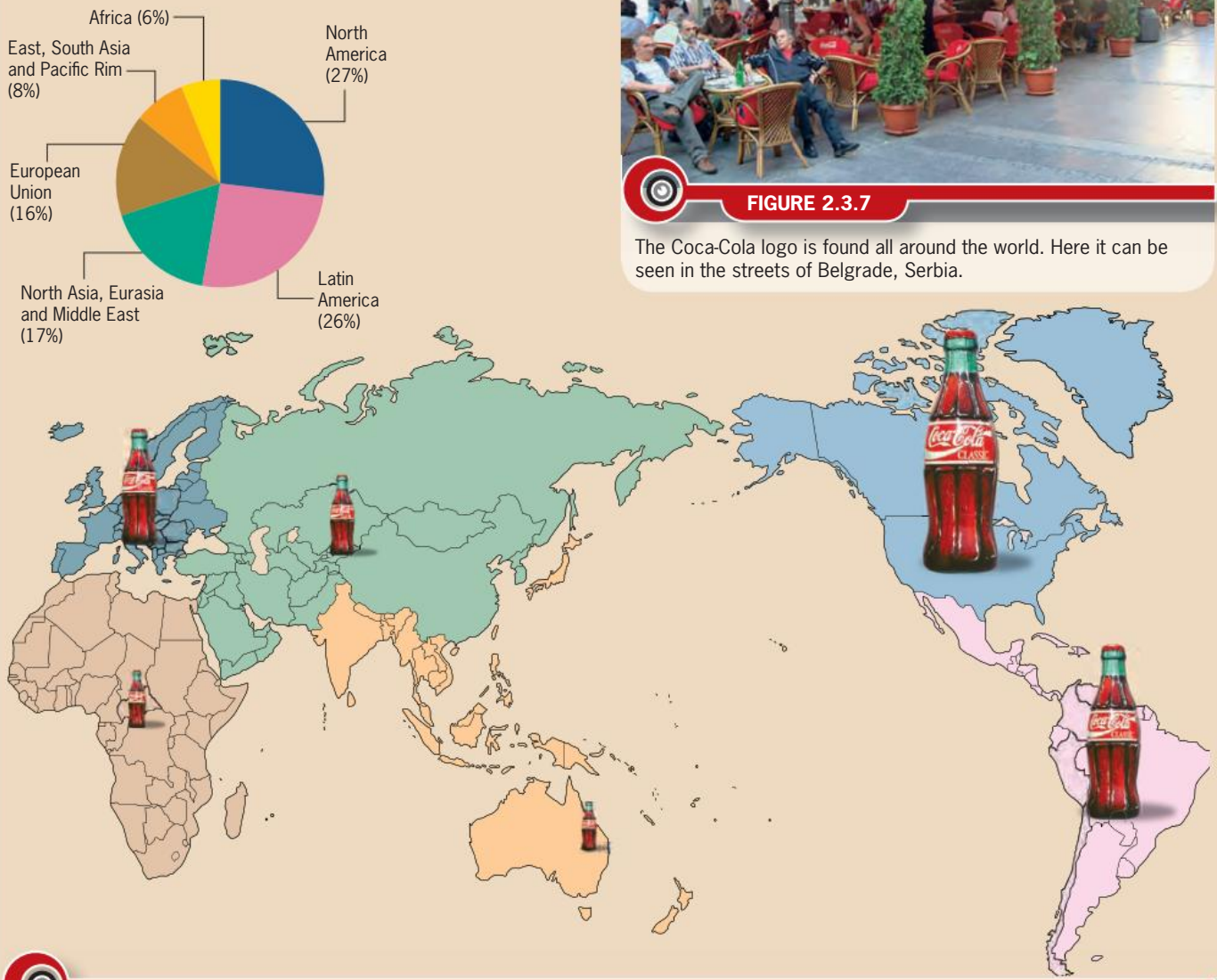


FIGURE 2.3.6

Per capita consumption of Coca-Cola beverage by region, 2006. (Serving size: 8 US fluid ounces.) The inset graph shows unit case sales of Coca-Cola products by region, 2006.

working geographically

1 **Interpreting diagrams** Study figure 2.3.3 (p. 314). With the assistance of an atlas, describe the global distribution of Starbucks.

2 **Interpreting text** Study the Geofocus box 'The golden arches' (p. 315).
- **a** Outline how McDonald's promotes fast-food in developing countries.
- **b** Outline the extent to which McDonald's adapts its products to meet local cultural traditions.

3 **Interpreting text** Study the newspaper extract 'China seeks known brands to go global' (p. 314).
- **a** Outline the strategies that Chinese-based firms are using to make their presence felt overseas.
- **b** Identify the forces to which these Chinese firms are responding.
- **c** Outline the factors that are enabling Chinese firms to spread their brand images on a global scale.
- **d** Note the impact that strategies such as these are likely to have on the future diffusion of brand images on a global scale.

4 **Interpreting text** Study the Geofocus box 'Coca-Cola'.
- **a** As a class, discuss the claim that Coca-Cola represents the 'life, colour and energy of Western commerce'. What does this say about the willingness of people to adopt elements of Western popular culture?
- **b** Study figure 2.3.6. Describe the spatial distribution of the consumption of Coca-Cola products.

5 **Group work** Working in groups, list other consumer products that enjoy an international profile similar to that of Coca-Cola. Where do each of these products originate? What types of images are used to promote each product?

understanding the text

1 **Distinguish** between the diffusion, adoption and adaptation of mass consumer culture.

2 **Outline** the spatial and cultural impact of the fast-food industry. Explain how vendors of traditional foods have responded to the competition.

FIGURE 2.3.9

Nike in Monte Carlo: a symbol of mass consumer culture on a global scale.

What's in a name? Influences on the fashion industry

The fashion industry is both dynamic and competitive. It is an industry that thrives on constant change and the promotion of youthful images. It dictates what is 'in' and what is not. Each season, designers look to the traditional fashion capitals of London, New York, Paris and Milan for inspiration. Whether you are aware of it or not, globalisation of the fashion industry is everywhere and it is the United States that leads the way. Hanes, Calvin Klein, Guess? and Levi Strauss are all brand names owned by large

FIGURE 2.3.8

The fashion industry thrives on constant change and the promotion of youthful images.

FIGURE 2.3.10

Fashion retailer in Nice, France. Popular fashion brands, such as Hugo Boss, can be found in boutique shopping districts of cities across the globe.

It's the middle of winter and I'm shopping with my daughter at Galeries Lafayette: Paris's most famous department store. The search for clothing acceptable to a fashion-conscious Australian teenager proves fruitless, until we come across racks of clothing bearing the logos of Rip Curl and Billabong.

My daughter is now the proud owner of an Australian-designed Rip Curl jacket, made in China and purchased in Paris. Globalisation at work!

Grant Kleeman

transnational corporations (TNCs), which target the youth market and subtly influence which brand of T-shirt or designer jeans you buy. It is interesting to note, however, that very few of the garments that are marketed and sold as 'made in the USA' or 'made in Australia' are actually made locally. Most are made in developing countries where labour is relatively cheap and health and safety conditions are not considered an important issue. See the Geofocus box 'Billabong, Quiksilver and Rip Curl'.

geofocus

Billabong, Quiksilver and Rip Curl: iconic Australian brands, global presence

The global boardsports market is dominated by three brands: Billabong, Quiksilver and Rip Curl. While Quiksilver is now a US-listed public company, based in California, all three companies have their roots in the Australian surfing culture.

Annual worldwide retail sales in the sector are now estimated to exceed US$5 billion. Billabong, Quiksilver and Rip Curl target the lifestyle brand conscious consumers in the 12 to 30-year-old age bracket.

Billabong

Since its founding in 1973, Billabong International Ltd (a publicly listed Australian company) has grown into one of the world's leading designers, producers and distributors of apparel and accessories for surf and board sports (surfing, snowboarding and skateboarding). It caters for both the male and female markets. Billabong's product range comprises over 2200 product lines in Australia, over 1300 product lines in North America and over 1200 product lines in Europe. Billabong's products are sold in more than 90 countries by its directly controlled operations in Australia, New Zealand, North America, Europe, Japan and Brazil and through licensed operations and distributors in other regions.

During the late 1960s and early 1970s, surfing emerged as a lifestyle choice for many young Australians. Gordon Merchant, founder of Billabong, settled on the Gold Coast designing and making surfboards. In 1973, Gordon and Rena Merchant began producing handmade boardshorts under their flat on Queensland's Burleigh Beach. The shorts were sold through local surf shops and markets. From these humble beginnings, Billabong was born.

As the demand for the Billabong branded boardshorts increased, a factory was first established at North Burleigh and then a larger one built at West Burleigh. During the 1980s Billabong went international when it began exporting clothing to California, Japan, New Zealand and Europe. In 1998, Billabong moved to its manufacturing and retail complex at 1 Billabong Place, Burleigh Heads.

In addition to Australia, Billabong produces its products in more than a dozen countries throughout North and South America, Asia and Europe.

The company's strategy has been to gain worldwide exposure by having surfers such as Joe Engle, Mark Occhilupo, Luke Egan, Wayne Bartholomew, Munga Barry, Shane Dorian, Taj Burrows and Sunny Garcia endorse its products. Other brand-building strategies include promoting and sponsoring boardsport events around the world.

FIGURE 2.3.11

Advertising for Billabong and Quiksilver merchandise outside a surf hire store on the Greek islands. Australian surf brands appeal to the lifestyle aspirations of young people by sponsoring popular sporting events around the world.

FIGURE 2.3.12

Australian surfwear retailer in Chamonix, France.

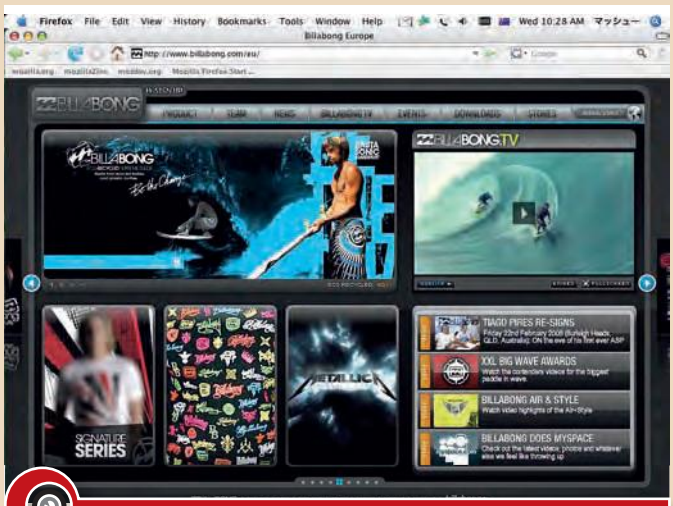


FIGURE 2.3.13

Billabong's European website provides an insight into the global reach of the brand.

Examples include the Billabong Pro contest held on the Gold Coast and Jeffreys Bau in South Africa.

Billabong's gross revenue exceeded $1 billion in 2006.

Quiksilver

In the late 1960s, Australian surfers Alan Green and John Law decided to pursue their dream: to live in Torquay, Victoria, make a living and go surfing. In 1969, Green started producing wetsuits (Rip Curl) with a loan of $2500 from his father. He next turned his attention to producing sheepskin boots (UGG Boots). In 1970, Green and Law formed a company, which they named Quiksilver.

US surfer Jeff Hakman was so impressed with the boardshorts produced by Quiksilver that he convinced Green and Law to grant him (and Bob McKnight) a licence to sell Quiksilver apparel in the United States. By the mid-1970s, a small office/warehouse/distribution centre was opened in Newport Beach, California. McKnight and Hakman built up their business using word of mouth and their extensive personal contacts with the owners of surf shops. In order to raise capital, Quiksilver undertook an initial public stock offering on the New York Stock Exchange in 1986. Green and Law continued to play a role in the company's Australian-based operations until 2002. In that year they sold the last of their rights to the Quiksilver name for $125 million to the US operations. Law and Green retained a 6% share in the company and have profit-share agreements in place.

Now in their sixties, Law and Green still live in Torquay for at least part of the year. The rest of their time is spent skiing or surfing at locations around the world, all funded by a combined fortune thought to be in excess of $400 million.

Today, the publicly listed US company's annual net revenue exceeds US$2.4 billion. It now controls a range of well-known brands, including Roxy, Rossignol and Dynastar (ski equipment), Cleveland (golf equipment) and Gotcha.

A big key to the success of Quiksilver has been its roots in surf culture and its sponsorship of top surfers, snowboarders, skateboarders, and surfing events. Quiksilver has the likes of world champion surfer Kelly Slater and skateboarder Tony Hawk on its sponsorship books. In order to maintain its 'edgy' brand image, the company has gone to great lengths to distance itself from mainstream retailing and advertising campaigns.

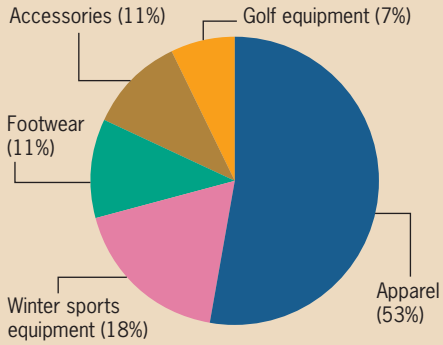


FIGURE 2.3.14

Quiksilver's sales by product type, 2006.

Rip Curl

Rip Curl was founded in 1969 by Doug Warbrick and Brian Singer at Torquay and is now a major Australian manufacturer and retailer of boardwear. From its initial focus on surfboards the company quickly identified the potential of adapting diving technology into a wetsuit suitable for surfing. Today Rip Curl produces not only surf gear but also apparel, mountainwear, eyewear, watches, footwear, bags and DVDs. Rip Curl has become one of the largest boardwear brands in Australia, Europe and South America and is growing rapidly in North America. Rip Curl remains a privately owned company. (See figure 2.3.15.)

FIGURE 2.3.15

Rip Curl, an iconic Australian brand.

FIGURE 2.3.16

Corporate sponsorship of large-scale sporting event. Taj Burrow of Australia celebrates winning the Foster's Association of Surfing Professionals (ASP) Men's World Tour–Rip Curl Pro at Bells Beach with runner-up Andy Irons of the United States in April 2007.

Corporate executives dream of a global market made up of people with homogenised tastes and needs… Logos on bottles, boxes and labels are global banners, instantly recognisable by millions who could not tell you the colour of the UN flag.

Richard J. Barnet and John Cavanagh, in D.C. Korten, *When Corporations Rule the World*, Earthscan, London, 1995

Global brands are the progeny [offspring] of global media, those mostly US-based media conglomerates which… have towered over the global market… [They are] the missionaries of our age, promoting the virtues of commercialism and the market loudly and incessantly through their profit-driven and advertising-supported enterprise and programming.

The Bulletin, 14 July 1998

The critical mass of teenagers—800 million in the world, the most there have ever been—with time and money to spend is one of the powerful engines of merging global cultures. Kids travel, they hang out, and above all they buy stuff.

E. Zwingle, *National Geographic*, August 1999

understanding the text

1 **Explain** the driving force of the fashion industry.
2 **Identify** where an increasing amount of clothing is made. Explain why.

working geographically

1 **Interpreting photographs** Study figure 2.3.8 (p. 317).
   - **a** What advertising techniques are used to promote the product advertised?
   - **b** Which market is being targeted?
   - **c** Find other examples of advertising that promotes teenage lifestyle aspirations. Share these with others in your class.

2 **Research task** At home, look in your wardrobe at clothes you have recently purchased and make a list of the brand names. Identify which are foreign made. In class, compare these lists and research where these companies are based.

3 **Research task** Study the Geofocus box 'Billabong, Quiksilver and Rip Curl' (pp. 318–19). Identify another popular brand you identify with and investigate its origins and global spread.

Promoting global consumerism: advertising and the media

The process of globalisation is responsible for both cultural and economic integration. As trade barriers around the world are lifted or altered, large corporations have been able to play an increasingly prominent role in the reshaping of society. Encouraged by the possibility of making huge profits, new industries in advertising, media, creative production, consumer research and marketing education have emerged to promote consumer consumption. When global corporations reach out and touch the four corners of the globe, they bring with them not only established products and brand names, but also their favoured media and sophisticated marketing methods.

The media, in all its forms, has become a central influence in shaping individual, community and national identities. It is also the preferred medium by which large corporations create a market for the products they sell. Global marketing campaigns, based around advertising and the sponsorship of major events (see figure 2.3.16), are used to promote products to vast audiences. By the end of 2002, just 10 TNCs (AOL Time Warner, Disney, General Electric, News Corporation, Viacom, Vivendi, Sony, Bertelsmann, AT&T and Liberty Media) controlled the vast majority of the media content available to audiences in most countries. These vast corporations have the power to determine what information is available to people and thereby influence public opinion, cultural identity and lifestyle expectations.

Advertising is one of the largest industries in the world. Tens of billions of dollars are spent annually creating demand for goods and services, all intended to improve one's 'self worth' or 'lifestyle'.

Advertisers are the major employers of persuasive language. They bombard audiences with jingles, trendy rhymes, rock songs and a variety of fast and fashionable images, which subtly take effect. Repetition and action are the key weapons used to reinforce the names and images of products in the audience's head. It is not uncommon during a sustained advertising campaign to see or hear the same advertisement broadcast numerous times throughout a TV program, particularly if a program is sponsored by a particular corporation; sponsorship is big business.

Two of the largest sponsors of community-related events and activities are Coca-Cola and McDonald's. Their aim is to create a forum in which their brand names can appear in front of vast numbers of people and thereby increase their sales. It is no secret that McDonald's and Coca-Cola are major sponsors of the Olympic Games. The exposure gained through such an event is enormous, as are the profits gained from this marketing opportunity.

Traditionally, advertisers tended to target two groups: children and what was referred to as the 'youth market' (11–19 year olds). There has, however, been a reclassification of 'youth' to include all those under 30. The reasons for this shift are many, but perhaps the most significant is the growing trend of this under-30s group not to leave home or marry until they are older. This, supposedly, leaves them with greater disposable income and savings available for the purchase of goods and services, such as cars, travel, computers, sporting equipment, gym memberships and home furnishings. Also falling into this new 'youth market' category are double-income families with no kids (dinks).

> *The spread of global communications technologies and global media empires has helped create a world of globalised culture. Barbie and the Lion King are as well known in Rio as they are in Perth or Hollywood. CNN brings us live coverage of the Superbowl and of missile strikes on Baghdad. Princess Diana's funeral becomes a globally televised ceremony of planetary grieving.*
>
> John Wiseman, Australian academic

understanding the text

1 **Explain** what allowed large corporations to play an increasingly prominent role in reshaping society.
2 **Identify** the new industries that have emerged to promote the consumption of the goods and services produced by TNCs.
3 **Outline** the role played by the media in the integrated global economy.
4 **Explain** why some people are concerned about the concentration of media ownership and control.
5 **Identify** the ethic underlying mass consumerism. Is such an opinion justified?
6 **Identify** some of the techniques that advertisers use to promote a product or service.
7 **Explain** why corporations such as Coca-Cola and McDonald's sponsor community-related activities.
8 **Explain** why advertisers have traditionally targeted the 'youth market'. How has this market been redefined in recent years?

working geographically

1 **Using ICT** Most large retailers are TNCs. Use the Internet to find out about the operations of one TNC. Write a report outlining its business operations and its record on environmental and human rights issues.
2 **Writing task** In your own words, explain the point that John Wiseman is making in the extract above.
3 **Research task** Take a class survey of the most memorable commercials. Consider what characteristics made them memorable. Also consider what image the commercial is trying to sell. As a consumer, would you be tempted to buy the product? Why or why not?

Sport

Sport is widely recognised as an important part of Australian culture. For many Australians, sport is tied up with the image we have of ourselves and the image we want the rest of the world to have of us. Sports stars often become popular heroes, sometimes placed on higher pedestals than film or rock stars. We watch and judge their performance keenly and share their triumphs and their failures, sometimes as if they were our own. For many, Australia's participation in international sporting events becomes an opportunity to express patriotism. Where sport is concerned, however, this appears to be an urge that is shared the world over; one only needs to look at international cricket or rugby matches to see evidence of this.

In Australia, sport was once considered to be the great 'leveller'. It symbolised equality between people by evening out differences and establishing what was once seen as a working class alternative to '**high culture**'. Today, this is not so evident, particularly with the infiltration of sports from other countries and events such as the Olympic Games, which attracts people from all classes in society.

Australian sport: is nothing sacred?

Australian sport is increasingly dominated by the three Ms: multinationals, marketers and managers. Tradition, loyalty and community heritage count for little. Sport is now a product to be sold like any other.

Players are bought and sold on the transfer market and have been transformed into human billboards. They carry advertising on their clothing and sporting equipment. At one stage Shane Warne wore a Nike swoosh on every piece of his clothing, as well as his earrings. Sporting personalities often have a number of corporate sponsorships, and product-endorsement agreements are negotiated by their management team.

Naming rights to stadiums are for sale together with their playing surface, now decorated with corporate logos that appear in perfect perspective on TV screens. Media companies have even experimented with 'virtual' advertising: the advertiser's message being temporarily 'projected' onto any surface, including spectators.

Whole sporting events have been 'hijacked' by large corporations. Nothing is sacred. The Melbourne Cup is now the Emirates Melbourne Cup. Cricket's historic Sheffield Shield has been replaced by the Pura Milk Cup. We also have the KFC Twenty20 Big Bash Cricket, The Louis Vuitton Cup (sailing), the Ford Ranger Cup (one-day cricket) and the Kia Australian Open tennis, and so on.

One outcome of this process is a huge increase in what critics have labelled 'visual pollution'. Sporting teams have become advertising billboards and the players are salespeople of everything from soft drinks to mobile phones. Sydney-to-Hobart yachts are floating billboards (see figure 2.3.17), with no name other than that of the corporate sponsor—a strategy that ensures maximum exposure of the sponsor's name and product.

It is not only the sporting personalities that can be hired, bought and sold; clubs too are now a product. They can be created to fit a corporate vision and can be destroyed when they no longer fit into a marketing strategy (rugby league's Perth Reds, Adelaide Rams and Hunter Mariners, for example). In rugby league, many older community-based clubs have been compelled to merge. If they fail to comply with the new corporate vision they are forced from the competition.

Two important factors are at play in this process:

- *Demographic change*. Larger disposable incomes, shorter working weeks, earlier retirement, longer life expectancy and healthier lifestyles have boosted the global demand for sport.
- *The communications revolution*. Ever more sophisticated TV coverage has made top sport (and the advertising, sponsorship and marketing that accompany it) available to a wider audience.

The future of sport is closely linked to that of the global media networks. (See pp. 337–9.) Rupert Murdoch's News Corp. (a New York and Australian listed public company) owns 50% of the National Rugby League in both Australia and New Zealand. In addition to this, News Corp. is a majority owner of the Brisbane Broncos and full owner of the Melbourne Storm and North Queensland Cowboys rugby league teams.

The amount of money involved is huge. Australia's top sportspeople now command million-dollar contracts.

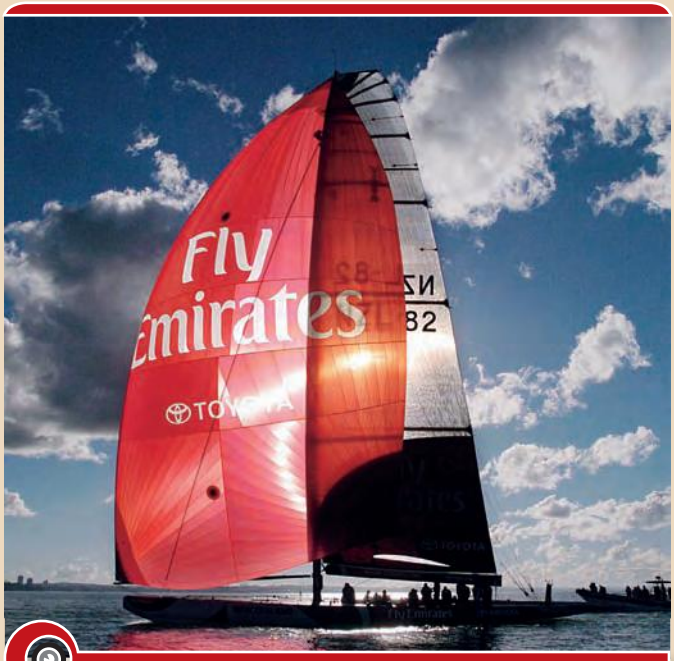


FIGURE 2.3.17

Emirates Airlines (together with Toyota) is the principal corporate sponsor of Team New Zealand's America's Cup yachting syndicate.

FIGURE 2.3.18

Australian sport is increasingly dominated by the three Ms: multinationals, marketers and managers. In the ARL every camera angle captures the logos of a team's major corporate sponsors. Henry Perenara of the Cronulla Sharks is tackled during a match against the Manly Warringah Sea Eagles at Toyota Park in 2007.

What is apparent, however, is the subtle change in the variety of sports played in Australia. It is only within the past 20 years that certain sports, including baseball and basketball, have taken off. Today, players from the US National Basketball Association (NBA) are recognised worldwide due to a slick marketing campaign that has sold the game and their faces are on everything from caps to bubble-gum packets. As a result, Australia has created its own Australian Basketball Federation (ABF) and has had some success in promoting players, such as Andrew Bogut and Lauren Jackson, to the US 'major league'. Like sponsorship deals, the 'buying' and 'selling' of players has become big business, and not only in basketball. Once again, cultural integration through economic activity is at work here.

The merchandising associated with sport is also another readily identifiable indicator of cultural integration. Australian teenagers, in common with their peers around the world, wear clothing and caps emblazoned with the names, logos and colours of US basketball and football teams.

understanding the text

1 **Outline** the role of sport in defining the Australian image.
2 **Explain** how the role of sport has changed in Australian society.
3 **Explain** how Australian sport has been influenced by the sports of other countries.

working geographically

1 **Group work** Working in groups, brainstorm the ways in which international sports have influenced Australia's culture. Share your findings with others in the class.
2 **Group work** Working in groups, brainstorm the impact of US sports marketing on Australian teenagers. Share the key points of your group's discussion.
3 **Class discussion** As a class, discuss the reasons why US sports have made little headway in securing commercial TV coverage in Australia.
4 **Using ICT** Use the Australian Sports Directory website to access the sites of the major Australian sporting organisations. Compile a list of the principal corporate sponsors of each sport.
5 **Using ICT** Access the website of Formula 1 racing. Identify the principal sponsors of the various Grand Prix and racing teams.
6 **Research task** Research which companies are sponsoring major events in your city or town. Consider areas such as sporting events, the arts, cultural events and educational activities. On the Internet or through other sources, try to find out how much money each of these companies spends on sponsorship and advertising and how many of them are foreign owned.
7 **Using ICT** Access the websites of the National Rugby League, Australian Football League and the Rugby Union. Compare these with the Internet site of the NBA in the United States. Assess the extent to which the Australian sites reflect a US approach to sports marketing.
8 **Using the media** Using the sports section of a major daily newspaper, compile a list of the corporate names, logos and advertising evident in the photographs. As a class, discuss the effectiveness of this type of advertising.

Music

One industry that is particularly at the mercy of marketing and globalisation is the music industry. If artists are to succeed in this highly competitive industry, they need to be contracted to one of the large music corporations: Sony BMG, EMI, Universal and Warner. These four companies have taken over vertical and horizontal control over almost every aspect of the industry. Universal maintains its position as the world's biggest recording company, with a 25.5% share of the world market. Sony BMG is next with a 21.5% share followed by EMI at 13.4% and Warner at 11.3%. The independent sector holds steady with a 28.3% global share. (See figure 2.3.19, p. 324.) In Australia, small bands are finding it difficult to compete and many of the local venues where they once played can no longer afford to sponsor them.

The only alternatives that exist for the truly competitive artist are to fund production of their own CDs or vie for a position as an opening act when internationally recognised groups or individuals perform. For some (including Pete Murray, Wolfmother and Silverchair) this

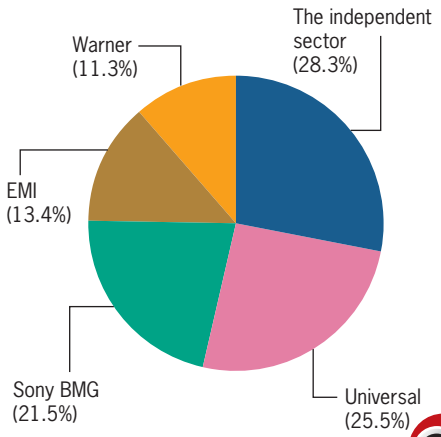


FIGURE 2.3.19

World music market shares, according to the International Federation of the Phonographic Industry (IFPI), 2005.

FIGURE 2.3.20

Globalisation is well advanced in the music industry. Many artists attract a worldwide following. Singer Matthew Bellamy of British rock band Muse performing at the Benicassim International Festival, Spain.

geofocus

Live Earth: concerts for a climate in crisis, 2007

Live Earth was a 24-hour, seven-continent concert series held in July 2007. It involved more than 100 artists and an audience estimated at 2 billion people. The aim of this global event was to trigger a worldwide movement to solve the climate crisis.

Live Earth reached this worldwide audience through an unprecedented global media network covering all media platforms: TV, radio, Internet and wireless channels. Official concerts were staged at the Giants Stadium in New York; Wembley Stadium in London; Aussie Stadium in Sydney; Copacabana Beach in Rio de Janeiro; the Coca-Cola Dome in Johannesburg; Makuhari Messe in Tokyo; the Oriental Pearl Tower in Shanghai; and HSH Nordbank Arena in Hamburg.

Live Earth marked the beginning of a multi-year campaign led by the Alliance for Climate Protection, The Climate Group and other international organisations seeking to convince individuals, corporations and governments to take action to solve global climate change. Former US Vice President Al Gore is the Chair of the Alliance and Partner of Live Earth.

FIGURE 2.3.21

Live Earth concert at Rio de Janeiro in July 2007: a global response to a global issue.

form of exposure has paid off, with all four being signed by large corporations.

Globalisation of the music industry also means that the music we are exposed to on radio stations and in music stores is mainly that of bands from the United States, Britain or Ireland. Australian artists account for less than 40% of the top 100 album sales by volume. This is considered an achievement given that recorded music is the most concentrated global media market and that Australia's share of global music sales is less than 2%. Part of this success can be attributed to radio stations such as Triple J and 96.1FM, which offer alternative music for the Australian 'youth' market.

geofocus

Grunge goes global

One of the best examples of how the media can promote a particular form of popular culture is the 'grunge' music of Seattle in the United States. In the early 1980s, grunge music was virtually unheard of outside the Seattle band scene. In 1987, the newly established record label Sub Pop set about recording the music of bands such as Nirvana, Soundgarden and Mudhoney. In 1989, Andy Catlin, an English music journalist, wrote an article for the influential *Melody Maker* magazine in which he promoted grunge and described Seattle as 'Rock City'. In 1991, Nirvana released their second album 'Nevermind'. A single from the album, 'Smells Like Teen Spirit', sold millions of copies worldwide.

The key to the band's success was the exposure it received in publications such as *Melody Maker* and on music video shows such as MTV. Grunge music now has a worldwide audience.

Rolling Stone magazine also played an influential role in building a cult following for this particular style of music. As with most new cultural styles, grunge music started off as a localised subculture. Its wider appeal is the result of the exposure it received in the media.

FIGURE 2.3.22

Grunge music, which originated in Seattle, in the United States, now has a worldwide audience. Tesla with special guests Adam and Matthew Genovese in concert.

geofocus

Hip hop

Hip hop is more than baggy jeans and explicit song lyrics. It's a cultural force that influences much of what we see and hear.

Hip hop (also known as rap) is a style of music that emerged in the Bronx, a borough of New York City, in the mid-1970s and became part of popular culture during the 1980s. Together with its associated breakdancing and urban-inspired graffiti 'art', hip hop is a cultural movement initiated by inner-city youth, mostly Blacks and Latinos. From New York it spread around the world. It is now widely regarded as an international, rather than American, genre of music.

In France, hip hop music and culture is closely associated with African and Arab teenagers living in the housing projects on the outskirts of Paris. Many of these teenagers have been alienated by racism and economic disadvantage.

Hip hop in the United Kingdom has been strongly influenced by the country's colonial links with the Caribbean and India. The influx of immigrants from these regions during the 1960s and 1970s has led to a hip hop focused generation born of immigrant parents and influenced by their cultural heritage, but who are firmly rooted in the Anglo (British) culture.

In Japan, the interest in hip hop mirrors the interest of many Japanese teenagers in all things African-American. A fashion style known as ganguro has emerged whereby young Japanese women darken their skin, apply flashy make-up and perm their hair or wear blond extensions in order to imitate hip hop beauty ideals.

Modern hip hop graffiti originated in Philadelphia and spread to New York City. It then spread to the rest of the world, with teenagers imitating and adapting the hip hop graffiti style. Today, there are also strong graffiti scenes in Europe, South America, Australia and Japan. Graffiti has been attacked by authorities and made subject to criminal sanctions.

FIGURE 2.3.23

Hip hop-inspired graffiti.

FIGURE 2.3.24

A Russian Orthodox church in suburban Sydney. Australia's religious diversity has grown as our society has become increasingly multicultural.

did you know?

Australia's changing religious affiliations

According to the 2006 Australian Census, nearly one in five Australians (19% up from 16% in 2001) stated that they are without religion, with the Anglican Church the hardest hit by decreasing numbers of followers.

Christianity remains the dominant religion, with 12.7 million followers in 2006. Yet, as a proportion of the population, Christianity dipped from 71% to 64%.

The number of Buddhists has doubled since 1996 to nearly 2% of the population, while Hinduism has also doubled in popularity since 1996 to now account for 0.7%.

One of the most influential forces promoting cultural integration is Music Television (MTV) and other local spin-off shows, such as *Rage*, which plays music videos simulcast on Triple J. MTV has become an advertiser's dream. Its near universal appeal to young people around the world makes it an ideal instrument for globalisation of the consumer culture. Whether we are aware of it or not, these processes are always inextricably linked with economic activity.

Religion

All individuals at some time in their lives ask questions to which there seem to be no ready answers. Such questions include:

- How is it that humans exist?
- What happens after death?
- What purpose, if any, does life have?
- Is there a god or some supreme being that controls the world?

Religions are an attempt to answer such questions. They offer a philosophy that seeks to explain the meaning of human existence and our place in the universe. Most religions or systems of belief share common features, such as a belief in a god and that god's prophet or messenger; the use of rituals; stories of the origin or creation of the world; and ethics and customs specific to that particular religion. There are some who argue that religion is based on belief, and that it is a cerebral or intellectual activity. The majority of world religious leaders would refute this, however, claiming that religion is an 'active' faith expressed through custom, practice and prayer.

People of different religions may argue over whether it is faith or 'works' that help one attain the afterlife. They may also view the world in different ways. Religions of the West tend to divide the world into the sacred and the **secular**. Eastern religions and those of indigenous peoples, however, do not generally make a distinction and view all created things as sacred. Many indigenous people are pantheistic; that is, they believe that God speaks to humankind through nature.

It is hard to imagine how globalisation may affect religion, but in many subtle ways it does. With the advent of the Internet, worldwide religious debates, discussion of ethical issues, and publishing of Scripture passages and other religious tracts became commonplace. International publishers, who once branded 'New Age philosophies' as 'whacky' or 'weird', are now finding that meditations on improving the soul have become mainstream and are big sellers. With increased tourism opportunities, people are able to visit cathedrals and other religious monuments far more easily than previous generations. Muslims around the globe who once thought they may never be able to make a pilgrimage to Mecca, now probably can, with the frequency and affordability of international flights increasing. All these developments promote cultural integration and are a consequence of globalisation.

Cultural integration in Australia has seen religious affiliation change over time. Anglicanism was once the largest religious denomination in Australia's colonial years. Today, however, due to increased immigration and the steady inflow of traditional Catholic families, Roman Catholicism is the largest denomination. (See figure 2.3.25.) In time, this may change again as Australians embrace more Eastern religions and New Age cults. One such religion that is on the rise worldwide is Buddhism. In Australia, Buddhism has become an attractive alternative to mainstream religions because of its emphasis on non-materialism. Such is the faith in the future of Buddhism here that in 1995 the Nan Tien Buddhist temple was built in Unanderra at a cost of $30 million. It is the largest Buddhist temple in the Southern Hemisphere and is open to visitors of all denominations.

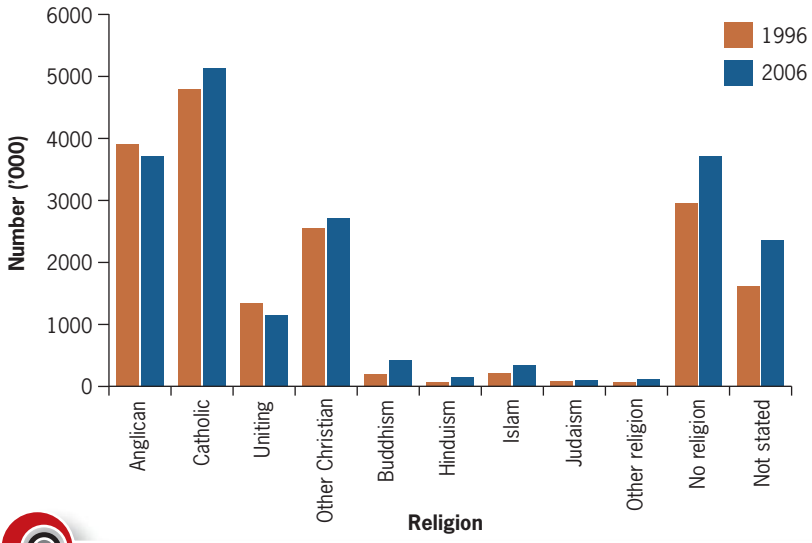


FIGURE 2.3.25

Change in religious affiliation, 1996–2006.

> *The accelerated movement of people and information has made borders more permeable and cultures of all varieties more interrelated and interdependent.*
>
> John Wiseman, *Global Nation? Australia and the Politics of Globalisation*, Cambridge University Press, Melbourne, 1998

understanding the text

1 **Explain** why the music industry is described as being at the 'mercy of marketing and globalisation'.
2 **Define** religion. Distinguish between religion based on 'belief' and religion as an 'active' faith.
3 **Explain** how globalisation has affected religion.
4 **Explain** how cultural integration has affected religious affiliations in Australia.

working geographically

1 **Research task** Investigate a song or artist that has been marketed without backing from music labels or have used the Internet to market their music in an innovative way. Start with Sandi Thom or Aimee Mann. The latter has produced her own records under a label she created and has sold her music via her website.
2 **Research task** Using the Geofocus boxes 'Grunge goes global' and 'Hip hop' (p. 325) as models, investigate the origins and spread of another music genre. Write a report outlining your findings.
3 **Interpreting graphs** Study figure 2.3.25. Write a paragraph outlining the changes in religious affiliation in Australia from 1996 to 2006. Speculate on the reasons for these changes.

Factors affecting cultural integration

When cultures interact they influence each other. Sometimes this occurs in quite subtle ways that do not enter the public's consciousness. On other occasions, the change may be more profound and become the focus of widespread community debate and protest. Any process that facilitates increased interaction between people will contribute to the process of cultural integration.

The factors affecting the rate and nature of cultural integration include technological change; the emergence of the global economy; TNCs; the liberalisation of world trade; the development of global media networks; and the actions of government.

The global economy

Economic activity forms an integral part of any culture. For this reason, it is important to gain an understanding of contemporary economic change and how it impacts on the lives of people.

Cyberspace is eroding [national] borders, at least in terms of jurisdiction. In fact, nation and state are often irrelevant in the formation and conduct of online communities. Intellectual properties flow freely across the Net, knowing no borders. What's more, all this is happening at a time when intellectual properties represent a greater and greater portion of both human industry and the global economy.

Vince Giuliano, *New York Times*, 5 June 1997

geofocus

Cyberspace

Cyberspace is perceived as a new human-created alternative place to the 'Real World'. A place which is seemingly a terra nullius. A place without history, without prior inhabitants. Is this a place that can be colonised without guilt?

M. Fuller and H. Jenkins, in D. Gibbs and K. Krause (eds), *Cyberlines: Languages and Cultures of the Internet*, James Nicholas Publishers, Melbourne, 2000

Cyberspace is the imaginary space in which computer users travel when 'surfing' the Internet. It is the universe created by computer networks. Cyberspace has created its own language and cybercultures. Many of the latter are a spin-off from existing subcultures. Commonly used tags include cyberpunks, technopagans, mondoids, informaniacs, zippies and cyberdelics; technocrats, technoprats, technobrats and cyberkids, computer geeks and cyberfreaks; hackers and slackers and cyberspace backpackers; cyborgs and bots and alters and cyberspace 'mirror creatures' and avatars; cyberjocks and cyberrockers, and technoravers and deadheads; and MUDders, and players and users and InterNETters, technicians and operators and Wizards, cyberspace cowboys, channel-surfers, site-hoppers and skin readers.

geofocus

Global village

In the 1960s, telecommunications and transport technologies experienced major advances. The world seemed to be shrinking. Marshall McLuhan, a Canadian writer, predicted that the planet would become a 'global village'.

For the first time, telephone users could make direct international telephone calls, and in developed countries TV began to compete with radio and print media. A new generation of passenger jets made international air travel faster and—thanks to cheaper fuel, increased capacity and reduced maintenance needs—more affordable. Yet such advances were still not available to all. Travel, for example, was still relatively expensive for many people.

In the decades following the 1960s, telecommunication and transport technologies have made tremendous advances. Today, high-volume communication technologies have greatly increased the flow of information. Reductions in the real cost of travel have greatly increased people's mobility. People travel more than ever, they communicate with others more frequently and they use Internet-based technologies to purchase goods and services via cyberspace. (See the Geofocus box 'Cyberspace'.) The global pattern of technology access is shown in figure 2.3.27. The countries with the darkest blue shadings have the greatest per capita technology access. Those with the lightest blue shadings have the lowest level of technological access.

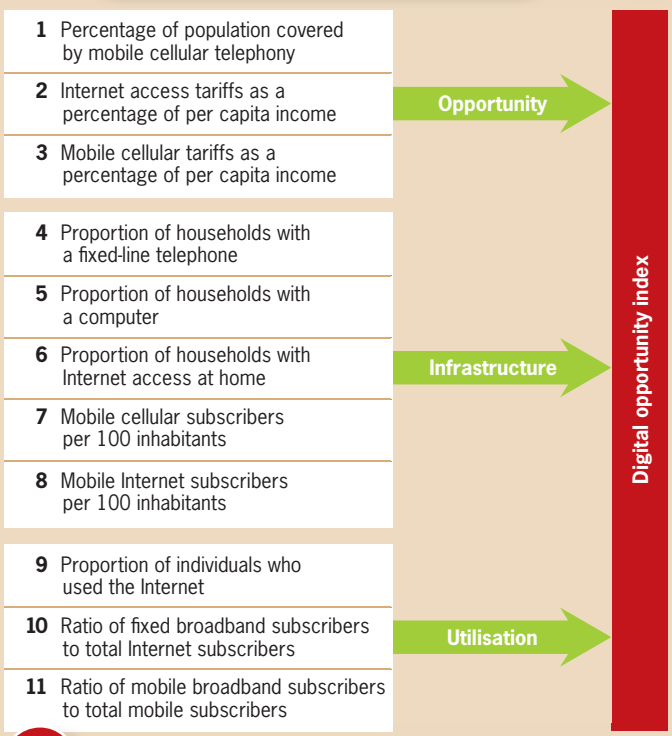


FIGURE 2.3.26

The components of the digital opportunity index.

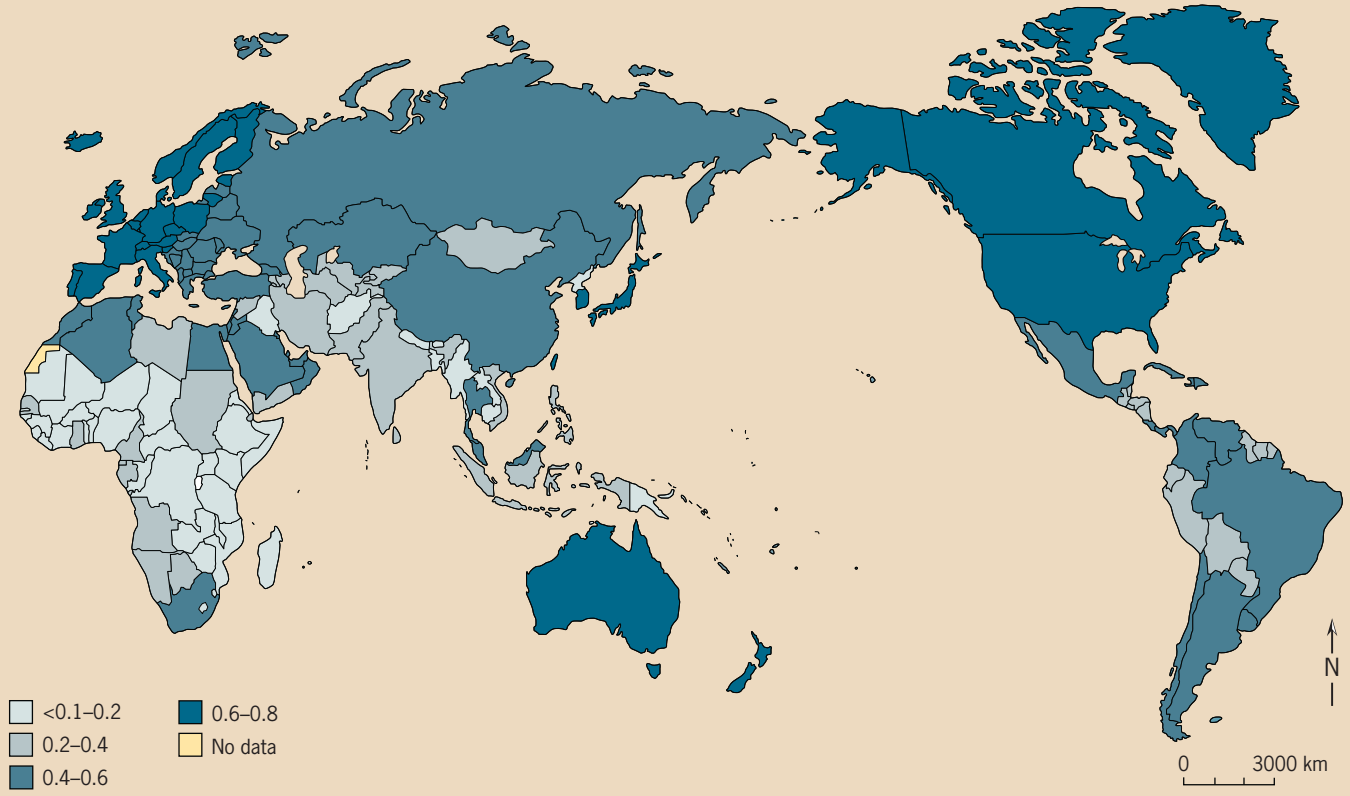


FIGURE 2.3.27

Accessing technology: the digital opportunity index (DOI), 2006. The index measures a country's ICT capabilities in infrastructure, access path and device, affordability and coverage, and quality.

geofocus

Technological change

New technologies in the area of telecommunications, transport and computers have transformed the ways cultures interact. Barriers that once existed, such as distance and cost, are being broken down at an increasingly rapid rate. This is allowing unprecedented mobility and has reconfirmed, at least in Western eyes, that the world really is a 'global village'. (See the Geofocus box 'Global village'.)

The *technological and telecommunications revolution* is redefining the way people and cultures interact. Large amounts of information can be accessed and transferred at the click of a mouse. Goods and services can be purchased from suppliers on the other side of the globe via the Internet. Financial transactions can be made over great distances 24 hours a day via telephone-based computer technologies. We can communicate with people in ways that were unimaginable just a generation ago and we can participate in events of global significance from the comfort of our living rooms via interactive TV and the Internet. These 'revolutions', made possible by microchip technology, have transformed our way of life, just as the Industrial Revolution did at the end of the nineteenth century.

did you know?

The DOI (see figure 2.3.27) can be used to track the changing dynamics driving the global information society. The index measures digital opportunity in terms of the possibility for a country's citizens to benefit from access to information. Index scores range from 0 to 1, with 1 representing complete digital opportunity.

geofocus

New technologies, new crimes; less privacy

While it is easy to see the many positive aspects associated with new computer technologies, their negative aspects are not always immediately clear. Two such aspects are the rise in new types of crime, and the potential threats to security and privacy; both are a consequence of these new global technologies.

Crime

Computers do not necessarily increase crime, but through modem and network connections they allow for new types of crime to be committed from the home or office. Because money can be moved about electronically, thefts can be committed without leaving any physical evidence.

Theft of knowledge and data is even easier. The speed and ease with which electronic data can be accessed makes it difficult to enforce copyright and patent laws. (A patent is a document granting an inventor sole rights to their invention.) New knowledge can be stolen as fast as it is recorded. In addition, the owners of such intellectual property have little or no way of controlling or even knowing who uses their property. International copyright laws grant and protect the exclusive right to publish and sell literary, musical or artistic work. These laws have been under scrutiny recently because of software piracy in South-east Asia and China. Piracy involves illegally duplicating software for commercial or personal use.

Types of computer crime include:

- *'Hacking'*. This involves gaining illegal entry to electronic networks and the data contained therein. These data may be 'stolen', have their copyright infringed or used illegally to gain a commercial advantage.
- *Creation of 'viruses'*. These are self-copying programs that, in general, are designed to create a nuisance, disable or even destroy computer systems and data.
- *'Slicing'*. This is the accumulation of the various fractions of a cent from account transactions in banks or retail stores. Fractions of a cent are normally rounded up or down but can be 'siphoned' off into a criminal's account instead.
- *Creation of false records*. Examples are creation of fake IDs, forgeries and false financial transactions, which might involve huge amounts of money.

In fact, because of the widespread availability of computer technology, every task or purpose to which computers can be put legally can also be used for illegal purposes.

Privacy

Databases exist today that store information about every person who has ever made an application for a loan, caught the attention of government security organisations, opened a savings account, applied for a passport or gained a driver's licence. If your name has been recorded for any purpose, chances are that you are in at least one database. Concerns about security and privacy of databases have further intensified now that databases have recently become commercial products. Databases may store information about a person's credit limit (from credit card records); address (from a phone directory on the Internet); buying history (from any credit card transaction throughout the world); assets (from banking records of money lending); criminal records (from police files); and education (from school examination results and university records). All these details provide organisations and other people with a considerable amount of knowledge about individuals. This can often be accessed without the person's permission.

Many of these databases are freely bought and sold between large corporations. In the United States these 'mailing lists' can sell for more than $100 000 and the practice has begun in Australia too. People are placed on mailing lists for 'junk mail' on the basis of their socioeconomic status, family size and age group. Certain companies make use of this information to sell particular products to selected individuals. Some organisations often know more about your financial activities than you do.

The computer has also become the heart of advanced police and military intelligence and surveillance systems due to its capacity for information storage, seeming infallibility, extensive search facilities and access to other computers.

Nick Leeson: rogue trader

Currency trading involves the buying and selling of currencies on the global market. In the early 1980s, currency trading was a glamorous job and the potential for large financial gains encouraged many traders to become greedy. The story of the collapse of Barings Bank at the hands of the rogue trader Nick Leeson is one of the most interesting case studies of financial disasters from this period.

Nick Leeson, born into a working class family in Watford, north-west of London, worked his way up from a low-paid job in London's financial sector in the early 1980s to become the star Singapore trader for Barings Bank. By 1993 Leeson had generated more than £10 million in profit for the bank. He was paid generous bonuses and was seen as a financial genius and rising star.

By 1994, however, Nick's luck had begun to run out as several of the world's markets began to move against him. For example, he gambled that the value of the Japanese yen would remain stable; however, the Kobe earthquake triggered an economic downturn that depreciated the yen significantly. In an attempt to recoup these losses, Nick made a series of increasingly risky new investments, which eventually resulted in losses of £827 million. This represented twice the bank's available trading capital and eventually led to the collapse of Barings Bank. Nick fled the country and was later recaptured and ordered to serve six and a half years in Singapore's Changi Prison for fraud and for deceiving his superiors. Barings Bank was eventually sold to a Dutch bank for £1.

geofocus

iPhone: transforming the way we communicate

Apple's iPhone (see figure 2.3.28) features an amazing range of technical abilities. In addition to being a mobile phone it is an iPod, and puts the Internet in the consumer's pocket with rich HTML email, web browsing, searching and maps. iPhone conects with both PCs and Macs to facilitate calling, texting, emailing, surfing, listening, and watching TV. Its multi-touch user interface makes it easy to use.

FIGURE 2.3.28

Technology continues to transform the way we communicate and interact. The iPhone is a multimedia and Internet-capable mobile phone from Apple.

The Internet is a global communications medium. Decentralized, flexible, and anti-monopolistic, it is particularly suitable to the promotion of pluralism, freedom of expression and access to public information.

Center for Democratic Technology

We are creating a world that all may enter without privilege or prejudice accorded by race, economic power, military force, or station of birth.

John Perry Barlow, former lyricist for the Grateful Dead, and co-founder of the Electronic Frontier Foundation

The period from the end of World War II (1945) to about 1970 is often referred to as the 'long boom' because it was characterised by relatively high rates of economic growth in the countries of the developed world. Most of this growth, which peaked in the 1960s, was based on the production of consumer goods by multi-plant (multi-factory), multi-product firms.

In the 1970s, ways of operating began to change. Firms endeavoured to expand by diversifying (that is, increasing the range of products they produced) or by increasing their market share. Mergers and corporate takeovers were common. By the late 1980s these processes had come to an end. In the 1990s, firms tended to concentrate on those core activities with which they had long-standing experience and left the non-core activities to specialist providers.

These changes occurred against a background of increasing international competition brought about by the emergence of the *global economy*: a system of interdependent national economies. The global economy is characterised by a system of production, marketing and finance that uses international trade and communication to move goods, money, information and people from one country to another.

understanding the text

1 **Identify** the factors affecting the rate and nature of cultural integration.

2 **Explain** how new technologies have transformed the ways in which cultures interact.

working geographically

1 **Interpreting text** Study the Geofocus box 'Cyberspace' (p. 328).
   - **a** Explain why cyberspace is referred to as a 'terra nullius'.
   - **b** Study the list of subcultures associated with the use of computers. Can you add to the list?

2 **Interpreting text** Study the Geofocus box 'Global village' (p. 328).
   - **a** Who coined the term 'global village'? What developments encouraged this type of thinking?
   - **b** Explain how technological advances have contributed to the process of cultural integration.
   - **c** Working in groups, list the technological innovations that have been introduced in your lifetime. How have these innovations changed the way people and cultures interact?
   - **d** Study figure 2.3.27 (p. 329). With the aid of an atlas, describe the global pattern of digital opportunity. With the aid of figure 2.5.5 (p. 416), describe the relationship between Internet use and GNI per capita.

3 **Interpreting text** Study the Geofocus box 'New technologies, new crimes; less privacy' (p. 330).
   - **a** Explain why copyright and patent law are difficult to enforce.
   - **b** List the types of computer crime. Explain each. Can you think of any others?
   - **c** Outline the privacy concerns associated with the new information technologies.
   - **d** Write a report outlining the costs associated with the introduction of the new technologies, particularly as they relate to crime and privacy.
   - **e** As a class, discuss the potential dangers you can see if security breaches continue to occur in global computer networks.
   - **f** Conduct a class debate. Topic: National security agencies should have access to companies' computer files.
   - **g** As a class, discuss what precautions, if any, could be put in place to protect database information. Consider why this is such a difficult undertaking.

4 **Using ICT** Using the media or Internet, find examples of the ways in which technology is used to facilitate the global transfer of information.

5 **Using the media** Collect newspaper and magazine articles relating to technological change. Write a synopsis of each and use the information to enhance your written responses to assessment tasks.

The global economy has several features:

- *It operates at a global scale*. Money no longer respects borders. With the tap of a keyboard, $2.26 trillion worth of foreign currencies are traded worldwide each day. The figure only appears as a blip on a computer screen but has the power to cause the downfall of an economy and, with it, the immediate plunge of millions of people into poverty.
- *It is networked*. Shoes from Italy and shirts from Hong Kong can be ordered by web and paid for by American Express, Visa or Mastercard through networked banking facilities. In terms of health issues, illnesses in Manila can be diagnosed by a doctor in Edinburgh and a second opinion obtained from a doctor in New York, all within hours of initial contact being made.
- *It is based on information*. In today's knowledge-based economy, **intellectual capital** drives the value of products. Therefore, rather than people manufacturing goods, more people are employed in service industries, particularly those involving IT.
- *It decentralises power*. The Internet allows anyone to publish, email, create or download information anywhere in the world. However, access to this service is confined mainly to Western countries and a limited number of wealthy people in developing countries.
- *It rewards openness*. The fact that it is basically a censorship-free zone, where information and ideas can no longer be repressed with ease, can be both a positive and negative aspect of globalisation.
- *It is becoming more specialised*. Goods can be ordered online directly from the producer, cutting out the wholesaler and retailer. Websites can be used to 'customise' the product; the consumer having the ability to select from a range of features, which the manufacturer then incorporates during the production process.
- *It is difficult for governments to regulate*.
- *It can be manipulated*. (See the text about Nick Leeson in the Geofocus box 'New technologies, new crimes; less privacy', p. 330.)

The changes described above and the impact they have on people are the result of a set of processes generally referred to as **economic restructuring**: the significant and enduring changes in the nature and structure of the economy brought about primarily by the emergence of the global economy.

The impacts of economic restructuring can be observed at a variety of geographical scales, from the global to the local. Economic restructuring has led to the rapid movement of money and other resources into and out of industries and sectors. Within the countries of the developed world, it has often involved the development of new conditions under which work is carried out and rewarded.

Rapid technological change and economic restructuring threatens to increase inequality and contribute to the development of a two-tier society. Workers who lack the necessary skills run the risk of being left behind. This will open the way for increased social disruption caused by retrenchments, factory closures and changes to the way production is organised. As the shift from the industrial era to the digital age continues to take place, this will become an all too common feature of our society.

Some commentators refer to the structural changes occurring, mainly in the countries of the developed world, as 'de-industrialisation'. *De-industrialisation* is defined as the relative or absolute decline in manufacturing employment. It is sometimes associated with a process known as 'jobless growth', where production increases without an increase in employment. A characteristic of the post-industrial society is the increased demand for services, resulting in the *service sector* becoming the dominant form of employment.

Transnational corporations: agents of cultural and economic integration

Central to the development of the global economy has been the emergence of transnational corporations (TNCs), which are businesses that operate internationally. The production and distribution of goods and services is increasingly dominated by these corporations, most of which are based in the countries of the developed world. There are currently about 69 000 such companies, with more than 690 000 foreign affiliate subsidiaries worldwide.

Although the earliest TNCs date from the mid-nineteenth century, it was not until the 1950s that their numbers began to increase significantly. As they grew, their economic dominance increased rapidly.

Most TNCs are very large. Of the world's largest 150 economic entities, 95 are corporations (63.3%). Wal-Mart, BP, Exxon Mobil and Royal Dutch/Shell Group all rank in the 25 largest entities in the world, above countries that include Denmark, Poland, South Africa, Greece, Finland and Ireland. In 2005, only 21 countries in the world had a GNP greater than the sales revenue of the world's largest TNC: Wal-Mart Stores of the United States. Another way to look at the power of TNCs is to recognise that the sales of the world's 10 largest companies exceed the combined gross national product (GNP) of the world's 100 economically least developed countries, including all the countries in Africa.

TABLE 2.3.1

Corporations versus countries, 2007

Country/Corporation	GDP/Revenue (US$ millions)
Wal-Mart Stores	287 989
BP	285 059
Exxon Mobil	270 772
Royal Dutch/Shell Group	268 690
Indonesia	257 641
Saudi Arabia	250 557
Norway	250 168
Denmark	243 043
General Motors	193 517
Finland	186 597
Ireland	183 560
DaimlerChrysler	176 688
Toyota Motor	172 616
Ford Motor	172 233
Portugal	168 281
Thailand	163 491
Hong Kong, China	163 005
Iran, Islamic Rep.	162 709
General Electric	152 866
Argentina	151 501

Source: mongabay.com

geofocus

Sydney's 'global arc'

When work on IT, or 'micro-electronics' as it was called then, first began in the United States in the 1960s, it began in a place known as 'Silicon Valley'. Silicon Valley is located on the west coast of the United States, in the San Francisco Bay area. Today, there are versions of Silicon Valley emerging all over the world. In Sydney, an 18-km stretch between North Ryde and Sydney airport, taking in North Sydney and Sydney's CBD, has become the new 'high-tech heartland' of the city. It is also commonly referred to as 'global Sydney' because it houses the offices of many of the corporations that are key players in the global economy. (See figure 2.3.29.)

FIGURE 2.3.29

Sydney's status as a world city was on show during the 2007 meeting of APEC.

> *There will be no national products or technologies, no national corporations, no national industries. There will be no national economies, at least as we have come to understand that concept… Each nation's primary political task will be to cope with the centrifugal forces of the global economy which tear at the ties binding citizens together—bestowing ever greater wealth on the most skilled and insightful, while consigning the less skilled to a declining standard of living.*
>
> Robert Reich, former US president Bill Clinton's Secretary of Labor

It has been said that arguing against globalisation is like arguing against the laws of gravity.

Kofi Annan, former Secretary-General of the United Nations

Globalisation, as defined by rich people like us, is a very nice thing... you are talking about the Internet, you are talking about cell phones, you are talking about computers. This doesn't affect two-thirds of the people of the world.

Jimmy Carter, former president of the United States (1977–81)

We must ensure that the global market is embedded in broadly shared values and practices that reflect global social needs, and that all the world's people share the benefits of globalisation.

Kofi Annan, former Secretary-General of the United Nations

Growth of TNCs

Most TNCs started out as small enterprises producing goods for sale in their domestic markets. Initially they used their profits to expand locally, often taking over other businesses within their particular industry. Before long some firms outgrew their domestic market and sought to expand overseas. Usually this involved the establishment of an overseas subsidiary through direct investment. During the 1960s and 1970s, many developing countries that had been a target of direct TNC investment tried to exercise some control over their activities by insisting on a degree of local equity (ownership and control) in such investments.

Partly in response to these restrictions, TNCs have developed systems of corporate control that, while not requiring direct ownership of capital (such as factories), still enable them to exercise control over the production, marketing and distribution of products, just as they did during the colonial era. To achieve this, they retain the ownership of a product, usually by a patent. Most TNCs now operate through a combination of joint ventures, licensing and franchise agreements, production agreements and subcontracting. This combination of processes, which is similar to those of the computer industry, is sometimes referred to as '*networking*'.

The main goal of the TNC is to generate a profit, which can then be reinvested with the aim of accumulating additional capital. By minimising the costs of production and by creating a worldwide demand for their products through global marketing campaigns, TNCs are often able to generate massive profits. These profits are then returned to the parent company based in a developed country. Very little of it ever reaches the poorly paid, low-skilled workers of the developing world. (See figure 2.3.30.)

The proliferation of TNCs and the growth of the global economy has, to some extent, diminished the sovereignty of the individual nation-state. Decisions made by TNCs are usually for the good of the company worldwide and may not be in the best interests of the individual countries in which TNCs operate. Decisions made in the boardrooms of New York, London and Tokyo, for example, can affect employment opportunities throughout the world. Individual national governments may be unaware of these decisions until after they are made.

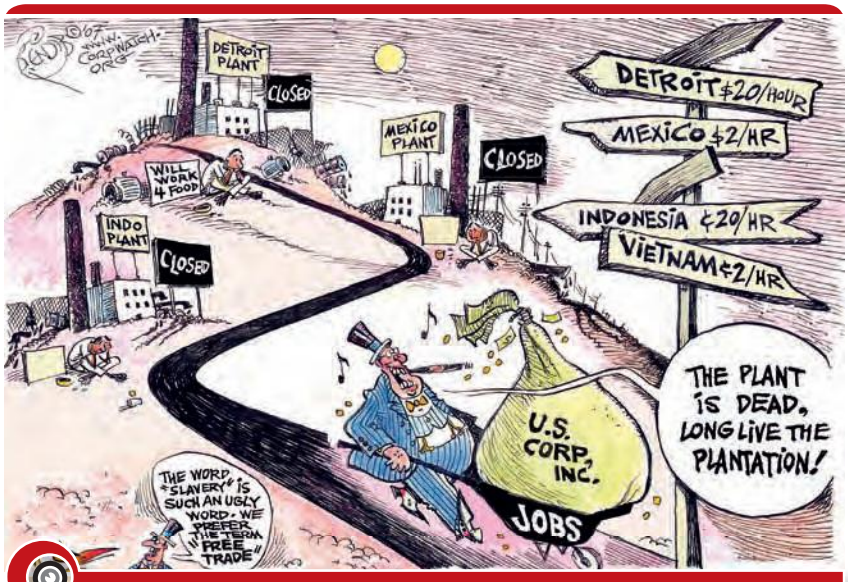


FIGURE 2.3.30

Many NGOs are critical of the actions of large TNCs that exploit differences in wage levels on a global scale to increase their profits.

Small firms going international

Many experts, speculating about the future of large TNCs within the global economy, believe that the influence of these corporations will diminish. They believe this will occur as a growing number of small- to medium-sized firms take advantage of the growth and accessibility of the global economy.

Factors enabling small- to medium-sized firms to go international include those listed below:

- Trade barriers have been removed. This has enabled small firms to gain access to markets that were once the preserve of the large corporations.
- Access to computer and telecommunications technology is no longer restricted, because of cost, to large firms. Each week an increasing number of small- to medium-sized companies are conducting their business operations 'online'.
- Financial markets have been **deregulated**. This has given small- to medium-sized firms access to capital investment.
- Consumer tastes have converged across borders as global TV marketing campaigns promote an ever-increasing range of lifestyle products and options.
- There is access to, and replication of, quality around the world. Smaller firms are often better placed to respond to changes in the patterns of consumption because they are often more able to adapt production to shifts in demand.

The benefits that large corporations derived from economies of scale are no longer apparent in a global marketplace that demands innovation and responsiveness. Trade data from the United States confirm this trend. There is evidence from the United States that small businesses send their exports to a wider diversity of countries compared with medium-sized and large firms. One explanation for this is that small firms are more flexible and therefore better equipped to take advantage of small export markets. These markets may not be attractive to larger businesses that focus on reducing costs through economies of scale.

The liberalisation of world trade

Central to the growth in the international movement of goods and services and the emergence of the global economy has been the liberalisation of world trade and a reduction in the costs of transport. Liberalisation of world trade is the removal of obstacles to free trade, such as quotas, nominal and effective rates of protection and exchange controls.The ability to move goods and services rapidly has been largely dependent on the removal of trade barriers.

The World Trade Organisation (WTO) is the international body that oversees the measures designed to reduce levels of *protectionism* and foster an expansion of international trade. Increasingly, the WTO is the focus of protests by those opposed to the process of globalisation. The meetings of the **G8** in 2007 (in Rostock, Germany) and WTO in 1999 (in Seattle, United States) were both disrupted by a series of often violent demonstrations. (See p. 353. See also the Geofocus box 'WTO protests and the response of popular culture', p. 336.)

Trade liberalisation has also taken place via regional trade agreements. These agreements aim to facilitate the movement of goods and services between member states. The most notable international trade-based groupings include the European Union (EU), North American Free Trade Association (NAFTA) and Asia Pacific Economic Cooperation (APEC). Of these, the EU is the most advanced. (See the Geofocus box 'The European Union', p. 336.) The EU's function now goes well beyond trade-related issues. It has introduced its own currency (the euro) and the movement of people across international borders has been deregulated.

FIGURE 2.3.31

The Internet has enabled small and medium-sized firms, such as Australian wine producer First Creek, to operate in a global marketplace.

did you know?

Protectionism refers to the policy adopted by some countries to protect local industries from competition from firms in other countries through such means as import quotas, tariffs and subsidies. More informal means of protectionism are time-consuming and expensive import-inspection procedures and the imposition of lengthy testing periods before new imported products are approved for sale. The policy of protectionism is consistent with the belief that domestic manufacturers and workers need to be shielded from foreign competition by placing trade barriers on foreign goods.

Group of Eight (G8) an international forum for the governments of Canada, France, Germany, Italy, Japan, Russia, the United Kingdom and the United States.

As a result of the expansion of world trade, many corporate executives of large TNCs claim that their firms have grown beyond a narrow national interest to become more global in their outlook.

> *Though few companies are totally untethered from their home countries, the trend toward a form of 'stateless' corporation is unmistakable. The European, American and Japanese giants heading in this direction are learning how to juggle multiple identities and multiple loyalties… These world corporations are developing chameleon-like abilities to resemble insiders no matter where they operate. At the same time, they move factories and labs 'around the world without particular reference to national boundaries', says Unisys Corp. Chairman W. Michael Blumenthal.*
>
> *Business Week*, quoted by Korten, 1995

All of this is done in the name of advancing global competitiveness. Many people, however, question the cost of these changes, especially in terms of their impact on people.

free trade unrestricted access to international markets. Advocates of free trade argue that by gradually removing barriers to the free international movement of goods and services it is possible to boost global economic growth and the prosperity of individual countries.

geofocus

The European Union

The European Union (EU) is the world's most powerful trading bloc. Formed in 1957 as the 'European Community', it now has 27 member countries with a combined population of more than 490 million people. Among the goals of the EU are economic and political integration. There is **free trade** between member states, and common labour and industrial laws now apply.

In the late 1990s, the EU (bar Britain, Denmark, Greece and Sweden) voted to introduce a single currency: the euro. This single currency is now shared by 13 countries, representing nearly two-thirds of the EU population. This has made travelling between countries easier. It has also done away with the systems of currency that were once unique to each country. This is not just a technical change of currency; it is the creation of a new economic bloc. It may, in time, rival the United States in the global marketplace.

geofocus

WTO protests and the response of popular culture

The anti-globalisation movement has influenced popular culture in a variety of ways. Several punk rock bands, for example, have aligned themselves with the movement. Bands such as Anti-Flag (whose song 'Seattle Was a Riot' was inspired by the protest), Pennywise (who wrote the song 'WTO' in protest to their actions) and Against Me! (the chorus to their song 'Baby, I'm an Anarchist' refers to the riots).

Rage Against the Machine used footage of the protests and subsequent police actions in their music video 'Sleep Now in the Fire'.

Bands such as Leftöver Crack released a CD in 2005 entitled F*** World Trade and, together with Crack Rock Steady 7, have often shown support for the anti-globalisation movement. The Seattle-based Infernal Noise Brigade, established as a musical group to play at the Seattle protests, remained together until 2006; they also performed at the protests accompanying events such as the 2004 Republican National Convention and the G8 summit in Auchterarder, Scotland, in 2005.

The Seattle Hip-Hop group Blue Scholars has a song named '50K Deep' on their 2007 album 'Bayani' that refers to the Seattle WTO 'uprising.'

FIGURE 2.3.32

G8 protest at Auchterarder, Scotland, 2005.

understanding the text

1 **Explain** what a TNC is.
2 **Explain** why the 1945–70 period is often referred to as the 'long boom'.
3 **Outline** how the behaviour of firms changed in the 1970s and 1980s.
4 **Define** the term 'global economy'. What is it characterised by?
5 **List** the features of the global economy.
6 **Explain** what is meant by the term 'economic restructuring'. Outline some of the impacts of economic restructuring.
7 **Explain** what is meant by the terms 'de-industrialisation' and 'jobless growth'.
8 **Outline** the role played by TNCs in the global economy.
9 **Outline** the development of TNCs.
10 **Explain** the concept of 'networking' when it is used to describe the manner in which TNCs operate.
11 **Explain** how TNCs respond to attempts by certain developing countries to exercise some control over their activities.
12 **Identify** the motives of the decision-makers within TNCs.
13 **Outline** the ways in which the actions of TNCs diminish the sovereignty of countries.
14 **List** the factors that have enabled small to medium-sized firms to go international.
15 **Explain** the difference between protectionism and free trade.
16 **Outline** the role of the WTO.
17 **Explain** the purpose of trade agreements made at a regional scale.

working geographically

1 **Research task** Investigate the impacts of economic restructuring in your local community.
   a Have any businesses closed? If so, what reasons were given for the closure?
   b Have any new industries been established?
   c How has employment in the local area been affected?
2 **Research task** Use the media and Internet to collect information relating to economic restructuring. Outline the social costs of economic restructuring.
3 **Writing task** Write a discussion. Topic: The benefits of economic restructuring outweigh the social costs.
4 **Class debate** Conduct a class debate. Topic: It is the responsibility of government to protect people from the impacts of economic restructuring.
5 **Using ICT** Use the Internet to investigate the role of the WTO.
6 **Using ICT** Use the Internet to investigate the opposition to the activities of the WTO. Why do many developing countries and human rights groups oppose the WTO's decision-making processes?

Global media networks

The media, in all its forms, remains the single most influential promoter of cultural integration. It is, therefore, important that we develop our understanding of the changes taking place within the industry, most notably the shift from national to global media networks.

Until quite recently, the electronic media were dominated by 'free-to-air' broadcasters, operated by both the public and private sectors at a regional and national scale. The regulation of these broadcasters centred on the notion of 'public interest', a belief that broadcasters should promote cultural and political unity.

The mechanisms used to regulate the industry included control over the granting of broadcasting licences, restrictions on foreign content and rules limiting the concentration of media ownership. Beginning in the mid-1980s, the major commercial operators were able to secure from governments a regulatory framework less reliant on the principle of public interest and more accommodating of commercial considerations. These operators had been encouraged by a shift in government policy towards deregulatory models of economic management. Viewers were no longer seen as members of a particular community, but as members of a consumer market. In Australia, as elsewhere, regionally based TV stations were progressively absorbed into national networks in a process known as *aggregation*. This process has now gone one step further. We are now seeing the increasing dominance of the global media organisation.

The process of globalisation is transforming the industry. It is driven by technological innovation, deregulatory economic policies, global economic integration and the emergence of a transnational corporate

culture. The process of change has resulted in an industry dominated by a handful of large, principally US and Western European corporate players: Time Warner, Rupert Murdoch's News Corporation, Walt Disney, Bertelsmann, CBS, Viacom and Vivendi.

These corporations have set about constructing a global media market. Their objective is to ensure their products (and those of their advertisers) reach the largest possible number of consumers. They regard international borders as **arbitrary** and irrational obstacles to this objective. The result has been a **standardisation** and **homogenisation** of world markets, which are characteristic of cultural integration.

arbitrary based on, or subject to, discretion; not fixed in a real sense.

standardisation the act of making something uniform in composition and/or character.

personalised media media where the user has greater discretion over the material and services they access.

Motivated by the pursuit of profit and capital accumulation, the major media players have sought to expand vertically. They are extending their control over all aspects of programming (that is, production, film archives), distribution and transmission. These companies are also at the forefront of technological innovation. They have taken advantage of the convergence of entertainment, information and telecommunications technology to move beyond the mass media and into that of **personalised media** and greater individual choice. They are, for the most part, the providers of the new media services; that is, pay TV, telecommunication services, home banking and shopping, video on demand, computer games and software and other interactive services. These services utilise new delivery systems (that is, satellites and cable) and new forms of payment, such as subscription. The merger of Time Warner and America Online in 2000 to create a US$350 billion media giant highlights the nature of the change taking place within the industry.

The development of global news providers (such as CNN, BBC World Service, Fox, Reuters and Sky News) has the potential to increase the amount of information available. However, it has also increased the level of standardisation, which, in turn, reduces the range of perspectives available to the public. Increasingly, the media is becoming detached from the restraints and influences of place and culture. Until the 1997 launch of CNN's Spanish language news network, CNN en Español, the CNN News Group largely ignored regional and local differences by providing a global English news service that had the same content, regardless of which country viewers live in. (CNN News Group is now owned by Time Warner.)

By its ability to implant identical images into the minds of millions of people, TV can homogenise perspectives, knowledge, tastes and desires, to make them resemble the tastes and interests of the people who transmit the imagery. In our world, the transmitters of the images are corporations whose ideal of life is technologically orientated, commodity orientated, materialistic and hostile to nature. And satellite communications is the mechanism by which television is delivered into parts of the planet that, until recently, have been spared this assault.

Jerry Mander, US commentator

This concentration of views has become known in media circles as the 'CNN effect', where audiences worldwide are presented with sober assessments of 'the facts' from a CNN perspective. During military campaigns in which US soldiers are involved (Kosovo in 1999 or the conflict in Iraq that commenced in 2003, for example), the media coverage is carefully orchestrated (or arranged) to ensure an impressive demonstration of Western military might. There is also a significant increase in the number of news bulletins to achieve mass saturation of the marketplace. Despite claims to the contrary, rarely do CNN news reports examine an issue from a range of perspectives. One point of view tends to prevail and it is usually a pro-Western perspective. Media organisations such as CNN and Fox News now dominate the dissemination of news and visual images. An alternative, Arab, perspective on world affairs is provided by Al Jazeera. (See the Geofocus box 'Al Jazeera'.)

In Australia, the commercial media is said to be in the hands of too few people. In fact, in no other democratic country is the media dominated by only two key players: News Corporation and John Fairfax Holdings. Many people believe that the increasing concentration of media ownership leads to a narrowing of information sources. Recent changes to the Federal Government's foreign ownership laws, along with the introduction of

private equity firms, is likely to significantly alter the pattern of media ownership in Australia over the next decade. There will be an increase in cross-media ownership (for example, newspapers buying an interest in TV and radio stations) and a growth in online media.

private equity firms firms that make capital available to companies or investors, but are not listed on a stock market.

Future media technologies

Over the past two decades, the entertainment and telecommunications industries have replaced the military as the driving force behind technological innovation. Billions are being spent on research and development. New technology-based products are released onto the market every day, many of which are superseded within months by faster, more powerful models. Technologists are working overtime to keep up with global demand.

Many of the technologies are converging. This means that they can perform an increasingly sophisticated range of functions. TV and Internet technologies have, for example, merged as a result of digitisation. Many media experts claim that digital TV (DTV) has not yet reached its potential to revolutionise the way people live. It is likely that in the near future people will begin to use DTV in the way they currently use computers. DTV has a range of advantages, including the following:

- Superior image resolution will greatly improve the quality of TV viewing. The emergence of high-definition digital TV (HDTV) has enabled further gains to be made in this area.
- It provides an opportunity for multi-channelling, whereby broadcasters provide more than one TV channel at the same time.
- It has compatibility with computers and the Internet. This enables instant access, via the Internet–TV-integrated DTV set, to the stock market and other financial institutions. Bank consumers will be able to access their account and conduct transactions from home as they can currently do through the Internet.
- New channels and multiple camera angles will be available.
- There will be instant access to world sports events as well as casino games. The TAB will be only a click away when making a bet.
- There will be direct access to takeaway restaurants. Select a meal, click on an icon, pay with a credit card and the meal will be delivered to your door.
- It offers the potential to order goods and services online through TV sets. Large retailers will be the first to provide interactive content on DTV. Consumers will be able to buy their groceries, white goods, electronics and books online through their TV sets as they currently do on the Internet.

dissenting view an opinion that disagrees with the dominant perspective or point of view.

International Monetary Fund (IMF) the international organisation that oversees the global financial system by observing exchange rates and balance of payments, as well as offering financial and technical assistance; based in Washington DC, United States.

geofocus

Al Jazeera: providing an alternative perspective on global events

Al Jazeera, Arabic for 'The Peninsula', is a TV network based in Doha, Qatar. First established as an Arabic news and current affairs satellite TV channel, the organisation has since expanded into a network of several specialty TV channels.

Al Jazeera's willingness to broadcast **dissenting views** created controversies in Arab Gulf States and in the United States. The station gained worldwide attention following the September 11 attacks when it broadcast video statements by Osama bin Laden and other al-Qaeda leaders. The network again came to prominence when it reported claims of torture against prisoners at the infamous Abu Ghraib prison and massacres allegedly committed by US troops in Afghanistan and Iraq during the conflicts there.

geofocus

The wide world of Disney

The Walt Disney Company is a US$59.8 billion media conglomerate. It may just be the single most powerful and influential force in the globalisation of Western culture. In this century, the real power to promote and consolidate consumer capitalism will not be held by the **International Monetary Fund (IMF)** or global brands, such as Nike or McDonald's. Instead it will lie with control over the 'infotainment' industry: film, TV, music, ideas and information.

Disneyland in Orlando, Florida, contains four separate theme parks. In addition, there are Disneylands in Anaheim (California); Hong Kong; near Tokyo; and outside Paris, France. Disney theme park attendances are shown in figure 2.3.33. Since 1952, Walt Disney parks and resorts division has grown to encompass the Disney Cruise Line as well as seven Disney Vacation Club resorts with more than 100 000 members.

Besides film production and distribution, the company is also involved in book, magazine and newspaper publishing; cable TV; music recording; live stage shows; real estate development; major league baseball and ice hockey; video production and sales; retail stores; product licensing; and computer software and online services. The revenues from these activities are shown in figure 2.3.35. In 1996, Disney signed a 10-year deal with McDonald's giving the fast-food chain exclusive rights to promote Disney products.

The Walt Disney Studios distributes motion pictures under Walt Disney Pictures (which includes Walt Disney Feature Animation and DisneyToon Studios), Touchstone Pictures, Hollywood Pictures and Miramax Films. Buena Vista International serves as the studio's international distribution arm.

Despite Disney's vast profits, contractors producing Disney-branded clothing in Haiti have an average hourly wage of 28 US cents. If workers meet the quota set by management they can reach the top wage rate of around 42 US cents an hour. The reality, however, is that even the best sewers only reach the quota two or three times a week.

FIGURE 2.3.34

The Walt Disney Company is one of the most influential forces in the spread of Western cultural domination.

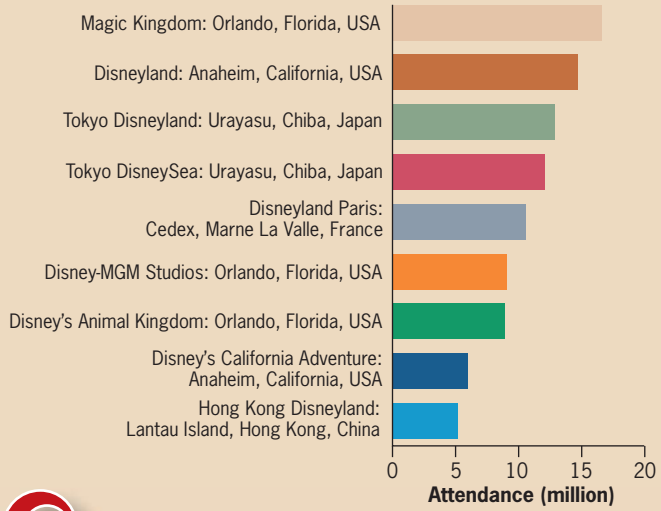


FIGURE 2.3.33

Disney theme park attendances, 2006.

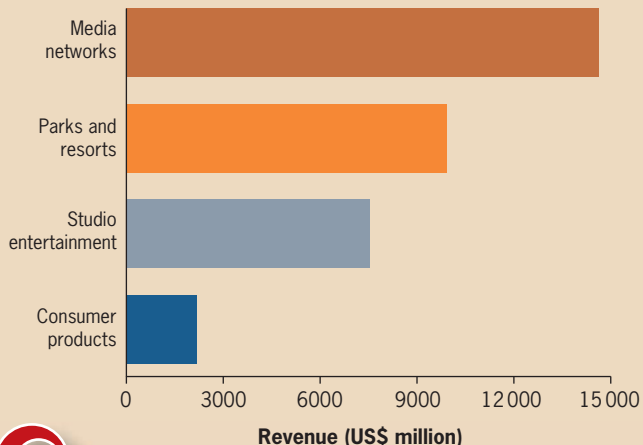


FIGURE 2.3.35

Disney revenues, 2006.

understanding the text

1 **Outline** the changes that have taken place in the media industry since the 1970s.
2 **Describe** the factors that have contributed to the emergence of global media networks. What is the objective of global media networks?
3 **Outline** the technological innovations taking place within the electronic media.
4 **Explain** what is meant by the statement 'the media is becoming detached from the restraints and influences of place and culture'.
5 **Explain** the 'CNN effect'.
6 **Outline** the impact that DTV (especially HDTV) is having on the way people interact with the media.

working geographically

1 **Using ICT** Use the Internet to investigate one of the global media corporations mentioned in this section of the text. Present an oral report outlining the results of your investigations.
2 **Writing task** Imagine you are a marketing manager for the companies making HDTV. Write the advertising campaign you would use to sell the product.
3 **Class discussion** Discuss how HDTV will be used to continue promoting cultural integration.

Cultural imperialism

American fast food, fashion, music, TV, books, magazines and especially movies are the universal elements of the emerging global culture. Their dominance is so widespread and pervasive that critics now refer to the process as cultural imperialism: the dominance or hegemony of one culture over all others.

There is plenty of evidence to support such a view. US-based media organisations, for example, produce over 75% of the TV programs shown around the world. In Australia, the cultural presence of the United States is particularly strong. Australian TV has a heavy reliance on US-produced programs. The same can also be said for Australian cinema. The vast majority (more than 60%) of the films screened in Australian cinemas over the past three decades have come from the United States. In contrast, local titles over the same time period have accounted for approximately 10% of all films. The US dominance is even greater when it comes to box office earnings: over 85% of tickets sold in 2006 were to US-produced films. The origin of films screened in Australia in 2005 is shown in figure 2.3.36.

There are those who regard the process of cultural integration as far more complex than simply the spread of American popular culture. They argue that globalised culture is really a *hybrid culture*: the result of the intermingling of cultures. This is most noticeable in countries with a multi-ethnic mix, such as Australia. In such a context, American popular culture becomes just one of many elements contributing to cultural change.

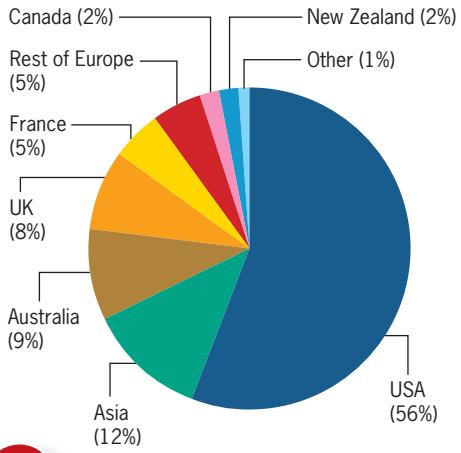


FIGURE 2.3.36
Origin of films screened in Australia, 2005.

The actions of governments

The difficult task of managing economic globalisation while maintaining some degree of social cohesion and cultural identity is common to all countries at the dawn of the twenty-first century. On one hand, many governments have actively promoted the process of cultural integration. They have done this by deregulating their economies, encouraging the introduction of new information-based technologies, supporting immigration programs and promoting multiculturalism. Other governments, while generally welcoming the perceived benefits of economic integration, fear that the introduction of American popular culture and excessive commercialism will destroy local cultures.

understanding the text

1 **Explain** what is meant by the term 'cultural imperialism'.
2 **Outline** the evidence to support the view that the world's cultures are threatened by US cultural imperialism.
3 **Outline** the problem that governments face when trying to manage economic globalisation.
4 **Explain** the conditions under which a hybrid culture develops.
5 **Outline** some of the ways countries have sought to protect local cultures.
6 **Outline** some of the strategies used by authoritarian governments to isolate their people from outside cultural influences.

working geographically

1 **Class discussion** As a class, discuss the reasons for the increasing international dominance of English.
2 **Class discussion** As a class, discuss the view that the Internet is a 'culture killer'. Is the description justified?

In particular, the countries of Europe and Asia have sought to protect themselves against the influence of American values and attitudes. In Europe, for example, governments have imposed quotas and local content targets to nurture local film industries and preserve local cultures. Despite these interventions, US films still account for more than 70% of the cinema market in Europe.

Some countries, including Vietnam, have taken a more aggressive approach and banned the importation of 'harmful cultural products'; that is, films, magazines and videos with 'unwholesome' content. In the early 1990s the Vietnamese Government launched a campaign aimed at removing unwanted cultural influences. During the campaign, 23 000 Vietnamese suppliers of 'harmful cultural products' were arrested.

The French have been particularly conscious of the impacts of cultural integration. The government goes to considerable lengths to protect the integrity of French culture. It has used both restrictive legislation and incentives to restrict English language material in France, especially US computers and software. Rather than allow the French language to absorb or adopt words from other languages the French create new French words.

The vehicles of cultural integration have also come under intense criticism from selected governments, including the French. These governments have labelled the World Wide Web a 'culture killer'. For these governments, the issues are US cultural imperialism and the Americanisation of cyberspace.

In some cases, governments, most notably those of North Korea and Burma, have used authoritarian measures to isolate their people from outside cultural influences. These measures include political repression, the control of the media, limited access to communications technology, and restrictions on travel to and from the country. (See the Geofocus box

geofocus

Technology shaping culture in North Korea

North Korea has a centralised government under the rigid control of the communist Korean Workers' Party. One of the key policies of this regime has been to strictly control the access to foreign media and Western cultural influences. Few North Koreans, for example, have access to the Internet. For the wealthy minority of the population who do, access is primarily available through Chinese networks and service providers. This is likely to change in future years as more and more North Koreans gain access to web-enabled mobile phones smuggled through northern China. Despite the best efforts of the government to stop this trade, increasing numbers of Korean youth are now starting to use mobile phones rather than computers to access information on the Internet.

Currently, those who gain Internet access through Chinese service providers are subject to the government's sophisticated filtering system. It blocks access to websites containing information considered detrimental or hostile to the Chinese regime. Online criticism of the government is monitored and sometimes punished with jail sentences. The interesting consequence of this is that while online information critical of the United States and the West is widely available on the Chinese-controlled Internet, information that is critical of the Chinese regime is generally much harder to come by. In short, North Koreans looking at the outside world via the Chinese-controlled web will see a much more favourable picture of China than of the United States.

'Technology shaping culture in North Korea'.) In 1996, Burma introduced laws that made owning, using, importing and borrowing a modem or fax machine without government permission a crime punishable by up to 15 years in jail.

Conclusion

As a result of the factors outlined above, the past two decades have seen the conscious and intentional transformation of the world into a borderless domain. The architects of this change have a vision: they desire to see a world in which universalised symbols, created and owned by the world's most powerful corporations, replace the distinctive cultural symbols that link people to a particular place. The fact that these cultural symbols are an important source of identity, which give meaning and value to people's lives, seems to pass unnoticed in the minds of corporate decision-makers. Essentially, they are seeking nothing less than a yielding of power, where countries allow corporations to define their culture. Thus, rather than being Australians or New Zealanders, we might simply become members of the 'Pepsi generation'. While this might seem a little far-fetched, we need to be aware that the market forces at work are more subtle and tyrannical than we may expect. TNCs are no less effective than state-led tyrannies at enslaving the many, to the interests of the few.

The impacts of cultural integration

The closing decades of the twentieth century ushered in the digital age and spelt an end to the Industrial Revolution. At no other period of time in our history has there been so much change affecting every aspect of our daily lives. Things that once made each culture unique and different are now being replaced or modified by things that don't. Individuality is out; being a part of the 'global village' is in. Politically, countries are being forced to change to accommodate decisions imposed on them by international bodies over which they have little control.

Globalisation has brought about a vast expansion of economic, social and cultural interactions. These interactions affect some places

FIGURE 2.3.37

The Chinese-born US architect Ieoh Ming Pei designed the glass pyramid that now dominates the entrance to the famous Louvre museum in Paris.

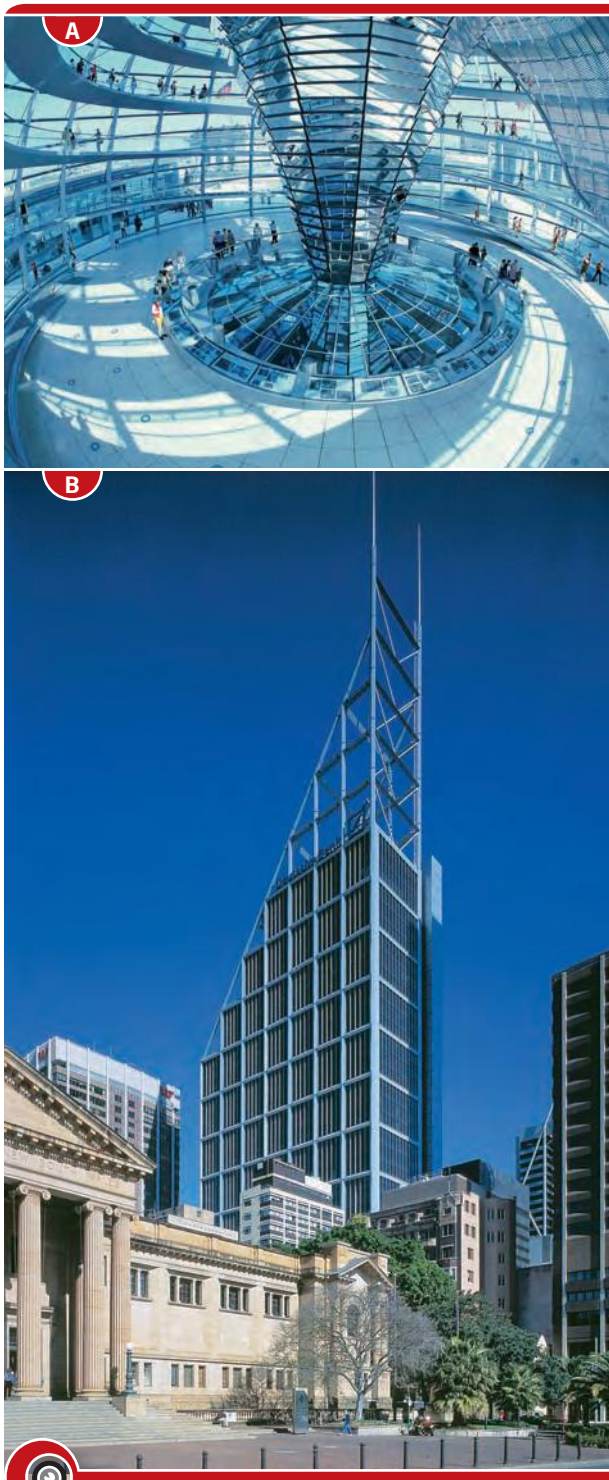


FIGURE 2.3.38

Examples of the architectual genius of Norman Foster can be found in all the world's great cities, including Sydney. **A** Reichstag Dome, New German Parliament, Berlin. **B** Deutsche Bank, Sydney.

Our village was prosperous… The real foundation of our prosperity… was the deep and enduring sense of community that enabled us to make the best use of these resources… We had all the things we needed—well-crafted, beautiful things that lasted a long time—but we did not do much 'consuming'.

Eknath Easwaran, author of the *The Compassionate Universe*

(and people) more than others. While nation-states continue to exert considerable influence, the process of globalisation makes it increasingly difficult for the state to control economic activity. States have responded in different ways, with some embracing globalisation and others seeking to insulate themselves from the global economy. The system of nation-states is unlikely to disappear, but the 'new world order' is likely to be one in which the spatial distribution of power is much more complex than suggested by the traditional map of nation-states. Describing and explaining that spatial distribution is the role of geographers.

In this section of the text we will examine some of the impacts of cultural integration: the homogenisation of urban landscapes; economic dominance and dependence; the threats to cultural diversity and sovereignty; and the 'shrinking' of time and space (the idea that distance and time are no longer the barrier they once were). Particular attention will be given to the growing backlash to the perceived excesses or disadvantages of cultural and economic integration.

Homogenised urban landscapes

In a world that is constantly changing, where we live and how we interact with each other has become increasingly important. Whether it is the local village or a large urban centre, where we decide to live, work and interact determines the access we have to the important social, economic and political networks. As globalisation continues, the landscapes and streetscapes that once helped define our countries and cities are no longer uniquely ours. Icons of cultural integration are everywhere; billboards advertising Calvin Klein underwear and neon signs for McDonald's and Pizza Hut serve to make our cities more similar. These are the new landmarks of a consumer generation and they are multiplying fast. They are not made to complement our landscapes, but rather to stand out as a unifying symbol of Westernisation (or Americanisation). They are symbols of hope and 'security' for some, but to others they mark the end of individuality and the beginning of a **monoculture**.

The architecture dominating our large cities is becoming increasingly international. The architectural diversity that once enriched our cities is

monoculture a culture with very low levels of diversity.

geofocus

The fate of place?

John Casey, in his book *The Fate of Place*, describes a growing trend towards a global monoculture in which technology, physical mobility, and the increased speed of global social and economic exchange converge to overwhelm traditional regional differences. Cities fall prey to increasing uniformity of architectural structures and commercial institutions; skyscrapers and McDonald's can be found from Santiago in Chile to Kuala Lumpur in Malaysia. Economic exchange makes it possible to access the same goods in multiple countries while decreasing the diversity among businesses from which we buy. Electronic technology makes it possible to connect with individuals across the planet while simultaneously permitting users to mask or reconfigure their own identities into online persona. The overall result of globalising influences is to cultivate an overwhelming sense of human anxiety regarding 'placelessness', or the inability to forge identity based on a sense of local or regional belonging.

FIGURE 2.3.39

Western-style shopping malls, such as this one in Dubai, contribute to the creation of homogeneous urban landscapes. Christmas is not a tradition in the Muslim United Arab Emirates, but in the cosmopolitan Gulf emirate of Dubai, it's an occasion for lavish decoration, shopping fever and elaborate celebration.

West rises in China's back yard: developers model European, American cities for new middle class

By ARIANA EUNJUNG CHA

Songjiang, China—The ding-dong from the neo-Gothic church next door signals to Wu Yuqing that it's time to wake up. On her way to the grocery store each day, she walks past the Cob Gate Fish & Chip shop and bronze statues of Winston Churchill, Florence Nightingale and William Shakespeare. Tall men decked out in the red uniforms of the Queen's Guard nod hello.

The place looks a lot like a small town on the Thames River, but Wu's new home is actually in a suburb of Shanghai.

As China's modernisation continues to pull hundreds of millions of people from farms to cities and suburbs, a construction boom has given rise to a vast landscape of foreign-looking settlements. These real estate developments are the latest manifestation of the technique that has fueled China's economic boom: making copies.

In Nanjing, there are Balinese retreats and Italian villas. In the southeastern city of Hangzhou, there are Venice and Zurich. In downtown Beijing, everything is about Manhattan, with SoHo, Central Park and Park Avenue.

'Many people in China today associate the exotic with wealth. They buy into these developments to differentiate themselves from ordinary people,' said Tino Wan, a manager of ERA Real Estate in Shanghai.

Shanghai's plan is among the most ambitious, calling for a ring of satellite developments modeled after different parts of Europe, including German, Czech, Spanish and Scandinavian districts, in addition to the one that looks like London, known as Thames Town.

Between now and 2015, about half the world's new construction will take place in China, with as much as 6 billion square feet [about 0.5 billion m^2] of space expected to be added each year. All over the country, block-like concrete edifices and empty fields are giving way to flashy architectural developments that promise to give the new middle class a taste of places most of them have never seen.

'Self-colonisation'

Some traditionalists, however, have lamented the trend, blaming it for the destruction of older, Chinese-style homes and attacking it as a form of 'self-colonisation'.

Yu Renze, 74, a retired government administrator from Shanghai, said she did not understand the appeal of the Western-style developments and that she would not allow her family to live in them even if someone gave her a house. 'We're not foreigners,' she said.

But Ren Bing, general manager of Venice Aquatic City in Hangzhou, said these theme complexes should not be disparaged. 'Even many Americans in America also prefer to buy non-American things,' Bing said. 'It doesn't mean people are denying traditions their ancestors have passed down.'

Indeed, Wu said she has no desire to leave her country even though she likes the comfort and ambience of her new four-bedroom townhouse. 'It's like I'm living abroad, but it's still China and everyone still speaks Chinese,' said Wu, 45, an investor.

If not for the street signs with Chinese characters in Venice Aquatic City, it would be difficult to place where in the world you were exactly. Gondolas ply canals just below Hu Jun's new apartment. Her view includes porticos with flowers and half-moon bridges. 'St Mark's Plaza' is a five-minute stroll away.

In all, the eight-square-mile (20.7 km^2) Venice Aquatic City will house 4500 residents in villas, townhouses and high-rises…

James Ho, director of Henghe Real Estate, which developed the downtown area of Thames Town, also talks about efforts to create an escape. Shanghai's Thames Town is not an exact replica of anything in Britain but features a mishmash of hundreds of years of architecture, from Gothic to Tudor.

Thames Town has, however, found itself embroiled in controversy. Shop owners in Britain contend the development has stolen names and details from their establishments. The owner of the Rock Point Inn and the Cobb Gate Fish Bar in Lyme Regis has complained that the Rock Point Inn and Cob Gate Fish & Chip shop in Shanghai look like someone cloned her businesses.

John Lu, a real estate agent with ERA, repeated the adage that imitation should be considered flattery. Even so, he said, most of his customers neither recognise nor care whether the details are perfect.

'Ninety-nine out of 100 Chinese will tell you they don't know Italian from Spanish from French,' Lu said. 'They just know it costs a lot and it's different—so it's good.'

Washington Post, 11 April 2007

FIGURE 2.3.40

Villas modelled on nineteenth-century French chateaux at Palais de Fortune, Beijing, China.

geofocus

Renzo Piano

Italian-born Renzo Piano is one of the world's most innovative architects. He first came to international attention with his radical design for the Georges Pompidou Centre in Paris. Since then he has been responsible for a number of imaginative projects in New Caledonia, Japan, the United States, Germany, Italy and France.

With offices in Paris, Genoa and Berlin, Piano's 100-person architectural firm manages as many as a dozen world-class projects at a time. Piano's recent projects include a performing arts complex in Rome, a pilgrimage church in southern Italy, a combination store and artisan's studio for the luxury goods maker Hermès in Tokyo and the Whitney Museum of American Art in New York. Piano's first Australian commission was a 38-storey office and apartment tower in Sydney's Macquarie Street. The striking building is enveloped in a massive translucent glass 'sail'. (See figure 2.3.41.)

Piano also oversaw one of the most politically and symbolically important building projects in postwar Europe: Berlin's Potsdamer Platz. Spanning an area the size of 100 football fields, this high-rise complex of offices, residences, shops, theatres and cinemas is intended to capture the pre-war vibrancy of the city's central business district. (See figure 2.3.42.)

FIGURE 2.3.41

Renzo Piano's apartment complex in Macquarie Street, Sydney.

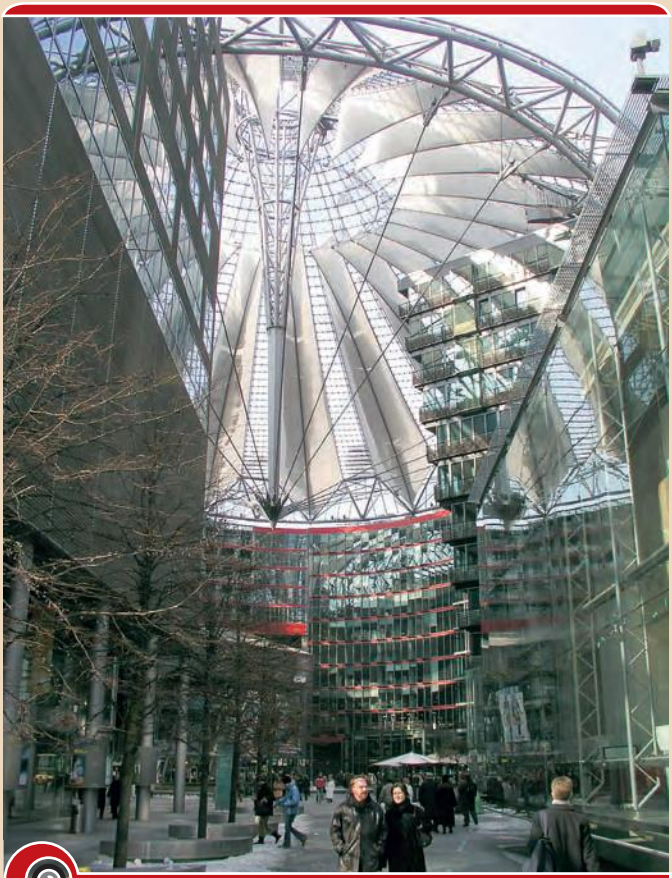


FIGURE 2.3.42

Part of the giant Potsdamer Platz project, Berlin.

FIGURE 2.3.43

Renzo Piano and his Aurora Place tower.

FIGURE 2.3.44

Australia's suburban landscape demonstrates how migration can spread elements of different cultures. Immigrants bring aspects of their architectural and cultural heritage with them.

being replaced by a blandness of design. The typical office tower owes nothing to the cultural or physical context in which it is located. They are part of the international style: 'Manhattanisation'. A tower in Sydney is much the same as a tower in Manhattan in New York or one in Tokyo, Cairo, Bombay or Cape Town. Another increasingly popular trend in some parts of the developing world is for urban planners to design satelite developments that mimic the city layouts and building designs of major Western cities, including London, Zurich and Venice. (See the newspaper article 'West rises in China's back yard', p. 345.)

There are, of course, exceptions to this blandness of design. A relatively small group of internationally renowned architects are leaving their creative mark on some of the world's great cities. Among the most prominent members of this group are Renzo Piano (see the Geofocus box 'Renzo Piano'), Ieoh Ming Pei (see figure 2.3.37, p. 343) and Norman Foster (see figure 2.3.38, p. 343).

Australia's suburban architecture also illustrates the impact of cultural integration. Successive waves of immigration have left their mark on the suburban streetscape. Each group of immigrants brings elements of its own architectural and cultural heritage. This is often reflected in the dwellings they build. (See figure 2.3.44.)

Economic dominance and dependence

The rise of the TNC and the increasingly dominant role played by the world's major economic powers has increased global inequalities and made many of the world's poorest countries increasingly subject to decision-making processes beyond their control.

As the activities of the TNCs have become more global, so too have the industries that service them. These include banking, management consultancy, accounting, law, insurance and advertising. Globalisation is most advanced in the world's financial markets. Large financial institutions speculate on movements in exchange rates and interest rates, and firms now have access to a global pool of investment capital. London, Tokyo, New York and Hong Kong are the most important financial centres in the new global economy. (See the Geofocus box 'The global city', p. 348.)

With a technologically linked global capital market, consumers are now able to benefit at a local level. Services once only offered at a bank

understanding the text

1 Refer to the quote by Eknath Easwaran on page 344. Explain, in your own words, the point being made by Easwaran.
2 **Outline** the impact of globalisation on the world's urban landscapes.
3 **Explain** how Australia's immigration program has affected the streetscape of its suburban areas.

working geographically

1 **Interpreting text** Study the Geofocus box 'The fate of place?' (p. 344).
   - **a** What is meant by the term monoculture?
   - **b** What evidence is there for the existence of this monoculture?
   - **c** What factors does Casey see as being responsible for the emergence of a global monoculture?

2 **Interpreting text** Study the newspaper extract 'West rises in China's back yard' (p. 345).
   - **a** List three examples of foreign-themed developments in Chinese cities. Describe the nature of these settlements.
   - **b** Explan why the Chinese are keen to invest in these types of properties.
   - **c** Outline the factors driving the current construction boom in China.
   - **d** Why do the 'traditionalists' object to these developments?
   - **e** Explain how this is an example of the adoption and adaptation of consumer culture.

3 **Writing task** Write a report outlining the impact that globalisation has had on the role of the nation-state.
4 **Interpreting text** Use the Internet to investigate the work of the architects mentioned in this section of the text.
   - **a** What are their latest projects?
   - **b** Where are these projects located?
   - **c** Describe the nature of the projects.

   Give a brief oral report outlining the findings of your research.

5 **Photography** Use digital photography to illustrate the view that our urban landscape is increasingly dominated by the icons and symbols of a 'global culture'. Mount a wall display.
6 **Undertake fieldwork** Identify elements of the streetscape in your local area that reflect the cultural heritage of particular immigrant groups.

The recent quantum leap in the ability of transnational corporations to relocate their facilities around the world, in effect makes all workers, communities and countries competitors for these corporations' favour. The consequence is a 'race to the bottom' in which wages and social conditions tend to fall to the level of the most desperate.

Jeremy Brecher, quoted by Korten, 1995

geofocus

The global city: facilitating economic and cultural integration

The term 'global city' is used to identify cities that have a global as well as national importance. They are centres of global finance and house the headquarters of many of the world's largest TNCs. Decisions made in these cities affect the livelihood and well-being of people all around the globe. World cities are the nodes (or central cores) in a web of long-range communications and are dependent on local, regional and global markets for their inputs of food, energy and raw materials. The profits generated by turning these inputs into goods and services contributes to their economic dominance and to other countries' economic dependence upon them.

Global cities are also centres of cultural dominance. The cultural innovations and trends that take place within them are transmitted, via the media, to communities around the world. Some of the innovations and trends interact with the local culture, which is modified to varying degrees, by this interaction.

FIGURE 2.3.45

Global cities, such as London, are centres of economic and cultural dominance.

can now be had from a variety of vendors, such as hotels, supermarkets, retail stores, service stations and post offices. This increased level of access has contributed to a major rise in the mass consumption of goods and services. As expected, much of the benefit derived from this technology and increased consumption has occurred in the developed, rather than the developing, world.

'Competition' in the new global economy is what it is all about. As a result, companies, both large and small, are pitted against each other

as they try to survive. As contracts become more difficult to obtain, some companies will resort to using child labour, others will reduce wages, while others will operate in unsafe conditions: all to ensure that their businesses stay profitable. With millions of people desperate for any kind of work, there will always be competitors in the marketplace willing to go just that little bit further.

Formal and informal economies

While working conditions in developed countries, particularly among migrant workers, are often poor, in the developing world, they are often substandard. In many developing countries there now exist two economic systems influencing patterns of employment: one is the *informal economy*, the other the *formal economy*. Often these economies occupy the same geographical space (that is, exist in the one location) but the links between them are poorly developed.

Features of the informal economy include the following:

- It is labour intensive, and usually small and locally owned.
- It exists to serve the needs of the urban and rural poor and tends to be outside the control of authorities.
- Jobs in the informal sector often foster self-reliance, personal autonomy, self-identity and the development of personal skills.
- Employment in the informal sector is usually greater than in the formal sector. If given the opportunity, however, most people would opt for work in the formal sector.
- At the community level, small self-help groups have cooperated to improve living conditions. Community-based groups have built schools and health clinics and provided basic infrastructure, such as communal taps and toilet blocks and waste collection. Much of the work performed within this context occurs on a reciprocal or unpaid basis.

Features of the formal economy include:

- There is large-scale manufacturing, most of which is foreign-owned or controlled
- Goods are produced for export markets.
- It has very high levels of unemployment and underemployment.
- Jobs are poorly paid and there is suppression of trade unions.
- Working conditions are often hazardous and workers are readily dismissed if they seek to organise and campaign for improved work conditions.
- Local wealthy elites and an expanding middle class use cheap labour and imported technologies.
- It includes jobs associated with government activities.

Given the role played by TNCs in many developing countries, one might assume that general working conditions would be of a reasonable standard. As the features of the formal economy show, however, this is very rarely the case. More often than not, the exploitative colonial tendencies of the past still exist. The exploitation of labour in developing countries is now the focus of a major international campaign by human rights organisations. (See p. 355.)

FIGURE 2.3.46

The informal economy, as shown in this photograph of a shoe seller in China, caters for the needs of the urban and rural poor and tends to be outside the control of authorities.

Land ownership

Overpopulation, it is often claimed, is a major cause of low living standards in developing countries. Many people wrongly assume that living standards would rise if people simply had fewer children. At first glance, this argument may appear to have some merit, but it fails to account for cultural differences between countries; for example, differences in terms of the status of women and the acceptance of contraception. Nor does it allow for the uneven distribution of wealth

and resources, especially arable land. Arable land is critical because it enables people to meet their own basic needs.

Land ownership is a strong indicator of levels of inequality in society, particularly when one considers that most of the available arable land in the world is owned by less than 0.5% of the population. Arable land refers to land suited to crops, and it is not a resource in abundant supply. Only approximately 22% of the planet's land surface is arable and more than half of this is already utilised. As a result, the world's food supply is less secure than at any other time in recent history.

In developing countries, it is often the case that a rich and powerful minority of landowners, including foreign corporations, occupy most of the productive land. The peasant majority are forced to make do with what is left. This is rarely enough to feed their families and, as a result, most are forced to live in poverty. As landlessness increases, many drift off to the already crowded cities in the hope of finding paid employment. Most end up living in squatter settlements and relying on the informal sector for a living.

Because of the debt crisis, developing countries have been encouraged by their creditors, and institutions such as the IMF and World Bank, to grow export crops (such as sugar, coffee and flowers) instead of food for local consumption. The IMF and **World Bank** solution of 'export or perish' all too often becomes a case of export and perish, as some countries pay up to 50% of their GNP in interest repayments on previously accumulated debts. A number of countries (including Indonesia, the Philippines, Thailand and Malaysia, to name just a few) are locked into high-interest repayment schemes. In some cases, the IMF and World Bank interfere directly in the affairs of debtor countries. In return for financial support, governments are required to deregulate their economy and cut government spending in order to attract foreign investment and reduce debt. Those most affected by spending cuts are the very poor. Throughout the developing world there is growing hostility to the interventions of these international bodies.

understanding the text

1 **Explain**, in your own words. the concept of economic dominance and dependence.
2 **Explain** how consumers have benefited from the technological developments within global capital markets. Have these benefits been equally shared? Explain your answers.
3 **Explain** how competition in the global economy leads to the exploitation of workers.
4 **Define** the term 'global city'. What functions do these cities perform?
5 **Outline** the features of the informal economy. Give examples of the types of activities you would normally associate with this sector.
6 **Outline** the features of the formal economy.
7 **Explain** why access to land is so important for the well-being of people in developing countries.
8 **Explain** how the actions of the IMF and World Bank have reduced the amount of arable land available for food production.
9 a **Describe** how the IMF and World Bank respond when countries are unable to repay debt or experience economic difficulties.
b **Explain** who usually suffers as a result of such interventions.

working geographically

1 **Critical thinking** Consider Jeremy Brecher's comment. (See p. 348.) In your own words, explain what he means by a 'race to the bottom'.
2 **Class discussion** As a class, discuss the reasons why the majority of workers would opt for employment in the formal economy rather than the informal economy even though work conditions are often worse in the former.
3 **Writing task** Write a report outlining the differences between the informal and formal economy.
4 **Class discussion** Why do you think that TNCs do not spend more of their profits on improving working conditions in developing countries? In your opinion, should they? Why or why not? Share your opinion with others in the class.

Threats to cultural diversity and sovereignty

Cultural diversity is what makes each country different. In the past, this diversity was always something to be celebrated. In a globalised world such diversity is often portrayed as irrational and backward looking. Corporations spend vast amounts of money trying to standardise consumer markets, and international bodies, such as the WTO, seek to regulate the operation of the global economy. While some countries are happy to go along with this, others are fighting to retain what national sovereignty and cultural identity they can. They fear that Westernisation will not only rob them of their identity, but also the values, faith and languages that have long been part of their culture. When one looks at the world emerging around us, it is understandable why some countries are struggling to protect what is their own. For other countries, it is already too late. (See figure 2.3.48.)

The 'Hollywoodisation' of the world

Many countries fear that their young people will sacrifice their own cultural identity to be more like the stereotyped characters portrayed by the Hollywood marketing machine. Hollywood thrives and survives by presenting images of youthful beauty, adventure and romance. It also promotes values and attitudes that are Western (American) in origin, and inevitably influence the thinking and lifestyle expectations of people throughout the world. Unfortunately, many of the attitudes and values on offer are not of the kind that teach respect for oneself and a love of diversity. They also portray lifestyles that are unattainable for the vast majority of the world's people.

This billion-dollar industry single-handedly controls more than 70% of the film content seen in some countries and its power to influence people's way of thinking is enormous. When the Taliban seized power in Afghanistan in 1996, their first commitment was to ban foreign films and other cultural intrusions. Elsewhere, the opposition comes from those whose livelihood is threatened by the importation of American movies.

FIGURE 2.3.47

Protesters demonstrate against the low wages paid to Chinese workers making merchandise for the Hong Kong Disney theme park. Disney films play an important role in generating the demand for the merchandise produced by the workers.

FIGURE 2.3.48

Icons of culture are everywhere.

geofocus

English as an agent of cultural integration

The role of the English language as an agent of cultural integration is of particular concern to many governments; and why wouldn't they be concerned?

- More than 1 billion people now speak English.
- Sixty per cent of the world's radio broadcasts are in English.
- Seventy per cent of the world's mail is addressed in English.
- Eighty-five per cent of international phone calls are in English.
- Eighty per cent of the material available via the Internet is written in English.

The French are not alone in seeking to protect the purity of their language. Iceland has a committee that uses existing Icelandic words and sounds to create new words, rather than simply adopting the English equivalent. In 1993, the Russian Government passed a law requiring all stores and businesses to display signs in Russian. So now McDonald's, Pizza Hut, Benetton and other Western-based retailers must have signs in Russian, and the Russian signs must be bigger and more prominent than those in English.

In French-speaking Quebec, a province of Canada, the parliament enacted a French-only sign law and appointed so-called language police to ensure there were no signs in English. Following a legal challenge, the law was changed to permit non-French words, but only if the French words were at least twice as big.

Other countries see lack of proficiency in English as limiting their economic potential. Many countries now promote English as a second language and become concerned when the education system fails to deliver the level of expertise considered desirable.

understanding the text

1 **Explain** why some countries are concerned about the loss of cultural diversity and sovereignty.
2 **Explain** why Hollywood is seen as such a threat to cultural diversity.

working geographically

1 **Using the media** Study the entertainment guide of a daily newspaper. Count the number of movies showing. Calculate the proportion of movies made in the United States. As a class, discuss the possible reasons for the results of your survey.
2 **Research task** Collect data relating to the TV-viewing habits of Australians. (This is published weekly in major newspapers.) What proportion of the programs are sourced from the United States and the United Kingdom?
3 **Writing task** Write an exposition. Topic: The homogenisation of language is a force for global harmony and economic efficiency.

The loss of languages

Another area of concern about the cultural dominance of the United States is the threat that English poses to the diversity of the world's languages. Just five languages—Chinese, English, Russian, Spanish and Hindi—are spoken by 50% of the world's population, though the planet is home to more than 6000 languages. More than half of these languages could well die out within the next 100 years or so, as their last remaining speakers die. This will certainly be the fate of Aore, which is spoken by just one native inhabitant of an island in Vanuatu.

About one-third of all the world's languages are now spoken by fewer than 1000 people and linguists fear that many speakers may succumb to the pressure to speak a mainstream language, such as English. To some, including the media magnate Rupert Murdoch, the loss of languages is inevitable and not necessarily a matter for regret. He argues that, 'The homogenisation of language is a force for global harmony and economic efficiency'. To reinforce this view, his satellite networks in India only produce programs in English and Hindi, thus ignoring the language diversity of the subcontinent. In China, Mandarin is spread across the country by the electronic media it dominates. Again, this ignores the linguistic diversity of the country. What this approach fails to recognise is that when we lose a language we lose a whole way of perceiving the world. Some people believe that language and culture are so intimately entwined that they are almost one and the same thing.

Time–space compression

The term *time–space compression* refers to a set of developments that have dramatically changed the way we think about time and space. Central to this idea is a reduction in the importance we attach to distance when, for example, a technological innovation makes it possible for people or goods to move from one place to another more easily and cheaply.

New forms of economic activity have also helped to compress time and space. Innovative forms of production methods have opened up new markets and brought places closer together in terms of time and space. Fluctuations on the New York stock market are mirrored in other stock exchanges within minutes; marketing campaigns can rapidly

turn a product innovation into a fad in far-flung corners of the globe; and flowers picked in Sydney today can be decorating Japanese homes tomorrow.

The rise of the Internet has accelerated the rate of time–space compression. Its role in reducing the importance of distance is yet to be fully realised, but will be substantial. Anyone with a computer and network connection can establish a website and advertise a good or service to a global market. Alternatively, they can access information, purchase goods and services or communicate, in real time, with friends and colleagues anywhere on earth.

The Internet, as with most technological innovations, has the potential to reinforce existing inequalities. The geographical distribution of network connections closely mirrors the map of 'haves' and 'have-nots'. (See figure 2.5.5, p. 416.) At the global scale this means that developed countries will continue to exert a disproportionate influence on Internet-based economic innovations. It also means that the traditional centres of economic and political power, especially large cities, will strengthen their position relative to areas that are less well off.

There is, however, some evidence to suggest that the communications divide between haves and have-nots may slowly be changing. In Bangladesh, for example, where more than half of its 140 million people survive on less than a dollar a day, sales of mobile phones are booming. This is in stark contrast to the situation a decade ago where villagers were buying mobile phones to sell 'call-time' to their neighbours, providing up to 1000 people with access to a telephone. The country now has more than 14-million-plus mobile phone users. Mobile phone networks in Bangladesh now provide coverage for approximately 90% of the population.

Community-based protests against globalisation

The speed and spread of global flows, particularly the flows of information and finance, are extraordinary. This threatens the capacity of people and governments to regulate, resist or even fully comprehend the local impact of changes that result from actions and decisions taken on the other side of the world. The autonomy and sovereignty of governments is increasingly constrained by the mobility of capital and the power of international financial institutions, **credit-rating agencies**, TNCs and global institutions, such as the IMF, the World Bank and the WTO.

Governments have responded to these challenges in different ways. Most have recognised the inevitability of the globalisation process and tried to position their countries to maximise any economic advantages while minimising the social impacts of change. Most governments have, however, proved ineffective in dealing with the social impacts of globalisation. Inequalities between and within countries continue to grow. Globalisation has created winners and losers, and the cultural heritage that once helped to sustain countries is threatened by forces that many cannot comprehend and few understand. As a result, the backlash against globalisation is becoming more apparent and widespread. (See figure 2.3.49.)

Much of this backlash stems from the insecurity and alienation that people experience in times of rapid economic and social change. An increasing number of people fear that they do not have the knowledge, skills and resources to adapt to the changes taking place. Even those with jobs feel insecure because the jobs they have are being rapidly transformed, downsized, streamlined or made obsolete by globalisation. The same global competition is forcing governments to downsize and

did you know?

- The speed of worldwide transport and communication has increased dramatically, while the monetary cost of these services has fallen rapidly. The cost of a three-minute phone call from London to New York has declined, in constant year 2000 dollars, from: US$60 in 1960 to 40 US cents today.
- Over the same period, the average price of a computer has dropped from US$1.8 million in 1960 to under US$1000 today.
- Since the 1980s, telecommunications traffic has been expanding on average by 20% a year.
- The number of messages sent by email in the United States exceeded those sent by post by the mid-1990s.
- In 1858, the first trans-Atlantic telegram from Queen Victoria to then US president James Buchanan took 16 hours to arrive.

credit-rating agencies organisations that determine a country's or corporation's financial standing and ability to meet its debts.

FIGURE 2.3.49

Riot police confront WTO protestors in Seattle, the United States, in 1999.

did you know?

- The income of some individual corporations exceeds the total wealth of some countries.
- The economy in some countries is so fragile that one wealthy person's currency trading can destabilise the whole economy.
- The nongovernmental organisation (NGO) Community Aid Abroad (CAA) is so concerned about where and how money is invested that it has created the Ethical Investment Trust, which only invests money in projects that are socially and environmentally beneficial. It promises that no money will be invested in areas where any of the following occurs: exploitation of the poor, human rights abuses, arms manufacture and promotion of environmentally harmful products.
- Like CAA, the Aid/Watch organisation has taken on the responsibility of ensuring that Australian aid dollars reach their intended destination. It is an NGO working to reform the Australian Government's overseas development assistance program. In other words, it is 'monitoring the development dollar'.

geolinks

Coca-Cola's response to the claims outlined in the Geofocus box opposite is to emphasise its environmental credentials. Refer to the Coca-Cola India: Water Management website.

streamline. The government services that people once took for granted are being **rationalised**, some have been withdrawn and others are now only available via technology. People living in regional areas have been affected more by these changes than those living in the large urban centres.

Those opposed to globalisation resent the growing gap between the rich and poor and the way it shifts jobs from high-wage countries to lower-wage countries. (See figure 2.5.5, p. 416.) Some do not like it because it exposes them to all sorts of global forces and influences that leave their children alienated from their own cultural heritage. Some do not like it because of the impact it has on the environment. Others are concerned about the exploitation of workers in developing countries. Many resent the power exercised by TNCs and international bodies, such as the WTO, IMF and World Bank. Meetings of the WTO have become a popular rallying point for those opposed to globalisation. (See figure 2.3.49, p. 353.)

Nationalist political movements, human rights activists, protectionists and environmentalists are just some of the groups protesting against the excesses of globalisation.

Right-wing political activism

Throughout the developed world, right-wing political movements have sought to exploit people's insecurity and sense of alienation. Examples of these right-wing elements in Australia include Pauline Hanson's One Nation party and several popular radio personalities (or 'shock-jocks).

geofocus

Indian community takes on a global giant

In July 2006, in the Indian town of Medhiganj in the state of Uttar Pradesh, a crowd of up to a thousand people chanted 'Coca-Cola band karo!' (shut down Coca-Cola!). The locals are opposing the extraction of 2.5 million L of water a day by Coca-Cola's bottling plant. In a region suffering from the failure of three successive monsoons, villagers spoke of their water woes and the exploitative and polluting practices of Coca-Cola.

In 2003, India's Central Pollution Control Board (CPCB) found that industrial sludge originating from the factory contained hazardous levels of cadmium, lead and chromium. Despite this the government has failed to take action against the Medhiganj bottling plant.

Other than stopping its earlier practice of selling the plant's waste as fertiliser, the company has not made any significant attempt to comply with the CPCB's demand that they properly treat and store the toxic byproducts of cola production.

In the United States, word of the plight of Indian communities has encouraged US citizens to call for an end to the company's unjust practices. Their call has been strengthened by the unmasking of Coca-Cola's tacit support for violent anti-union forces in Colombia.

At numerous universities across the United States, students are forming coalitions to ban Coca-Cola from their colleges or have the company's exclusive contracts revoked. This growing alliance across borders and cultures presents an opportunity for activists around the world to unite against one of the most prominent symbols of globalisation. Their aim is to defend the labour rights and the well-being of rural communities.

Adapted from 'The opposition to Coca-Cola and water privatization' by Gina Drew and Mike Levien, 25 July 2006, published on ZNet

These groups and individuals work to successfully exploit the fears of older, more conservative Australians. One Nation's policies, for example, included the protection of Australian manufacturing, an end to immigration, and a commitment to protect Australia's cultural identity and 'traditional' family values. Similar right-wing movements have emerged in Germany, France, Austria and the United States.

Human rights activists

Some of the most effective opposition to the excesses of globalisation has come from human rights groups. These groups have focused on the exploitation of workers by TNCs operating in developing countries. TNCs in the footwear and clothing sector have been accused of allowing their products to be manufactured in sweatshops, where workers are forced to work in dangerous conditions for long hours at low rates of pay.

Through the effective use of the media and Internet, these groups have had some success in encouraging TNCs, such as Nike, to address the conditions under which their products are manufactured. (See the Geolinks box at right.)

Protectionists

Organised labour (trade unions), left-wing political parties and regional conservatives advocate a return to protectionism as a means of protecting jobs and slowing the rate of economic and social change. Such groups challenge whether the WTO should have the authority to enforce international trade agreements.

Environmentalists

Those concerned about the state of the world's environment fear that the liberalisation of world trade, the growth of TNCs and the power exercised by institutions such as the WTO, World Bank and IMF will result in accelerated rates of environmental degradation. They argue that the environmental impact of any proposal should be thoroughly assessed and debated before it is implemented.

understanding the text

1 **Explain**, in your own words, the term 'time–space compression'.
2 **Explain** how the Internet has contributed to the compression of time and space.
3 **Explain** how the Internet reinforces existing inequalities.
4 **Account** for the growing backlash against globalisation.
5 **Outline** the issues that concern those who are opposed to globalisation.
6 **Explain**, in your own words, the points Robert Reich is making in the quote on page 333.
7 **Explain** the link between globalisation and the resurgence in right-wing political activism.
8 **Outline** the concerns of human rights activists. How are they seeking to influence TNCs?
9 **Outline** what protectionists advocate.
10 **Explain** why environmentalists are concerned about globalisation.

working geographically

1 **Using ICT** Access the Internet site of a group involved in human rights issues. Examples include those in the Geolinks box above. Use the following points to help you prepare an oral report:
- name the organisation
- state where it is based and who it represents
- briefly outline its objectives
- describe the nature of its campaign
- list some of its achievements.

2 **Using ICT** Use the Internet to investigate the activities of the WTO, IMF and World Bank.
3 **Using the media** Gather information related to community-based responses to globalisation. Share these with the rest of your class.

> Politics is war without bloodshed, while war is politics with bloodshed.
>
> **Mao Tse-tung, former Chinese leader**

> There was never a good war, nor a bad peace.
>
> **Benjamin Franklin, one of the founding fathers of the United States**

> You cannot simultaneously prevent and prepare for war.
>
> **Albert Einstein, physicist**

unit 2.4

Political Geography

Not long ago, it was believed that the process of globalisation and the revolution in information and communications technologies would bring the peoples of the world closer together; but the opposite appears to be happening. While global economies are converging, cultures appear to be diverging. The widening cultural differences are leading us into a period of heightened social conflict, growing inequality and increased segregation. At a global scale, old national identities are proving surprisingly durable, and, in some instances, have been radicalised by the process of globalisation. Even the most superficial analysis of contemporary geopolitical events draws attention to the role played by groups that both fear and reject the intrusion of outside cultural influences. For example, in rejecting what they see as the amoral cultural influences emanating from Europe and North America, Islamic extremists have pursued an aggressively intolerant version of traditional Islamic purity.

This observation is consistent with the views outlined by the political scientist Samuel P. Huntington, who argues that future conflict will occur most frequently and violently along cultural instead of ideological lines.

In this unit we examine the nature of power and conflict, the changing role of the nation-state, the causes and geographical outcomes of political tensions and conflicts, and the resolution of conflict.

exam-style questions

extended responses

- Analyse the changing role and nature of the nation-state.
- Evaluate the extent to which international governance and nongovernmental organisations pose a threat to national sovereignty.
- Analyse the extent to which transnational corporations pose a threat to national sovereignty.
- Analyse the causes of political tensions and conflicts.
- Explain the relationship between political tensions and conflict and the migration and mobility of people.
- Outline the various paths towards the resolution of political tensions and conflicts.

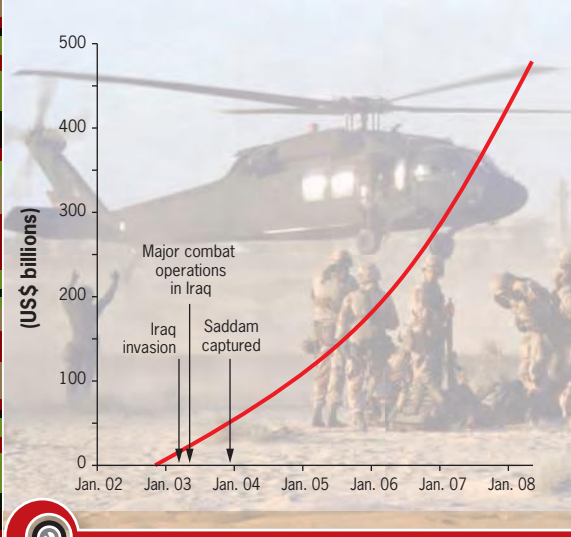
The costs of war

One thing is certain about war: it is expensive. Wars come at a terrible cost, in terms of both human suffering and economic cost. The Iraq War, for example, had by May 2008 resulted in the death of more than 4400 coalition military personnel. More than 29 900 coalition troops had been wounded. Between 84 600 and 92 300 Iraqi civilians are thought to have died in the violence that has followed the invasion of Iraq.

The war costs at least US$200 million each day. By May 2008, the Iraq War had cost US taxpayers US$520 501 800 000. (See the graph below.) What is the opportunity cost of such expenditure?

Every dollar spent on the Iraq War is a dollar that cannot be spent on addressing other priorities. Economists call this an 'opportunity cost'. One opportunity cost is the resources needed to meet the needs of the world's poor. It has been estimated, for example, that the additional foreign aid required to reach the UN's Millennium Development Goals (see p. 413) by 2015 is US$40–$60 billion a year.

The Vietnam War cost the United States 58 000 lives and 350 000 casualties. It also resulted in between 1 and 2 million Vietnamese deaths. The financial cost of the Vietnam War was US$550 billion in today's dollars.



The financial cost of the Iraq war.

glossary

- **agricultural society** a society based on an agricultural economy and way of life.
- **autocratic** a form of government in which the political power is held by a single person.
- **autonomy** the right or power to govern oneself.
- **colonialism** a government policy of imperial conquest (*see* imperialism) or the founding of colonies to gain new territories for occupation so as to exploit the resources and people of that territory.
- **community** a group of people with a strong shared interest about which they communicate regularly. Communities vary in size. Examples include a club, a neighbourhood, a town, a political movement or a group of scholars scattered across the globe.
- **country** a sovereign state in the world system of states, having an internationally recognised border.
- **dictatorship** a form of government in which democratic politics and decision-making are suppressed and replaced with a self-appointed, usually military, autocratic ruler who governs by personal decree rather than by constitutional means.
- **empire** a region over which imperial power is exercised.
- **ethnic** of or relating to sizable groups of people with a common, distinctive racial, national, religious, linguistic or cultural heritage.
- **ethnicity** the distinctive combination of racial and cultural attributes of a group that distinguishes that group as a separate people.
- **federation** a political unification of formerly separate states or colonies in which the former states retain some sovereignty and surrender some sovereignty to the new federal government. There is thus a constitutional division of powers between the two levels of government; that is, state and federal.
- **fundamentalism** the reduction of a religion or theory to its most simple, basic form and the elevation of that simplest form to be the absolute truth about the world and human behaviour. A fundamentalist is a person who practices or advocates fundamentalism.
- **geopolitics** the processes of interaction of politics and geography and the study of politics in its geographical context. Geopolitics attempts to explain the impact that political tension and conflict have on geography, economy, society, culture and population, globally and on other levels.
- **globalisation** the process of integration of all the markets of the world into a single market so that a unified global economy and culture will eventually result. The process has gone furthest in the financial and popular cultural spheres.
- **ideology** a set of ideas about how economy, society, culture and institutions are and/or should be organised and function.
- **imperialism** the conquest and political and military domination of a new territory by a foreign empire.
- **indigenous people** the original inhabitants of a territory.
- **individualism** a philosophy that advocates the power of individuals to make effective choices and act on those choices, and a theory of social organisation being the outcome of individual choice and rationality.
- **information society** a society based on an information-producing economy and way of life.
- **nation** a group of people with a common and distinctive racial, national, religious, linguistic or cultural heritage.
- **plebiscite** a general vote or referendum of the population in order to decide on a particular issue.
- **political philosophies and theories** general ideas about how politics should work; about the proper structure and role of political constitutions, institutions and governments; about electoral systems; and about how politics does and should relate to societies, economies and cultures.
- **political power** the power to govern states and their peoples and thus control the destinies of states and peoples.
- **racism** a theory and attitude that leads to the ill-treatment of individuals because they are thought to embody a general, supposedly inferior, category of person entirely determined by race. Racism is the opposite of *individualism* and the upholding of human rights.
- **revolution** the complete overthrow of the existing sociopolitical system and replacement with a new system.
- **sovereignty** autonomous, self-obtained and self-constituted power to control and govern a state.
- **state** a territory that has a well-defined boundary and is autonomously and effectively governed by a sovereign government; also known as a country or nation–state.
- **superpower** a country that has the power and capacity to influence events on a global scale.
- **terrorism** the use or threat to use violence against innocent people to achieve political goals.
- **totalitarian** the political system in which absolute power is vested in a single party or dictator.

Political geography and geopolitics

The study of political geography, which is sometimes called **geopolitics**, is concerned with the interrelationships between politics and the geographical context in which politics takes place. The gaining and exercising of power is the primary objective of political activity. Politics always takes place within a particular geographical setting or space and within particular social, economic and cultural contexts, and cannot be understood except in those contexts.

Geopolitical inquiry attempts to see all the forces at work in political processes and outcomes as being interconnected and taking place within a particular spatial or geographical context. These forces include resources, environments, ideology, ethnicity, class, culture and religion.

Much of political thinking, activity and conflict are directed towards the control of land, and its resources and people. The geographical location and resources of countries and regions have a significant influence on political activity and power. In turn, **political power** results from the control of land, resources and people, on a local as well as a global level. The exercise of political power often has a profound influence on the geographical environment.

Power and conflict

Politics is more than the seeking of power of government or the mere administration of people and resources. For genuine politics to exist there must also be some public debate and argument. This implies disagreement, so there must be a spread, or sharing, of power to make decisions and some degree of openness in decision-making. This is often referred to as transparent government. (See figure 2.4.1.) Without debate and disagreement, politics doesn't exist. In a purely **totalitarian** country there is no politics because debate is prevented. (See figure 2.4.2.) Politics seems to be a normal part of people's social existence, even if it is driven 'underground' by repressive governments.

Furthermore, since politics has disagreement, there is always tension. The extent to which tension becomes conflict depends on the particular causes of tensions and the possibility of resolving tensions peacefully. The

FIGURE 2.4.1

True politics exists when there is opportunity to disagree with governments in peaceful and democratic ways. Students participating in an anti-Bush demonstration in Sydney during the Asia-Pacific Economic Cooperation (APEC) summit, September 2007.

The policy of a state lies in its geography.

Napoleon Bonaparte, Emperor of France, 1804–15

did you know?

In his influential essay *The Clash of Civilisations?* (1996), Samuel P. Huntington claimed that future conflict would be culturally based. He wrote:

It is my hypothesis that the fundamental source of conflict in this new world will not be primarily ideological or primarily economic. The great divisions among humankind and the dominating source of conflict will be cultural. Nation-states will remain the most powerful actors in world affairs, but the principal conflicts of global politics will occur between nations and groups of different civilisations. The clash of civilisations will dominate global politics. The fault lines between civilisations will be the battle lines of the future.

Samuel P. Huntington (1993)
Foreign Affairs 72(3), p. 22

FIGURE 2.4.2

In totalitarian regimes, such as the Nazi regime that ruled Germany during 1933–45, real politics does not exist because debate and alternative views are not permitted.

FIGURE 2.4.3

With 201 member states, virtually all the world's countries belong to the United Nations.

FIGURE 2.4.4

Rugby World Cup 2007, Australia versus Fiji. Communities are groups of people who share a common interest or geographical location.

United Nations an international organisation whose stated aims are to facilitate cooperation in international law, international security, economic development, social progress and human rights issues. Its headquarters are located in New York.

very large amount of violent political conflict that the world has experienced for thousands of years and still experiences today demonstrates the volatility of politics and the political nature of all human society.

In today's world, most politics takes place within and between nation-states. The characteristics of these nation-states and their role in causing and controlling tension and conflict is one of the major issues in geopolitics. Another significant area of interest is the question of whether nation-states will survive the new processes of **globalisation** that are now affecting us all.

States and communities

Much of political activity and ideas are consciously directed towards the governing of states and communities and the relationship that states and communities have with other states and communities.

A **state** (also referred to as a **country** or nation-state) is a territory that is autonomously (independently) governed in the sense of having a boundary that is defined by laws and regulations and policed by legally established powers. Each of the world's states has a government that has the power to make and enforce laws. The government also has the power to determine movements of people and things, and control transactions of goods and money within and across its borders.

States officially recognise each other's existence and deal with each other in official ways. In other words, states conduct international relations with each other. Today the world political system consists of approximately 200 states or countries that are officially equal in autonomy and legal power to govern their territories. Almost all countries belong to the **United Nations** (UN) organisation. (See figure 2.4.3.) We know that, in reality, the power of states is very uneven in the world geopolitical system. This is a major cause of tension and will be discussed below.

A **community** is much smaller than a state and consists of a group of people with some degree of common interest. Very often a community will also share a geographical space, although the emergence of digital or virtual communities has made this less so. Examples include an urban-based community of a town or suburb, and a group of people who communicate regularly about some shared concern or activity, such as the work of a school or a club. For a genuine community to exist the members must, as the name implies, communicate.

Communities usually have a geographical basis to their communication, such as having transport, telecommunications, media and other infrastructures that enable them to interact. There may be a high degree of tension in a community about the control and governance of the geography of the community, such as the urban infrastructure, and about the spatial distribution of the economic system. Local politics can be just as intense as national and international politics, and just as interconnected with geographical factors. Geographical factors will often motivate members of a community to unite to protect the welfare of individuals and the community. This can be seen with community action groups that form to deal with specific geographical issues in local communities. For example, the action group Residents Against Polluting Stacks was formed to protests against exhaust stacks associated with road tunnels that affect local communities in Sydney.

States, nations and nationalism

A fundamentally important issue in geopolitics, and one that lies at the heart of much political conflict in today's world, is the relationship of states to nations. States are defined more or less by their territorial borders (see figure 2.4.5) and their systems of government.

FIGURE 2.4.5

Cars wait at the border to enter the United States from Tijuana, Mexico. Nation-states are defined by specific geographical boundaries.

Nations, or nationalities, are defined more by shared features of an **ethnic** kind, such as language, race, religion and culture. Some states contain multiple nations. For example, Canada has three distinct nations within the one state. The first nations of the Inuit and American Indian people are the **indigenous population** of Canada. There is a significant French-speaking minority centred around the province of Quebec. The third nation consists of the majority of the population, who are English speaking and of Anglo heritage.

For centuries, the people of many nations have had a strong desire to break away from nation-states and form independent nation-states. This has often led to violent and long-lasting conflict, as in the case of Ireland where for centuries conflict took place between those seeking independence and those loyal to Britain. Other examples include the former Yugoslavia where a series of bloody civil wars in the late twentieth

FIGURE 2.4.6

Forensic experts search for evidence in the International War Crimes Tribunal's identification centre, in a morgue in the central Bosnian town of Visoko, 2001. The former Yugoslavia was torn apart by a bloody civil war based on ethnic and religious lines.

geojobs

Foreign affairs and trade officer

Foreign affairs officers and trade officials work on the policy and operational aspects of Australia's international relations and trade interests. They use their knowledge and skills to:

- provide policy advice to government; that is, advice on plans that will guide decision-making and actions
- gather information relating to international strategic, political, economic and trade issues
- negotiate issues relating to international treaties and matters of international law
- promote Australia's interests overseas
- support Australia's human rights objectives
- provide assistance to Australians travelling abroad
- assist in implementing Australia's international aid program.

The Department of Foreign Affairs and Trade recruits graduates from a range of disciplines, including geography, economics, commerce, law, politics, Asian studies, history, international relations, languages and strategic studies.

and early twenty-first century saw the country split into several smaller countries based on distinct ethnic and religious lines. (See figure 2.4.6, p. 361, and the maps and text on pp. 366–7.)

Nationalism is the political world view that sometimes accompanies the emergence of nations and nation-states. Nationalism is defined as the loyalty and devotion to a nation or ethnic group that places emphasis on promoting the interests, cultural and social values, or religion of one group above all others.

Another issue arises when a group of people identify themselves as a nation but its members are not all located within a single nation-state. A notable example of this is the Sami people, who occupy the frozen arctic regions of Norway, Sweden, Finland and Russia. Being spread over multiple nation-states has made it difficult for the Sami people to exert their rights. A similar situation exists for the Kurdish people, whose traditional lands are found in Iraq, Iran, Turkey and Syria. As a minority in each of these countries, the Kurdish people have suffered considerable discrimination and in some cases have resorted to acts of **terrorism** to advance their political aims.

One of the major issues in Australian politics today involves the question of the nature of the Australian state. Should Australia be a **multi-ethnic** and **multicultural** country? Does it make sense to say that a country can have many cultures? Is, in fact, Australia a unified country at all? It is in the sense that there is a single official language and a single government. Yet in terms of culture, religion, beliefs and use of minority languages there is enormous diversity, which comes from being an immigrant country. What is the future of the Australian nation and state if it becomes a **republic** and moves economically and politically closer to our Asian and South Pacific neighbours? Although Australia is geographically located in the Asia–Pacific region, and thus surrounded by Asian and Pacific cultures, the culture we have inherited is mainly European. The possible contradiction between Australia's location and culture has been a cause of contention and of possible future conflict.

nationalism loyalty and devotion to a nation or ethnic group that places emphasis on promoting the interests, cultural and social values, or religion of one group above all others.

multi-ethnic a mix of people with distinctive racial, national, religious, linguistic or cultural heritages.

multicultural the existence of many cultures within a state. It means valuing the differences of others and creating an environment that does not require assimilation and celebrates diversity.

republic a state in which the supreme power rests in its voting citizens and is exercised on their behalf by representatives elected by them and responsible to them. The head of state is elected or appointed by the people's elected representatives.

understanding the text

1 **Define** the term 'geopolitics'.
2 **Explain** the concept of 'true politics'.
3 **Explain** why an understanding of geography is important when looking at political processes and their outcomes.
4 **Explain** why true politics cannot exist in a totalitarian government.
5 **Explain** why it is that some political disagreements (tensions) result in conflict when others do not.
6 **Describe** the characteristics of a nation-state.
7 **Outline** the concept of a community.
8 **Distinguish** between a state and a nation.
9 **Explain** why Canada can be said to be a nation-state with multiple nations.
10 **Explain** the relationship between nationalism and the potential for conflict.

working geographically

1 **Research task** Use your knowledge and local newspapers to create a file of current issues that are sources of tension and conflict in your community. Create a wall display outlining the causes, impacts and potential solutions to these issues.
2 **Using ICT** Access online newspapers and digital archives and collect a media file of ethnically-based tensions in Australia or another country. Analyse the articles and write a brief report outlining the main issues involved.
3 **Research task** Locate an atlas published recently and another published in the 1980s or earlier. Compare the map of Europe in each atlas. Outline the changes that have taken place.
4 **Research task** Conduct research into the Sami people. Present your findings as an oral report.
5 **Research task** On a map of the Middle East, show the location of Kurdistan (the traditional lands of the Kurdish people). Write a report outlining the nature of the conflict that has developed between Kurdish minorities and the nation-states in which they live.

The changing role and nature of the nation-state

The origins of the nation-state: imperialism, democracy and nationalism

Until the nineteenth century, the main form of government was the **empire**, each of which was ruled by small elites of monarchs and nobles. These empires were the outcome of conquests. They usually contained many different ethnic groups or nations. Because they were so large they were loosely governed from the centre, with local rulers or agents of the emperor given a lot of **autonomy**.

During the nineteenth century and early twentieth century, this age-old system began to be transformed rapidly in Europe into a system of nation-states. During the twentieth century, nation-states emerged throughout the rest of the world so that today virtually everyone lives within, and is a member of, a nation-state.

To understand the origin of the nation-state, we have to see the basic connection between nations and states in our times. During the colonial era, the governments of empires had little interest in issues of national identity or unity. By the middle of the nineteenth century, in Western Europe and North America the stirrings of democracy were beginning to unleash forces that would totally transform the nature of states. These forces were the notions of freedom and democracy. At the same time, the European-based empires of countries such as Great Britain, France, Germany, Austria, Russia, Portugal and the Netherlands were being consolidated throughout the rest of the world.

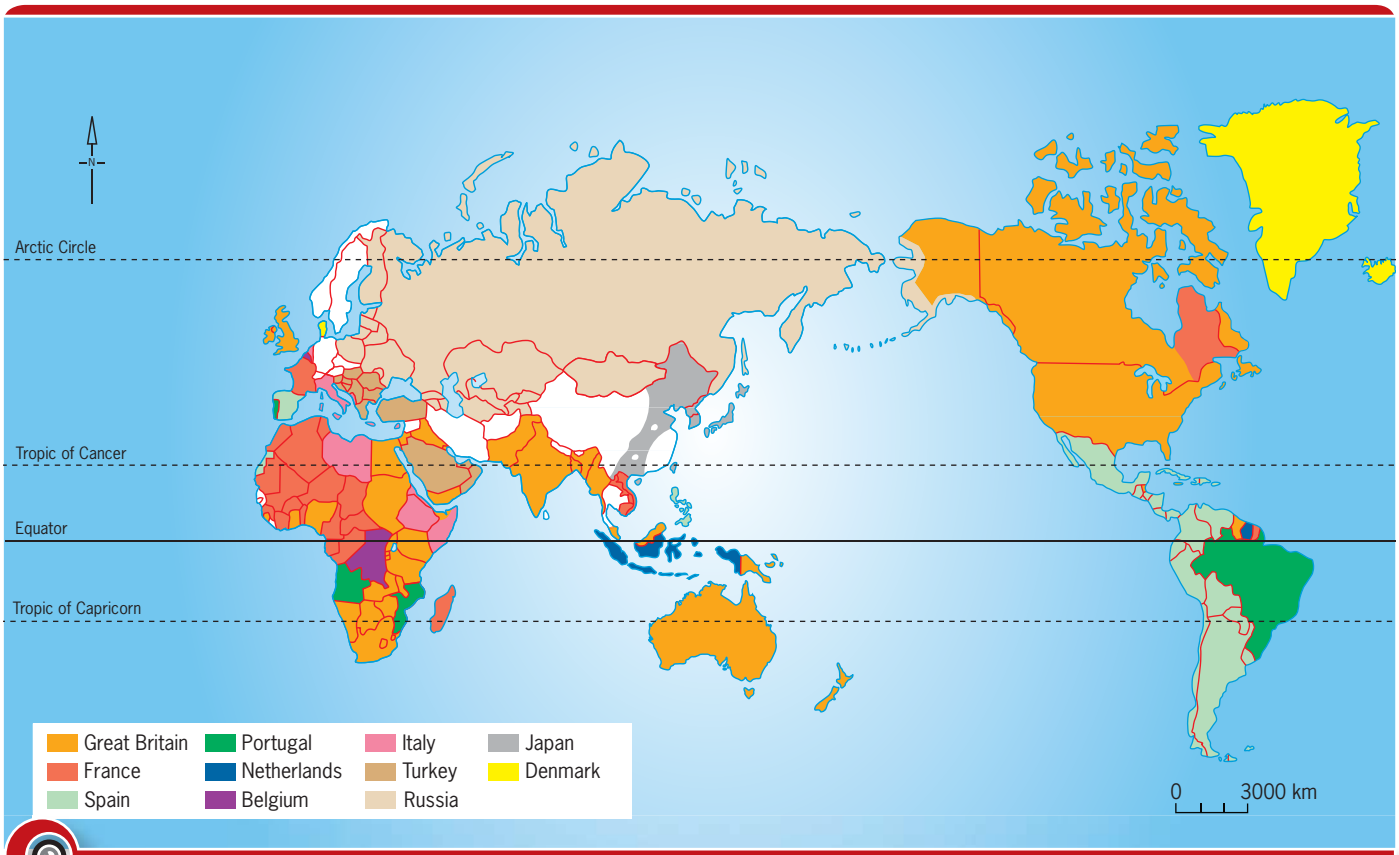


FIGURE 2.4.7

The extent of European empires from 1550 to 1950.

By 1900, almost all the world had been divided up among European empires (see figure 2.4.7, p. 363) or had become independent from former imperial rulers. A number of South American countries had gained independence from Spain, for example. Thus, in Europe and North America in the nineteenth century there existed three forces: democracy, imperialism and nationalism. These forces were to be crucial in bringing about the world system of nation-states that we see today.

Democracy is the idea that representative government and the sharing of power among the people is the only fair system and the one that makes leaders responsible to the people. **Imperialism**, on the other hand, is the imposition of power over a society, region or country by the rulers of another country. It also denies the colonised country any independence or democracy. Imperialists reject the idea of democracy for colonised people because those people would then demand political independence. The idea of, and movement for, independence for each **colony** or country of the world is nationalism, but not all nationalists want democracy.

imperialism the practice of one country extending its control over the territory, political system or economic life of another country.

colony the territory controlled by an imperial power.

Nationalism exists in both broad and specific forms. *Broad nationalism* is the movement for independence of each colony or country in the world. It is also the movement to build the strength of countries that are already independent, especially when they are in rivalry with other countries. Broad nationalism is focused both inward and outward. It is inward in that it attempts to achieve and build an autonomous and unified country. Its outward focus is to succeed in competition against other countries, even to the point of warfare. Colonies and countries, whether independent or not, can have within them several nations. Examples include Indonesia, Great Britain, Mexico, Nigeria and Russia. *Specific nationalism* is a movement for independence of every specific ethnic or national group within larger countries.

FIGURE 2.4.8

A bitter civil war between Russia and independence fighters in the province of Chechnya has raged for well over a decade: during 1994–96 and commencing again in 1999. This has resulted in widespread destruction and thousands of deaths.

Many multi-ethnic or multi-national states, including those listed earlier, are facing growing demands from the forces of specific nationalism. There are numerous examples of nationalism that threaten the cohesion (internal unity) of large, multi-ethnic states. They include the recent wars in the former Yugoslavia; the Russian war against the Chechens (see figure 2.4.8); the independence movements in the Indonesian provinces of Aceh and Papua; the civil war for independence by the Tamils within Sri Lanka; the independence movement within Quebec for separation from Canada; and the successful movement for a degree of independence by Scotland within the United Kingdom. All such large states today face these kinds of forces, and specific nationalism is bound to become one of the major forces causing conflict and the reshaping of national borders in the early twenty-first century. In other words, nationalism still is one of the most important political forces shaping the geography of the world and has some distance to go before it achieves the goal of a separate state for every nation on earth. This goal may never be achieved, for one of the basic problems is in deciding how to define and separate each nation from other nations.

referendum a vote of the entire electorate on a law or proposal.

secede to withdraw from a political entity in order to become independent.

centralism the tendency to concentrate power in a central body.

linguistic related to language.

geofocus

Federations: successes and failures

Federations are nation-states made up of territorial components that have joined together. Federations have peculiar difficulties of **sovereignty** for there are two, often conflicting, sources of sovereignty: the historically older constituent elements, generally called states or provinces, which join together to form a larger, newly sovereign entity (country). The new federal government acquires much of the sovereignty of the older constituent parts. The sharing of power in federations is a major source of tension, especially if wealth and prosperity are unevenly distributed between the states (or provinces) and if there are major ethnic and cultural differences. The following examples demonstrate this tension, which can ultimately lead to war.

The United States

The United States of America was formed as a federation of 13 colonies following their revolt from Britain in 1776 and the successful War of Independence, led by George Washington. The US federal constitution does not allow for succession; that is, for the states to break away in order to become independent. However, in 1861 most of the southern states attempted to leave the federation over the issue of slavery and associated cultural, economic and geographical differences with the northern states. America was, in effect, two quite different societies, economies and cultures, and the southern one feared domination by the larger, richer north. The rebellious Confederated States of America (CSA) were formed from the breakaway southern states.

The CSA hoped that their new country would be recognised by the outside world as well as by the United States. Instead, the remaining states (usually called 'the Union') refused to allow the southern states to leave legally and so war broke out. The first shot was fired by the southerners. The northerners prevailed in the ensuing civil war due to their far greater resources and stronger manpower base. These enabled them to wear down and destroy the south's economy. In this case, the geographical and economic bases of the war were the decisive factors.

The Australian federation: a successful federation

The Australian federation, in contrast to many others, was formed in an atmosphere of peace and celebration. (See figure 2.4.9.) No war was necessary to achieve this federation. Rather, the colonies voluntarily came together in 1901 for their mutual benefit after a series of peaceful **referenda**. There was already a high degree of cultural and ethnic homogeneity (similarity) between the colonies. Many inhabitants of the colonies already thought of themselves as Australians rather than just Victorians or Queenslanders and so on.

FIGURE 2.4.9

Australia was proclaimed a federation on 1 January 1901 in a special ceremony held in Sydney's Centennial Park.

The federation has been remarkably cohesive, despite occasional tensions, such as Western Australia's attempt to **secede** in 1933 over what it felt was unfair distribution of federal funds. Today Australia is moving towards greater **centralism**, with power being held increasingly in the hands of the Federal Government. However, the State and Territory Governments retain considerable power in key areas, such as health, education and law enforcement.

FIGURE 2.4.10

Yugoslavia before its collapse. As shown on the map, the country consisted of a wide range of ethnic groups, each with distinct cultures and traditions.

FIGURE 2.4.11

Yugoslavia began to disintegrate in a series of civil wars in the 1990s resulting in the formation of several new countries.

The Yugoslav federation

As noted in Unit 2.1 (p. 243), the Yugoslav federation was formed in the years immediately after World War I, and was supposed to unite all the South Slav peoples. However, the new federation would include two peoples—the Croats and Serbs—who had been engaged in a struggle for control of the Balkans for hundreds of years. (The Balkans consists of the countries in the Balkan Peninsula, including Yugoslavia, Bosnia and Herzegovina, Croatia, Macedonia, Slovenia, Romania, Bulgaria and Albania.) Although having a common ethnic and **linguistic** background, the Croats and Serbs have distinctive religious and historical traditions, and experiences have kept them apart and antagonistic (hostile) towards each other.

The historical tensions in the region were made worse by atrocities committed by Croatia's puppet fascist government during World War II. The Bosnian Muslims—who were ethnically, linguistically and historically South Slavs—were despised by the other two groups because of their historic conversion to Islam and because they collaborated with the Islamic Ottoman Turkish Empire during its occupation of the region from the fourteenth century until 1908.

Adding to the region's ethnic and cultural diversity are the Kosovars, another Islamic nation occupying a large part of Serbia. The Kosovars spoke Albanian and, in terms of cultural heritage, they had much in common with the people of Albania.

The Socialist Federal Republic of Yugoslavia was established immediately after World War II. Its president—Josip Broz Tito—ruled in a repressive manner. Tito suppressed nationalist insurrections and maintained unity throughout the country.

In the 1990s, after the death of Tito the Yugoslavian federation started to disintegrate (see figure 2.4.11), with secession by Slovenia, Croatia, Macedonia and Bosnia. There were violent attempts by elements of the remaining Serbian-dominated federal government to prevent the break-up. When that failed, Serbia tried to retain as much territory as possible. In particular, this was at the expense of Bosnia and Croatia and denied any autonomy to the Kosovars. At the heart of the conflict was the intermingling and mutual hostility of Croatian, Serbian and Bosnian peoples within the official borders of Croatia and Bosnia; the attempts by the government of Serbia Montenegro to support the Serbs within Croatia and Bosnia; and the specific nationalism of the Kosovar people.

As part of the disintegration of the former Yugoslavia, the Republic of Bosnia-Herzegovina experienced three years (1992–95) of bloody inter-ethnic war between Bosnian Muslims, Croats and Serbs. The war left the country's infrastructure and economy in tatters. Around 2 million people—about half the population—were displaced from their homes.

In 2006 Montenegro seceded and in 2008 Kosovo declared its independence.

The war crimes trials that followed the conflict saw a number of Bosnian Serbs face the International War Crimes Tribunal in The Hague. The accused were charged with murder, torture and rape of Muslim and Croat civilians.

The characteristics of modern nation-states

As pointed out previously, nation-states (or countries) combine features of both nations and states. *Nations* are defined by shared features of language, culture, religion and traditions. *States* are defined by government of territory and by the powers, or sovereignty, that governments have within their territories. One useful way to describe a state is to say that it is a centralised government that has been able to gain 'a monopoly of violence' within a specific territory and to use that monopoly to impose its control over the people of the territory. This control of law and order then enables the government to prevent violence within the population and to make and implement laws for peaceful behaviour. Laws are the rules about social behaviour: what is permitted, what is not and what must be done by the people so that the society can operate in an orderly and prosperous fashion.

States today all have a high degree of centralised authority rather than the **devolved** authority that existed a century or more ago. The transport and communications revolutions of the past half century have enabled states to develop more powerful and effective ways of governing the lives of their citizens. At the same time, there have developed new theories and ideas about what governments should do. The governments of states wish to actually govern their territories rather than have decisions imposed on them by others; for example, by an imperial power. The governance of states is now a highly developed and effective process compared with the imperial era of 100 years ago. All governments are now able to affect the lives of their citizens through economic and social policies that centre on the processes of taxation, expenditure and economic management.

As a general rule, the more developed a state is, the more effectively it is able to use these policies. Governments of less developed states in

devolve grant powers from the central government of a state to government at the national, regional or local level.

parts of Africa, Central America and South Asia have far less power to improve the lives of their citizens. In some African states the government's authority has broken down completely. For example, numerous civil wars and internal conflicts have resulted in thousands of casualties in Somalia, Sierra Leone, Liberia, Sudan and several other African states.

Nation-states (or countries) can and do fall apart, sometimes into violence and smaller sub-states. Somalia, for example, is now one of the most lawless countries in the world. (See figure 2.4.12.) After a civil war in the 1980s and 1990s saw the country fall into severe famine, the United States led a UN mission to the troubled east African country. Eventually the United Nations pulled out all troops, leaving the country in the hands of **warlords**. Today there is no real effective government throughout most of the country and the people are left largely to fend for themselves.

warlords individuals who run organised crime syndicates that are involved in drug and people smuggling, arms dealing and piracy.

mandate the authority granted by an electorate to act as its representative.

National or state sovereignty

The problem of sovereignty in national politics is a major issue for understanding political action and conflict. *Sovereignty* means having autonomy, or independent power, to achieve desired outcomes, such as the power to make laws that can be implemented in an efficient way. A ruler or government of a country has a greater or lesser degree of sovereignty to govern. The degree will depend on the political constitution of the state, the extent of the citizens' acceptance of the government and the influence that international organisations and treaties have over states. *Popular sovereignty* first emerged at around the time of the French Revolution and is the notion that the people provide a **mandate** to the government to rule. Of course, this mandate can be withdrawn at the next election, meaning that ultimate power rests with the people themselves. (See figure 2.4.15.)

The extent to which a country is truly democratic is determined by the extent to which sovereignty or power is shared with the people and the various organisations to which they belong. In states that are totalitarian **dictatorships** very little power is shared. In mature democracies (such

FIGURE 2.4.12

A child soldier roams the streets during the conflict in Somalia. Effective government has all but collapsed in the East African nation-state of Somalia. The country is now run by groups of warlords who run criminal networks.

FIGURE 2.4.13

Affluent Lebanese visit a destroyed neighbourhood in Beirut, the capital of Lebanon. In 2006, Israeli forces mounted a large-scale assault on Hezbollah forces within Lebanon. (Hezbollah is the Islamic resistance movement in Lebanon.) This action breached Lebanon's sovereignty.

as Australia and the countries of Western Europe and North America) power is dispersed among many organisations and groups. As we shall see later in this unit, there are increasing forces of an international kind that are challenging the sovereignty of nation-states. Furthermore, many forces within states are also attempting to gain greater power from central governments.

Threats to a nation's sovereignty can come from its neighbours (see figure 2.4.13) or from civil disorder within its borders. (See the Geofocus box 'Darfur: the sovereignty dilemma.)

geofocus

Darfur: the sovereignty dilemma

Darfurians—those who live in the Darfur region of Sudan—have long been subjected to discrimination and disadvantage. At the start of the twenty-first century, groups of armed militia, known as the Junjaweed militia, began to carry out systematic attacks on Darfurian villages. In these raids they killed the male population and either enslaved the women and children or left them to seek out protection in neighbouring countries.

By 2007, there were more than 2.5 million Darfurians living in refugee camps across the border in Chad. (See figure 2.4.14.) Chad is one of the poorest countries in the world and the camps there have little food and water and no sanitation. In July 2004, the UN General Assembly passed Resolution 1556, which called on the government of Sudan to disarm the Junjaweed militia and bring their leaders to justice. Much of the violence continued, however, and it was not until 2007 that UN peacekeepers were allowed into Sudan in a bid to ease the violence.

The reason for this unacceptable delay was largely the result of the principle of sovereignty. Sovereignty grants national governments the right to make decisions for their own countries. As Darfur is part of Sudan, the violence was essentially an internal issue. Had the Junjaweed militia been attacking people outside Sudan then the United Nations would have had considerably more power to take action against the government of Sudan. Thus, while sovereignty is an important issue and is a way of protecting the rights of nations, it can also be a barrier to peace.

FIGURE 2.4.14

Violence in the Darfur region of Sudan has resulted in more than 2.5 million Darfurians fleeing to refugee camps in neighbouring Chad.

FIGURE 2.4.15

Popular sovereignty exists when the people have the right to grant power to the government and then remove that power through electoral processes. Maxine McKew, the Labor member for Bennelong. As a candidate in the 2007 federal election, Maxine defeated the then prime minister, John Howard. He was only the second Australian prime minister to lose his seat at a general election.

understanding the text

1 **Outline** the key differences between empires and nation-states.
2 **Define** the term 'democracy'.
3 **Distinguish** between democracy and imperialism.
4 **Differentiate** between broad nationalism and specific nationalism.
5 **Explain** how technological developments have influenced the role and importance of federal governments within nation-states.
6 **Define**, in your own words, the terms 'sovereignty' and 'popular sovereignty'.
7 **Describe** the way in which sovereignty (or the power to make decisions) is maintained in a totalitarian regime.

working geographically

1 **Constructing diagrams** Create a timeline outlining the origins of the nation-state, imperialism, democracy and nationalism.
2 **Writing task** Study the Geofocus box 'Federations' (pp. 365–7). Write an extended response comparing the Australian federation with that of Yugoslavia. Suggest reasons for the differences between the two federations.
3 **Writing task** Study the Geofocus box 'Darfur' (p. 369). Write a short report outlining the way that sovereignty affected the chances of securing peace in Darfur.
4 **Research task** Undertake research into a current civil war. Explain the nature of the conflict and describe the impact that it is having on innocent civilians.

supra-region a large regional entity made up of smaller, distinctive regions.

supra-state a political federation made up of individual states with various degrees of political sovereignty.

Regions, supra-regions and supra-states

The term 'region' refers to two kinds of places: intranational regions, such as south-west New South Wales, and international regions, such as the Middle East.

Intranational regions are parts of a nation or country that have a particular form of natural cohesion or identity that sets them apart, perhaps only slightly, from the rest of the nation or country. In Australia, this term has been applied to various parts of the country that have some special geographical, economic, social and cultural features that the people there believe separate them and allow them to feel they have a special identity. The people of such regions as North Queensland, New England, Hunter, Illawarra and Western Sydney identify themselves, to some extent, as belonging to these places because of certain features that they share. The existence of these regional identities does not mean that people think of themselves only as belonging to these regions. Most people feel they have several overlapping identities or senses of belonging. For example, they may feel they belong to Australia, New South Wales and Sydney (or Newcastle or New England) and then perhaps to their locality, such as a town or suburb.

International regions are areas that span more than one nation. Some international regions have a rather natural existence due to a shared culture, religion or language. For example, the Middle East consists largely of Arabic-speaking Islamic cultures. However, there are important exceptions to the degree of integration. Within this region there are conflicting elements: such as Israel (a largely Jewish, Hebrew-speaking state), Turkey (a Turkic-speaking, Islamic state), Iran (a mostly Persian-speaking, Islamic state), marked differences between and within Sunni and Shia sects of Islam, and very significant disagreements over borders and control of resources. Many of the state boundaries in the region are colonial creations dating from early in the twentieth century when most of the region was parcelled out among the British and French empires. Tensions over borders led to several conflicts between countries in the second half of the twentieth century, several of which continue today. Most notable of these is the conflict between Israel and the Palestinian people. (See figure 2.4.17.)

Western Europe, to take another example, is an increasingly integrated **supra-region** in spite of major ethnic and linguistic differences among its people. A common cultural heritage dating from the Roman imperial and early Christian times has always been a unifying force in this region. Europe has had a degree of economic integration since late medieval times. Language has been a uniting element among the educated elite to some extent, whether it was Latin in medieval times, French in early modern times or English today. Economic forces and the desire to avoid another disastrous war of the 1939–45 kind have pushed the countries closer together over recent decades. It has resulted in the formation of the European Union (EU) as a major step towards turning the region into a **supra-state**; that is, a political federation of several states.

Thus, in today's increasingly integrated world there are powerful forces pushing some international regions towards ever-greater integration. Western Europe is the best example. North America and Australasia are also undergoing such a process, as is the Association of Southeast Asian Nations (ASEAN) to a lesser extent. This growing integration is nevertheless creating powerful tensions at a more local level, indicating a two-level process at work. At the international level the forces are making for greater integration, often leading towards political federation, including the creation of supra-states made up of several states. However, at the intranational, or community, level there are opposing forces of specific nationalism or localism. These forces are pushing for the break up of existing large states into smaller mini-states (or large communities) and wish to gain ethnic or regional autonomy within the much larger international grouping. An

geofocus

Division within Iraq

Iraq has traditionally contained three dominant ethnic groups: the Sunni Muslims, the Shiite Muslims and the Kurds. These three groups have long-standing rivalries. Under the regime of dictator Saddam Hussein (1979–2003), the Sunni Arabs, of which he was a member, became the dominant group and used fear and terror to maintain control.

In 2003, the United States, together with its allies (collectively known as the 'coalition of the willing'), invaded Iraq with the stated aim of toppling the regime of Saddam Hussein and seizing control of the country's weapons of mass destruction (none of which were ever found). Having toppled Saddam and seized control of Iraq, the coalition found itself having to deal with a country that was religiously and ethnically divided. Within a short time, Iraq descended into a state of near civil war as the militias of both the Shiites (who are the majority of the population) and Sunnis fought each other as well as the coalition forces. Figure 2.4.16 clearly shows the ethnic and religious regions of the country. Only the Kurdish area in the north, which has practically shut itself off from the rest of the country and formed a semi-nation-state, has any real stability.

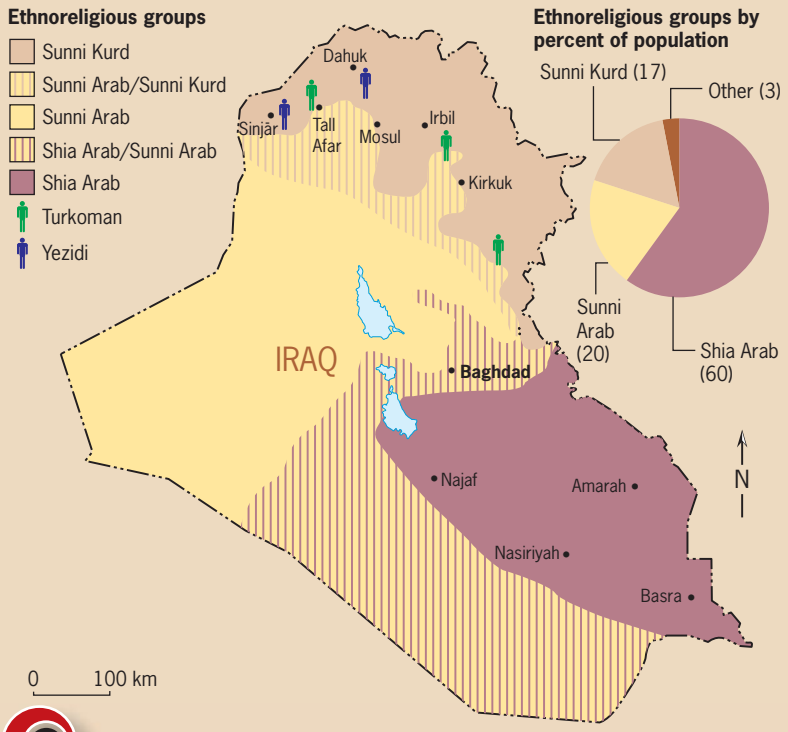


FIGURE 2.4.16

The ethnic/religious divisions of Iraq.

FIGURE 2.4.17

The modern state of Israel was created in 1948 in the area of Palestine that had formerly been part of the British Empire. Since its formation, Israel and the Palestinians have been in conflict. In recent times, Israel has constructed a wall in an effort to secure its territory.

example of this is the movement for independence in Scotland and Wales. The independence movements in Indonesia are examples of local actions to create separate, new states, which could then join the ASEAN grouping.

Despite, or perhaps because of, the degree of integration taking place there are many sources of tension within regions:

- ethnic, religious and cultural differences
- control of resources and trade
- levels of economic development and income
- artificially drawn borders resulting from imperial impositions or previous conflicts.

Tensions and conflicts at the country level are strongly influenced by tensions at the global and regional levels. The way states are governed varies greatly, and is generally the outcome of long historical processes of conflict and compromise. Very few countries, if any, are internally harmonious and no countries are entirely homogeneous in ethnic, linguistic and cultural senses. Certainly no country is economically homogenous. These sources of tensions and conflicts will be examined later in the unit.

understanding the text

1 **Explain** what is meant by the term 'intranational region'.
2 **Differentiate** between intranational and international regions.
3 **Outline** the forces promoting increased integration between countries.
4 **Describe** the integration of Western Europe.

working geographically

1 **Writing task** Write a short report explaining the ethnic composition of Iraq. Outline the possible conflicts this has caused.
2 **Using ICT** Select one of the international regions or supra-states from the list below:
- the European Union (EU)
- the Association of Southeast Asian Nations (ASEAN)
- the North American Free Trade Agreement (NAFTA)
- the Organisation of Petroleum Exporting Countries (OPEC).

Using a search engine, find the home page for the organisation and complete the activities below:
- **a** Outline the history of the formation and membership of the organisation.
- **b** Create a time line illustrating the key events in the formation of this alliance.
- **c** Outline the main aims and mission of this alliance.
- **d** Explain the alliance's process for decision-making.
- **e** Construct a table outlining the advantages and disadvantages of being a member of this supra-state or international region.

did you know?

Not long ago, it was thought that the process of globalisation, and the revolution in information and communications technologies, would bring the peoples of the world closer together. But the opposite appears to be happening. While global economies are converging, cultures appear to be diverging, and the widening cultural differences are leading us into a period of heightened social conflict, increased inequality and growing segregation. Much of the conflict in the world today, including the rise of global terrorism, has its roots in these cultural tensions and the poverty and social and political alienation experienced by particular peoples.

Pressures on the nation-state: Does it have a future in a globalising world?

Nation-states face a range of complex pressures that in extreme cases, as in Yugoslavia, can lead to their collapse. Broadly, these pressures are divided into two types:

- *internal pressures*—those that result from problems and issues within the nation-state
- *external pressures*—those that result from forces beyond the nation-state.

Internal pressures

In many nation-states there are movements within regions, communities, subcultures and political groups seeking to gain power over decision-making. In an extreme form, this could result in a collapse of central authority within the state in favour of local authorities. For example, in some parts of the United States there is strong support for a less centralised form of government and for greater power to be handed over to state governments and even smaller county authorities. Here in Australia there has been some support for a similar notion; although in recent years power has become even more centrally controlled by the Federal Government.

Specific nationalists within some multi-ethnic states are demanding the establishment of autonomy (independence) for their own smaller states. This has been seen in the former Yugoslavia, which fell apart into ethnically-based new states. Indonesia provides another example, where East Timor gained independence in 2000 and long-standing conflicts are found in the Aceh region and the province of Papua (formerly known as Irian Jaya).

geofocus

Internal conflict within the Philippines

The Philippines is predominantly a Christian country, being a former colony of Spain and then the United States. The region of Mindanao (see figure 2.4.18), however, is dominated by Muslims. For many years this region has suffered the effects of conflict as Mindanao nationalists have sought independence from the Philippines. The problem has become greater since a government policy to populate Mindanao with Christians has led to the Muslim population becoming a minority and further disempowered. The Moro National Liberation Front (MNLF), which is currently the ruling party of the Autonomous Region of Muslim Mindanao, has engaged in some peace talks with the Philippines Government. These have been largely unsucessful and fighting between the MNLF fighters and the Philippines Army occurs regularly. In recent years a more radical Islamic group, Abu Sayyaf, has begun kidnapping foreigners, including aid workers. The group, which some claim has links with al-Qaeda (see the Geofocus box 'Osama bin Laden and al-Qaeda', p. 386) has also engaged in terrorism outside Mindanao.

FIGURE 2.4.18

On the Philippines island of Mindanao, there has been long-standing conflict between separatists and the Philippines Government.

External pressures

Globalisation

Globalisation is the process whereby there is a breakdown in the political, economic and social barriers to international trade, movement of finance, spread of information and ability to travel. A set of global markets and societies is coming into being, with global firms, global products and even a global language, English, emerging to facilitate trade and cultural exchanges.

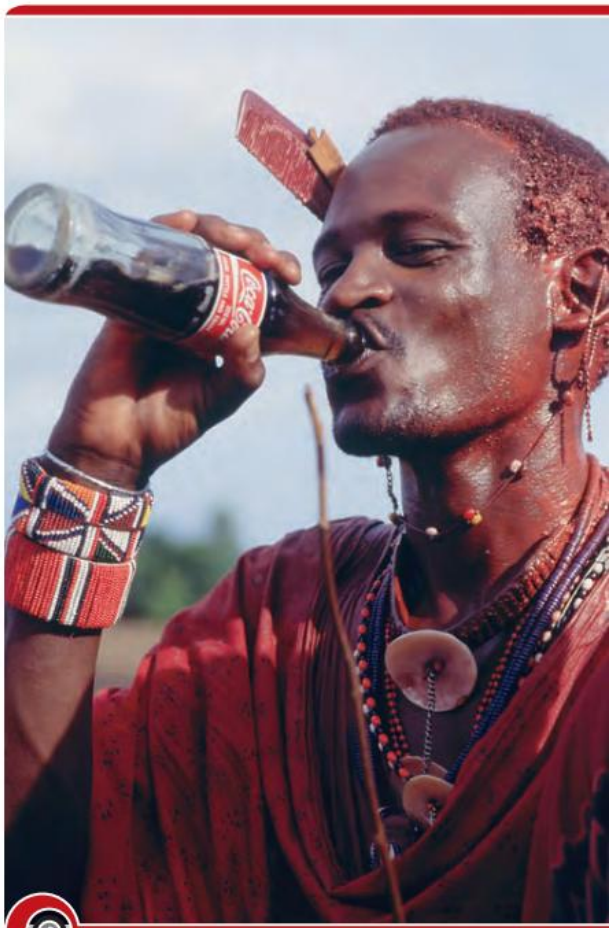


FIGURE 2.4.19

Products and the companies that sell them are becoming increasingly globalised.

FIGURE 2.4.20

Clean up Bhopal protest. NGOs, such as Greenpeace, can exert significant pressure on governments by highlighting inadequate policies.

did you know?

Tony Blair, former British prime minister, sees today's terror-based conflicts in terms of a struggle over 'the values that will shape our future'. He argues that if the struggle against Islamic extremism is to be won, we need to demonstrate that our values are stronger and more just than the alternative. Blair stated, 'Unless we revitalise the broader global agenda on poverty, climate change and, in respect of the Middle East, ... making peace between Israel and Palestine, we will not win.' In other words, he advocates tackling the causes of **dissent** and **alienation**.

dissent the refusal to conform to the decree of an authority.

alienation the rejection felt in a setting where one's views are considered unacceptable.

Transnational and global corporations

Many large firms are now richer and perhaps more powerful than many countries. *Transnational corporations (TNCs)*, which have separate branches and processes in a series of countries, are becoming increasingly globalised and so are losing loyalty to any particular country. Global firms tend to demand the same sorts of laws, government policies, employment practices and social welfare provisions from all the countries in which they operate. They try to push governments into a uniform pattern of social arrangements.

Nongovernmental organisations

Nongovernmental organisations (NGOs) exert significant pressure on nation-states through their efforts to promote social justice, ecological sustainability, self-determination and equality across the globe. NGOs lobby governments on a range of issues, including:

- environmental protection (prominent NGOs in this area are Greenpeace, Australian Conservation Foundation and the Wilderness Society)
- human rights (Amnesty International)
- poverty in developing countries (World Vision and Oxfam).

The strategies used by these organisations range from letter-writing campaigns to large-scale global events, such as the Live Earth concerts that took place in every continent in 2007 to protest against inaction on global warming. NGOs are also often involved in protests aimed at spotlighting issues at large international forums, such as the APEC conference held in Sydney in 2007.

International organisations and treaties: towards global governance

Global governance is the political interaction of transnational actors aimed at solving problems that affect more than one state or region when there is no power to enforce compliance. In many respects the twentieth century can be seen as the century that marked the internationalisation of politics. Following the devastation of World War I there was a move towards using international agreements to resolve conflict and to regulate relations between nation-states. It was at this time that the first ever international organisation of nation-states was formed: the League of Nations, which is seen as the forerunner to the United Nations. Following World War II more and more international bodies were created to regulate a range of international matters. Some of these organisations deal exclusively with trade (such as the World Trade Organisation or WTO), some deal with peace creation (the United Nations or UN), while others deal with environmental issues (the United Nations Environment Program or UNEP) or one of many other concerns.

Through their focus on international relations and peaceful dispute resolution these organisations and the international laws and agreements that govern them have become powerful forces in controlling the actions of governments. For example, the International Atomic Energy Agency (IAEA), which regulates nuclear technology around the world, has played a very important role in limiting the opportunity for countries to develop nuclear weapons. At present Australia is party to more than 900 international treaties and agreements. By joining these voluntary agreements Australia gains the benefits that flow from its membership. It also has to abide by the obligations laid out in the agreements. In this sense these organisations can limit the power of the nation-state.

Regional conflicts and border disputes

A region is an area of the earth's surface that has definable boundaries or distinguishing characteristics. At this scale there are many examples of conflicts, including those between India and Pakistan and between Eritrea and Ethiopia. Conflicts of this kind often have a devastating impact on the countries involved.

geofocus

Goma: the forgotten war

Conflict in the Central African country of Democratic Republic of Congo (DRC) has often been referred to as the forgotten war and sometimes even Africa's First World War. The conflict is centred around the Goma region where, since 1998, troops from up to seven African countries have fought for control of the vast mineral resources of the region. Conflict in surrounding countries, most notably Rwanda and Burundi, has complicated the situation. As a result, a staggering number of refugees have moved into the DRC. By 2007 the conflict in Goma had resulted in more than 3.5 million deaths and at least 3 million refugees. The natural environment has also suffered. The highly endangered mountain gorillas are further threatened by illegal mining, habitat loss and hunting by poachers in the lawless region.

FIGURE 2.4.21

Fighting over mineral resources in the Goma region of Democratic Republic of Congo has led to massive casualties.

FIGURE 2.4.22

During conflicts the natural environment often suffers. Here poachers carry a mountain gorilla they have slaughtered in Democratic Republic of Congo. The mountain gorilla is a highly endangered species.

Challenges to national sovereignty

The maintenance of national sovereignty is now under question in a world of economic and cultural globalisation, regionalisation and nationalism. All these forces are threatening to weaken and pull apart existing states. As the world has become gradually more globalised during the past century (especially in terms of economics, politics and culture), there has gradually come into being some elements of global governance. Today, global governance in its various forms is becoming a major force affecting how states govern their own territories.

International organisations

The expanding size and authority of international institutions, such as the EU and UN, raises a number of significant questions for the governments of their member states:

- Should states participate in the building of regional and international alliances?
- Does integration into regional and international organisations mean that countries will increasingly lose control of their own affairs?
- Can countries afford not to participate in international organisations in an era when the power of the state is giving way to the power of multinational arrangements and structures?

understanding the text

1 **Describe** the main internal pressures that nation-states face.
2 **Explain** the effect of nationalism on the Philippines province of Mindinao.
3 **Define** the term 'globalisation'.
4 **Explain** the impact of globalisation on nation-states.
5 **Describe** the characteristics of nongovernmental organisations (NGOs).

working geographically

1 **Writing task** Write an extended response assessing the extent to which NGOs and international agreements exert pressure on nation-states.
2 **Using ICT** Study the Geofocus box 'Goma'. Use an Internet search engine to investigate the conflict in the DRC. Outline the current situation there and assess the accuracy of the view that this is a forgotten war.

FIGURE 2.4.23

There is constant tension in many countries between the desire to attract TNC investment through limited government control and the need to maintain high social and environmental standards.

did you know?

Transfer pricing refers to the pricing of goods and services within a multi-divisional organisation, particularly in regard to the cross-border transactions of TNCs. For example, goods from the production division may be sold to the marketing division, or goods from a parent company may be sold to a foreign subsidiary. This allows the transfer price to affect the division of the total profit among the parts of the company. It is often used to minimise a company's tax liability.

Profit shifting refers to accounting practices within large TNCs that help to reduce the tax paid by the company.

Conflicting points of view exist concerning these issues. Some people believe that institutions such as the International Monetary Fund (IMF), World Bank and WTO have too much influence over the decision-making processes of governments worldwide. They accuse these organisations of reinforcing the highly uneven global distribution of political and economic power. Others suggest that there is ample proof that membership of these international organisations provides a range of benefits for member states. They believe that being left out can have serious adverse consequences for a country.

Transnational corporations

When looking at the impact of TNCs on the sovereignty of nation-states it is important to recognise that our opinions of these organisations are often shaped by generalisations that are made popular by the media and often by TNCs themselves. The belief that globalisation is all encompassing and that TNCs are immune to domestic government regulation are examples of such generalisations. These generalisations are often accompanied by the rapid growth (or proliferation) of global metaphors, including 'the global factory', 'global markets', 'the global village', 'global workplaces' and 'the world car'. The problem with these generalisations is that they exaggerate the degree of global integration between countries and underestimate the power that nation-states have to influence the activities of TNCs. The policies of some governments (especially the United States, Japan and the countries of the EU) have a significant influence over the pattern of world trade and the adoption of new technologies. These governments have created the conditions required for the growth of TNCs and continue to attempt to regulate their activities. Greenhouse gas emission controls in the EU, for example, apply equally to TNCs as they do to small European businesses.

The expansion of TNC operations in the developing world has certainly involved the exploitation of low-cost labour; access to subsidised electricity, water and land; government grants; tax breaks; tariff duty reductions; less strict pollution controls; and less rigorous health and safety standards in the workplace. In addition, **transfer pricing** and **profit shifting** have enabled these companies to minimise or avoid paying taxes in developed countries. Thus, the perceived benefits of TNC investment in the developing world are often overestimated. By having the option to withdraw investment from a country, TNCs can exert considerable influence over that country's government. For example, if a government policy conflicts with a TNC's goals they may simply shut down their operations there and move to another location. Hence, governments, particularly those in the developing world, face a constant tension between exerting their sovereign powers over TNCs and ensuring that they continue to be viewed favourably by the TNCs by having pro-business policies, often at the expense of social and environmental needs.

Nongovernmental organisations

Worldwide, there are currently more than 4000 nongovernmental organisations (NGOs) lobbying governments on a range of issues and causes, including scientific exchanges, religion, emergency aid and humanitarian affairs. While some NGOs campaign against the actions of individual governments, many governments openly support the activities of these organisations: particularly those NGOs involved in the delivery of foreign aid. Governments have realised that well-managed NGOs are more effective in delivering aid than governments themselves. This seems to be particularly the case in small-scale projects,

provision of emergency assistance and situations where an official government presence would be politically sensitive. As a result of this, the Australian Government, for example, is increasingly channelling aid funds through NGOs. The government encourages individuals and corporations to support the work of NGOs by making donations to such organisations tax deductible.

One limitation that NGOs face in their attempts to lobby governments is the diversity of their views. Some NGOs are highly critical of foreign aid agencies while others not only support aid but are highly dependent on it for their financial survival. Nevertheless, NGOs are continually finding new ways to achieve their aims and convey their message. Some NGOs have, for example, recognised the potential of trade measures to influence environmental practices.

Another strength of NGOs is derived from having a formal role in **multilateral** bodies, such as the UN, the Organisation for Security and Cooperation in Europe (OSCE) and the EU. Article 71 of the UN Charter actually instructs the United Nations Economic and Social Council (ECOSOC) 'to make suitable arrangements for consultation with [NGOs]'. NGOs make it possible for contacts and information exchanges between conflicting parties to take place across borders without the involvement of governments. Already an accepted part of international relations, by influencing national and multilateral policy-making NGOs are becoming increasingly important.

Causes of political tensions and conflicts

Political tensions and conflicts have many causes and operate at many levels. Tensions arise naturally out of political processes. Whether tensions become conflicts depends on the particular processes at work, and the kinds of problems and institutions that exist. Political processes are concerned with the power to govern and administer states or parts of states. The processes of government and administration are always contentious (controversial) because they involve certain basic aspects of human life, such as distribution of income and wealth; control of resources; access to education, housing and health; criminal justice; cultural production and control; and, ultimately, the life and death of individuals, groups and classes. Major problems can arise in these processes. In most places, there are institutions that are supposed to solve these kinds of problems, but often the institutions are inadequate or are bypassed. The extreme outcome of such a situation is armed conflict.

On another level, government is responsible for organising and ensuring the defence of the state against external and internal enemies. Some political theorists have argued that this is the prime duty of a government. However, the role of governments as defenders of the state against enemies is very controversial. A bad government may see its own survival and prosperity as being more important than the prosperity of the state. (See the Geofocus box 'Burma' on page 387.) This may lead it to attempt to stop internal critics and even start external wars of aggression to divert attention from internal dissent. Internal dissent as well as external relations often have a strong geographical basis. The lack of homogeneity within the state in terms of ethnic distribution and local economic development may be a source of discontent.

There are many causes of political tensions and conflict in today's world.

did you know?

The International Committee of the Red Cross and Red Crescent (ICRC) is the NGO with the power to enforce the Geneva Conventions: the agreements governing the treatment of non-combatants and prisoners of war. It was founded by Frenchman Henri Dunant in 1863 after he witnessed great human suffering at the Battle of Solferino between France and Austria in 1859.

multilateral involving more than two sides (or nation-states).

understanding the text

1 **Explain** how the growth of international organisations has affected individual nation-states.
2 **Outline** the advantages and disadvantages of being a member of an international organisation, such as the EU.
3 **Define** the term 'supranational organisation'.
4 **Explain** why the terms 'global village' and 'world car' are said to be misleading.
5 **Outline** some of the factors considered by TNCs when making their decisions about where to locate their operations.
6 **Assess** the extent to which NGOs are effective in challenging national sovereignty.

working geographically

1 **Using ICT** Visit the European Union website and complete the following activities.
   a List the member states of the EU.
   b Outline the role of the institutions of the EU.
   c Explain how the EU could be seen as a challenge to the national sovereignty of its member nation-states.
2 **Debate** Hold a class debate. Topic: Australia has more to gain than lose by belonging to international organisations.
3 **Using ICT** Visit the Fair Trade Association of Australia and New Zealand website. Outline the concept of fair trade and explain how fair trade movements could limit the power of TNCs.
4 **Writing task** Write an exposition. Topic: TNCs undermine the authority of individual governments to make decisions affecting the well-being of their people.

FIGURE 2.4.24

Political tensions between nation-states can lead to armed conflict.

FIGURE 2.4.25

Pro-environment protestors call for a stop to mining and illegal logging in the Philippines.

Material and human resources

The power to control and use resources has always been at the heart of political tension and conflict. *Resources* are things with particular attributes that make them useful to humans. Things are only resources if they are available for human use. Their availability depends on technology, organisation and ownership. The minerals in national parks or Antarctica, for example, may be abundant but they are not resources, as such, because national and international laws to preserve wildernesses in a pristine (unspoilt) state prevent them from being exploited. In this case, it is wilderness that is the resource.

There are many types of resources, but the main types are capital, human resources, raw materials and material products.

The most basic resource in the contemporary world is *capital* (mainly money and finance). Command over this resource gives power to control all other resources, including human resources. Some political geographers have argued that access to fresh water will become a major source of conflict in many parts of the world as climate change begins to affect rainfall patterns. Already tensions over water rights have arisen in the Middle East, between the United States and Mexico and between numerous African nation-states.

Human resources are the productive capacities of people, which depend on their education and skills, their diligence and their human management. Systems of human management and control of people's productivity are, in turn, affected by the nature of the economic entreprise in which they work.

The third type of resource consists of the natural *raw materials* of the earth. These materials include minerals, soil, water, plants and animals. Control of these resources is also basic to human welfare. (See figure 2.4.25.) Ownership and control of territory has been a fundamental cause of conflict throughout human history and continues to be one of the main causes of conflict in many places, such as the former Yugoslavia. Control of land is closely connected with wealth derived from productive (often agricultural) production. Yet it cannot be separated from the historical and cultural considerations that impact on people's ownership and control of productive assets.

The fourth main type of resource is the *material products* of human economic systems. They include technologies, infrastructure (such as transport systems, education systems and buildings) and the other accumulated physical wealth of society. How these resources are owned and used is vital to social cohesion and conflict.

Landuse and control of natural resources

Land is fundamental to human welfare. For this reason, the control and use of land has been a very powerful cause of political tension and conflict throughout human history. Control of and access to land have been essential to human survival ever since humanity evolved several million years ago. **Agricultural societies**, which have dominated the earth for the past several thousand years, rose and fell according to their ability to control large areas of territory. With territory came the potential for agricultural production, and hence the potential to produce more food than was required to feed the farmer's family. The surplus was used to feed the urbanised population and large armies. Territory also provided large numbers of people to work the land as slaves or peasants, pay taxes and be conscripted into armies. These age-old reasons for the control of territory remain a fundamental motivation of political tension and conflict in agricultural societies. These societies are still prevalent in the world. India and China are examples.

With the rise of industrial societies, territory took on other vital attributes in addition to those agricultural ones, which were still important. Land was now also the source of vital raw materials and energy: wood from forests for fuel and construction; minerals for industry; and fossilised hydrocarbon energy, such as coal and oil. In the beginning of industrialisation, during the eighteenth and early nineteenth centuries, raw materials were difficult to transport given the available transport technology. Early industry, therefore, was located as close as possible to the raw material and energy supplies (such as iron ore, forests for fuel and running water for energy) and to transport arteries (such as canals and ports). As time went on, the dependence on physical location declined because of transport revolutions, such as the invention of railways, the steamship, the internal-combustion engine and aircraft.

Yet secure access to raw materials for industry and energy is more vital than ever, and the controllers of strategic raw materials, such as oil and gas, have powerful cards to play in global geopolitics. Furthermore, modern industry needs vastly increased markets for its cheap products, so if the territories in which those consumers live can be controlled then competitors can be excluded. Thus, early industrialisation by Western European countries in the nineteenth century intensified the scramble by their governments to control the whole territory of the earth. The need by the North Atlantic societies (Canada and the United States) for food, industrial raw materials and markets pushed them to try to expand their control right across the planet, resulting, of course, in tension and conflict.

Access to secure food supplies is still a vital consideration for geopolitics. Hong Kong and Singapore, in spite of their lack of territory, have prospered through industrialisation due to their communications revolutions and, having an educated population, by being rich in human resources. However, they would be vulnerable if all external transport networks were cut. Even their water and electricity are imported. Similarly, accessing land and water are fundamental for Israel, which has fought a series of wars to secure territory on which to actually build a state, grow food and house its rapidly growing immigrant population.

FIGURE 2.4.27

The colonial wars of the eighteenth and nineteenth centuries revolved around the control of land and the agricultural and mineral assets held in them.

FIGURE 2.4.26

Many people have argued that the US-led invasion of Iraq was largely motivated by the desire to secure the country's oil supplies.

geofocus

Natural resource conflict

Natural resources often lie at the very heart of wars and civil conflict. Huge mining and resource companies do not hesitate to use force when advancing their corporate interests. Such companies include giants, such as Exxon, Mobil and Anglo American/De Beers. There are many players in such resource-based conflicts, including shadowy resource traders, smugglers, corrupt local officials, arms dealers, transport operators and mercenaries. Increasing scarcity of resources, driven by world population growth and the spread of unsustainable consumption, increase the likelihood of such conflicts. NGOs, investigative journalists and UN expert panels have revealed some of the players in these clandestine networks and exposed governments that give them comfort, in both the developed and developing worlds.

Some of the key natural resource-based conflicts are centred on the resources discussed below.

Timber

Revenue from illegal forestry has financed the purchase of weapons and been the cause of many conflicts. It has also displaced indigenous populations.

Diamonds

The trade in diamonds has fuelled much of of the conflict in Sub-Saharan Africa. (See the Geofocus box 'Blood diamonds', p. 288.) In Democratic Republic of Congo, Angola, Sierra Leone and Liberia, rebels have used the proceeds of illegal diamond sales to purchase weapons, deepening the intensity of conflicts.

Oil

Oil has often been the source of violent conflict. The struggle to control the world's oil supplies has fostered military adventurism (for example, Iraq), human rights abuses by governments (and large corporations), and international conflict as well as **civil conflict**.

Water

While water is a 'renewable' resource, population growth and growing consumption per capita puts pressure on freshwater supplies. Water scarcity fosters communal conflict within communities. It also has important implications for interstate conflict, due to the **transboundary** flow of many waterways.

Minerals

In addition to diamonds, the mining of minerals such as cobalt, copper and gold has fuelled civil and interstate conflict. Mineral resources promote conflict by providing rebel groups with revenue to purchase arms, and by providing governments with the incentive and the resources to establish a repressive military presence in mineral-producing regions.

civil conflict conflict between two groups of people who are citizens of the same state.

transboundary across borders.

did you know?

The name the neo-conservatives give the US empire—Pax Americana—is taken from the name for the British Empire (Pax Britannica), which, in turn, was taken from Pax Romana, the name for the Ancient Roman Empire.

Ideologies

Ideology can be a prime determinant of political tension and conflict. An **ideology** is a system of ideas about how economy, society, culture and institutions are and/or should be organised and function. Most strong advocates of ideologies (called 'ideologues') have a rather *utopian* (idealistic) and even mystical vision. They tend to believe that the world is a fairly simple place or that the real world is imperfect and needs to be reshaped to fit their ideological view of what the world should be like. In reality, the actual organisation and functioning of societies are more pragmatic (practical) than ideological. Societies usually combine elements of many organisational and ideological systems. The real world stubbornly refuses to adapt and fit into the simplified mould of an ideology. Nevertheless, some regimes try to implement their ideological view and, in doing so, tend to pressure the members of their society to conform to the dictates of the chosen ideology.

The most influential ideologies of the twentieth century were capitalism, communism and fascism. (See figure 2.4.30, p. 383.) These competing ideologies led to countless conflicts throughout the century as supporters of each sought to extend their influence around the world.

Capitalist ideology holds that all resources and productive activity should be privately owned and that the state should play almost no economic or social role. Allocation of wealth, income and the products of the economy should take place in free markets, where purchasing power should be the sole determinant of the ability to buy and, therefore, consume. Emphasis is placed on **individualism**, with little regard for those who are unable to help themselves.

geofocus

The rise (and fall) of US neo-conservatism

Neo-conservatism is best defined as the proposition that US leadership is good both for the United States and for the world; and that such leadership requires military strength, diplomatic energy and commitment to moral principle. While such thinking was on the rise well before the tragic events of 11 September 2001, it was that attack on US sovereignty and national prestige that brought to the fore many of the policies advocated by US neo-conservatives.

Neo-conservatives argue for increased military spending so that the United States can carry out its global responsibilities: strengthening their country's links with democratic allies; challenging those regimes hostile to US interests and values; promoting the cause of political and economic freedom abroad; and accepting responsibility for the unique role of the United States in preserving and extending an international order friendly to the country's security, prosperity and principles.

Prior to 2001, influential neo-conservatives had been arguing for years in favour of an assertive US strategy in the post-**Cold War** world. In 1997, they and other like-minded intellectuals organised the Project for the New American Century, which urged then-president Clinton to confront Iraq. 'America was being too timid, too weak, and too unassertive in the post-Cold War world,' argued William Kristol, a leading neo-conservative and newspaper editor. 'American leadership was key to not only world stability, but any hope for spreading democracy and freedom around the world.' The neo-conservatives advocate a major shift in which the United States spreads American values by asserting American power—by force, if necessary.

Who are the Neo-cons?

The principal proponents of neo-conservatism have close links with the Project for a New American Century (PNAC), which is a **think-tank** that advises on military and diplomatic affairs. PNAC's members include leading politicians, defence experts and editorialists. It has links with the American Enterprise Institute for Public Policy Research, which is Washington's most influential conservative foreign policy think-tank.

Prominent neo-conservatives include:

- Dick Cheney (US Vice President, 2001–09)
- Donald Rumsfeld (former secretary of defense in the George W. Bush administration)
- Paul Wolfowitz (former deputy secretary of defense and former head of the World Bank)
- Peter W. Rodman (assistant secretary of defense, 2001–07)
- Elliott Abrams (deputy national security advisor, 2005–07)
- Steve Forbes (editor-in-chief, *Forbes Magazine*)
- Zalmay Khalilzad (US Ambassador to Iraq, 2005–07, US Ambassador to the United Nations, 2007–)
- Jeb Bush (former governor of Florida and brother of President George W. Bush)
- Richard Perle (former chair, US Defense Policy Board Advisory Committee, 2002–04).

As can be seen from the list above, all these neo-conservatives have played a prominent role in the administration of President George W. Bush and a decisive role in the President's decision to invade both Afghanistan and Iraq.

The invasion of Iraq

The main reason for the 2003 invasion of Iraq was the belief that Iraq possessed and/or was actively engaged in the development of weapons of mass destruction (WMDs).This was the primary reason put forward by President George W. Bush, the then prime ministers of the United Kingdom (Tony Blair) and Australia (John Howard), the then president of Spain (José Maria Aznar) and their domestic and foreign supporters. Much of the evidence to support their claim came from the intelligence agencies of the US Government. It was later revealed that Iraqi nationals who had fled the regime of Saddam Hussein were the source of the 'evidence' on which these intelligence assessments were based.

While the majority of diplomats representing the other member countries of the UN Security Council supported the intelligence assessments, they opposed the nature of the US intervention. They believed that a diplomatic solution could be found to the apparent crisis.

The WMDs, it was argued, posed a threat to the United States, and its allies and interests. In his 2003 state of the union address, President Bush argued that the United States could not wait until the threat from Iraqi leader Saddam Hussein became imminent. Bush also tried to establish a link between the Hussein regime and al-Qaeda. (See the Geofocus box 'Osama bin Laden and al-Qaeda', p. 386.)

Despite widespread opposition, the Iraq War commenced on 20 March 2003, when Iraq was invaded by a largely US and British force supported by small contingents from Australia, Denmark, Italy, Poland and Spain.

The Iraqi forces were little match for the superior firepower of the US and British forces. The invading forces quickly captured Baghdad and forced Saddam Hussein to flee.

FIGURE 2.4.28

Nicholson's view on the ambitions of the neo-conservatives.

The US-led coalition forces occupied the country and put in place the infrastructure needed to support the election of a new, democratic government. They failed, however, to restore order in Iraq. The invasion's planners had underestimated the number of troops required to establish and maintain order. The Bush administration had expected the US troops to be greeted as liberators. They were not. In the absence of a centralised authority, old cultural-based animosities (deep hatreds) quickly emerged as the various ethnic groups manoeuvred to maximise their influence in the new government.

The unrest led to widespread conflict involving Iraqi **insurgency** groups using armed resistance against the US-led coalition in Iraq. It also led to the outbreak of a civil war between many Sunni and Shia Iraqis. Al-Qaeda forces took advantage of the disorder to open a new front on its war against the United States and its Western allies. By 2006 public support for the war had plummeted and the administration of George W. Bush was widely criticised for its mishandling of the war. The causes and consequences of the war remain very controversial.

After the invasion the coalition failed to find any evidence of WMDs, or programs facilitating their development. The claims that there existed a link between Saddam Hussein and al-Qaeda were also discredited; a US congressional investigation concluded there was no evidence of any operational or collaborative relationship between the Hussein regime and al-Qaeda.

By May 2008 the war in Iraq had cost the US people US$520 501 800 000. More than 4400 allied troops had been killed and the estimates of the number of Iraqi civilians killed exceeded 84 600.

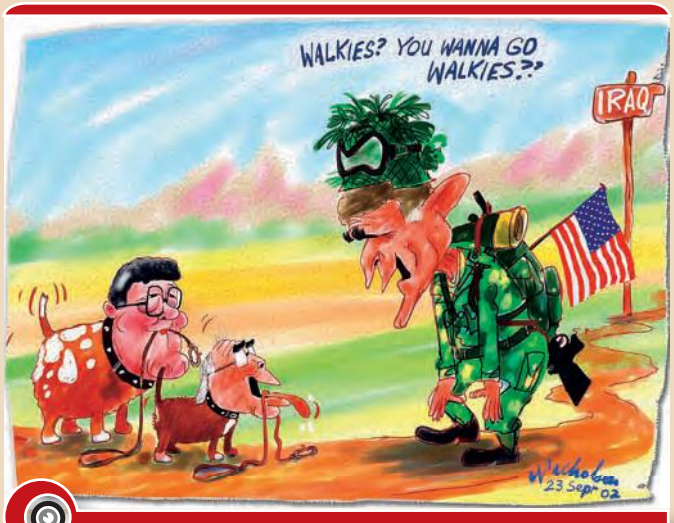


FIGURE 2.4.29

Nicholson's view on Australia's willingness to participate in the invasion of Iraq.

'Collateral damage' of the Iraq intervention

All wars carry a tremendous cost. In addition to the lives lost, the conflict in Iraq has had the following impacts:

- It was another demonstration of the limits of military power. Even the world's most sophisticated, well-resourced and technologically equipped military force had difficulty subduing insurgents using guerrilla-like military tactics.
- Neo-conservative thinking had been challenged (and perhaps discredited).
- A presidency was derailed (perhaps permanently). George W. Bush's approval ratings never recovered during his term in office and his presidency is widely regarded as one of the United States's least successful.
- New geopolitical challenges emerged in the form of Iran and North Korea. Iran in particular was emboldened by the inability of the United States to impose its authority on Iraq. Some intelligence experts believe that Iran has the intention of becoming a nuclear power, thereby threatening to reshape the balance of power in the region.
- Oil prices have risen, which may lead to increased inflation and a global recession.

Cold War the period after World War II (1945–89) that was marked by political tension and an arms race between the Soviet Union and the United States.

think-tank an organisation or group of experts researching and advising on issues.

insurgency an organised rebellion, armed uprising or revolt against an established civil or political authority.

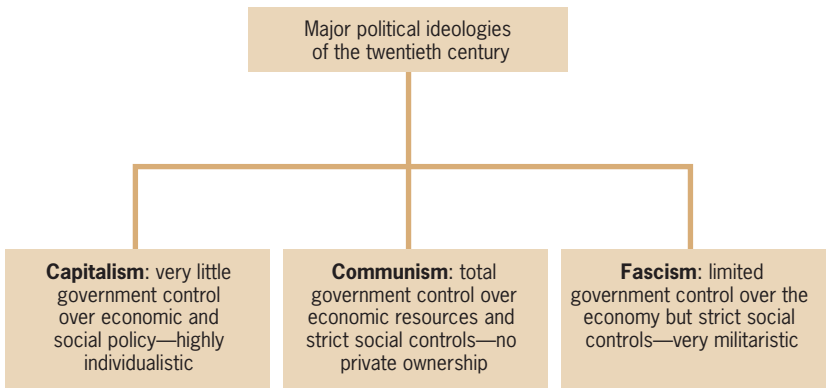


FIGURE 2.4.30

Major political ideologies of the twentieth century.

geolinks

- To update the Iraq War's civilian casualties see the Iraq Body Count website.
- To update the number of coalition military casualties see the Iraq Coalition Casualty Count website.
- To update the financial cost of the war see the National Priorities Project website.

Communist ideology maintains that all resources and productive activity should be collectively owned and controlled via the state, which is supposed to operate on behalf of the people. Private ownership of the means of production, including all capital, is abolished and labour is no longer exploited for profit by private capitalists. Wealth and income should be allocated according to needs rather than market purchasing power.

Fascist ideology combines an extreme form of nationalism with its own peculiar ideas about the role of the state and a desire for social harmony. The original form of fascism in Mussolini's Italy in the 1920s to 1940s had imitators in many European and European-derived societies, especially Latin America. It advocated a powerful militaristic state that would **subordinate** all personal activity to the glory of the country. The economy and society were to be organised along supposedly efficient military lines and all dissent and disharmony were to be eliminated. More extreme versions of fascism, such as that of Adolf Hitler (see figure 2.4.33) and the German Nazi Party, had an avowedly **racist** social policy. This policy advocated the subordination and even extermination of all so-called 'non-Aryan' races. (See figure 2.4.34.) The idea of '**Aryan** superiority' was one of the central myths of Nazism.

Extreme nationalist ideology holds that the nation-state has a collective will and power, which should be superior to the will and power of individuals. People should be **subservient** to the collective welfare of the state. The notion of national superiority in nationalist ideology is, in its extreme form, racist. This is because extreme nationalism holds that the ethnic group that defines the state is culturally or racially superior to all other ethnic groups. Nationalists ruled Japan until its defeat by the

FIGURE 2.4.34

Auschwitz concentration camp. More than 6 million Jews and around 1 million people from other minorities were exterminated between 1933 and 1945 during the rule of the fascist Nazi Party in Germany.

subordinate to assign to a lower priority than other obligations.

Aryan a term used by the Nazis to mean white Western European. For the Nazis, a typical Aryan was blond, blue-eyed and tall. This ideal was based on the appearance of the mythical ancestors of the German people.

subservient compliant and obedient to authority.

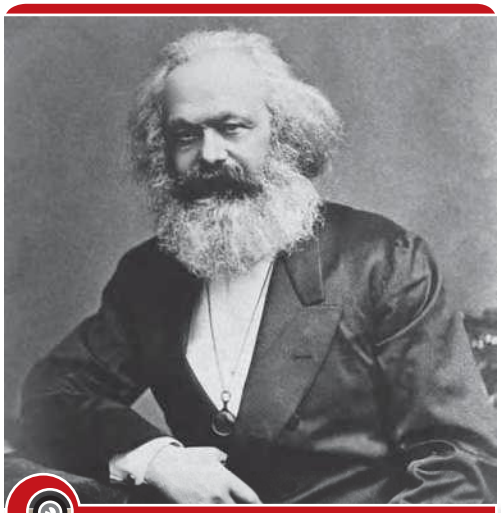


FIGURE 2.4.31

Along with Frederick Engels, Karl Marx wrote the Communist Manifesto in the nineteenth century. It outlines the principles of communism.

FIGURE 2.4.32

Known simply as Chairman Mao, Mao Tse-tung led the communist revolution of China and is revered in many parts of the country as a demi-god.

FIGURE 2.4.33

Adolf Hitler adopted an extreme form of fascism that incorporated a belief in racial supremacy.

geolinks

The American Enterprise Institute for Public Policy Research is a conservative (neo-conservative) American think tank. You can use its site to investigate the pro-Iraq intervention/invasion perspective and the neo-conservative perspective more generally.

allies in World War II. (See figure 2.4.35.) There are often strong parallels between fascism and extreme nationalism, and other ideologies also borrow from nationalism when it suits their ambitions.

Religious ideology is an extension of religious beliefs to include a system of ideas about how societies, economies and cultures should be organised. Most pure or fundamental forms of religion have an explicit, all-encompassing ideology based on what are believed to be divine teachings. Followers of the religion are led by these teachings when deciding how institutions and economies should function. What is good and what is bad, and how to live every aspect of human life is religiously inspired and controlled in some societies, which tend to forbid many social practices and ways of life that would be tolerated in other societies.

FIGURE 2.4.35

Extreme nationalism in Japan led to the attack on the US Pacific fleet at Pearl Harbor, which saw the United States enter World War II.

geofocus

Muhammad cartoons' controversy

The Muhammad cartoons' controversy occurred when 12 editorial cartoons—most of which depicted the Islamic prophet Muhammad—were published in the Danish newspaper *Jyllands-Posten* in 2005. Danish Muslim organisations, which objected to such depictions, responded by holding public protests. The controversy deepened when further examples of the cartoons were reprinted in newspapers in more than 50 other countries. This led to protests across the Muslim world, some of which escalated into violence; more than 100 people died.

FIGURE 2.4.36

Nicholson's perspective on the role of cartoons.

Fundamentalist religion

Religious ideology is one of the most powerful political forces in some parts of the world today. Of particular significance is the age-old tension between Christianity and Islam. Today, this tension is inflamed by the socioeconomic gulf that exists between the very different organisational bases of an Islamic economy and a Western capitalist economy.

Islam is often interpreted as, in effect, teaching against capitalism. Most Islamic societies of the Middle East have been anti-modern, relatively poor, village-based and stable. The **Koran**, for example, has been interpreted by **fundamentalists** as forbidding the charging of interest on loans. Recent decades have seen the end of **colonialism** and an increase in **Westernising** and modernising influences. These changes, greatly aided by the influx of wealth from lucrative (profitable) oil exports, have contributed to an upsurge in fundamentalist Islamic teaching that is anti-modern and anti-Western. The political agenda of the fundamentalists has been aimed at Israel, which is seen as the agent of the United States and as a so-called imperial **enclave** in the region. It has also been directed at the **secularist**, pro-Western leaders of many Middle Eastern countries, including Egypt, Algeria and Lebanon.

From the late 1970s, **revolutions**, insurgencies and civil wars have broken out in many Middle Eastern countries, partly over the extent to which religious influences should dominate in government. The most famous example is the Iranian revolution of 1979, which overthrew the US-backed Shah and installed a fundamentalist religious government led by Ayatollah Khomeini. A complicating religious factor in the region is the schism, or division, within Islam between the Sunni sect and the larger Shia sect.

Today, fundamentalist religion is blamed for the extreme forms of terrorism that have emerged in the early part of the twenty-first century. Attacks that have been blamed on fundamentalist Islamic groups include those on the World Trade Center in New York in 2001, Bali in 2002 and 2004, the Madrid train system in 2004, the London transport system in 2005 (see figure 2.4.37) and the failed attempts in Britain in 2007. Fundamentalist religious world views have also contributed to the severity of conflicts in the former Yugoslavia and Northern Ireland.

Koran the sacred writings of Islam revealed by God to the prophet Muhammad during his life at Mecca and Medina.

Westernising the process whereby non-Western societies come under the influence of Western culture.

enclave a tract or territory enclosed within another state or country.

secularist separating religion from politics.

FIGURE 2.4.37

The terrorist attack on the London transport system in 2005 has been blamed on religious fundamentalist groups.

Osama bin Laden and al-Qaeda

Osama bin Laden is a militant Islamist and founder of the al-Qaeda terrorist organisation. In 1988, al-Qaeda brought together the international network of terrorist organisations that had been established during the former Soviet Union's invasion of Afghanistan. The organisation's goals include the advancement of Islamic revolutions throughout the Muslim world and the defeat of foreign intervention in the Middle East.

Bin Laden, son of a billionaire Saudi businessman, first came to prominence in the Afghanistan conflict during 1979–88. In this conflict, the Soviet Union was defeated by international militias of Muslim fighters backed by the United States, Saudi Arabia and Pakistan. During the war, bin Laden established military training bases in Afghanistan and founded Maktab al-Khidamat, or Services Office, a support network that provides recruits and money to terrorist groups throughout the world.

During 1991–96 al-Qaeda mounted several major terror attacks. These included the bombing of hotels used by US troops in Aden, Yemen. The troops were in transit to Somalia on a humanitarian and peacekeeping mission. Al-Qaeda's support of the Somali militias eventually forced the United States to withdraw from Somalia in 1994.

It is also thought that bin Laden was involved in an assassination attempt against Egyptian president Hosni Mubarak in 1995, and two major terrorist actions against the US military in Saudi Arabia in 1995 and 1996.

In 1996, bin Laden issued al-Qaeda's first 'declaration of war' against the United States. He called all Muslim 'brothers' to mount a **jihad** against the Americans occupying the Land of the Two Holy Mosques (Saudi Arabia) and expel the heretics (non-believers) from the Arabian Peninsula.

FIGURE 2.4.38

Al-Qaeda leader, Osama bin Laden.

On 11 September 2001, al-Qaeda executed its most **audacious** assault on the United States. The attack involved the hijacking of United Airlines Flight 93, United Airlines Flight 175, American Airlines Flight 11 and American Airlines Flight 77, and the subsequent destruction of New York's World Trade Center and partial destruction of the Pentagon outside Washington DC. In all, 2974 people died in the attack. Bin Laden claimed responsibility for the attack in a video aired on Arabic TV.

jihad a Muslim holy war or spiritual struggle against non-believers.

audacious unrestrained by convention or by moral regard for the rights of others.

Nationalist conflict

Nationalist-inspired tension and conflict in the world today take three main forms: conflicts between existing states; conflicts between ethnic groups within states; and economic nationalism.

Tension and conflict between independent, existing states can be inspired by national pride and feelings of ethnic superiority, by ethnic insults and even by ethnic phobia (an irrational, persistent fear). Examples here include conflicts that begin as peaceful sporting events but turn into diplomatic or even military conflicts; attempts by states to redraw boundaries to better reflect ethnic borders; and tensions over immigration of certain ethnic groups.

Perhaps the single biggest cause of conflict are nationalist demands by ethnic groups (or nations) that are part of multi-ethnic states. This form of tension is widespread. There are many examples from Africa, where most countries have within them several ethnic groups. The political borders of Africa, Asia and Europe do not often reflect ethnic boundaries, and many ethnic minorities wish for independence. Examples include the Scots, the Basques of Spain (see figure 2.4.40, p. 388), the Chechens of Russia, the Kurds of Iraq and Turkey, the Biafrans of Nigeria, the Eritreans and Tigreans of Ethiopia, and the Tamils of Sri Lanka.

The third form of nationalist-inspired tension and conflict is *economic nationalism*. As the world economy becomes increasingly globalised,

geofocus

Burma: democracy suppressed

Burma (or Myanmar) achieved independence from the United Kingdom in 1948. The country's initial experiment with democratic rule ended in 1962 when the military mounted a **coup d'etat**. Pro-democracy civil unrest was ruthlessly put down in 1974 and again in 1988. In each instance, hundreds of demonstrators were killed and martial law was declared.

In 1990, the government held free elections for the first time in almost 30 years. The National League for Democracy, led by Aung San Suu Kyi, won 392 of the 489 parliamentary seats. However, the election results were **annulled** by the government, which refused to step down.

Since 1992, Burma has been ruled by a military junta, led by Than Shwe. In March 2006, the military moved the national capital from Yangon to Naypyidaw, meaning 'city of the kings'. In so doing, it insulated the leadership from any popular unrest or civil uprising.

Mass public demonstrations occurred on 18 August 2007 when the government raised the price of gas and diesel oil by 500%. The price was increased in order to cover a budget deficit that resulted from a large salary increase granted to public servants. The protests, which were led by the country's revered Buddhist monks, were again ruthlessly repressed.

FIGURE 2.4.39

In 2007, Burma's military rulers crushed a pro-democracy demonstration headed by the country's revered Buddhist monks.

many governments and **pressure groups** within states are concerned about a loss of economic autonomy or independence. They fear that with the decline of state economic control they will lose the power to intervene in the spending of money for social purposes, such as the redistribution of wealth. A consequence of globalisation of financial, agricultural and consumer markets is that some governments must remove subsidies, reduce taxes and welfare spending, and privatise government assets. Against this tendency there is a growing economic nationalism, supporters of which want governments to assert greater economic independence against the power of global financial markets. They also want governments to continue with existing welfare spending, employment structures and subsidisation of government-owned industries and services.

coup d'etat the sudden overthrow of a government through unconstitutional means by the military; also known as a coup.

anull declare null and void.

pressure group a group of people with common interests who attempt to influence government policy and decisions in their favour.

Ethnicity

Nationalism is closely connected with ethnicity. The definition of ethnicity is a highly controversial matter and this very controversy has been one of the prime causes of political tension arising out of ethnic conflict within societies. **Ethnicity** is a combination of identifications, including race, language, geographical location, culture, cuisine, dress and general way of life. Ethnic identification is defined both objectively and subjectively. For example, Italian ethnicity is based on language, culture and territory. Therefore, anybody who lives in Italy, speaks Italian as a first language and engages in general Italian customs can fairly confidently be said to be an Italian. If that Italian person then migrates to Australia, starts speaking English most of the time, eats mainly fish and chips and steak and eggs, and participates in Australian customs, then objectively they are losing their Italian ethnicity. However, if that person wishes to be known by others as an Italian and maintains some of the ways of life of most Italians, then subjectively they remain Italian. Their children may cease to feel they are Italian, whereas they would continue to do so if they were still living in Italy.

FIGURE 2.4.40

Bombing of Barajas airport by Basque separatists in the Spanish capital, Madrid, 2007. For decades, in their bid to gain independence from Spain, nationalists in the Spanish Basque region have undertaken a terror campaign that has included assassinations, bombings and kidnappings.

FIGURE 2.4.41

Ethnically motivated riots, such as this one in Cronulla in southern Sydney in 2005, demonstrate the impact of ethnicity on conflict.

Thus, ethnicity is like a skin that can be replaced gradually with a quite different skin. Over a long period of time, especially several generations, ethnicity may have little or nothing to do with race. The racial identification of ethnicity, or its lack, is therefore a major issue for personal relations and political processes. The *common humanity* of people is deeper than more superficial ethnicity but, unfortunately, some people relate positively or negatively to other people on the basis of their ethnicity.

The role of ethnicity in politics has grown in significance throughout the twentieth century and now represents a major cause of tension and conflict in many parts of the world. As communications have grown and people have become more aware of other ethnic groups, people have had to think about their attitudes to other cultures and races. Ethnicity is closely related to geography in that ethnic groups have traditionally derived their identity partly from specific, historically occupied territory, as well as from specific ethnic factors, such as language, culture and race. A complicating factor in recent times has been large-scale movements of people to other countries, such as Australia and New Zealand. New tensions have arisen when ethnic groups mix as a result of immigration.

We can identify two kinds of ethnic tension and conflict in the world:

- There is the traditional historical tension and conflict between ethnic groups in particular territories, such as Northern Ireland, Yugoslavia, Rwanda, Sudan and Burundi. (See figure 2.4.42 and the Geofocus box 'The Darfur humanitarian crisis'.)
- Immigration-induced tension can arise from the forced intermingling of people. This occurs in territories traditionally occupied by one race, such as West Indian immigrants in Britain, Turkish immigrants in Germany and Algerian immigrants in France. It can also exist within settler societies, such as Australia. Recent race riots in several countries highlight the extent of these tensions. (See figure 2.4.41.)

FIGURE 2.4.42

Australian peacekeepers in Rwanda in 1994 after ethnic violence erupted there.

geofocus

The Darfur humanitarian crisis

With an area of 2.5 million km^2, Sudan is the largest country in Africa. Despite reserves of oil and other natural resources, the vast majority of Sudan's 35 million people live in poverty, and its government is one of the most repressive regimes in the world.

Darfur is located in western Sudan and covers an area equal to the size of France. It is home to 6 million people who live largely rural lives. Some are nomadic herders, while others are settled farmers. The name Darfur means homeland (Dar) of the Fur, which is one of its largest ethnic groups. Darfur is an entirely Muslim region.

Darfur is one of the most dangerous places on the planet. The current conflict, which began in early 2003, is principally ethnic and tribal, rather than religious. One side of the armed conflict is the Sudanese military and the Janjaweed. The Janjaweed is a militia group recruited mainly from the Arab Baggara tribes of the northern Rizeigat, who are camel-herding nomads. The other side consists of a variety of rebel groups, notably the Sudan Liberation Movement/Army and the Justice and Equity Movement. They are recruited largely from the farming Fur, Zaghawa and Massaleit ethnic groups. The Sudanese Government, while publicly denying that it supports the Janjaweed, has provided money and assistance to the militia and has participated in joint attacks targeting the tribes from which the rebels draw support.

Today Darfur hosts the world's largest humanitarian operation. Since the Darfur Peace Agreement was signed by the Sudanese Government and the Sudan Liberation Movement/Army leader, Minni Minawi, in May 2006, attacks against peacekeepers and humanitarian workers have increased significantly. These attacks include beatings, rapes, robberies and assassinations.

Since the current conflict began in 2003, over 400 000 civilians have died and 2.8 million people have been displaced within Sudan. A quarter of a million Sudanese have fled abroad, mainly to Chad where they are facing further violence. Ninety per cent of the villages of Darfur's targeted ethnic groups have been destroyed. The Janjaweed militia and government forces have been responsible for 97% of the killing. While 3.5 million people are dependent on international humanitarian assistance, one-third of people in need are beyond the reach of humanitarian workers.

Social class

Social class is one of the elements that make up all societies and is a main cause of political tension and conflict. The nature, strength and significance of classes has varied enormously throughout human history. The division of societies into classes has always been closely related to geographical and economic considerations. However, there are many theories about how classes are composed and about their power and significance.

The three main ways to define classes are based on occupation; cultural function and status; and relationship to property. Yet these definitions do not take account the crucial issues of social class-consciousness. Classes can exist as organised categories (such as occupations) without their members being conscious that they belong to a distinct class or are deliberately acting in the interests of their class. Once a class of people recognises that they have a shared class interest against the interest of some other class and that they must defend their interest collectively, we can say that *class-consciousness* and class action occurs. Generally this only happens when large numbers of people are in close contact, have a strong sense of shared interest—especially a serious grievance about their quality of life—and are forced into concerted action.

Class and conflict in agricultural societies

In agricultural societies (such as China, India and most of Africa) the basic class distinction is between the rural agricultural population and the urbanised elite, or nobility, who live on the surplus agricultural products. The interests of the two classes are opposed and the latter dominates the former and often keeps them repressed. Labour as well as food is extracted from the rural population, usually to build public buildings, palaces, roads and irrigation schemes. Within the elite there are sometimes conflicting interests between various classes or factions who become involved in conflict over their cultural role or position, the extent of state control and policies affecting accumulation of wealth.

FIGURE 2.4.43

The French Revolution of 1789 was one of the first successful class revolutions.

Class and conflict in industrial societies

In the course of industrialisation, social classes change their character. The fundamental shift is brought about by the rise to complete dominance of capitalist manufacturing as the way of organising economy and society. There is a tendency in the capitalist industrialisation process for the various classes of agricultural society to form a new society existing of only two classes. These two great classes—capitalist industrialists and workers—are opposed to each other in terms of their interests. The greatest theorist of social classes, Karl Marx (see figure 2.4.31, p. 383), argued that this class division, or polarisation, would ultimately result in revolution; a peaceful revolution if universal suffrage (the right to vote) was achieved. In reality, true polarisation of classes has not occurred. Nevertheless, the underlying tension between capitalists and workers is always there and is often reflected in conflict over wages and work conditions. Trade unions, employer organisations and political parties are the institutionalised forms of social classes in most industrialised societies. This can be seen in the basic divisions in Australian politics where the Labor Party is more or less representative of working-class interests, the Liberal Party is more or less representative of business interests and the National Party is more or less representative of rural interests.

Revolutions are one of the most important outcomes of class conflict. A *revolution* is the complete overturning and replacement of the political and social structure of a whole society. A revolution occurs when a large proportion of a society is sufficiently angered by the political processes to rise up collectively in a class-conscious fashion against the ruling-class system.

There were many sociopolitical revolutions and near revolutions in the world in the twentieth century. The most significant of these were the Russian, Chinese, Cuban and Iranian revolutions, all of which could be attributed largely to class conflict. No complete revolution has occurred in an advanced industrial society. All these revolutions or near revolutions came during the early to mid stages of industrialisation and

Capitalists/administrative elite	Retention and growth of power
Professional middle class	Growth in power through monopolisation of knowledge
Class of information/entertainment providers and controllers of information technology	Rise of a new class to significant power
Bureaucratic class	Decline in power with privatisation of public services
White collar administrative class	Decline to insignificance in numbers and organisation with rise of information technology
Small business/farmer class	Decline in power and increasingly dependent as franchisees/tenants of large capitalist corporations
Industrial working class	Decline to insignificance in numbers and power
Underclass of unemployed and semi-employed class	Growth in numbers but completely unorganised and the target of law and order campaigns as well as welfare groups

FIGURE 2.4.44

Model of the class structure of modern industrialised societies.

could be seen as a result of the great upheavals caused by that process. Once industrialisation is achieved and societies begin to experience some of the benefits of growing affluence, the revolutionary impetus seems to pass. There is a significant absence of actual revolutions and even genuinely near revolutions in advanced industrial societies.

Lack of class conflict in information societies but increased inequality

The rise of information economies and societies, sometimes called '*post-industrial societies*' or 'service economies', is a change as dramatic as the agricultural and industrial revolutions. Australia is becoming one such **information society**. Several strong counter (opposing) tendencies are occurring in the economic and social organisation of these information societies. (See figure 2.4.44.)

First, there is the rapid rise of the information sector in advanced economies. This sector now employs more than 25% of the workforce and includes such overlapping industries as TV and radio broadcasting and other means of gathering and spreading information; book and magazine publishing; software production; higher education; scientific research; and information technology research and production. These industries are highly dynamic and constantly changing. Salaries tend to be large and there is usually a high degree of individual competition and job satisfaction.

Second, there is a correspondingly rapid relative decline in the economic significance of the industrial, manufacturing sector. During industrialisation, agriculture declined as a proportion of employment through much greater efficiency. Likewise, industry, construction and related material production have declined to under 25% of the economy and workforce but are still able to produce the material goods required by the whole of society.

Third, growing affluence, education and economic efficiency within much of the population have allowed for greater expenditure on leisure and culture in information societies. There has been a correspondingly rapid rise in the hospitality industry. This industry requires many semi-skilled, part-time workers. They are relatively poorly paid and often dissatisfied with work. However, because the work tends to be part-time and employs many married women there is little class organisation or consciousness.

This leads to the fourth tendency: growing *social inequality* between rich and poor, especially in those countries where social welfare has been reduced. In post-industrial societies, there is a strong tendency towards the creation of an *underclass* of unemployed or partially employed people who have little, if any, prospect of ever gaining well-paid work. Among these people there is a feeling of hopelessness because of a lack of education and skills and of future prospects. Crime and drug-taking are often the result.

Culture

Culture is the complex set of beliefs, customs, rituals and artforms that result from people's interpretations and understandings of the deeper meanings and significance of the world and their place in it. All people are cultural beings. Most people define themselves partly by their culture, which is closely related to ethnicity, religion and territory. Culture is an integral part of daily life in all societies. In more traditional, agricultural societies there is little or no distinction between cultural and economic activities and almost no distinction between popular (that is, of the people) and elite culture. In modern Western industrialised societies

understanding the text

1 **Outline** the processes that give rise to tensions and conflicts within nation-states.
2 **Define** the term 'resources'.
3 **Explain** how the distribution of resources can lead to tensions and conflicts.
4 **Explain** why land is often a source of political tension and conflict.
5 **Describe** the main ideologies of the twentieth century.
6 **Explain** the relationship between poverty, social oppression and fundamentalist religion.
7 **Outline** the three main causes of nationalist-inspired tension and conflict.
8 **Outline** the concept of 'ethnicity'.
9 **Differentiate** between ethnicity and race.
10 **Discuss** two ways in which tension and conflict can be fuelled by ethnic differences.
11 **Outline** the three main ways of defining class.
12 **Explain** the term 'social class-consciousness'.
13 **Describe** the way in which conflicts over class occur.
14 **Describe** the process by which societies in capitalist countries are becoming increasingly divided in terms of class.
15 **Outline**, in brief, Karl Marx's theory regarding class division.
16 **Describe** what a revolution is.
17 **Outline** the conditions that often give rise to revolutions.
18 **Explain** the link between revolutions and the process of industrialisation.
19 **Explain** why industrialised countries have not experienced revolutions.

many people feel that cultural expression has become divorced from more practical concerns of economic activity and money making. In fact, this is not really the case, for popular culture (such as TV, sport and shopping) is indeed part of daily life, whereas observation and participation in elite culture are often only occasional.

Religion

Religion is closely related to culture and the two are often difficult to separate. Until the twentieth century that was almost always the case. During the twentieth century, however, religion has declined in importance in many developed countries, such as Australia. This decline has occurred under the impact of industrialisation, affluence, science and modernism. Elsewhere in the world, religion is still a fundamental part of daily life, providing a way for people to understand and make sense of the world.

A religious view of the world is all-encompassing in the sense that religions claim to explain everything about existence, the universe and the conduct of human life. There are two fundamental types of religion:

- polytheism (including animism, magic and idolatry), where there are many gods with superhuman spirits and powers
- monotheism (including Zoroastrianism, Judaism, Christianity and Islam), where there is only one universal and supreme God.

Monotheistic religions in their pure, or fundamental, forms are absolutely **dogmatic** in the sense that they claim to have been divinely revealed and have not grown from human reason or experience. They therefore contain complete wisdom and cannot be tolerant of other religions or of **atheism**. True believers of such religions try to fulfil all the commands made to live an **exemplary** life. In the world today there is a revival of fundamentalism in all the great religions: Christianity, Islam, Judaism and Hinduism.

dogmatic characteristic of an established belief or doctrine that is thought to be authoritative and not to be disputed or doubted.

atheism the belief that God does not exist.

exemplary worthy of imitation.

Indigenous rights

The particular ethnic problem of the relationship of indigenous people to the dominant, more recently settled population of a country is an ancient issue. It became much greater after the fifteenth century with the further spread of European empires.

In Africa and Eurasia there have been large-scale movements of people into territories that had already been occupied by previously arrived people for many tens (perhaps hundreds) of thousands of years. Thus, the modern peoples of Africa and Eurasia are the result of the intermingling of people over many centuries. Nevertheless, there is a strong sense among many ethnic groups that they are the historic occupiers of certain territories, even if they were not, in fact, the original human inhabitants. For all practical purposes they think of themselves as the indigenous inhabitants. For example, the Celtic peoples of the western and northern fringes of the British Isles, and the Germanic peoples of north-west Europe believe themselves to be the indigenous populations of those regions. Whether they really are is unimportant in this context.

The situation in the rest of the world is a little different. There the first humans arrived much later than in Africa and Eurasia. The Aboriginal Australians arrived in Australia at least 60 000 years ago. The Polynesians of the Pacific spread into their island territories during the past 5000 or so years and arrived in New Zealand about 1100 years

FIGURE 2.4.45

In Canada, the indigenous people, known as the First Nations, have gained extensive land rights.

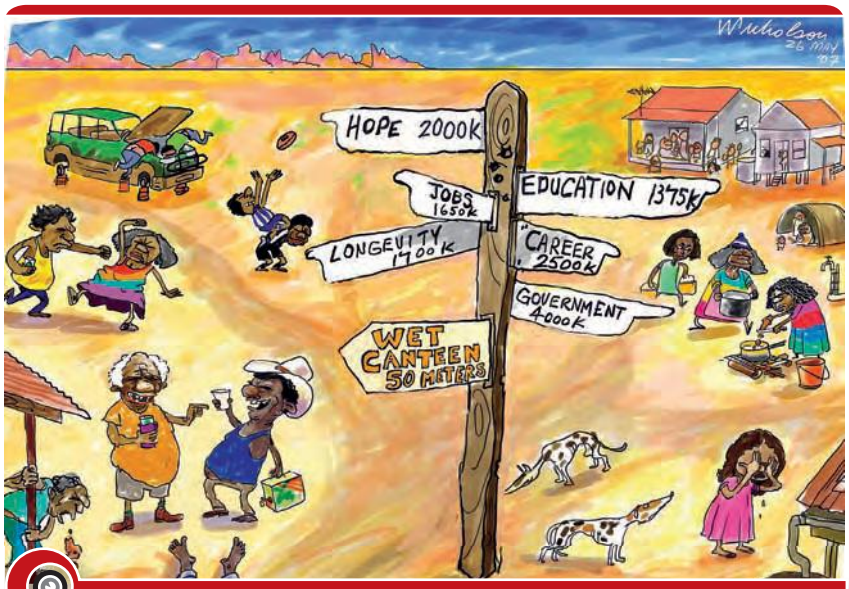


FIGURE 2.4.46

Aboriginal disadvantage.

ago. The native Americans first arrived in the Americas from north-east Asia about 12 000 to 14 000 years ago.

The Europeans expanded overseas to the Americas, Asia, Africa, Australasia and Oceania from the late fifteenth century. In each of these places, they obviously encountered the local indigenous people. In many places these indigenous people were conquered and sometimes enslaved. In the Americas, Australasia, Oceania and parts of Africa there was little or no recognition of native land ownership or native rights. The people were often treated as subhuman. Through a combination of violence, maltreatment, disease and starvation, their populations were decimated (largely destroyed). In some places they were exterminated (wiped out) completely.

In many occupied territories there was an influx of European land-seeking settlers. They, in turn, imported large numbers of slaves and contract labourers to replace the labour supply of the disappearing indigenous population. This led to the emergence, especially from the early nineteenth century, of a complex ethnic structure in many of these colonial territories.

In the late twentieth century there was a strong upsurge in demands by surviving indigenous people for their rights to be upheld and for the wrongs against them to be redressed. These movements have taken many forms, and the form has depended on local social and political conditions. In South Africa, for example, there was virtually a civil war waged by black groups against the white-settler **apartheid** regime. In the United States, native Americans have agitated (mainly peacefully, but occasionally violently) for redress for past wrongs. In Canada, the native people have succeeded in gaining extensive land rights and a degree of political autonomy. (See figure 2.4.45.)

In Australia, in 1988 the Aboriginal land rights movement succeeded in its quest to establish the legal principle of native land title in the Mabo decision of the High Court. This principle is being implemented through a political and judicial process that is ongoing but also politically and socially highly contentious in many parts of the country. (See figure 2.4.47.)

FIGURE 2.4.47

Indigenous land rights remains a significant sociopolitical issue in Australia.

apartheid the racial, political, and economic segregation of non-European peoples.

Economic instability

Economic security is essential if a country is to attract investment funds, sustain consumer confidence and reduce the potential for economic tensions. Governments seek economic stability through:

- promoting full employment and price stability; that is, keeping inflation low
- maintaining an acceptable level of foreign debt and boosting international confidence in the national currency
- encouraging economic growth; that is, the ability of a country to satisfy the material wants of its population over a period of time. A stable level of economic growth is required to increase the standard of living, improve employment opportunities and provide greater access to services, such as health and education.

The absence of economic stability can have disastrous consequences for the level of political tension within regions and individual nation-states. For example, in 1997–98 there was a major economic downturn in many Asian economies. Throughout the late 1980s and 1990s the economies of East and much of Southeast Asia had boomed due to significant foreign investment. This led to economic stability and sustained growth. However, a series of business failures across the region sent a wave of fear through foreign investors. This caused them to abandon the region, leading to mass bankruptcies and soaring unemployment. There was little that national governments could do to stop this from occurring, but local citizens took out their frustrations on their governments by rioting and protesting. This resulted in political instability across the region.

understanding the text

1 **Describe** the concept of culture.
2 **Describe** the link between indigenous rights, economic policies and conflict.
3 **Explain** how economic instability can contribute to tensions and conflicts.

working geographically

1 **Writing task** Define the following terms and, for each, write a sentence using the term in the context of political geography:
   a capital
   b human resources
   c raw materials
   d material products.
2 **Writing task** Select one of the main political ideologies of the twentieth century. Using specific examples, explain how this ideology impacted on conflict during that century. Assess the extent to which this ideology continues to affect political geography today.
3 **Interpreting text** Study the Geofocus box 'The rise (and fall) of US neo-conservatism' (pp. 381–2).
   a Explain what is meant by the term 'neo-conservatism'.
   b Outline the ideas that neo-conservatives advocate.
   c List the reasons the neo-cons gave for the invasion of Iraq.
   d Outline the political, human and financial costs of the Iraq invasion.
   e Write an extended response outlining the 'collateral damage' of the Iraq intervention.
4 **Research task** Study the Geofocus box 'Burma' (p. 387). Investigate the current political and humanitarian situation in Burma. Share your findings with the rest of the class.
5 **Research task** Collect a media file containing articles about the links between natural resources and political conflict. Use this information to write an exposition. Topic: The strategic value of natural resources is a major cause of political conflict at both regional and global scales.
6 **Oral presentation** Divide the class into small groups. Each group is assigned a different ideology of the twentieth century to evaluate. Prepare an oral presentation of the advantages and disadvantages of the ideology.
7 **Mapping task** On an outline map of the world mark on the major conflicts currently taking place around the world. Classify these conflicts according to their main causes.
8 **Writing task** Write an exposition on the following topic: Nationalism is closely connected with ethnicity.
9 **Writing task** Study figure 2.4.44 (p. 390). Write a report outlining the social transformation taking place in post-industrial societies.
10 **Using the media** Use newspaper, Internet and journal articles to construct a wall display outlining the role of wars, famine, poverty, persecution and economic instability in the promotion of political conflict.

Geographical outcomes of political tensions and conflicts

Migration and mobility of people

One of the major consequences of political tensions and conflicts arising from all the causes discussed in the previous section is the large-scale movement of people. People are dislodged, displaced, ejected and generally forced into moving by geopolitical forces over which they have little or no control. Wars and famines are two of the main causes of dislocation, but poverty, **persecution** and economic opportunity are also major causes of the large-scale migration of people.

Famines

Famines, diseases and other hardships often result from the socio-economic collapse that accompanies war. Sometimes more people die through these causes than through military activity. For example, more people in Europe were killed by the influenza **pandemics** of 1918 and 1919 than by the fighting in World War I in the period 1914–18. In some cases famine is used as a weapon against people. For example, there have been allegations against the dictatorial governments of North Korea and Zimbabwe that they have deliberately created famine by denying aid agencies access to internally displaced persons in order to repress them.

Genocide

Genocide is the most extreme demographic consequence of war. It is the attempt to exterminate a whole ethnic population or a whole class of people.

The Nazi's 'final solution' to the existence of Jews and gypsies in Europe was to try to exterminate them all in death camps. At least 6 million such people were killed before the Nazi regime was destroyed.

Similarly, the Hutu-dominated government of Rwanda attempted, in 1994, to exterminate the Tutsi ethnic minority. They succeeded in killing at least 1 million Tutsis before being forced to flee by the incoming Tutsi-led rebels. (See the Geofocus box 'Rwandan genocide', p. 396.)

During the late 1970s and early 1980s, the Khmer Rouge government of Cambodia attempted to exterminate the entire upper, middle, urbanised and educated classes of the population in an ideologically driven desire to 'cleanse' the country of all capitalist, modern or Western-influenced elements. Their aim was to create a 'clean sheet' on which to conduct a social experiment. (See figure 2.4.51, p. 397.)

Forced migrations

Forced migrations of people take place before, during and after a war. The refugee problem has been one of the major global geopolitical issues since World War II. In the twentieth century, many wars were started with the express purpose of expelling and/or capturing large numbers of people so as to either 'ethnically cleanse' a territory or resettle a population. Tens of millions of refugees have fled from conflicts in recent decades and many of those people are unable or unwilling to return to their homelands. These displacements, in turn, often cause major humanitarian relief problems for aid agencies, host countries and the United Nations.

Voluntary migrations

After conflicts have been settled, many people remain very dissatisfied with the outcome and look for ways to migrate to new homes. Thus, even though not displaced by the conflict, as such, their movement

persecution the persistent mistreatment of an individual or group by another group.

pandemic a situation where a disease affects many people in different regions around the world.

geofocus

Afghan refugees

Afghanistan is one of the most fought over regions in the world. It is considered to have great strategic importance because passes through the mountainous country create an overland route linking Asia to Europe. After a failed invasion by the Soviet Union in the late 1970s, Afghanistan fell into civil war and lawlessness for much of the remainder of the twentieth century. This continued until an extreme Islamist group, known as the Taliban, seized control. Throughout the 1980s and 1990s, around 8 million Afghans fled into neighbouring countries, mostly Pakistan.

In 2002, democratic rule was returned to Afghanistan; although today there is still widespread fighting, especially in regional areas. Between 2002 and 2007 more than 4.8 million Afghan refugees returned home, but over 3.5 million remain in refugee camps near the border. Many people in these camps have been there for more than 20 years and a large number were born in the camps and know no other life.

FIGURE 2.4.48

Millions of Afghans live in refugee camps after fleeing fighting and religious extremism.

geofocus

Rwandan genocide

In July 1994, the small central African republic of Rwanda became the focus of world attention as more than 4 million people fled the intertribal genocide that swept across their homeland. (See figures 2.4.49 and 2.4.50.)

Before the outbreak of civil unrest, Rwanda was the home of nearly 8 million people crowded into an area less than one-third the size of Tasmania. About 85% of the population were Hutu and 15% Tutsi.

Three months of fighting between the followers of the majority Hutu government and the minority Tutsi rebels of the Rwandan Patriotic Front (RPF) left at least half a million dead. Most of the victims were Tutsi civilians slaughtered by Hutu militia. Many of those who survived the genocide fled the country. A resurgent RPF gradually gained the upper hand and soon controlled much of Rwanda. This led to a second exodus of an estimated 1.2 million Hutu refugees, forced to flee for fear of retribution from the now victorious Tutsi-led rebels back in Rwanda.

At the height of the crisis, international observers estimated that, in addition to the hundreds of thousands killed, more than 1 million people had crossed into Zaire (now the Democratic Republic of Congo) and a similar number into Tanzania and Burundi. Inside Rwanda there were as many as 1 million displaced people in a small area protected by French peacekeepers, and another half a million in camps in the rest of the country. A further half million roamed the countryside.

The number of refugees overwhelmed the authorities in neighbouring states and the resources of the international aid agencies. Refugee camps grew at an alarming rate. Outbreaks of cholera and other infectious diseases killed an estimated 100 000 people. Bodies could not be buried quickly enough, and the limited amount of water that was available quickly became contaminated by faecal matter and decaying corpses.

The cause of the conflict between the Hutu and Tutsi tribes has its roots in Africa's colonial era. Before Rwanda and Burundi were colonised by Germany, and then handed over to Belgium after World War I, the two tribes were clearly differentiated, even though they spoke the same language. Both the Germans and Belgians preferred the Tutsi, partly because they found them better-looking and partly because there were fewer of them; colonial powers usually lavish their favours on smaller and, in their opinion, superior tribes.

Over time the two tribes intermarried and the distinction between them has become almost entirely social and financial: if you have a car, an education or a larger house, you are a Tutsi. The outbreak of violence in 1994 was part of a deliberate attempt to stamp out an entire economic caste. This was fostered by the extremist Hutu leadership and enthusiastically followed up by elements in the army. It was the equivalent of Pol Pot's attempt to eliminate the Cambodian **bourgeoisie**. Hutu propaganda depicted Tutsi as gripping the throat of the country, stuffing their pockets with the state's money and carrying out murders.

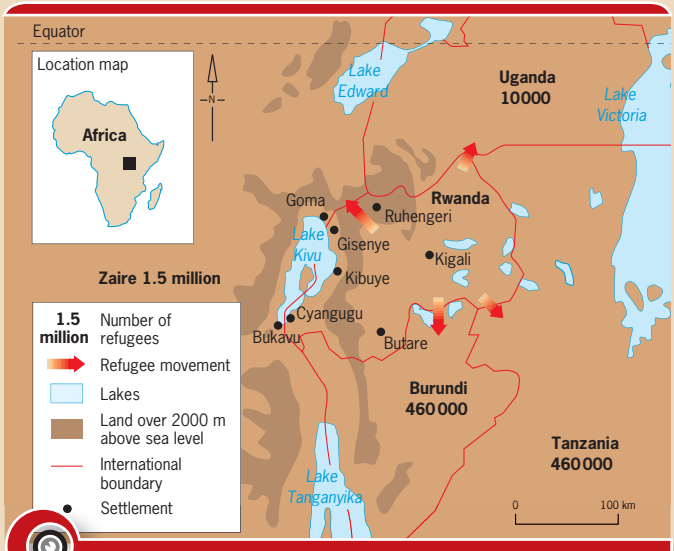


FIGURE 2.4.49

Refugee movements out of Rwanda following the ethnic violence there.

FIGURE 2.4.50

Intertribal violence saw hundreds of thousands of Rwandans killed.

bourgeoisie a term given to the middle class people in society.

is a longer-term consequence of conflict. Migrations in small boats of millions of Vietnamese and Cambodians to countries of Southeast and East Asia and and to Australia has been an enduring consequence of the communist victory in the Vietnam War.

FIGURE 2.4.51

Exhumed remains of victims of the Khmer Rouge regime. The Khmer Rouge attempted to kill the entire upper and middle class of Cambodia.

Refugee discontent

Large populations of refugees that are settled semi-permanently in host countries form fertile breeding grounds for ethnic discontent. Many terrorist events of recent decades, for example, are directly attributable to the great discontent and alienation felt by refugee populations of Palestinians dispersed throughout the Middle East.

Sociopolitical outcomes of tensions and conflicts

All tensions and conflicts have outcomes that affect many levels of sociopolitical life to a greater or lesser extent. Throughout this unit, attention has been drawn to many of the outcomes of particular tensions and conflicts. The following is a summary of the main types of outcomes.

Political

Almost all geopolitical tensions and conflicts result in political changes. Some may simply involve a change of government by a peaceful election, such as happened in Australia's constitutional crisis of 1975. Others may involve the violent overthrow of a government by a revolutionary upheaval, or the establishment of a new constitutional basis for government.

Constitutional

With the exception of about a dozen countries (including Australia, New Zealand, the United Kingdom, the United States, Canada and Switzerland), all countries in the world experienced major constitutional and political change during the second half of the twentieth century. Such changes have come about as a result of events such as liberation from imperialism and foreign occupation; revolution; federation; **unification**; civil war; or conquest.

geojobs

International aid worker

International aid workers are employed by a variety of organisations, including nongovernmental organisations (such as Oxfam), government agencies (such as AusAID) and intergovernmental agencies (such as the Office of the United Nations High Commissioner for Refugees or UNHCR). Some aid workers have specific skills in medical fields, engineering and trades. For example, many agencies need carpenters and other skilled tradespeople. Although aid workers are usually not well paid and work in very difficult environments their work is highly rewarding.

did you know?

The dismissal

The Australian constitutional crisis of 1975 (commonly called 'the dismissal') refers to the series of events that led to the removal (sacking) of Australia's then prime minister, Gough Whitlam, by the then governor-general, Sir John Kerr. The governor-general appointed the then leader of the opposition, Malcolm Fraser, as caretaker prime minister. Fraser won the subsequent election.

unification the coming together of separate political entities to form a single political entity.

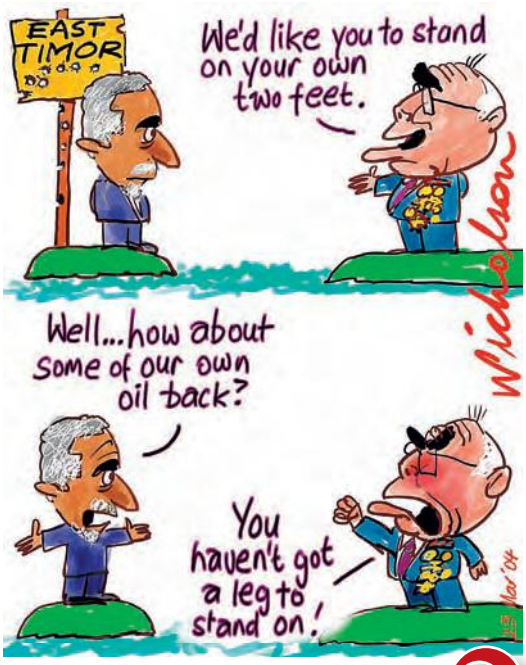


FIGURE 2.4.52

The uneven allocation of resources has often led to conflict.

Territorial

Many of the kinds of events that have resulted in constitutional changes have also brought about territorial changes through the forced redrawing of boundaries. Since the end of the Napoleonic Wars in 1815, the big powers have been willing to intervene in the map of Europe, just as they have in the rest of the (colonised) world. On several occasions they have redrawn boundaries to try to accommodate ethnic distributions, national rivalries and aggressive national attitudes.

These forced boundary redrawings have rarely succeeded in permanently solving such problems. Generally, throughout the world today, there is a reluctance to redraw boundaries. This is even the case when those boundaries, especially if inherited from a colonial situation, are inappropriate on ethnic grounds. The Organisation of African Unity has always been resolutely opposed to redrawing boundaries and subdividing states in Africa. To do so would require all the borders of Africa to be redrawn, unleashing numerous territorial and possibly ethnic conflicts in the process.

Landuse

Since landuse is often at the root of tension and conflict, outcomes directly affecting landuse necessarily result from them. Ownership and control of land gives power to use that land, so land conflict is usually about control. Struggles over the control of land are as old as human society.

Resource allocation

The capture and defence of resources and/or their reallocation have always been a significant outcome of conflicts. Soil, oil and labour have been the most important resources at the heart of tensions and conflicts in the twentieth century. All instances of resource control and allocation are consequences of power. The role of OPEC and the interventions of the Western powers in the Middle East during the past few decades have resulted in a continuation of the flow of oil to the industrial countries. However, the oil was supplied at significantly higher prices for a period in the 1970s and 1980s, and again in 2000 and 2006–08. The control of water supplies is likely to become an important issue in resource conflicts and outcomes in the twenty-first century.

Environmental alteration

Outcomes of geopolitical disputes can have significant environmental consequences. One of the main causes of tension is environmental policy. Environmental policy can have major consequences for the political process. The fate of Tasmania's old growth forests and the proposal to build a large pulp mill in Tasmania were major political issues in the 2004 and 2007 federal elections.

Social structure

A reorganisation of social structures can occur as a result of a geopolitical crisis. In the case of some conflicts (particularly those resulting from inequality of social classes) there can be quite profound alterations in the class and family composition of societies. This is particularly so following revolutions. Marxist-inspired revolutionary movements and upheavals (such as in Russia, China, Vietnam and Cuba) had great social structural effects in the long run. Whole social classes disappeared, especially landlords and capitalists. New classes of bureaucrats and party officials rose to prominence. With the demise of the communist

regimes of Europe, the capitalist class has returned but not the landlord class. The social structure of the former communist countries of Central Europe is today quite different from the more established capitalist societies of Western Europe.

Cultural reorganisation

Cultural reorganisation can also be the outcome of a conflict. Sometimes cultures, or their key aspects (such as languages), can be suppressed and even disappear because of the outcomes of geopolitical conflicts. The suppression of minorities and the banning of languages and other forms of cultural expression can be of lasting significance. In many parts of the world, ethnic cultures disappeared as a result of colonialism and/or policies of **assimilation**. Against this, indigenous peoples are today fighting back vigorously and policies of multiculturalism are common in many Western countries. In many developing countries there are still strong movements to suppress minority cultures.

Paths towards resolving issues and meeting challenges

The resolution of political tension and conflicts takes place at many levels, involves many forces and can have many outcomes. Each tension and conflict can only be resolved in a lasting manner by addressing and overcoming the deep-seated causes of the problem. This statement should be obvious but, unfortunately, many attempts to resolve conflicts fail because of a lack of good understanding of the causes. It must be acknowledged that many wars are deliberately started and pursued by leaders and countries that have definite objectives in mind. Outside forces, such as the major powers (or the major powers acting on behalf of the United Nations), have often failed in their attempts to intervene in, or **mediate**, conflicts. This failure is a result of their inability or unwillingness to grasp the complex social causes involved and the deliberate motives of some combatants. Because the causes of conflicts are complex, so too are lasting resolutions.

A traditional point of view on the resolution of serious political conflicts and wars is known by the German term *realpolitik*. This **doctrine** suggests that disputes and conflicts are inherent in human society and should be solved in a so-called practical, rather than moral or ideological, manner. A 'practical' solution often means that interests of a material (that is, economic) and biological (that is, racial) nature are more important than rationality and morality. Therefore, solutions should only take account of material and biological interests. In practice this usually means that force should prevail. This is achieved by using some external power to forcefully remove the causes of the dispute. It can also be achieved by allowing one of the contending parties to overthrow the other in the interests of removing the problem permanently.

Unfortunately, as *realpolitik* accepts, it is a sad fact of history that political violence often (but not always) works to the advantage of its perpetrators. Furthermore, the continuing resort to violence throughout history shows that the willingness to employ violence has not diminished. Advances in 'civilisation' and 'modernisation' have not been accompanied by an abandonment of political violence. There is no good reason to think humanity has progressed in its attitudes towards using violence. The prevalence of wars throughout all ages of history right up to the present shows this to be so.

FIGURE 2.4.53

The conflict between conservationists and forestry industry workers has long been a source of political tension in Tasmania.

did you know?

Napoleonic Wars

The Napoleonic Wars of 1799–1815 were a series of European wars fought between Napoleon Bonaparte's First French Empire and various European countries. They ended with Napoleon's defeat by the Duke of Wellington at the Battle of Waterloo.

assimilation the social process of absorbing one cultural group into another.

mediate act between parties with a view to reconciling differences.

doctrine a belief (or system of beliefs) accepted as authoritative by some group.

understanding the text

1 **Explain** the link between conflict and migration flows.
2 **Define** the term 'genocide'.
3 **Describe**, using examples, the effects of genocide.
4 **Outline** the relationship between conflict and famine.
5 **Distinguish** between forced and voluntary migration.
6 **Outline** the potential effects of refugee discontent.
7 **Describe** the political and constitutional consequences of conflict.
8 **Explain** the concept of boundary redrawing.
9 **Explain** the link between resource allocation and conflict.
10 **Describe** the consequences of conflict on social structures.

working geographically

1 **Using ICT** Using the Internet, research the history of conflict in Afghanistan. Construct a simple time line of this conflict.
2 **Writing task** Study the Geofocus box 'Afghan refugees' (p. 395). Write a short report explaining the extent of the Afghan refugee problem.
3 **Using ICT** Visit the website of the Office of the United Nations High Commissioner for Refugees (UNHCR). Briefly outline the main refugee crises that the UNHCR is dealing with. Describe the causes of these refugee movements.
4 **Writing task** Study the Geofocus box 'Rwandan genocide' (p. 396). Write a report describing the causes and consequences of the Rwandan genocide.
5 **Writing task** 'European countries should accept some responsibility for the Rwandan genocide'. Discuss the accuracy of this statement.
6 **Writing task** Write an exposition explaining why you think boundary redrawing rarely succeeds.

Carl von Clausewitz was an early nineteenth-century German theorist of the geopolitics of war. He also participated as an officer in the French Revolutionary and Napoleonic Wars, and wrote that:

> *War is a clash between major interests that is resolved by bloodshed; that is the only way in which it differs from other conflicts. Rather than comparing it to an art we could compare it to commerce, which is also a conflict of human interests and activities; and it is still closer to politics, which in turn may be considered as a kind of commerce on a larger scale.*

Elsewhere, he made the famous statement that, 'War is a continuation of politics by other means.'

Clausewitz seems to have been correct, at least in the case of some wars. Sometimes hatreds are very deep seated, and aggressive policies are firmly entrenched. In such cases there may not be sufficient common ground between conflicting groups, classes or states to resolve conflicts without one of the following occurring:

- the total destruction of one side by the other (or of both by each other)
- the total and permanent domination of one by another
- the total separation of the contending parties.

Even with the best will to solve tensions and conflicts by mediation, and even with an excellent understanding of causes of conflicts, there may be no other possible outcomes. On the other hand, many conflicts are resolvable before they become violent, and much violence can be ended through negotiation by employing third parties and sufficient power to enforce agreements.

Towards global governance

The foregoing discussion, and the whole examination of the tensions and conflicts in geopolitics, seem to lead logically towards an argument in favour of some form of limited global governance. Such governance would be concerned with at least trying to prevent and then resolve violent disputes. Such thinking lay behind the founding of the League of Nations in 1919 and the United Nations in 1945, in which a significant role was played by Australia's then foreign minister, Dr H.V. Evatt. (See the 'Did you know?' box opposite.) The possibility that such global governance would actually have an effect depends on:

- the willingness of states to surrender a little sovereignty
- the organisation having sufficient force and resources to command compliance with decisions and to finance whatever changes may be necessary, such as the resettlement of large populations
- the organisation having sufficient wisdom to understand and act on the causes of conflicts.

Together these three provisos (qualifications) amount to the beginning of global federation, something that member states have so far been unwilling to contemplate.

Yet, as we discussed earlier, in the economic and environmental spheres there have been some limited steps towards global governance. Also, in the sphere of geopolitics there are already many limitations on the powers of states to act independently of the international political community. The pace of globalisation increases and the need grows for certain states to take joint environmental and defence measures against pollution, nuclear weapons and military aggression. As as result, further steps towards global governance will occur. Until then, there are a number of paths available for the attempted resolution of geopolitical conflicts.

Resolving tensions and conflicts

There are numerous paths towards resolution of conflicts, and usually a combination is employed to resolve a particular conflict. The Bosnian

War of 1993–95 is a recent example of the great complexity of geo-politically inspired violence, the paths to its resolution and the possible outcomes.

Conquest, domination and flight

Conquest, domination and flight is the most extreme solution but it is sometimes the only one that works permanently, albeit unfortunately for the vanquished (defeated) or displaced people. Two major examples seem to confirm this.

First, the German case. The two world wars were essentially two phases of one war of German aggression in Europe. Germany sought to dominate the European continent and to then dominate the world. The first war ended in 1918, almost in a stalemate of exhaustion in the sense that Germany was not conquered and invaded as a territory but surrendered before that happened. The subsequent peace treaty stripped Germany of control of some eastern and overseas territories. However, it left large German populations in the eastern territories in Czechoslovakia and Poland. The treaty also imposed major reparations (penalties). However, most of Germany was not occupied and German politics were left to run their own course.

In the 1920s and 1930s there arose in Germany a theory that the country had been betrayed in 1918. The Nazi government started the second war partly to seek revenge for the partial defeat in the first war. If Germany had been completely conquered, occupied and restructured after the first war, the Nazis may never have come to power.

In the second war, Germany was completely conquered, physically destroyed and occupied. Subsequently, there was political restructuring; partitioning of the east and west until 1989; rehabilitation within new borders; and massive migration of Germans out of Eastern Europe back to Germany. All these actions removed any possibility of a major totalitarian resurgence and aggressive policy. Thus, from a *realpolitik* viewpoint (and confirmed by the subsequent history of peaceful European integration) a complete German defeat was not only necessary in 1945 but removed the 'German threat' from Europe once and for all by the massive migration of German peoples.

The second example is the ending of the Yugoslavian wars of the 1990s. This only came about after implementation of the *realpolitik* solution of a more or less complete forced separation of the warring ethnic groups of Croats, Serbs and Bosnian Muslims, and a negotiated settlement on the basis of that separation. (See the Yugoslav federation section of the Geofocus box 'Federations', p. 367.)

International treaties and alliances

Often conflicts are resolved (or prevented) with treaties. Treaties are special agreements between nation-states. In order to be valid, treaties must be entered into voluntarily and require the parliament of a country to ratify them. This means that the parliament must pass a law accepting the conditions of the treaty.

Treaties can prevent tensions from becoming conflicts. Australia has several treaties with its neighbours. These are designed to either prevent conflicts, as in the case of the Australia–Indonesia Treaty of 1995, or to gain security through mutual defence, such as the ANZUS Treaty with the United States and New Zealand.

Perhaps the most significant treaties made since World War II have been the various nuclear arms limitation and reduction agreements between the **superpowers**. These agreements were aimed at preventing deliberate or accidental nuclear war and became especially important after the Cuban missile crisis of 1961.

did you know?

Dr Herbert V. (Doc) Evatt (1894–1965) was an Australian jurist, politician and writer. Evatt was elected as an Australian Labor Party member for Balmain in the NSW Legislative Assembly in 1925. He served there until 1930. In 1930 the Scullin Labor (Federal) Government appointed Evatt as the youngest-ever justice of the High Court of Australia.

In 1940 Evatt resigned from the High Court to return to politics, and was elected federal MP for the Sydney seat of Barton. When Labor came to power under John Curtin in 1941, Evatt became attorney-general and minister for external affairs (foreign minister).

Evatt was a member of the diplomatic councils of the allies during World War II. In 1945 he played a leading role in founding the United Nations. Australia is one of the 51 founding members of this body. Evatt was president of the UN General Assembly during 1948–49 and was prominent in the negotiations that led to the creation of Israel. He helped draft the United Nations Universal Declaration of Human Rights.

In 1946 Evatt became deputy leader of the Labor Party. In 1949 Labor was defeated by Menzies's Liberal Party and Evatt went into opposition. Evatt was elected Labor leader without opposition when Ben Chifley died in 1951.

FIGURE 2.4.54

With its headquarters in New York, the United Nations was formed for the purpose of maintaining peace between nation-states.

Alliances between various parties, especially states, involved in tensions sometimes have the effect of preventing tensions from becoming wars. This is achieved by deterring possible aggressors or by projecting such power that the will of the alliances can be imposed on another country. Most states join alliances as a means of gaining security against potential enemies. The Cold War of the 1950s and 1960s never became 'hot' in a direct sense because of a balance of power and the fear of mutual annihilation. On the other hand, the existence of two great alliances on the eve of World War I meant that when war did break out in the Balkans, most of Europe was drawn into a major war. Thus, alliances can both prevent wars or widen them when they do start.

Partitions and separations

When tensions and conflicts are caused by inter-ethnic hostility or ideological divisions, the partition (division) of a territory and the forceful separation of potential combatants can prevent further violence and even produce a permanent peace. Throughout history there have been numerous examples of partitions. Some of these have been successful, while others have prolonged conflict.

For example, following World War II, Korea was partitioned into North and South Korea. North Korea became a communist state and the south became nominally democratic. The Korean War (1950–53) followed the invasion of the south by the north. When the war came to an end it was agreed that the partition would return to its original point, the 38th line of latitude. (See figure 2.4.55.) This is where the border remains today. Tensions between the two nation-states remain very high.

Other partitions include the partition of India following the granting of Indian independence by the British. This partition was based on religious grounds, with the creation of Pakistan and later Bangladesh for the Islamic population of India. This partition has led to conflict around disputed territory in the province of Kashmir.

did you know?

New Zealand withdrew from the ANZUS Treaty in 1984 after New Zealand refused to allow US nuclear-powered ships to use its ports.

geofocus

The Sea-Bed Treaty (1971)

As nuclear and military technology progressed in the years following World War II, fear of nuclear war increased. One of the most significant concerns was that countries would place nuclear weapons platforms below international waters near their enemies. The spectre of nuclear missiles sitting just off the coast of countries was a very real concern.

In response to this fear, and the arms race it would lead to, the United Nations sponsored the 1971 Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and the Subsoil Thereof (usually referred to as the Sea-Bed Treaty). The treaty prohibits the placement of nuclear weapons and other weapons of mass destruction on the sea-bed. Also banned are launching platforms and facilities for storing or testing weapons. The treaty only allows nation-states to undertake these activities within 21.5 km of their own shoreline. The treaty has been very successful in reducing this nuclear threat.

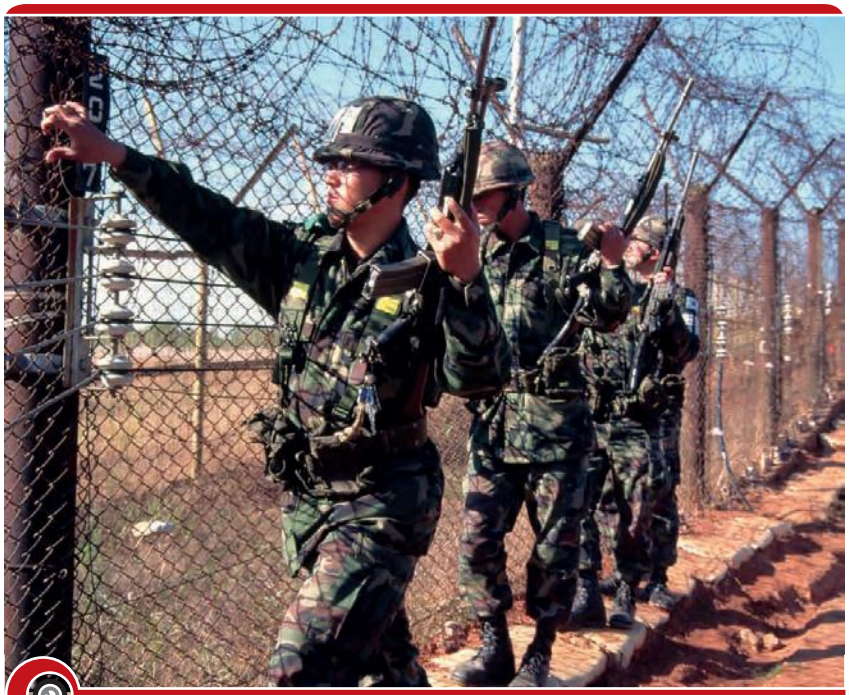


FIGURE 2.4.55

Korea was partitioned into North and South Korea using the 38th line of latitude as the border.

geofocus

The partition of Cyprus

Located in the Mediterranean Sea, the island of Cyprus has a long history of domination by various great empires. In the nineteenth century the Ottoman Empire, centred around Turkey, took control of Cyprus. Britain also became interested in the island. The Greek population of the island frequently clashed with the Turkish population and a series of partitions began. In 1960 Britain, along with Greece and Turkey, agreed to make Cyprus an independent nation-state. One of the key clauses in the agreement was that Cyprus would not be permitted to form alliances with any other country and it would not be partitioned.

Despite these agreements the longstanding conflict between Greek and Turkish Cypriots intensified. By 1963 open fighting broke out between the two groups. In 1964 the United Nations authorised peacekeepers to be sent to the island. Both Turkey and Greece threatened to invade the island, but the UN intervention kept them at bay. By 1983 the Turkish population had formed their own government and the island become unofficially partitioned with the formation of the Turkish Republic of Northern Cyprus. Turkey is the only country to recognise the legitimacy of this republic. Today Cyprus remains divided. UN peacekeepers still operate in the country in what has become one of the longest peacekeeping missions in history.

FIGURE 2.4.56

UN peacekeepers, including Australian Federal Police, have operated in Cyprus since 1964 in one of the longest-running peacekeeping missions ever.

International agencies: military intervention and civil aid

As we have seen in a previous section, there are two main types of international agencies whose task is to help prevent or resolve geopolitical conflicts:

- *intergovernmental agencies*, many of which are part of the United Nations
- *nongovernmental organisations (NGOs)*, which are public, non-profit, cooperative agencies mainly relying on financial donations.

The United Nations was founded as the principal international agency for promoting peace through civilian and military programs. Since World War II and the foundation of the United Nations there have been many instances of UN interventions in conflicts to try to bring about peace or, at least, prevent further conflict. There have also been several forceful military interventions on the side of one of the combatants to repel aggression, most notably in the Korean War of 1950–53 and the Gulf War of 1990. Peacekeeping work has greatly increased in recent years following the ending of the Cold War and the United Nations gaining improved moral authority. The success of peacekeeping has been mixed, but on the whole has had some success in recent years, such as in Namibia, Cambodia and the Iran–Iraq border dispute. There have also been some notable failures, such as in Somalia and Bosnia. It is often argued that UN peacekeeping only works when the warring parties want it to work.

The United Nations also engages in much civilian aid work, notably in refugee assistance. The UN High Commissioner for Refugees (UNHCR) has had a huge task in recent years with the tragedies in Ethiopia, Afghanistan, Rwanda, Bosnia and Darfur.

Other intergovernmental agencies concerned with conflict resolution include the Commonwealth of Nations, which assisted the transition

FIGURE 2.4.57

The United Nations is often criticised for not stopping war. However, it is limited by the reluctance of many countries to surrender some of their sovereignty and thus allow the organisation to do its work.

More than ever before in human history we share a common destiny. We can master it only if we face it together. And that, my friends, is why we have the United Nations.

Kofi Annan, former UN Secretary General (1997–2006)

FIGURE 2.4.58

A Médecins Sans Frontières' doctor attends to a child injured during civil unrest in Africa.

majority rule the idea that all the people in a group or society should be held to the rules and decisions established by more than half the people.

rule of law one of the cornerstones of democratic society, meaning that everyone (including politicians and government agencies) is subject to the law.

to **majority rule** in Zimbabwe, and NATO, which keeps the peace in Bosnia after having first forced the warring parties to negotiate.

There are many kinds of NGOs. Those providing relief (such as CARE, Oxfam and Médecins Sans Frontières) are not so much concerned with resolving disputes as alleviating their consequences. This alleviation may, in turn, have the effect of preventing a further outbreak.

Political, constitutional and judicial interventions

Most geopolitical disputes and conflicts at all levels are, in principle, capable of legal resolution under local, national or international law. Laws govern all aspects of social life, including the conduct of war. Nevertheless, if legal procedures and judgements could always resolve tensions there would be no conflicts. Clearly the **rule of law** and the jurisdiction and power of courts are often ignored in international tensions. National and local tensions, on the other hand, are most often resolved by law. This is because courts and police forces within states have a legal monopoly of force, which is nearly absolute in the practical enforcement of decisions. Of course, throughout history, there have been many (strictly illegal) rebellions against legally constituted power.

War crimes tribunals

The establishment of war crimes tribunals has been a direct result of the Geneva and Hague Conventions about the conduct of war and statements of principles about human rights. Examples include those established at Nuremberg (see figure 2.4.59) and Tokyo after World War II, and the current UN War Crimes Tribunal at The Hague, which is investigating and prosecuting atrocities in the Balkans and Rwanda. A chief criticism of these tribunals is that only the victors establish them, or that the United Nations establishes them only when prompted to do so by one of the big powers.

International Court of Justice

The aim of the International Court of Justice (ICJ), formed in 1946 by the United Nations, is to help maintain peaceful relations between nation-states. The court has two key functions. The first is to settle disputes

geofocus

Regulation of war: the Geneva and Hague Conventions

One of the most famous international conventions (international agreements) is the so-called Geneva Convention. This convention is, in fact, four separate conventions that were agreed to over a period of more than 60 years. The first convention, the Convention for the Amelioration of the Wounded in Time of War, was enacted in 1864. All four conventions were last revised and ratified in 1949. The Geneva Conventions mostly deal with the treatment of non-combatants during war. These are people who are not directly taking part in the fighting, and include civilians, the wounded and medical personnel. Also included in the conventions are laws relating to the treatment of prisoners of war. One of the interesting features of the Geneva Conventions is that they are governed not by the United Nations but by the International Committee of the Red Cross and Red Crescent (ICRC).

Although often seen as a failure, The Hague Conventions of 1899 and 1907 were very important in terms of regulating war. They were the first real attempt to create a way of reducing the need for countries to resort to war. Importantly these conventions led to the formation of the Permanent Court of Arbitration in 1899. This was a special court for nation-states to use to peacefully resolve disputes. This court became the model for the International Court of Justice, which was established in 1945 and still exists today.

FIGURE 2.4.59

The Nuremburg tribunal was the first war crimes tribunal and was used to try Nazi war criminals after World War II.

geofocus

War crimes tribunal for Rwanda (ICTR)

Following the tribally motivated genocide that took place in Rwanda in 1994, in the same year the United Nations created the International Criminal Tribunal for Rwanda (ICTR). At the first sitting of the tribunal (from 1995 to 1999), six people were convicted of crimes against humanity. The second session, beginning in 1999, saw more than 20 people arrested and tried for crimes.

One of the most significant cases involved Sylvestre Gacumbitsi who was the mayor of the Rwandan District of Kibungo during the genocide. Gacumbitsi was accused of driving around the district inciting Hutu men to hunt down and rape Tutsi women and of ordering the murder of women and children who had been hiding in a church. The ICTR found Gacumbitsi guilty of the crimes against humanity of genocide, rape and extermination and he was sentenced to 30 years imprisonment.

While the ICTR will not be able to prosecute every person involved in the Rwandan genocide it has an important function in demonstrating to the people of Rwanda and, more generally, the world that such crimes are not acceptable, even in times of war. The ICTR also states that one of its key aims is to promote reconciliation in Rwanda by restoring the rule of law. (See page 396 for more information about the Rwandan genocide.)

between nation-states. The second is to offer advisory opinions to countries on matters relating to international law.

The court is located in The Hague in the Netherlands and has 15 judges. Each judge is elected for a nine-year term and there can be no

geolinks

More information about the International Court of Justice can be found on its website.

more than one judge with the same nationality. The judges are usually from the highest ranking courts of their home country or are widely recognised as leading experts in international law.

Only countries can take a case to the ICJ. It is not possible for individuals, companies or NGOs to use the court to settle disputes, even if they involve issues of international law.

The most common cases heard in the court are those concerning countries that are having border disputes. This is where two countries are unable to decide where the border that separates their two countries lies. In the past, such disputes would have commonly been settled by war. The ICJ provides a peaceful alternative and one that many countries now use. Between 1946 and 2007 the ICJ has settled more than 92 disputes between countries, many of which may have resulted in conflict had the ICJ not been in existence.

Not all countries have accepted the ICJ's jurisdiction, and the ICJ can only hear those cases where all states in dispute agree that the ICJ should make a judgement. For example, with regard to French nuclear tests at Mururoa, Australia and New Zealand argued before the ICJ in 1974 and again in October 1995 that France had a case to answer under international law as it was a signatory to the Nuclear Test Ban Treaty. France invoked (put into effect) its rights under the concept of national sovereignty and refused to participate in either of the cases. However, there are examples of how the ICJ has been effective in peacefully resolving disputes. (See the Geofocus box below.)

geofocus

Republic of Benin v. Republic of Niger [2005] ICJ Reports 2005/2 (the *Frontier Dispute Case*)

The *Frontier Dispute Case* is a recent case heard in the ICJ. It demonstrates how the court can provide an effective way to peacefully resolve disputes between nation-states. The border between the two countries concerned, Benin and Niger, has long been in dispute. (See figure 2.4.60.)

Benin argued that the border lay on the left bank of the Niger River, meaning that the islands in the river belonged to Benin. Niger, however, argued that the border lay on the right bank and the islands belonged to them. In 2002 both countries agreed to allow the matter to be decided by the ICJ.

After hearing evidence for some time the court found that neither country could prove ownership of the islands and that the best evidence of the border was the navigable channel that runs along the river. Thus, the islands to the left of the channel would belong to Benin and those to the right were owned by Niger.

Both nation-states accepted the ICJ's decision and the matter was resolved peacefully. There had been no need to resort to conflict as had happened in many similar border disputes around the world.

FIGURE 2.4.60

The border dispute between Benin and Niger, along the Niger River, was resolved peacefully by the ICJ.

Devolutions (transfers) of power

There have been many cases where the granting of a high degree of local autonomy to an ethnic, religious or cultural minority has prevented or resolved a serious conflict. The case of the Swiss federation is the best example of a multi-ethnic state that has known a long period of peace and great prosperity due largely to a high degree of autonomy that each of its cantons (subdivisions) and communities possess. In Great Britain, Scotland has been granted greater autonomy and now has its own parliament. Such federal and **quasi-federal** solutions have gained popularity in Western Europe as the power of the central institutions of the newly established European Union have grown. Many minorities now feel they can have local autonomy within a supra-state as the power of the old nation-states has gradually declined relative to the power of the European Union. A similar method has been used in Canada where the indigenous peoples (referred to as First Nations) and the people of the French-speaking province of Quebec have gained increased self-autonomy. This has helped to reduce considerable ethnic tensions there.

Community-based initiatives

Local tensions and conflicts often have to be resolved locally through community initiatives. The establishment and activities of citizens' research organisations, reconciliation movements, community awareness groups and self-help organisations are often instrumental in overcoming conflicts within and between communities. Many permanent organisations exist for these purposes. Such groups include church groups, service clubs and youth groups.

Plebiscites and elections

Disputes and conflicts at all levels of geopolitics are often resolvable, at least temporarily, by the holding of an election.

Many interventions of the United Nations have been with the express purpose of organising and holding fair elections for new governments. Examples are Namibia in 1990, Cambodia in 1993 and East Timor in 1999.

Many democracies not only decide their government by elections but resolve major contentious issues by general **plebiscites** or referendums of the population. Steps towards or away from federation, for example, are usually decided in this way. Sometimes plebiscites do not resolve the actual issue, especially if the discontented group is still unsatisfied because the vote went against them. For example, the desire by a proportion of the population of Canada's Quebec province for independence has been defeated in two plebiscites, yet the **secessionists** have not accepted the verdict and are continuing their agitation.

quasi-federal having some resemblance to federal.

secessionists those having a desire to separate from a political union.

understanding the text

1 **Explain** the concept of *realpolitik*.
2 **Explain** why *realpolitik* is often not successful.
3 **Outline** the concept of global governance.
4 **Assess** the extent to which global governance is an effective means of creating peace.
5 **Describe** what a treaty is.
6 **Outline** the concept of partition.
7 **Explain** why Cyprus was partitioned and evaluate the success of this partition.
8 **Explain** the role of nongovernmental and inter-governmental agencies in promoting peaceful resolutions to conflicts.
9 **Describe** the importance of the Geneva and Hague Conventions.
10 **Explain** how a devolution of power can assist in the promotion of peace.
11 **Define** the term 'plebiscite' and outline the role of plebiscites in creating peace.

working geographically

1 **Writing task** Write an exposition in favour of or against Carl von Clausewitz's proposition that 'War is a continuation of politics by other means.'
2 **Writing task** Using illustrative examples, assess the effectiveness of international treaties and the International Court of Justice in resolving conflict.
3 **Using ICT** Visit the UN Department of Peacekeeping website. Using a blank world outline map, shade in the areas where a current UN peacekeeping mission is underway.
4 **Using ICT** Conduct research into a war crimes tribunal, other than the Rwandan tribunal. Outline the conflict that led to the formation of this tribunal and explain its key aims.

unit 2.5

> Poverty is the worst form of violence.
> **Mahatma Gandhi, Indian independence leader**

> The test of our progress is not whether we add more to the abundance of those who have much; it is whether we provide enough for those who have too little.
> **Franklin D. Roosevelt, former US president**

> Education is a human right with immense power to transform. On its foundation rest the cornerstones of freedom, democracy and sustainable human development.
> **Kofi Annan, former Secretary-General of the United Nations**

Geographies of Development: Towards Global Equity?

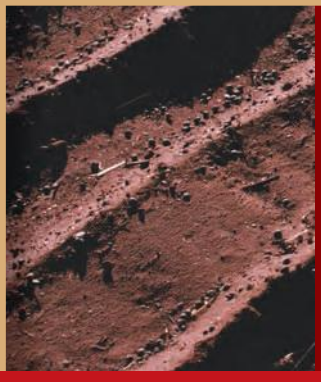
Geographers have always been interested in the spatial patterns that occur in our world at a variety of scales, from the local to the global. Of particular interest are the enormous variations in the quality of life experienced by people living in different parts of the world. You only have to watch the evening news to realise the extent to which people in different parts of the world have unequal access to resources of all kinds. In attempting to understand and explain these differences, countries have often been classified as either 'developed' or 'developing' (although you will soon see that these terms are not easy to define).

In completing this topic you will consider a range of ideas about what 'development' means, and examine the spatial variations in the living standards of people throughout the world. (Compare figures 2.5.1 and 2.5.2, p. 411.) As well, you will think about how spatial variations in development can be measured. Most importantly, this topic will help you to explore the underlying factors that give rise to global inequity and the differential living standards experienced by people in the various parts of our world. We will see that the forces that contribute to different types and rates of development are complex and interrelated.

exam-style questions

extended responses

- Examine the nature of development.
- Evaluate the effectiveness of the qualitative and quantitative indicators used to measure development.
- Outline the spatial variations in the level and rate of development at a global scale.
- Explain why countries experience different types and rates of development.
- Outline the factors affecting the nature and rate of development.
- Examine the internal factors that affect the nature and rate of development experienced by countries in the developing world.
- Outline the external factors that affect the nature and rate of development experienced by countries in the developing world.
- Account for the spatial variations in TWO of the following: food, shelter, social support, health and educational opportunity.
- Analyse the role of aid in addressing the needs of people in the developing world.
- Examine the role played by nongovernmental organisations in developing countries.



Two worlds or three?

For many geographers it no longer makes sense to divide the countries of the world into rich and poor. The process of economic and cultural integration (globalisation) has created a big category in the middle.

It used to be common to portray the world's population as 1 billion rich and 5 billion poor—with the 1 billion rich people being those living in the 30 countries of the Organisation for Economic Co-operation and Development (OECD). Today, it is more meaningful to distinguish between the 1 billion rich, the 4 billion living in countries that are developing rapidly (and converging in terms of living standards with those living in the rich countries) and the 1 billion in countries that are desperately poor and falling behind.

You need only look at the rates of economic growth experienced by the three groups for the 25 years to 2005 to see why this means of division makes sense. The real income per person of the rich (OECD) group grew at an average annual rate of 1.8%, producing total growth of 57%. For the middle 4 billion, the average growth rate was 3.5% a year, or 137% in total. So there are clear signs of the middle converging on the top. The real income per person of the 54 countries making up the bottom billion grew by only 1% a year over the past quarter century, yielding total growth of just 29%. Worse, if you look just at the bottom half of the bottom billion, their income per person actually went backwards, contracting by 7% over the period.

What should we make of these data from the development perspective? The plight of people living in the bottom 50 or 60 countries deserves much more attention than we need to devote to the middle-income group, which is making good progress.

Adapted from 'Trade beats aid when it comes to helping poor' by Ross Gittins, *Sydney Morning Herald*, 15 September 2007

glossary

- **absolute poverty** not having access to minimum necessities or essentials for living.
- **cash cropping** the growing of crops that, when harvested, are sold to make a quick return in the form of money. (This contrasts with crops grown primarily for the use of the growers and their families.)
- **comparative (relative) poverty** poor in comparison with other members of a society.
- **cottage industry** a system of employment in which rural labourers or craftspeople, with the help of their families, work at home to produce goods for sale.
- **development** a process of change that involves an improvement in the quality of life as perceived by the people undergoing change. It is usually focused on reducing poverty. The nature of development will vary, depending on the context in which it is occurring.
- **export-oriented growth** the expansion of industrial or agricultural activities that aim to produce goods for sale abroad as a means of generating national income.
- **gross national income (GNI) per capita** the total market value of goods and services produced in an economy over a year, divided by the total population of a country.
- **informal sector** the part of a national economy that is involved in providing productive labour or service without formal systems of control and payment, and which usually operates without official recognition.
- **infrastructure** the installations that provide the framework for an economy and which facilitate industrial, agricultural and urban activities, such as transport, communications and public utilities.
- **labour-intensive** an activity or industry that requires a comparatively large workforce, while usually not needing a large capital investment.
- **monoculture** commercial agriculture in which farms or areas produce a single crop or type of livestock, year after year.
- **poverty** the inability to meet the basic needs for food, clothing and shelter. The absence of money, goods or the means of subsistence.
- **qualitative indicator** a quality that can be used as a basis for comparison between places or things, and which is not easily measured or quantified, such as freedom and happiness.
- **quantitative indicator** a numerical measure of something that can be counted or quantified and which can then be used as a basis for comparison between places or things, such as income and life expectancy.
- **rural–urban migration** the movement of people from rural areas to urban areas.
- **self-sufficient** the situation whereby a community or country can meet all its own needs. It is sometimes referred to as 'economic independence'.
- **squatter settlement** unplanned, slum-like settlement dominated by makeshift dwellings built of scrap timber, iron and even cardboard. They often develop on the outskirts of a city.
- **subsistence agriculture** an agricultural system in which products are produced for consumption by the farmer's household rather than for sale.
- **sustainable development** processes of development or change that benefit local peoples but do not interfere with the balance in interrelationships between organisms and their environment, which is essential for the survival of both. They are processes that are able to continue indefinitely.
- **trickle-down effect** the theory that economic growth will ultimately benefit all. According to this theory, investments in industrialisation and economic growth will generate income, the benefits of which will eventually trickle down to the poor.

Global poverty is a powder keg that could be ignited by our indifference.

William Jefferson Clinton, forty-second president of the United States

Understanding development

Many people throughout our world do not enjoy the consumer luxuries we do. The worry for them is not how they will pay their mobile phone bill or upgrade their computer, but how they will manage to access the basic necessities of life, including clean water, adequate food and shelter. When discussing countries where large numbers of the population live in **comparative (relative) poverty**, the term **'development'** is often used to describe a desirable condition or an improvement in conditions in those countries.

What the term 'development' means in practice is hotly debated and there are many different views about what that might be. Indeed, there are over 700 different definitions of development used in books written on the subject. Economic growth and industrialisation are commonly

regarded as keys to successful development. However, other definitions of development feature the role of the local community in planning for and bringing about change. Others stress the importance of generating changes that can continue without harming other people, communities or the environment. This is often known as **sustainable development**.

Sometimes development is used to describe a *process* of change, but there are a wide range of opinions about what the *outcomes* of that process of development should be. For decades, modernisation, industrialisation and the attainment of high material standards of living were assumed to be the goals of development. It was believed that for poor countries to achieve these goals and become 'developed' it was necessary for them to follow the path of the wealthy countries. Today, many continue to assume that the path to development lies in the pursuit of economic growth and modernisation. However, there is increasing recognition that those living in the developed world would do well to emulate the lifestyles and values of those living in many 'traditional' societies. This is despite the fact that people in those societies may not have access to the consumer goods and services we do. All societies can benefit from the traditional values of many developing societies, such as strong family and community ties, sharing and cooperation, and living in harmony with the environment. In contrast, the assumption that industrialisation and modernisation are a more advanced state than traditional ways of life based on **subsistence agriculture** or traditional subsistence economies based on hunting and gathering is being questioned. This assumption ignores the disadvantages of industrial growth, such as pollution, traffic congestion, social disharmony and stress.

So, development has different meanings for different people, depending on what aspects of quality of life they value. The meaning of development is context specific: it varies from place to place and depends on the interests, culture and values of those who define it. For this reason, opinion remains divided about what the outcomes of development should be. Common to all definitions of development, though, is the implication that the change process should be beneficial for those countries or people engaged in development.

Another way to think about what development might be is to ask what it is not. No matter what people think development might be, there is general agreement that it concerns the eradication of **poverty**. If people are living in poverty (that is, are unable to attain the basic

FIGURE 2.5.1

The majority of people living in developed countries enjoy a high standard of living.

FIGURE 2.5.2

Shanty settlement, Abidjan, Ivory Coast. Millions of people living in the world's poorest countries live in absolute poverty.

geolinks

The Millennium Development Goals

For more information on the Millennium Development Goals access the following sites:

- The World Bank Group: Millennium Development Goals
- UN Millennium Development Goals.

necessities of life) then their community or society could be regarded as underdeveloped. So any discussion of the meaning of development should logically focus on the elimination of **absolute poverty**.

Development is difficult to define, but has several essential elements:

- It is a *process of change* that results in improvements in quality of life (as perceived by the people experiencing change).
- The central focus of any change should be the *reduction of absolute poverty*.
- The nature of the change will vary, depending on the *context* of the development process. In other words, the values and priorities of the community, region or country undergoing change should shape the nature of the change.

geofocus

The Millennium Development Goals

Goals for developing countries were agreed to at the Millennium Summit in 2000. Their establishment was in recognition of the enormity of the challenge of tackling widespread global poverty through global economic and social development. It was hoped that the Millennium Development Goals (MDGs) would set targets to assist countries in the reduction of poverty, disease and illiteracy by the year 2015. The MDGs are listed in table 2.5.1.

> *In the Millennium Declaration of 2000, world leaders set forth a new vision for humanity... Leaders committed themselves 'to spare no effort to free our fellow men, women and children from the abject and dehumanising conditions of extreme poverty'.*
>
> *We must recognise the nature of the global trust at stake and the danger that many developing countries' hopes could be irredeemably pierced if even the greatest anti-poverty movement in history is insufficient to break from 'business as usual'. Are we on course to look back, in 2015, and say that no effort was spared?*
>
> *Kofi Annan, United Nations*, 2006

FIGURE 2.5.3

TABLE 2.5.1

The Millennium Development Goals

Goal	Description
1 Eradicate extreme poverty and hunger	Halve the number of people in extreme poverty, and the number of people who suffer from hunger, by 2015
2 Achieve universal primary education	Ensure by 2015 that all children will be able to complete a full course of primary education
3 Promote gender equality and empower women	Eliminate gender disparity in primary and secondary education by 2005, and in all levels of education by 2015
4 Reduce child mortality	Reduce by two-thirds the under-five mortality rate by 2015
5 Improve maternal health	Reduce by three-quarters the maternal mortality rate by 2015
6 Combat HIV/AIDS, malaria and other diseases	Halt the spread of HIV/AIDS, malaria and other major diseases, and begin to reverse the spread, by 2015
7 Ensure environmental sustainability	Halve the proportion of people without sustainable access to safe drinking water by 2015
8 Develop a global partnership for development	Further develop an open, rule-based, predictable, nondiscriminatory trading and financial system

Source: The International Bank for Reconstruction and Development/The World Bank, 2007

With the increasing concern about the impacts of development on the environment, many geographers argue that an essential element of development should be that it is ecologically sustainable. This means it should not impact on the biophysical environment in a way that will prevent the process from continuing into the future.

geofocus

Defining poverty

Poverty means different things to different people. The following extracts illustrate a range of perspectives.

Poverty is hunger. Poverty is lack of shelter. Poverty is being sick and not being able to see a doctor. Poverty is not having access to school and not knowing how to read. Poverty is not having a job, is fear for the future, living one day at a time. Poverty is losing a child to illness brought about by unclean water. Poverty is powerlessness, lack of representation and freedom.

Source: The World Bank, 2007

… poverty is about more than inadequate income. It is also about lack of fundamental freedom of action, choice and opportunity. It is about vulnerability to abuse and corruption.

Source: The World Bank, 2006

Poverty has traditionally been measured as a lack of income—but this is far too narrow a definition. Human poverty is a concept that captures the many dimensions of poverty that exist in both poor and rich countries—it is the denial of choices and opportunities for living a life one has reason to value. 'The HPI-1—human poverty index for developing countries—measures human deprivations in the same three aspects of human development as the HDI (long and healthy life, knowledge and a decent standard of living). HPI-2—human poverty index for selected high-income OECD countries—includes, in addition to the three dimensions in HPI-1, social exclusion.

For HPI-1 (developing countries), deprivation in health is measured by the probability at birth of not surviving to age 40; deprivation in knowledge is measured by the percentage of adults who are illiterate; deprivation in a decent standard of living is measured by two variables: the percentage of people not having sustainable access to an improved water source and the percentage of children below the age of five who are underweight.

For HPI-2 (selected high-income OECD countries), deprivation in health is measured by the probability at birth of not surviving to age 60; deprivation in knowledge is measured by the percentage of adults lacking functional literacy skills; deprivation in a decent standard of living is measured by the percentage of people living below the income poverty line, set at 50% of the adjusted median household disposable income; and social exclusion is measured by the rate of long-term (12 months or more) unemployment of the labour force.

Source: UNDP, 2007

geofocus

Defining development

The following extracts highlight the range of development definitions found in the literature.

We believe that countries are responsible for their own development, driven by economic growth led by the private sector and by integration with the global economy.

Source: AusAID, 2006

Human development is about much more than the rise or fall of national incomes. It is about creating an environment in which people can develop their full potential and lead productive, creative lives in accord with their needs and interests. People are the real wealth of nations. Development is thus about expanding the choices people have to lead lives that they value. And it is thus about much more than economic growth, which is only a means—if a very important one—of enlarging people's choices.

Fundamental to enlarging these choices is building human capabilities—the range of things that people can do or be in life. The most basic capabilities for human development are to lead long and healthy lives, to be knowledgeable, to have access to the resources needed for a decent standard of living and to be able to participate in the life of the community. Without these, many choices are simply not available, and many opportunities in life remain inaccessible.

Source: UNDP, 2007

Our view is that development is an ongoing, dynamic process by which individuals identify themselves as a community and are collectively empowered to use the necessary knowledge, values and organisational skills to sustainably share and enhance that community's resources and to bring about positive change for the benefit of all its members. Development is the realisation of rights, especially economic, cultural and social rights aimed at ending poverty, inequities, suffering and injustice.

Source: Oxfam, 2007

Sustainable development refers to development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Source: Brundtland Commission, 1987

[Development] assumes the conservation of natural assets for future growth and development.

Source: OECD, 2007

Development cannot be divorced from ecological and environmental concerns. Indeed, important components of human freedoms—and crucial ingredients of our quality of life—are thoroughly dependent on the integrity of the environment.

Source: UNDP Human Development Report, 2007–08

geofocus

Absolute and comparative (relative) poverty

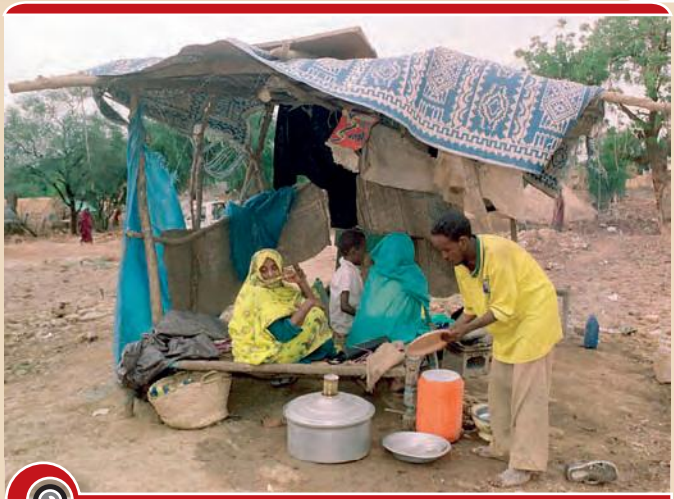


FIGURE 2.5.4

A person living in absolute poverty lacks the basic necessities of life.

Absolute poverty refers to not having access to the minimum necessities or essentials needed to sustain an acceptable standard of living. It is often based on what a household should be able to count on in order to meet its basic needs. The determination of the absolute poverty line is often based on estimates of the cost of basic food needs (that is, the cost of the nutritional basket considered minimal for the healthy survival of a typical family), to which a provision is added for non-food needs. (See figure 2.5.4.)

Comparative (relative) poverty is defined in terms of a person's standard of living compared with the overall distribution of income or consumption in a country. For example, the poverty line could be set at 50% of the country's mean income or consumption. In other words, a person may be living in relative poverty if their income is below the median level in a community or society. In developed countries with advanced social infrastructure, comparative (rather than absolute) poverty is the main form of disadvantage experienced by people. It means that they lack the material means to fully participate in accepted daily life.

understanding the text

1 **Explain** why it is difficult to define the term development.
2 **Identify** the essential elements of any definition of development.
3 **Explain** why the meaning of development is said to be value specific.
4 **Distinguish** between a country's economic development and human development.

working geographically

1 **Interpreting text** Study the Geofocus box 'Defining poverty' (p. 413). List all the characteristics of poverty mentioned in those definitions.
2 **Interpreting text** Study the Geofocus box 'Defining development' (p. 413). Working in groups, compare the definitions of development and then discuss the following questions:
   - **a** In each definition of development, what outcomes of development are anticipated?
   - **b** Similarly, what different processes of development lead to those outcomes?
   - **c** What do you think causes these different understandings about development?
3 **Thinking geographically** Think about the topic of this chapter: geographies of development. What do you think the term development means when used in reference to countries? To assist you to think about the issues involved, answer the following questions:
   - **a** If the term development is applied to countries, what does it mean? Try to write your own definition of what development of a country means.
   - **b** If the term development implies positive change, or advancement to a better condition, what changes do you think are positive for the people of the world's poorer countries?
   - **c** Of the changes you have suggested, would any be of benefit to all countries, including richer countries (such as Australia)?
   - **d** Explain what human development means. How does this definition differ from other definitions of development?
4 **Writing task** Definitions of development usually fall into two broad categories: those that emphasise economic growth and those that emphasise social well-being. Write an example of each.
5 **Research task** Study the Geofocus box 'The Millennium Development Goals' (p. 412).
   - **a** What difficulties do you think may prevent some of the world's economically poorer countries from achieving these goals?
   - **b** Undertake a web-based search to see whether you can find what gains have been made towards meeting the MDGs. The MDG Monitor website will prove very helpful.
6 **Interpreting cartoons** Study figure 2.5.3 (p. 412). Write a paragraph outlining the point the cartoonist is seeking to make.
7 **Clarifying key concepts** Study the Geofocus box 'Absolute and comparative (relative) poverty'. Distinguish between absolute and comparative (relative) poverty.

Development and spatial variations

Describing the developing countries

It has been difficult to define the term 'development'. So, too, finding a collective term that describes the world's poorer countries has proved problematic. Although it first emerged in the 1950s in France as a political term, the term *'Third World'* is still frequently used. This term was originally used to describe the newly independent former colonial states, which were often politically unaligned with either the Soviet Union or the United States and its allies during the Cold War. (See the Did you know? box at right.) Over time the term became used to describe economically poor countries. The term *'First World'* was used to designate the Western, capitalist, usually democratic countries, and the *'Second World'* was the descriptor given to the then socialist countries, primarily located in Eastern Europe. The poorest countries, which had been singled out by the United Nations (UN) as 'least developed' and deserving of special assistance, also became commonly known as the *'Fourth World'* by the 1980s. Increasingly, though, the 'Fourth World' is used to refer to poor or marginalised groups of people, often indigenous or 'first nation' peoples, within wealthy countries.

This set of terms is clearly dated—processes of democratisation among former socialist countries mean that 'Second World' as a political term now has little meaning. As well, the distinction between 'rich' and 'poor' countries became less obvious with rapid economic growth in other economies, primarily in East Asia. Along with the formation of new political alignments among poor countries, these changes largely invalidated the original political intentions of the terminology 'First', 'Second' and 'Third' worlds. Despite this, the term 'Third World' is still commonly used and widely understood to refer to the world's economically poorer countries.

During the 1980s, the terms *'North'* and *'South'* became popular, with the connotation that the world could be divided geographically between the wealthier northern countries and the poorer southern countries. However, the world cannot neatly be divided in this way, as the southern countries of Australia and New Zealand, at least, clearly do not fit into this classification system. The terms *'developed'* and *'underdeveloped'* (or *'undeveloped'*) have also been used widely as collective terms to describe the rich and poor countries. However, these commonly used terms have been condemned by peoples of the world's economically poorer countries as being Eurocentric. It is maintained that these terms imply that material items or their monetary value alone determine states of development. For peoples whose cultural, spiritual and social systems have much of value, social characteristics such as harmony, cooperation, sharing and peace may be more important to a community than material possessions. The terms *'industrialised'* and *'modernised'* have similarly attracted criticism for their inference that poor countries have little industrial activity. These terms imply that being more 'traditional' equates to being 'backward' and that the dominance of non-Western traditions is not consistent with 'development'.

The label *'developing countries'* has been widely adopted in an attempt to lessen the offensiveness of other terminology. Yet this term still suggests that low levels of economic development are necessarily problematic. This ignores the reality that communities in some countries may exist happily and healthily in a local economy based on subsistence farming. In other words, lack of material wealth may not necessarily be a cause for concern in all communities.

did you know?

The Cold War

The Cold War was the struggle for power between the Soviet Union and the United States that lasted from the end of World War II until the collapse of the Soviet Union. The war was considered 'cold' because the aggression was ideological, economic and diplomatic rather than a direct military conflict.

did you know?

- The distribution of global income resembles a champagne glass. (See figure 2.5.7, p. 417.) At the top, where the glass is widest, the richest 20% of the population hold three-quarters of the world's income. At the bottom of the stem, the poorest 40% hold 5% of world income, while the very poorest 20% hold just 1.5%. The poorest 40% roughly correspond to the 2.8 billion people living on less than US$2 a day.
- The income of the world's 500 richest people exceeded that of the poorest 416 million people.
- The amount needed to lift 1 billion people above the US$1 a day poverty line is US$300 billion, equivalent to less than 2% of the income of the richest 10% of the world's population.

Source: UNDP Report, 2005

working geographically

1 **Writing task** Write a brief statement explaining why the terms North and South may not be appropriate to describe the division between the rich world and the poor world.

2 **Class discussion** The terms underdeveloped or undeveloped have often been used to collectively describe the world's poorer countries. As a class, discuss whether you think these terms are appropriate. How do you think the residents of the poorer countries would feel about the use of these terms?

3 **Class discussion** In describing the world's wealthier countries, the terms modernised or industrialised are often used, while the words traditional or non-industrial are employed as descriptors for the economically poorer countries. As a class, discuss whether you think this is appropriate terminology. Give reasons for your answers.

In the last decade, a number of aid agency staff and development practitioners and academics have adopted the terms *'two-thirds world'* or *'majority world'*. These descriptors reflect the reality that the poor world occupies at least two-thirds of the global land mass and contains even more of its population, without carrying any value judgements. While these may be the least value laden of the terminology, the terms are still not widely understood and used.

As noted on page 409, for an increasing number of geographers (and economists) it is becoming increasingly difficult to divide the countries of the world into the developing and developed worlds because the process of economic and cultural integration (globalisation) has created a big category in the middle. Today it is becoming more meaningful to distinguish between the 1 billion rich, the 4 billion living in countries that are developing rapidly and the 1 billion in countries that are desperately poor and falling behind. It is the plight of people living in the bottom 50 or 60 countries that we focus on in this unit. For the purposes of this book, we will continue to refer to these countries as 'developing countries'.

Can development be measured?

Spatial patterns in the levels of development evident throughout the world—and the reasons for these variations—have been of interest to geographers for many years. Of course, development is a relative term: determining the extent to which a country may be developed is only possible if you compare that country to others. To enable such comparisons to be made at a global scale, a range of methods have been used to try to measure the relative development of countries.

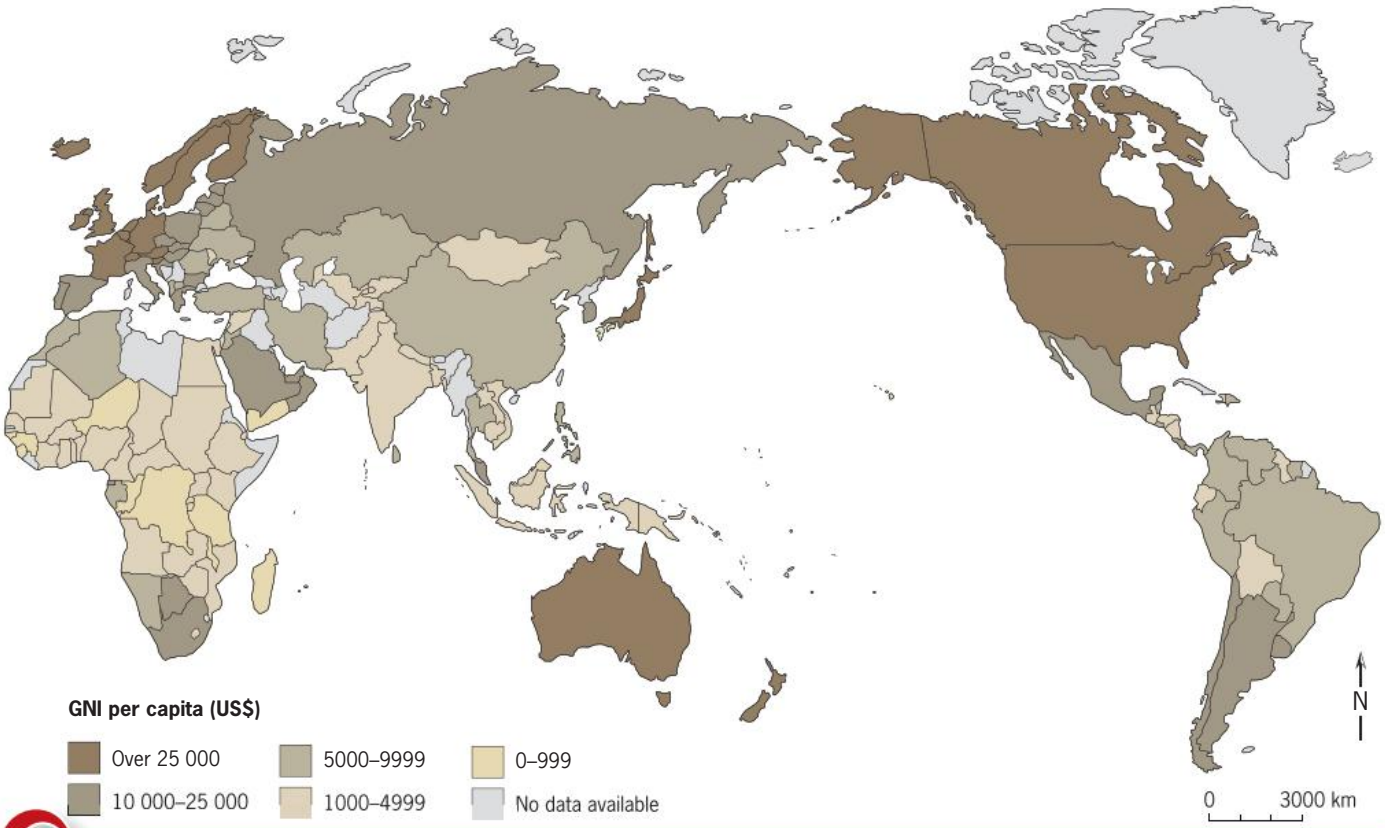


FIGURE 2.5.5

Income (US$) per person (that is, GNI per capita), 2006.

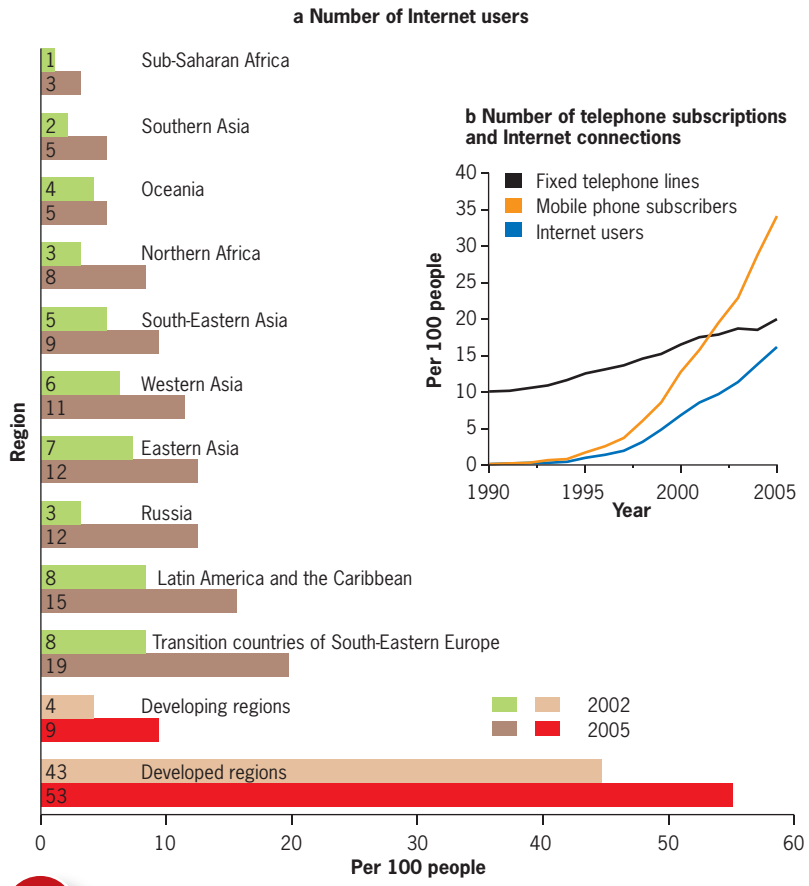


FIGURE 2.5.6

Internet use is growing but remains low throughout the developing world.

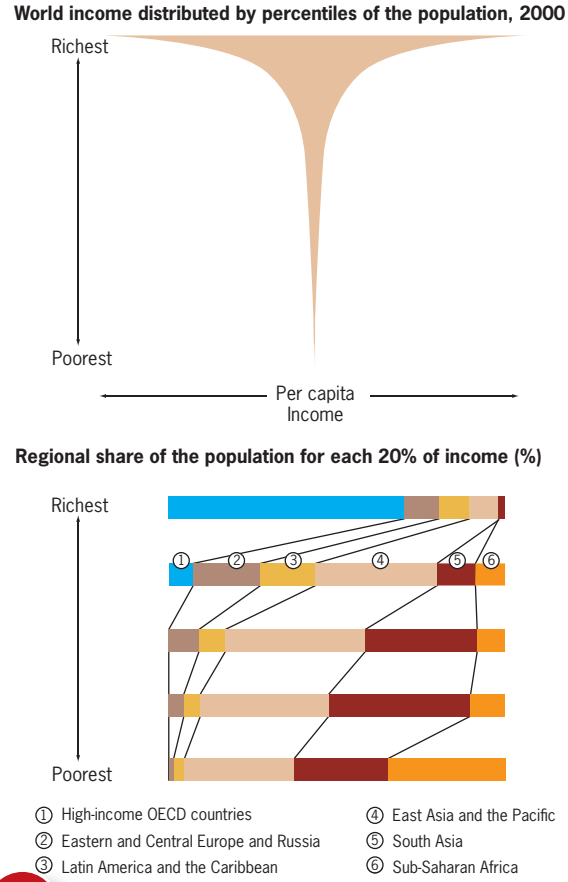


FIGURE 2.5.7

Where the money is.

Historically, the most commonly employed means of comparison has been to use **quantitative indicators** of development. In general, a quantitative indicator is simply a numerical measure of something that can be counted or quantified. A variety of quantitative indicators have been used to measure development, with **gross national income (GNI) per capita** being the most commonly used measure of a country's state of development. These data are then used as a basis for comparison between countries. Figure 2.5.5 shows a map of the countries of the world categorised according to their level of income; that is, their GNI per capita. Other quantitative indicators commonly used to compare countries include energy consumption, literacy rates or school completion rates, life expectancy (see figure 2.1.22, p. 239), infant mortality rates and the availability of services, such as safe water, sanitation, and telephone lines and the Internet (see figure 2.5.6).

Measures of economic growth, such as GNI, are frequently used to compare levels of development of countries. However, there are a number of disadvantages in doing so. Some of these are discussed below.

In many of the world's poorer countries a large percentage of the population is engaged in subsistence activities, such as subsistence agriculture, simple home-based manufacturing or small-scale **informal sector** business activity. Often such subsistence activities do not attract monetary income or, in the case of businesses outside the **formal sector**, it is very difficult to assess income earned by those engaged in such activities. The total value of such production in dollar terms is therefore difficult to measure and is usually excluded from calculations of GNI.

did you know?

Purchasing power parity (PPP) refers to data that equalise the purchasing power of different currencies in their home countries for a given basket of goods. It is often used to compare the standards of living between countries.

formal sector the formal economy with its regulated economic and legal institutions.

did you know?

- Life expectancy at birth for Indigenous Australians was estimated to be 59.4 years for males and 64.8 years for females for the period 1998–2000. This compares with 76.6 years for all Australian males and 82.0 years for all females for the same period; a difference of approximately 17 years for both males and females.
- Indigenous Australian students were still around half as likely as non-Indigenous Australian students to progress to the final year of schooling in 2004. Indigenous Australian students are under-represented in the higher education sector, accounting for only 1% of the total higher education population in 2003.
- Indigenous Australians experience lower levels of labour force participation and employment and higher levels of unemployment than non-Indigenous Australians. In 2002, Indigenous Australian adults were about two and a half times as likely as non-Indigenous Australian adults to be unemployed: 13% compared with 5%.
- The mean gross household income of Indigenous Australian adults in 2002 was only 59% of the corresponding income of non-Indigenous Australian adults.
- The disadvantage and alienation experienced by Indigenous Australians has resulted in them having a rate of imprisonment 11 times greater than that experienced by non-indigenous Australians.

Source: Australian Bureau of Statistics

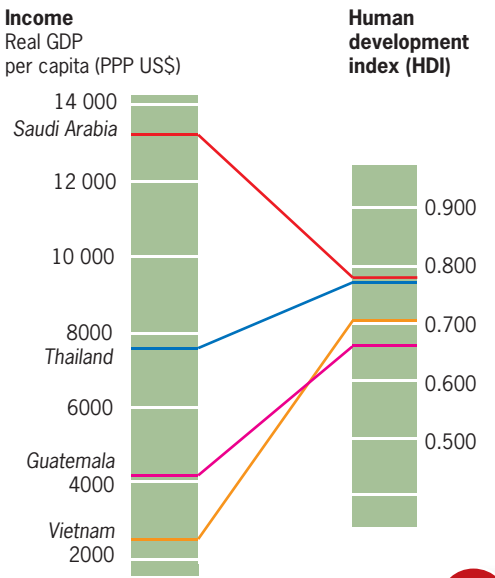


FIGURE 2.5.8

Different income, similar HDI, 2005.

Therefore, much production that may be the basis of survival for people living in developing countries is not valued and recorded.

Figures based on income per person reveal little about the purchasing power of that income. Even if the people of one country appear to have high incomes, the price of goods and services may also be high, so the income may not have great value in terms of what it is able to buy. Thus, the living standards of the population of such a country may not be any better than those of people living in a country where incomes per person are much lower but where goods and services cost less.

Remoteness of communities, inefficient bureaucracies, poor transport and communication systems, and high levels of illiteracy can all cause problems in collecting survey based data. This makes it very difficult to collect accurate financial and other quantitative data in many countries, which means that available figures may not be accurate. As well, there is no global consistency in years of census data collection or in inter-censal periods; that is, periods between census counts. For this reason, census data collected in different countries cannot be compared easily.

A common criticism of the use of economic indicators of development is that they fail to measure the distribution of income or other resources within countries. Let's take small oil-producing countries as an example. These countries may have very high incomes per person, but most of the wealth within each country is enjoyed by just a few beneficiaries of the oil-based wealth. Meanwhile, the majority of the population has a very low standard of living. Similarly, income statistics may quite rightly indicate that a majority of people in a certain country do have a high standard of living, but disguise the fact that minority groups within the country may live in extreme poverty.

Carefully examine figures 2.5.5 (p. 416) and 2.5.6 (p. 417). It will be obvious that some countries (such as the United States) are always placed in the category containing those countries with the best outcome in terms of each development indicator. However, other countries do not always fit consistently into the same category. An example is Thailand. Thus, it becomes apparent that it is difficult to define exactly which countries the poor world consists of if we rely on economic, social, demographic or educational indicators. As well, using national boundaries as a basis for delineating the poor world ignores the question of inequality within countries.

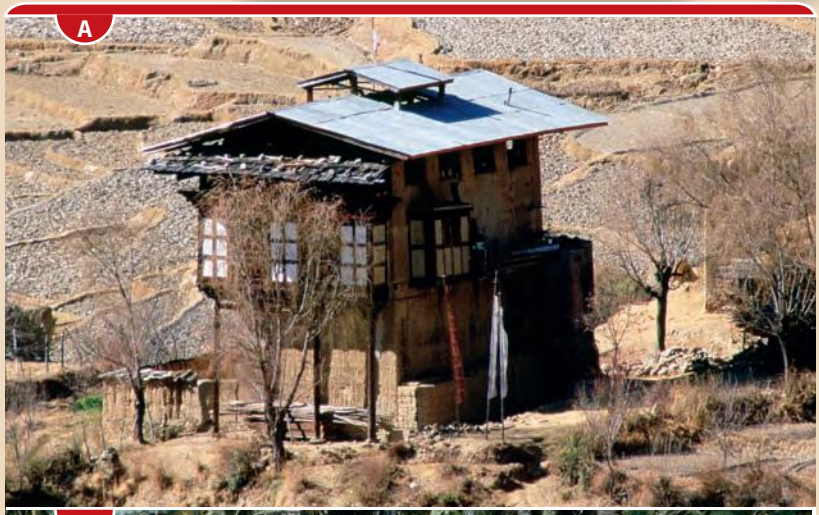
In attempting to find a better way to measure development, the UN Development Program (UNDP) has generated what it calls the human development index (HDI) as a measure of development. A composite statistical measure, the HDI includes life expectancy at birth, educational attainment and income. Unlike GNI per person, the HDI is not solely focused on economic wealth. Instead, the measure incorporates the basic factors necessary for people to be able to participate in, and contribute meaningfully to, society.

Figure 2.5.8 shows that levels of human development may be quite different in individual countries, even when those countries have similar levels of income. Equally, improvements in the income levels of the poor do not necessarily result from high rates of economic growth. In other words, there are high levels of inequality in some countries,which mean that the poor do not necessarily benefit from economic growth. The Geofocus photographic study opposite provides further illustration of this point.

Figure 2.5.9a is the home of a rice farmer in Bhutan. Figure 2.5.9b is the home of a farming family in rural southern Thailand. You may be surprised to discover that figure 2.5.9c is the home of an Australian family living in a remote Aboriginal community near Yuendamu, in

geofocus

Housing as a measure of development: photographic interpretation



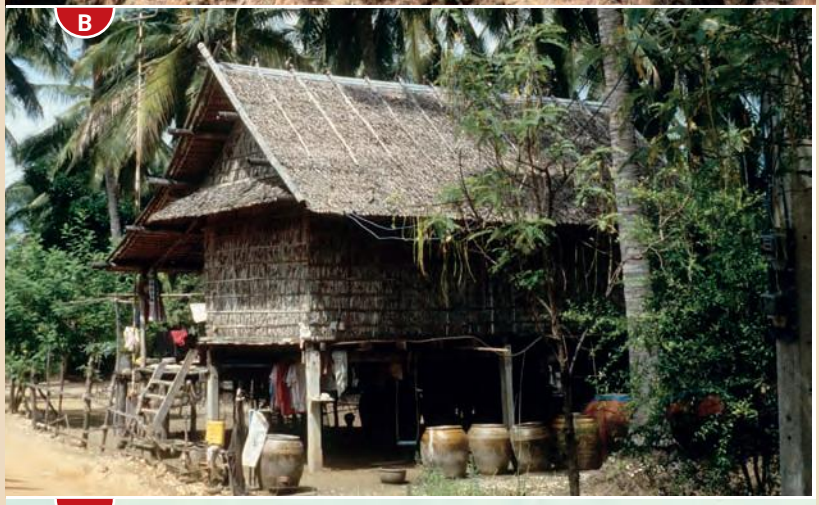


FIGURE 2.5.9

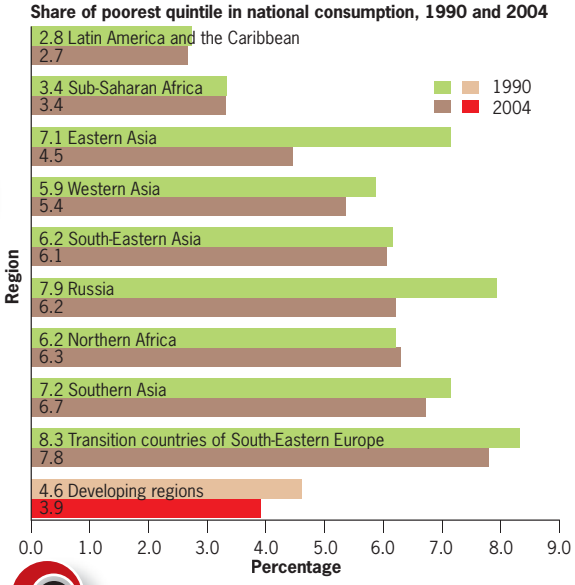


FIGURE 2.5.10

Poverty reduction has been accompanied by rising inequality.

geolinks

Listed below are some Internet sites that are useful sources of information about development issues:

- New Internationalist
- OneWorld
- AusAID
- Australian Council for International Development (ACFID)
- World Bank
- World Resources Institute
- UN Development Program
- MDG Monitor.

The first site contains copies of most of the *New Internationalist* magazines. The OneWorld site provides lots of information about current affairs in different countries. The AusAID and ACFID sites provide details about Australia's official and nongovernmental aid, as well as press releases and information about current issues in different developing countries. The MDG Monitor site provides useful information about global progress in meeting the Millennium Development Goals. The rest of the sites are good sources of development data.

did you know?

- While 1.7 billion people earn enough to be classified as members of the 'consumer class' (users of such items as televisions, telephones and the Internet), as many as 2.8 billion people struggle to survive on less than US$2 a day.
- The 12% of the world's population that live in North America and Western Europe account for 60% of private consumption spending, while the one-third living in South Asia and Sub-Saharan Africa account for only 3.2%.
- Providing adequate food, clean water and basic education for the world's poorest could all be achieved for less than people spend annually on makeup, ice cream and pet food.

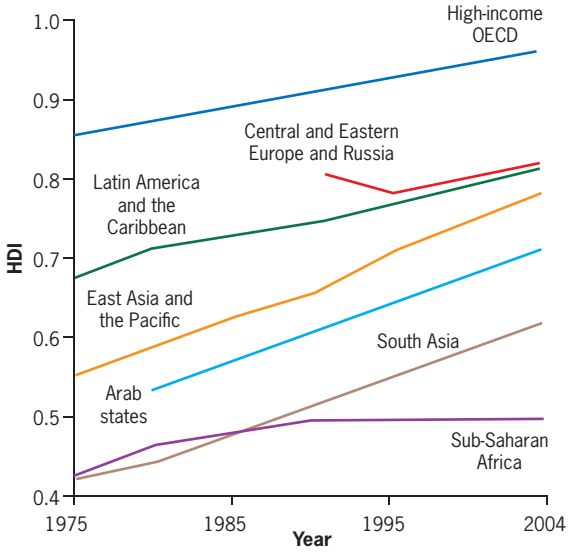


FIGURE 2.5.11

The human development trend is upwards but uneven.

Central Australia. These photographs make it obvious that it is difficult to generalise about wealthy and poor countries. People living within the so-called 'developed world' sometimes have standards of living, literacy, health and life expectancy similar to people living in the poor world. Likewise, as the photo of the home in Bhutan illustrates, residents of what we think of as poorer countries are often able to enjoy a high material standard of living.

Although useful as a starting point for making comparisons between countries, quantitative indicators mask inequalities at a different scale. Geographers are not only concerned about the differences between countries, but also with spatial variations in the levels of development *within* countries. If quantitative indicators are used as a basis for answering the question 'Which are the developing countries?' the complexity and diversity within countries can be overlooked.

Dependence on quantitative indicators of development means that other important aspects of development may be undervalued. Earlier in this chapter you thought about which values might be positive attributes of a developed society. Values such as peace, harmony, cooperation and joy are important contributors to quality of life. Yet, how can they be measured? It is not as simple to gauge 'national harmony' or 'levels of joy in a country's population' as to count dollars or determine death rates. Similarly, it is difficult to measure levels of human rights, individual freedoms and the status of indigenous people, all of which are today generally regarded as important components of human development.

Factors such as traffic congestion, social disharmony and stress also affect quality of life, yet are rarely used as a basis for comparing the levels of development of countries. If **qualitative indicators**, such as social harmony and low stress levels, were used as a basis for comparison between countries or regions, the boundaries drawn between what are regarded as developed or less developed countries may well be very different from those based on quantitative indicators, such as per capita incomes.

By now, you should understand some of the difficulties involved in attempting to define the term 'development' and in attempting to delimit (or demarcate or identify) the poor world. The ready acceptance of generalisations and assumptions may limit understanding of the complexity and diversity of the developing countries. Despite this, it is possible to recognise some general characteristics that give a measure of unity to much of the poor world. The following section will describe some of these characteristics and discuss the factors that have contributed to different levels of development throughout the world.

geofocus

East Timor

East Timor (also often known as Timor-Leste) is a South-east Asian country located north-west of Australia in the Lesser Sunda Islands at the eastern end of the Indonesian archipelago. East Timor includes the eastern half of the island of Timor and the Oecussi (Ambeno) region on the north-west portion of the island of Timor.

Manusau Village, East Timor

By SIAN POWELL

Erica de Araujo was born into the smoky chaos of battle in August 1999, two weeks before East Timor finally voted for independence and an end to 24 years of brutal Indonesian occupation. She first drew breath in a dirt floor shack in the capital, Dili, in a slum where clouds of mosquitoes clotted the warm air and the sound of gunfire crackled through the night…

…[now] Erica lives in the village of Manusae, in the high hills south of Dili. It's a four-hour drive from the capital, over appalling roads, rivers and, in certain places, boulders; the last leg of the journey is on foot along a steep, difficult track.

No public buses or private cars (other than four-wheel-drives) can get anywhere near the village. If the people of Manusae want to see a doctor, or a police officer, or a government official, they walk the three hours into the district capital of Ermera…

Manasae is a sleepy, coffee-growing village, with a school, a little church and bamboo huts on steep inclines divided by grassy paths. The children are scrawny and small by Australian standards, all knees and elbows, but they are remarkably independent—five-year-olds can be seen trotting along mountain paths alone.

There is no electricity, so it's quiet—no TV, no radios, no machines, no subdued hum of 21st-century Western living. Coffee is processed in a water mill after it has been laid out to dry on tarps, firewood is chopped with axes, and clothes are washed by hand…

…like so many East Timorese, he [Boromeo, Erica's father] and his family await better times. Although grateful that his children can go to school, and there is enough (just) to eat, Boromeo is poor. There are no books, toys, dolls or games in the family home. Erica carries her younger brother, three-year-old Jaimito, around on her hip, and occasionally, for fun, climbs trees—'She's very naughty,' says her mother. A sixteen-year-old girl, Clara, helps Filomena (Erica's mother) with the housework in return for her meals.

Most East Timorese rely on subsistence agriculture and by Western standards they do it tough…

Julio Boromeo…rebuilt his ruined house in a month, without help from government, aid agencies…or the church. On the spur of a hill, looking across valleys to the mountains, it has bamboo walls, an iron roof, a packed-earth floor and corrugated-iron doors. Filomena cooks over an open fire, and a couple of plastic tubs serve for washing. Coffee is grown on a hectare of ground down the hill, and once it's harvested, Boromeo hauls it into Ermera on his back—a six-hour trek there and back…

In the Boromeo household, protein is a rare delight. The children eat mostly cassava, rice and sweet potato. 'There was one chicken, we just ate it,' says Filomena, gesturing to the feast she'd prepared in honour of her sister's visit. 'And there's cassava in the garden.'

Despite the poverty, education is a strong suit. All Filomena's school-aged children, barring 16-year-old Rojina, who was married in March, are busily getting an education. Even the oldest child, 17-year-old Florinda, lives with her grandmother in Dili so she can finish high school. Of the children born after the family made it back to Manasae late in 1999, one-year-old Elefino and three-year-old Jaimito are obviously too young for school, and Maria Agama, five, will start this year.

Education is now free in East Timor, and Erica goes to the village school along with 40 other children…

East Timor is doing well schooling its children… school participation rates increased dramatically after East Timor tore itself away from Indonesia, with eight in 10 children between the ages of 12 and 15 enrolled in a school by 2001. There is a lot of ground to make up. Almost half [the] population is under 15, and the adult population is poorly educated—almost three-quarters … have never been to school…

It is easy to forget those who live in the quiet and isolated hills of East Timor. Yet the battling East Timorese will soldier on, with or without assistance, in the hope of a better life for themselves and their children.

What does Julio Boromeo hope the future brings? 'Peace,' he says, nodding slowly. 'Peace.'

Source: *Weekend Australian Magazine*, 25–26 August 2007, pp. 22–6

FIGURE 2.5.12

Children of the revolution: Erica (far right) with her family (from left, Jaimito, Molina, Leonitu, Filomena, Elefino, Maria Agama and Julio).

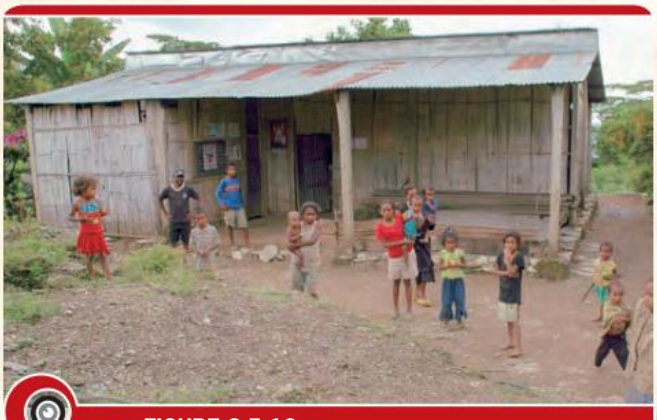


FIGURE 2.5.13

Boromeo rebuilt the family home in Manusae after the retreating Indonesian military knocked it down.

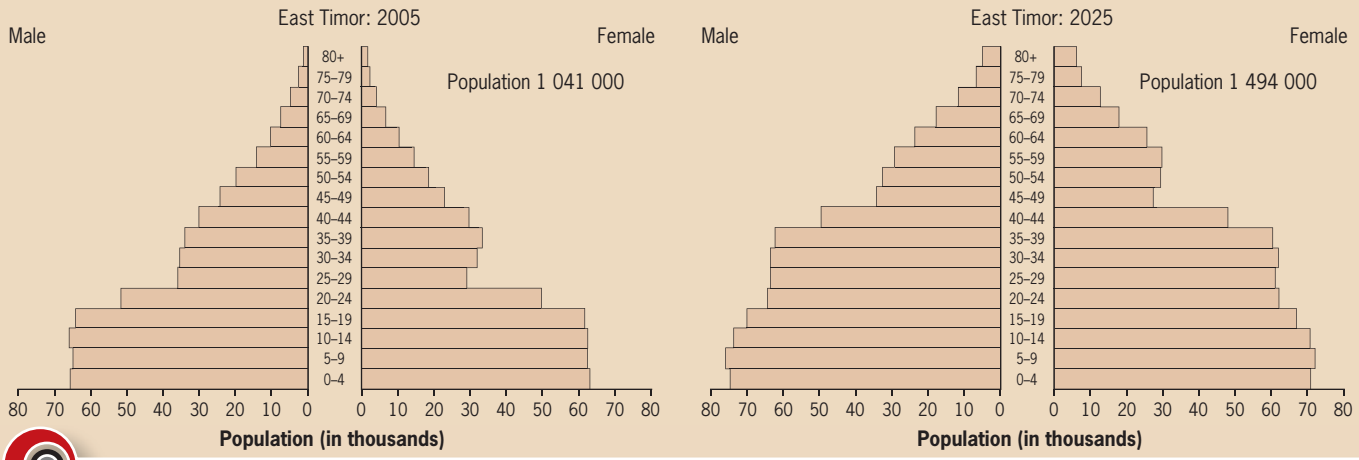


FIGURE 2.5.14

Population pyramids for East Timor, 2005 and 2025 (projected).

FIGURE 2.5.15

East Timor.

TABLE 2.5.2

Profile of East Timor

Area: 15 007 km^2
Density: 74 persons per km^2 (2007 estimate)
Arable land: 8.2% (2007)
Forest: 53.7% (2005)
Climate: tropical, hot, humid. distinct rainy and dry seasons
Capital: Dili

The East Timorese

- Language: Tetum and Portuguese (official), Indonesian, English (Note: There are about 16 indigenous languages. Of these, Tetum, Galole, Mambae and Kemak are spoken by significant numbers of people.)
- Religion: Roman Catholic 98%, Muslim 1%, Protestant 1% (2005)

Housing

- Electricity: 294 kilowatt-hours per capita (UN estimate, 2004); it can be assumed that many of the rural majority are still without electricity
- Population using an improved water source: 58% (2004)
- Access to sanitation facilities: 36% (2004)

Population

- Total: 1.1 million (2005)
- Annual growth: 3.4% (2005–2015 estimate)
- Urban: 26.5% (2005); 31.2% is the estimate for 2015
- Rural: 73.5%
- Projected population: 1.5 million in 2015
- Population structure (See figure 2.5.14.)
- Ethnic minorities: Eastern Tetum 45%, Mambai (Damata) 11%, Galolo 7%, Timorese (Vaikino) 7%, others (30%) (2007)

Education

- Adult literacy rate: 50.1 (2005)
- Gross enrolment ratio (GER): 72% (2005) (See the 'Did you know?' box below.)

Health

- Life expectancy: 59.7 (2005)
- Infant mortality: 52 per 1000 live births (2005)
- Birth rate per 1000 population: 26.77 births/1000 population (2007 estimate)
- Death rate per 1000 population: 6.19 deaths/1000 population (2007 estimate)
- Fertility rate (per woman): 7.0
- Maternal mortality: 830 per 100 000 live births (2005)

Economic activity

- Agriculture: 73% (1999 estimate)
- Industry: 5% (1999 estimate)
- Services: 22%
- GNI per capita: US$750
- National currency: US$
- Major exports: coffee, sandalwood, marble, wood, some petroleum and natural gas, livestock and fish products, spices, coconuts, cacao
- External debt as a percentage of gross domestic product (GDP): none
- Overseas development assistance as a percentage of GDP: 52.9%

Source: The International Bank for Reconstruction and Development/The World Bank, 2007

understanding the text

1 **Explain** the difference between quantitative and qualitative indicators of development.
2 **Identify** the advantages and disadvantages of using quantitative measures of development.
3 **Outline** the limitations of using qualitative indicators of development.
4 **Explain** some of the problems inherent in attempting to decide on a precise boundary for the developing world and the developed world.
5 **Explain** what the Human Development Index (HDI) is. What indicators of development does it include?
6 **Explain** why the HDI is a more useful measure of development than other indicators.

did you know?

Gross enrolment ratio

The gross enrolment ratio (GER) is a statistical measure used in the education sector and by the United Nations. The GER gives a rough indication of the level of education from kindergarten to postgraduate education. The GER is calculated by expressing the number of students enrolled in primary, secondary and tertiary levels of education, regardless of age, as a percentage of the population of official school age for the three levels.

1 **Interpreting diagrams** Study figure 2.5.5 (p. 416) carefully. On the basis of this map, list five countries you would regard as developed and five countries you would regard as poor. Justify your selection.

2 **Writing task** Write a short statement explaining why measures of economic performance are sometimes preferred as a means of measuring development.

3 **Writing task** Write a short statement explaining the shortcomings of using only an economic measure, such as GNI per person, as a basis for ranking countries on a scale of development.

4 **Interpreting diagrams** Study figures 2.1.22 (p. 239) and 2.5.6 (p. 417), which show life expectancy and Internet users.
   - **a** If you were to use the maps in figures 2.5.6 and 2.1.22 as a basis for determining the boundaries of the poor world, is it clear where that boundary should be?
   - **b** Quantitative measures can be used to rank countries according to their level of development. When different quantitative indicators are compared, some countries do not always fit neatly into the same category. Use an atlas map to name some of these countries.

5 **Writing task** Study figure 2.5.8 (p. 418). Write a brief report describing the relationship between incomes and levels of human development illustrated by the graph.

6 **Interpreting diagrams** Study figure 2.5.10 (p. 419). Explain what this figure displays about changes in the share of consumption by the world's poorest people.

7 **Film activity** Watch the first 20 minutes of the film *The Gods Must Be Crazy*. Then answer the following questions:
   - **a** What are the benefits of being part of civilisation?
   - **b** What attributes of the hunter–gatherer society do you regard as civilised?
   - **c** The intrusion of one object from civilisation—a Coca-Cola bottle—had profound impacts on the community in the Kalahari. What were they?
   - **d** How do you think we can best measure which societies are developed and which are not?

8 **Class discussion** The World Bank described poverty as 'the inability to attain a minimal standard of living'. What do you think a 'minimal standard of living' should be? Is it possible to define a minimal standard of living that is appropriate for all people in all societies?

9 **Interpreting photographs** Study the Geofocus box 'Housing as a measure of development' (p. 419).
   - **a** Which photograph do you think is from the poorest country? Give reasons for your answer.
   - **b** Which home belongs to people with the highest standard of living? Why do you think this?

10 **Interpreting text and diagrams** Study the Geofocus box 'East Timor' (pp. 420–3).
   - **a** List the ways in which the lifestyle of Erica de Araujo's family differs from that of your own family.
   - **b** Think about agricultural practices in Australia. Using the material in the Geofocus box, outline obvious differences between rural life in East Timor and in Australia.
   - **c** From the material in the Geofocus box, including the statistics, can you list any features of life in East Timor that could be regarded as symptoms of underdevelopment?
   - **d** Explain how levels of development in East Timor impact on the quality of life of Erica de Araujo's family.
   - **e** Conduct research into the history of East Timor. What historical factors do you think may account for some of its present-day problems?
   - **f** Study figure 2.5.14 (p. 422).
     - **i** Estimate the population of East Timor under the age of 15 years in 2005 and 2025.
     - **ii** Calculate the proportion of East Timor's population under the age of 15 years in 2005 and 2025.
     - **iii** Explain why East Timor's population will continue to grow for the foreseeable future.

Hunger is actually the worst of all weapons of mass destruction, claiming millions of victims every year. Fighting hunger and poverty and promoting development are the truly sustainable way to achieve world peace ... There will be no peace without development, and there will be neither peace nor development without social justice.

Luiz Inácio Lula da Silva, President of Brazil

Development issues

Characteristics of developing countries

Although it is important to remember that there is tremendous diversity between and within all countries, there is a variety of issues that more commonly confront developing countries than the wealthier developed countries. To some extent, these issues can be regarded as defining characteristics of the world's poorer countries. Some of these issues will have become apparent when you completed the activities based on the Geofocus box 'East Timor' (pp. 420–3).

Through your reading, you will have identified some of the distinctive characteristics of poor countries, which are outlined in more detail below. It should be noted that many of these correspond to the quantitative indicators (discussed on pp. 416–18 and 420) that are frequently used to measure development.

Although these features of developing countries are regarded as common to them, keep in mind that not all developing countries share

all of these characteristics. For example, although Thailand and Vietnam are commonly regarded as developing countries and average incomes per person are not high, they have high levels of adult literacy: 92.6% and 90.3%, respectively, from 1995 to 2005. Therefore, when discussing poverty and development, it is important to remember that spatial and temporal variations (that is, variations over time and space) will always ensure that there are exceptions to any generalisation.

Poor health and low access to health services

The availability of health services is generally low in developing countries. For example, in the period 2000–04, Niger had two physicians per 100 000 people and Ethiopia had three physicians per 100 000 people. In the same period, Australia had 247 physicians to 100 000 people, while the equivalent measure in Belgium was 449.

Low life expectancy at birth

The low availability of medical services in poor countries means people are less likely to survive diseases of poverty. They are also more susceptible to preventable diseases because immunisation is not freely available. Furthermore, a greater proportion of women and infants are likely to become very ill or die as a result of lack of medical care at childbirth. These problems are compounded by factors that contribute to poor health and disease, including comparatively poor nutrition, unclean water, poor sanitation and inadequate supplies of food. The average life expectancy in the least developed countries was still only 54.5 years in 2005, compared with 79.4 years in the high-income OECD countries. Figure 2.5.17 illustrates the differences in life expectancy for people in wealthy and poor countries.

High infant mortality rates

Although infant mortality rates have decreased in the developing world, they are still high, at 57 per 1000 live births in 2005 and 97 per 1000 in the least developed countries, compared with 6 deaths per 1000 in the high-income countries. The under-5 mortality rate is particularly high in some of the poorest countries; as high as over 250 per 1000 live births in some countries in 2005, with an average in that year of 184 per 1000 in countries classified as having 'low human development' by the UNDP.

Low per capita income

In general, developing countries tend to have low levels of per capita income when compared to the wealthier countries. As you saw in figure 2.5.7 (p. 417), by the middle of the first decade of the twenty-first century, the richest 20% of the population shared three-quarters of the world's income, while the poorest 40% betweem them consumed only 5% of world income. The very poorest 20% of the global population shared only 1.5% of world income.

Poverty and indebtedness

It is estimated that 2.8 billion people live on less than US$2 a day, the majority of them in the world's economically poorer countries. Most of these people are less likely to be able to access basic education and health services than are people in the world's wealthier countries.

Developing countries have tended to be heavily indebted. Initiatives to 'forgive' debt in the last decade have reduced the debt burden of many countries. Despite this, on average, the total debt service burden of developing countries still represented 13% of total exports of goods, services and net income from abroad in 2005. Some countries were spending a significant proportion of their GDP on servicing debt; for

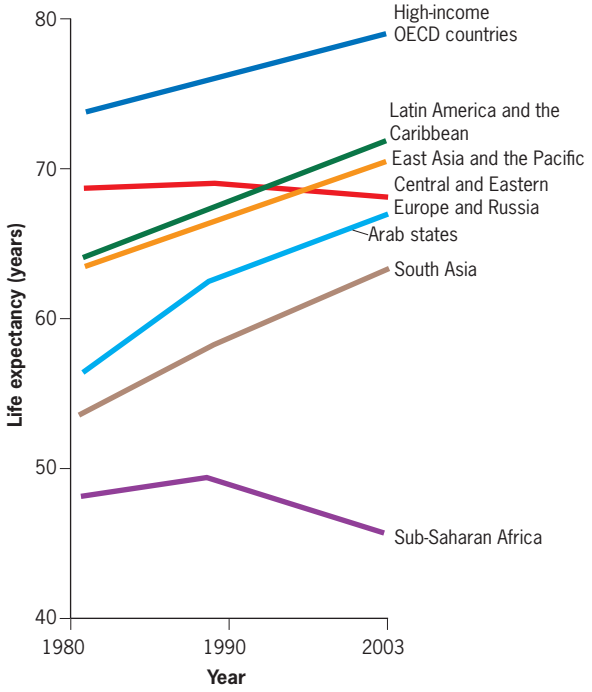


FIGURE 2.5.16

Life expectancy is improving in most regions of the world.

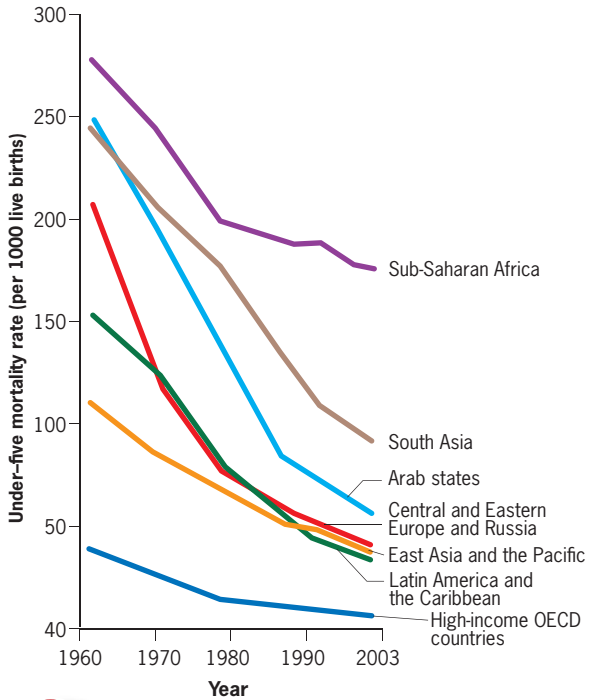


FIGURE 2.5.17

Child death rates and trends improving.

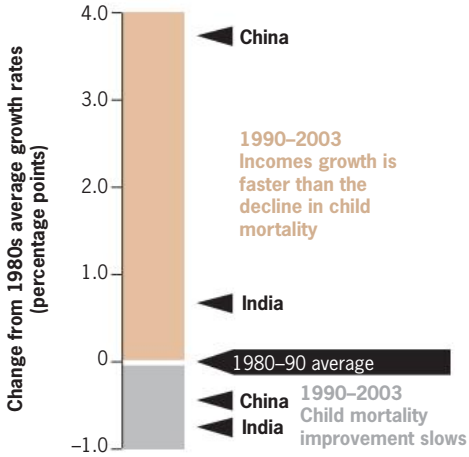


FIGURE 2.5.18

The scale of improvement in child mortality does not always reflect the scale of improvement in income: the diverging trends of China and India.

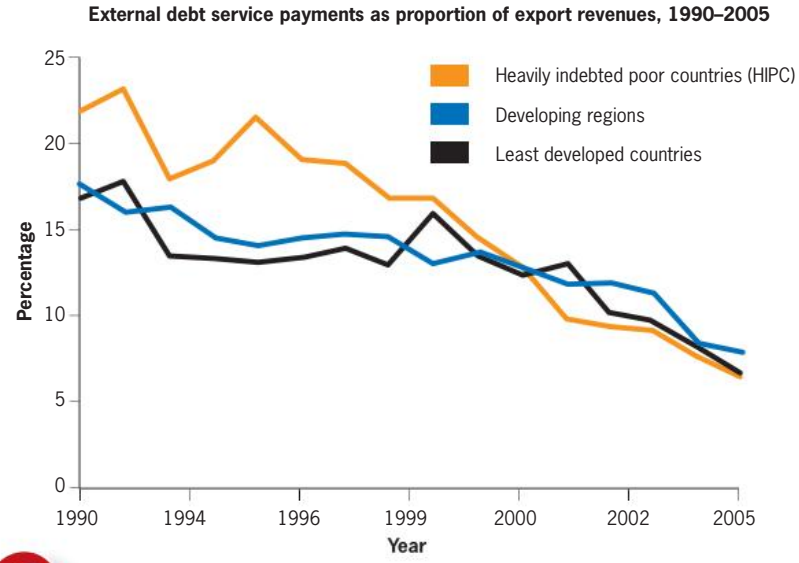


FIGURE 2.5.19

The debt service burden of developing countries continues to lighten.

example, 16.1% of Lebanon's GDP was used to service debt in 2005. This figure was 20.7% for Belize and 32.1% for Kazakhstan in the same year. The external debt of many developing countries drains public budgets and uses the resources needed to support essential service provision and improve levels of human development.

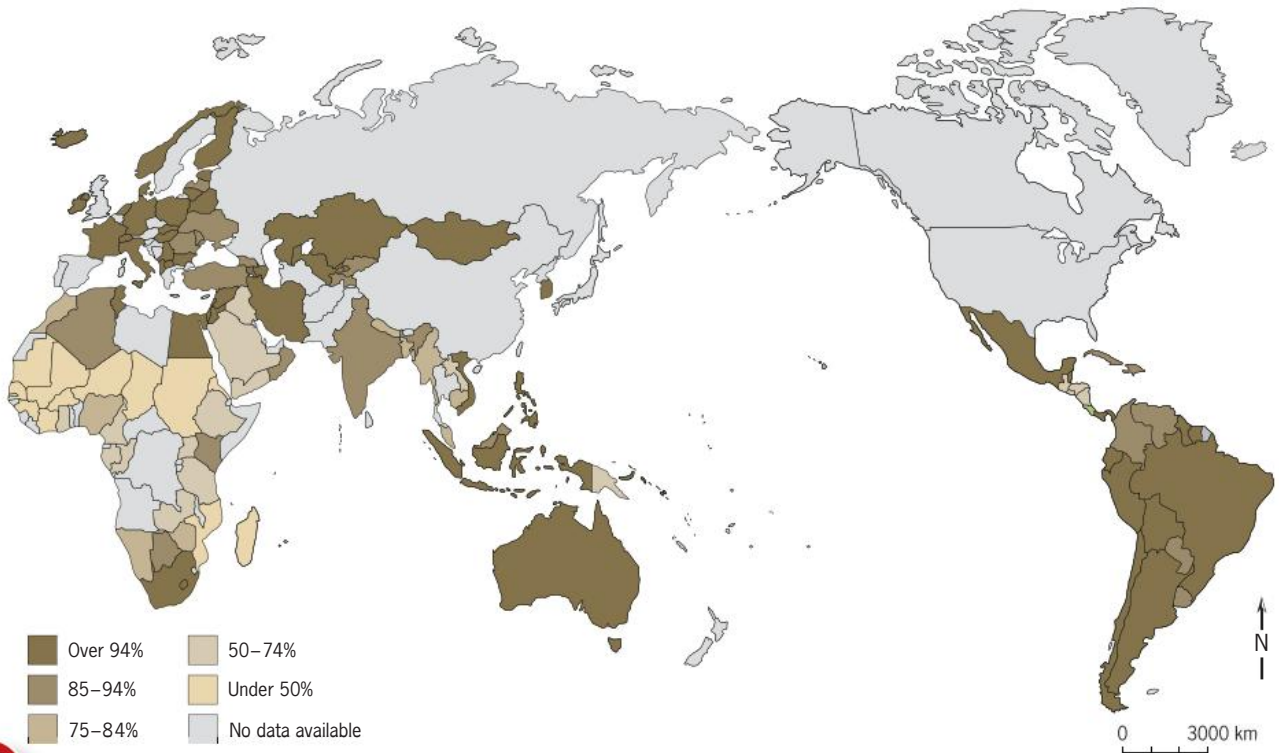


FIGURE 2.5.20

Percentage of children completing primary education, 2000–05.

High levels of illiteracy

Among the most frequently used indicators of development are adult literacy rates and school-retention rates. The adult literacy rate is generally taken to be at 99% in developed countries, compared with 76.7% in all developing countries between 1995 and 2005. However, in the least developed countries, the adult literacy rate for the same period was 53.9%. (See figure 2.5.20.) Just over 72 million primary school aged children were not in school in 2005, with the majority of these from West Asia and Sub-Saharan Africa.

High rates of population growth

Developing countries generally have higher birth rates than is the case in the wealthier countries. The annual population growth rate for high-income countries is projected to be 0.5% for 2005–15, compared with 1.3% for developing countries as a whole. At 2.5%, the rate is even higher for the least developed countries. The growing population in the world's poorer countries places added strain on already limited national resources. This creates additional demand for employment, schooling, **infrastructure**, health and other services.

Low levels of technology

In developing countries there are comparatively low levels of technology and applied science in agriculture and industry. **Labour-intensive** methods of production still tend to dominate in both agriculture and industry in the world's poorer countries.

FIGURE 2.5.21

Weaving. In developing countries many industrial processes still employ labour-intensive methods of production.

geolinks

Try accessing the World Food Program website for further information about dietary deficiencies.

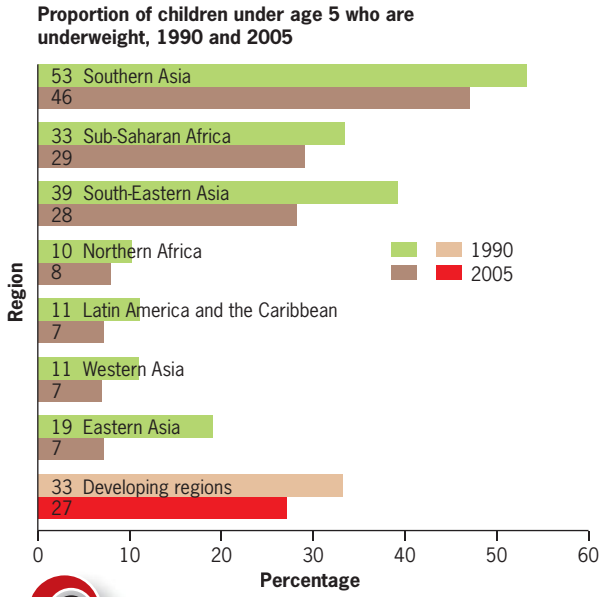


FIGURE 2.5.22

Child hunger is declining in all regions, but meeting the MDG target will require accelerated progress.

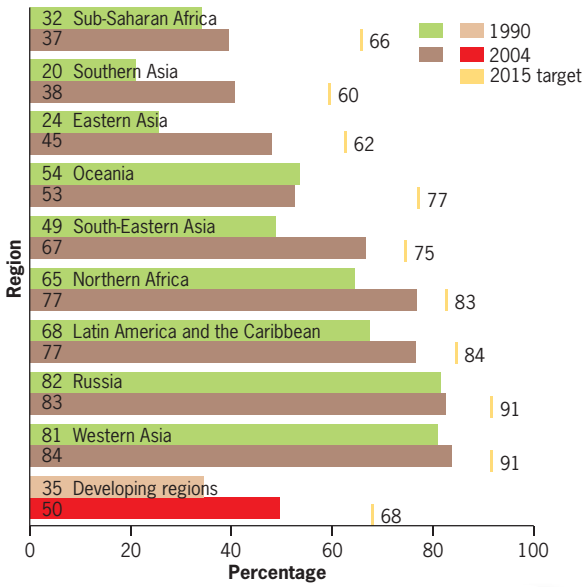


FIGURE 2.5.23

Proportion of population using improved sanitation, 1990 and 2004.

An injustice committed against anyone is a threat to everyone.

Montesquieu, French social commentator and political thinker

Emphasis on primary production

A high percentage of the labour force is engaged in primary production; often subsistence production. Processes of urbanisation have been increasing in developing countries. However, in general a far greater percentage of the labour force is still engaged in agricultural activities in these countries than is the case in the high-income countries. The percentage of the population engaged in agriculture was 2% in the United States in 2004, about 1.8% in the United Kingdom and 8% in Europe. This contrasts with 58% of the population in East Asia and the Pacific, 55% in South Asia and 58% in Sub-Saharan Africa in the same year. Corresponding with this, the manufacturing and industrial sectors engage far less of the labour force in economically poorer countries.

Dietary deficiencies

Dietary deficiencies result from an inadequate food intake. The food may be of poor quality and/or an insufficient quantity of food is consumed. The World Food Program reports that about 854 million people worldwide were undernourished during 2001–03 and that one child dies of hunger every five seconds. The majority of undernourished people (820 million) live in developing countries. On average, from 2002–04, 35% of the population of the least developed countries were undernourished, and 17% of the population of all developing countries suffered from undernourishment. (See figure 2.5.22, p. 427.)

Low levels of infrastructure

Low national incomes are often reflected in low levels of public infrastructure provision. (See figure 2.5.23.) Refer, for example, to the statistics about East Timor in the earlier Geofocus box (pp. 420–3). They reveal that in East Timor many of the rural population do not have access to electricity, only 58% of the population have access to safe water and only 36% of the population have access to basic sanitation facilities. In 2004, 1.6 billion of the world's people were living without electricity. The majority (706 million) of these people lived in South Asia, followed by Sub-Saharan Africa (547 million) and East Asia (224 million).

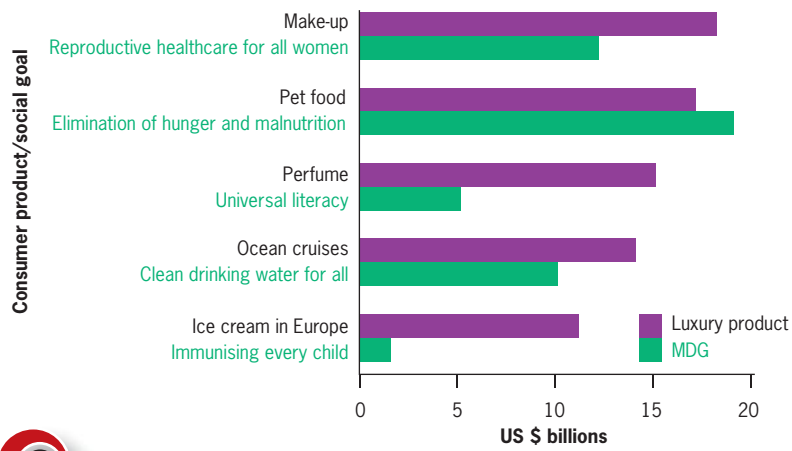


FIGURE 2.5.24

The Western world spends more on luxury products than it would cost to achieve the UN Millennium Development Goals. The graph contrasts annual expenditure on consumer goods with the additional annual investment needed to achieve social goals.

Comparatively low levels of energy consumption

Developing countries consume far less of the world's global energy supplies than do the wealthy countries. For example, developing countries together consumed 1221 kilowatt-hours of electricity per person in 2004, while the high-income countries consumed 10 210 kilowatt-hours per person.

geofocus

Humanity's environmental footprint

It has been calculated that if the entire world's population consumed food, fuel and other natural resources at the same rate as the people of the rich countries, three planet earths would be needed to support everyone.

Even though the US population is only a fourth as large as India's, its environmental footprint is over three times bigger: it releases 15.7 million tonnes of carbon into the atmosphere each year compared with India's 4.9 million tonnes. Hence, the impact of the current 3 million annual population increase in the United States is greater than that of India's 16 million increase.

Most surprising is the dramatic surge in energy use in many industrial countries. Compared with just 10 years ago, for example, Americans are driving larger and less efficient cars and buying bigger homes and more appliances. As a result, US oil use has increased over the decade by nearly 2.7 million barrels a day. This is more oil than is used daily in total in India and Pakistan, which together contain more than four times as many people as the United States does. In total, the average American consumes five times more energy than the average global citizen, 10 times more than the average Chinese, and nearly 20 times more than the average Indian.

Yet energy consumption is rising fastest in the developing world, where petroleum use alone has quadrupled since 1970. China is already the world's number one coal consumer and the third largest oil user, while Brazil is the sixth largest oil consumer. Current trends in global energy use simply cannot be sustained: if the average Chinese consumer used as much oil as the average American uses, China would require 90 million barrels per day. This is 11 million more than the entire world produced each day in 2001.

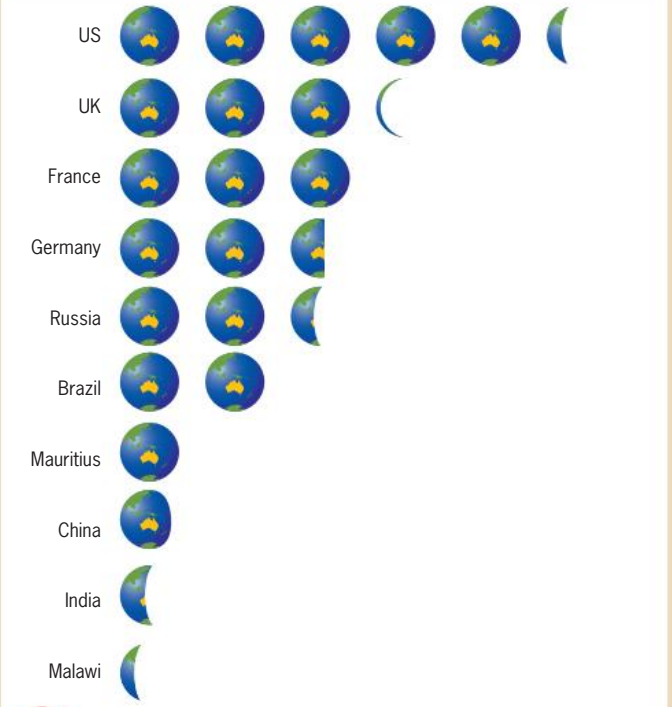


FIGURE 2.5.25

The number of planets needed to sustain the world at different countries' levels of consumption, 2005.

Man's footprint on the planet today.

FIGURE 2.5.26

geolinks

For more information about humanity's environmental footprint access the website of the Worldwatch Institute.

There are a number of websites you can use to calculate your environmental footprint. Try one of these:

- Environment Protection Authority Victoria
- World Wildlife Fund
- Australian Conservation Foundation
- Royal Melbourne Institute of Technology.

TABLE 2.5.3

Millennium Development Goals: 2007 progress chart

	Africa		Asia						Commonwealth of Independent States	
Goals and targets	**Northern**	**Sub-Saharan**	**Eastern**	**South-Eastern**	**Southern**	**Western**	**Oceania**	**Latin America and Caribbean**	**Europe**	**Asia**
Goal 1: Eradicate extreme poverty and hunger										
Reduce extreme poverty by half	Low poverty	Very high poverty	Moderate poverty	Moderate poverty	Very high poverty	Low poverty	—	Moderate poverty	Low poverty	Low poverty
Reduce hunger by half	Very low hunger	Very high hunger	Moderate hunger	Moderate hunger	High hunger	Moderate hunger	Moderate hunger	Moderate hunger	Very low hunger	High hunger
Goal 2: Achieve universal primary education										
Universal primary schooling	High enrolment	Low enrolment	High enrolment	High enrolment	High enrolment	Moderate enrolment	Moderate enrolment	High enrolment	High enrolment	High enrolment
Goal 3: Promote gender equality and empower women										
Equal girls' enrolment in primary school	Close to parity	Almost close to parity	Parity	Parity	Close to parity	Close to parity	Close to parity	Parity	Parity	Parity
Women's share of paid employment	Low share	Medium share	High share	Medium share	Low share	Low share	Medium share	High share	High share	High share
Women's equal representation in national parliaments	Very low representation	Low representation	Moderate representation	Low representation	Low representation	Very low representation	Very low representation	Moderate representation	Low representation	Low representation
Goal 4: Reduce child mortality										
Reduce mortality of under-5-year-olds by two-thirds	Low mortality	Very high mortality	Low mortality	Moderate mortality	High mortality	Moderate mortality	Moderate mortality	Low mortality	Low mortality	Moderate mortality
Measles immunisation	High coverage	Low coverage	Moderate coverage	Moderate coverage	Low coverage	High coverage	Low coverage	High coverage	High coverage	High coverage
Goal 5: Improve maternal health										
Reduce maternal mortality by three-quarters	Moderate mortality	Very high mortality	Low mortality	High mortality	Very high mortality	Moderate mortality	High mortality	Moderate mortality	Low mortality	Low mortality
Goal 6: Combat HIV/AIDS, malaria and other diseases										
Halt and reverse spread of HIV/AIDS	Low prevalence	Very high prevalence	Low prevalence	Low prevalence	Moderate prevalence	Low prevalence	Moderate prevalence	Moderate prevalence	Moderate prevalence	Low prevalence
Halt and reverse spread of malaria	Low risk	High risk	Moderate risk	Moderate risk	Moderate risk	Low risk	Low risk	Moderate risk	Low risk	Low risk
Halt and reverse spread of tuberculosis	Low mortality	High mortality	Moderate mortality	Moderate mortality	Moderate mortality	Low mortality	Moderate mortality	Low mortality	Moderate mortality	Moderate mortality

Millennium Development Goals: 2007 progress chart (continued)

	Africa		Asia						Commonwealth of Independent States	
Goals and targets	**Northern**	**Sub-Saharan**	**Eastern**	**South-Eastern**	**Southern**	**Western**	**Oceania**	**Latin America and Caribbean**	**Europe**	**Asia**
Goal 7: Ensure environmental sustainability										
Reverse loss of forests	Low forest cover	Medium forest cover	Medium forest cover	High forest cover	Medium forest cover	Low forest cover	High forest cover	High forest cover	High forest cover	Low forest cover
Halve proportion without improved drinking water	High coverage	Low coverage	Moderate coverage	Moderate coverage	Moderate coverage	High coverage	Low coverage	High coverage	High coverage	Moderate coverage
Halve proportion without sanitation	Moderate coverage	Very low coverage	Very low coverage	Low coverage	Very low coverage	Moderate coverage	Low coverage	Moderate coverage	Moderate coverage	Moderate coverage
Improve the lives of slum-dwellers	Moderate proportion of slum-dwellers	Very high proportion of slum-dwellers	High proportion of slum-dwellers	Moderate proportion of slum-dwellers	High proportion of slum-dwellers	Moderate proportion of slum-dwellers	Moderate proportion of slum-dwellers	Moderate proportion of slum-dwellers	High proportion of slum-dwellers	Moderate proportion of slum-dwellers
Goal 8: Develop a global partnership for development										
Youth unemployment	Very high unemployment	High unemployment	Low unemployment	High unemployment	Moderate unemployment	Very high unemployment	Low unemployment	High unemployment	High unemployment	High unemployment
Internet users	Moderate access	Very low access	Moderate access	Moderate access	Low access	Moderate access	Low access	High access	Moderate access	Moderate access

The progress chart operates on two levels. The words in each box tell what the current rate of compliance with each target is. The colours show the trend towards meeting the target by 2015 or not. See legend below.

- Target already met or very close to being met
- Target is expected to be met by 2015 if prevailing trends persist, or the problem that this target is designed to address is not a serious concern in the region
- Target is not expected to be met by 2015
- No progress, or a deterioration or reversal
- Insufficient data

Source: UN website

working geographically

1 **Interpreting diagrams** Study figure 2.5.18 (p. 426). Write a paragraph outlining the nature of the relationship between neonatal mortality and GDP in China and India.

2 **Writing task** Write an explanation outlining the relationship between poverty, undernourishment and disease and their impact on human potential.

3 **Interpreting diagrams** Study figure 2.5.20 (p. 426). With the aid of an atlas, identify the countries with the lowest primary school completion rates.

4 **Interpreting diagrams** Study figure 2.5.22 (p. 427). Write a paragraph outlining the trends in undernutrition in developing countries.

5 **Thinking critically** Think about the Millennium Development Goals. Which do you regard as most likely to improve the prospects of the poor in developing countries? Make a note of these and explain why.

6 **Thinking critically** Study table 2.5.3.

- **a** Which aspect or 'goal' do you think is most likely to be met by 2015?
- **b** Which aspect of global deprivation do you regard as the most significant? Why?
- **c** After examining the progress chart, conduct a class discussion. Topic: Is it possible to suggest any connections between the global progress made and global deprivation? Summarise the points made in the discussion.

7 **Class debate** Conduct a class debate. Topic: High consumers should live more simply so that others may simply live.

We have the means and the capacity to deal with our problems, if only we can find the political will.

Kofi Annan, former Secretary-General of the United Nations

There are only two families in the world, as my grandmother used to say: the haves and the have-nots.

Sancho Panza in *Don Quixote* by Miguel de Cervantes

Alone we can do so little; together we can do so much.

Helen Keller, US author and activist

Factors affecting the rate of development

Spatial variations, or the differences between places, have always been of interest to geographers. Geographers also attempt to understand the differences they observe between countries and within countries, and to describe and account for changes that occur over time. You now have some understanding of the common characteristics of poor countries that differentiate them from the wealthier countries. It is important that, as geographers, you explore further some of the factors that have contributed to the creation of these patterns.

When you think about what may cause the differential rates of development between countries, it is important to consider the following:

- *Scale.* At the local level (for example, amongst indigenous minority groups, such as Aboriginal Australians) factors contributing to poverty may not be the same as those responsible for poverty at the national level, or on the macro scale.
- *Internal or external?* Factors internal or external to a community or country may cause poverty and the characteristics common to poor countries.
- *Complexity.* Complex interrelationships usually exist between factors that contribute to poverty and lack of development.

Early geographical studies of the developing world tended to be descriptive, focusing primarily on the uniqueness of foreign places and their peoples. References to internal factors were used to explain the persistence of poverty. These factors include a poor natural resource base and climatic conditions. Some believed that the poor were the chief cause of their own problems. Today, it is widely acknowledged that a complex relationship between frequently interrelated factors contributes to their ongoing problems. These factors are both internal and external to the developing countries and are outlined below.

Internal factors influencing development

The resource base

Differing levels of wealth can be partially attributed to the resource base available to communities or countries. Some countries are able to derive considerable wealth from the exploitation of natural resources. These nation-states include oil-producing countries, such as Qatar and the United Arab Emirates. However, there may be only limited potential for other countries to generate income from the exploitation of natural resources.

When a country's biophysical environment (that is climate, soils and landform) is suitable for a range of agricultural activities, the country has the potential to become **self-sufficient** in production of food resources. Any surplus can be exported to generate capital for investment in other areas. Lack of a suitable environment for production of food resources means a country may be forced to rely on costly imports to meet the needs of its people.

If other compensatory factors come into play, however, the lack of a strong natural resource base need not be an impediment to development. Japan, for example, has few natural resources but was able to achieve a high level of development based on the importation of raw materials and the export of manufactured goods.

Political instability

Economic and social development may be hampered and poverty caused by political instability. History has left many countries with fragile and artificial national boundaries. Many of the world's former colonies are now

among the world's poorer countries. The national boundaries and notions of national sovereignty, which they inherited after the demise of colonialism, often fit uneasily with local traditions and customs. Frequently, formerly distinct groups of people, often from different ethnic groups, were forced together within national boundaries. This led to conflict and instability within the newly formed countries. Internal political instability can carry a heavy cost burden. Instead of funds being devoted to development-related projects or social infrastructure, which may improve levels of human development, they are often diverted to finance the activities of the military and police forces. As a result, infrastructure is often damaged, crops destroyed, people displaced and the economy disrupted.

East Timor (see the Geofocus box on pp. 420–3), Rwanda, Cambodia and Sri Lanka, amongst others, provide examples of the effects of political upheaval. Although present-day political instability is internal to a country, it must be remembered that often the seeds of instability were sown in the form of artificial national boundaries, which are a product of history.

Population growth

A decrease in mortality rates since the middle of the twentieth century has resulted in rapid population growth rates in the poor world. Improvements in nutritional intake and access to health care and immunisation have resulted in a decline in early deaths. The decrease in mortality means that more women reach child-bearing age. As a result, the fertility rate has increased. (See Unit 2.1, p. 235.)

A country's ability to provide medical and educational facilities, infrastructure and adequate food supplies is immediately affected by a rise in the number of births. There are added demands for infrastructure as a result of increased population. For this reason, many countries have tried to introduce national population policies that encourage couples to limit family size.

The issue of population growth and control is very controversial. Many would argue that population growth is largely to blame for the world's environmental and development problems. Others argue that poverty, indebtedness, inequities in access to land, and global inequalities are the real causes of environmental degradation and poverty. Women's groups argue that the population issue can be addressed by improving the lot of women. This could be achieved by providing access to education, employment and family planning services. However, as figure 2.5.27 demonstrates, women often have less access to education than their male counterparts. People of the developing countries also argue that overconsumption by the industrial countries has to be addressed, rather than just focusing on controlling population growth.

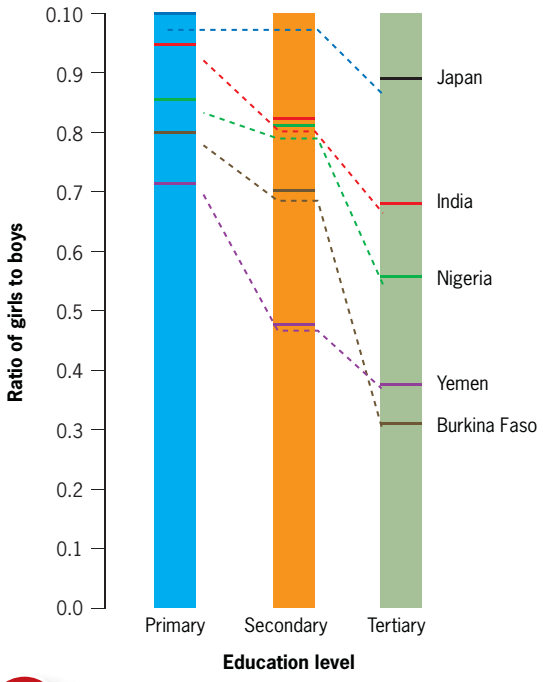


FIGURE 2.5.27

Gender discrimination tracks girls through education in some countries.

Environmental degradation

Environmental degradation in developing countries is both a symptom of poverty and a factor contributing to ongoing poverty. At the local level, people are often engaged in practices that can cause environmental degradation. This is frequently the result of the struggle of individuals to survive. Population growth and increased use of land for commercial agriculture can force the extension of subsistence agricultural activities into marginal areas. This results in land being cleared for agricultural purposes or to access timber for firewood or housing. Furthermore, land overuse results in the reduction of soil fertility. At the national level, the necessity to repay foreign debt means that governments of many developing countries have encouraged the extension of cash cropping, mining and forestry, frequently at the expense of the environment.

In some areas, such as the Sahel region of Africa, overuse of land and destruction of ground cover have led to rapid desertification. Because the boundaries of the desert are gradually being extended, arable land

is subject to increasing pressure through overuse. Subsistence farmers simply do not have the resources to reverse these processes or to be able to reduce their use of the land. Thus, the land is further degraded and becomes less fertile, and the poor become still poorer. Today there is growing concern about the impacts of climate change on the world's most vulnerable people. As figures 2.5.28 and 2.5.29 demonstrate, the people of the world's poorer countries have contributed least to global climate change. Yet these are the people who are most at risk from its impacts. The following Geofocus boxes illustrate the destructive effects of climate change on local environments and the positive attempts by some local communities to adapt to changing climate.

LDCs least developed countries.

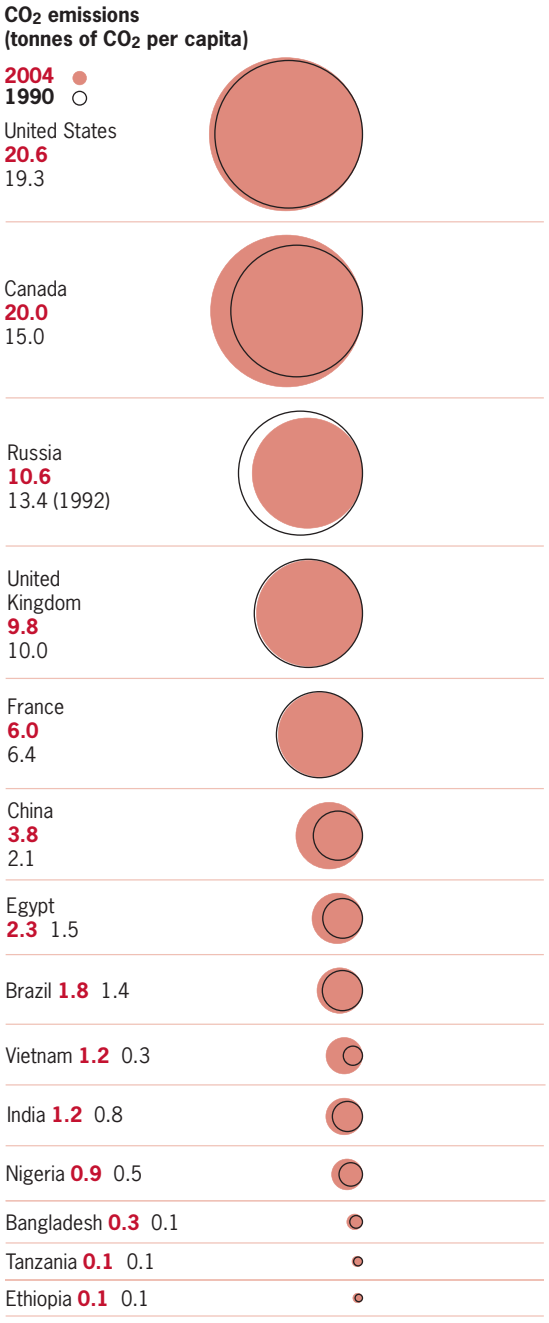


FIGURE 2.5.28

Rich countries—deep carbon footprints.

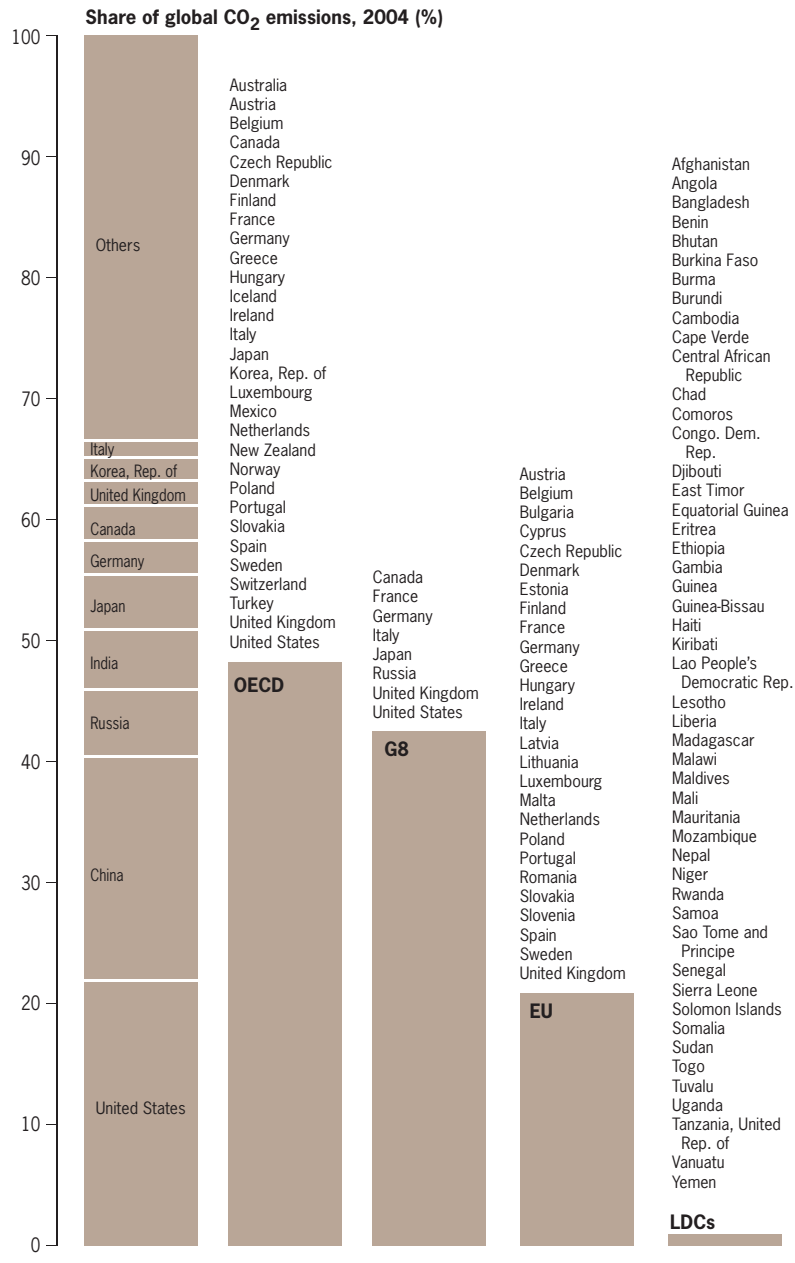


FIGURE 2.5.29

Global CO_2 emissions are highly concentrated.

geofocus

Drought and food insecurity in Niger

Niger is one of the poorest countries in the world. It ranks close to the bottom of the HDI, with a life expectancy of nearly 56 years, 40% of children having low weight for their age in an average year, and more than one in five children dying before their fifth birthday. Vulnerability to climate shocks in Niger is linked to several factors. These include widespread poverty, high levels of malnutrition, precarious food security in normal years (that is, years with average or expected climate conditions), limited health coverage and agricultural production systems that have to cope with uncertain rainfall. During 2004 and 2005 the implications of these underlying vulnerabilities were powerfully demonstrated by a climate shock, with an early end to rains and widespread locust damage.

FIGURE 2.5.30

A Nigerois farmer sells his goat for a quarter of the normal price at the market in the northern town of Fala.

Agricultural production was immediately affected. Output fell sharply, creating a cereals deficit of 223000 tonnes. Prices of sorghum and millet rose 80% above the five-year average. Along with the loss of pasture and nearly 40% of the crop of fodder (feed for livestock), there was an increase in the price of animal feed and the number of distress sales; that is, the selling-off of stock because of adverse conditions. Together, these factors pushed down livestock prices, depriving households of a key source of income and risk insurance. Vulnerable households tried to sell undernourished animals for income to buy cereals. The drop in prices adversely affected their food security and terms of trade.

By the middle of 2005 approximately 56 zones across the country were facing food security risks. Some 2.5 million people—around one-fifth of the country's population—required emergency food assistance. Twelve zones in regions such as Maradi, Tahoua and Zinder were categorised as 'extremely critical'. This meant that the people there were reducing the number of meals eaten each day, consuming wild roots and berries, and selling female cattle and production equipment.

The crisis in agriculture led to severe human costs, including:

- There was migration to neighbouring countries and less critically affected zones.
- In 2005 Médecins Sans Frontières (MSF) reported an acute malnutrition rate of 19% among children aged 6–59 months in Maradi and Tahoua. This represented a significant deterioration over average levels. MSF also reported a fourfold increase in the number of children suffering from severe malnutrition in therapeutic feeding centres.
- A United States Agency for International Development (USAID) survey team reported women spending entire days collecting anza, a wild food.

In some respects, Niger's low level of human development makes the country an extreme case. However, developments during 2005 demonstrated in stark fashion the mechanisms through which increased climate-related risk can disrupt coping strategies and create extensive vulnerabilities.

Adapted from the *Human Development Report*, 2007–08

Compounding the problems of developing countries

The symptoms of underdevelopment often contribute to the ongoing problems of developing countries. For example, it is frequently argued that poor health can reduce the productivity of people in certain areas. Similarly, low levels of national income mean some governments do not have the capacity to invest in health care services and education facilities, or in efforts to mitigate the increasing effects of climate change.

The priorities of individual governments may also significantly determine the nature of development within a country. For example, a government may choose to spend the limited available capital on meeting the basic needs of the poor majority. Another government may direct it towards priorities such as the protection of the interests of wealthy elites or military expenditure. So, good governance in terms of

geofocus

Reducing vulnerability through agriculture in Malawi

One of the ways in which climate shocks create cycles of disadvantage is through their impact on agricultural production. When a drought or flood destroys a harvest, the resulting loss of income and assets can leave households unable to afford the seed, fertiliser and other inputs needed to restore production the following year. Well-framed public policy interventions can break the cycle, as demonstrated by the experience in Malawi.

The 2005 maize harvest in Malawi was one of the worst on record. Following successive droughts and floods, production fell from 1.6 million tonnes in the previous year to 1.2 million tonnes—a decline of 29%. Over 5 million people faced food shortages. With rural incomes in free fall, households lacked the resources to invest in inputs for the 2006 cropping season. This raised the spectre of a famine on the scale of that experienced in 2002.

Supported by a group of donors, the Government of Malawi put in place a strategy for providing small-scale farmers with productive inputs. Around 311 000 tonnes of fertiliser and 11 000 tonnes of maize seed were sold at subsidised prices. Over 2 million households purchased fertiliser at US$7 for 50 kg—less than one-third of the average world price. For distribution, the government used private sector outlets as well as state agencies, enabling farmers to choose their source of supply.

Subsequent harvests showed that this productive inputs program was a moderate success. Good rains and an increase in the area planted to improved crop varieties raised productivity and overall output. It is estimated that the program generated an additional 600 000–700 000 tonnes of maize in 2007, independent of rainfall variation. The value of this extra production has been estimated at between US$100 million and US$160 million, compared with the US$70 million cost of the program. The Malawian economy has also benefited from a reduction in food import requirements. Furthermore, the increased production has generated household income and employment opportunities.

The productive inputs program is not a stand-alone strategy for human development. Nor is it a panacea (remedy for all ills or difficulties) for rural poverty. Far more needs to be done to strengthen the accountability of government, tackle deep-seated inequalities and increase the level of investment in basic service provision for the poor. The program will have to be retained for several years if it is to break the cycle of low productivity that afflicts Malawian agriculture. Nevertheless, the country's experience underlines the role that public policies can play in reducing vulnerability to climate risk by creating an enabling environment for poverty reduction.

Adapted from the *Human Development Report*, 2007–08

giving priority to spending on human development through improving access to education and health services can significantly affect levels of human development.

Similarly, local culture and traditions are sometimes regarded as obstacles to development. For example, in India, people of the Hindu religion are born into particular social classes known as castes. An individual's caste frequently determines their occupation and status in life. The persistence of such rigid social systems can hinder development for some social groups or communities.

Corruption is also frequently cited as an internal cause of poverty and therefore of continued underdevelopment. Of course, corruption exists everywhere. You only have to consider the spate of royal commissions and inquiries within Australia to realise that this is not solely a problem of the poor world. However, in some poor countries people are more vulnerable to the influence of corrupt individuals, elites and bureaucracies. This is because in these countries there are higher levels of illiteracy and less understanding of rights. In addition, people's lives are more likely to be dominated by a daily struggle to survive.

National development and the impacts of external factors

Influences originating within developing countries are not the only causes of poverty. Some of the commonly recognised external causes of poverty, many of them historical, are discussed below.

The legacy of history

Many of the world's poorest countries were once colonies, part of vast European empires. In the years immediately after World War II,

understanding the text

1 **List** the characteristics of developing countries. Give at least one piece of factual information to illustrate each characteristic.
2 **Outline** the importance of natural resources to the process of development.
3 **Explain** why the biophysical environment is capable of supporting a range of agricultural activities that contribute to the well-being of its people.
4 **Outline** the causes of the political instability mentioned on pages 432–3.
5 **Outline** the ways in which political instability can hinder development.
6 **Identify** the reasons why rapid population growth is being experienced in the developing world.
7 **Outline** the ways in which rapidly growing populations hinder development.
8 **Explain** why the issue of population control is controversial.
9 **Explain** why it is important to improve the status and rights of women.
10 **Contrast** the environmental impact of a family living in the developing world with one living in the developed world.
11 **Explain** why people living in developing countries are sometimes forced to degrade the environment.
12 **Outline** the impact that rapid population growth is having on the environment.
13 **Identify** who is to blame for the environmental crisis.
14 **Explain** why the high-consumption lifestyle of the developed world is said to be unsustainable.
15 **Explain** the ways in which environmental degradation within developing countries could be regarded as being caused by factors external to developing countries, rather than by factors internal to poor countries.
16 **Outline** the ways in which the priorities of individual governments can affect the nature and rate of development.
17 **Explain** how some characteristics of poor countries could also be regarded as obstacles to development.

working geographically

1 **Class discussion** Study figure 2.5.27 (p. 433). Conduct a class discussion on the topic: Why do girls have less access to education than men?
2 **Thinking geographically** What development impacts are the lower education levels of women likely to have?
3 **Class debate** Study figure 2.5.29 (p. 434). The world's poorest people walk the earth with a very light carbon footprint. Conduct a class debate. Topic: Those who have contributed most to climate change should take responsibility for it.
4 **Writing task** Write an extended response outlining the relationship between responsibility for climate change and risk from climate change threats.
5 **Interpreting text** Study the Geofocus boxes 'Drought and food insecurity in Niger' (p. 435) and 'Reducing vulnerability through agriculture in Malawi' and locate Niger and Malawi on a world map. Then answer the following questions:
   a What development issues does Niger face?
   b How has climate change impacted on Niger?
   c What adaptations have been made in Malawi to reduce the impacts of climate shocks?
6 **Research task** Undertake library and Internet research. Investigate the causes of the conflict in East Timor. How much of the conflict can be said to be a legacy of the colonial era?
7 **Research task** Undertake library and Internet research. Find the population growth rates for five developing countries and five wealthy countries. Does a clear pattern emerge? Can you account for this?
8 **Class discussion** Compile a list of the common characteristics of wealthy countries.
9 **Class discussion** Identify the type of natural resources that can bring wealth to a country. List some countries that have been able to exploit natural resources to achieve increased national income. Does exploiting natural resources to generate national income have any negative consequences?
10 **Group work** Working in groups, identify at least five countries whose economic and social development are constrained by the limitation of available natural resources.
11 **Writing task** Write an essay that details and accounts for the problems associated with the migration of people from rural to urban areas in poor countries.
12 **Research task** Undertake library and Internet research. Find out what changes in developing countries are referred to by the term 'the Green Revolution'. List the advantages and disadvantages of the Green Revolution.
13 **Using the media** Use media resources, including the Internet, to trace the development of a conflict over the use of one or more resources in a developing country.

most colonial powers gave up, or were forced to give up, their colonial territories. The legacy of colonialism remained, however, and it influenced the development paths of many of the former colonies of the wealthier, industrialised countries. The extent to which their colonial past hinders development varies, but this is generally seen to be a contributing factor.

Many of the colonies were used as markets for finished products and other surpluses produced in the industrialised countries. At the same time, the colonial countries supplied raw materials and foodstuffs needed by the colonial power. Restrictions were often placed on the

FIGURE 2.5.31

His Imperial Majesty, King George V, Emperor of India (1865–1936), riding on an elephant at a tiger hunt. circa 1911. Despite achieving independence, the legacy of the colonial era continues to influence the development of many developing countries.

The 'environment' is where we live; and development is what we all do in attempting to improve our lot within that abode. The two are inseparable.

Our Common Future, UN World Commission on Environment and Development

did you know?

- Most of the increase in debt during the 1990s was to pay interest on existing loans. It was not used for productive investment or to tackle poverty. In six of the eight years from 1990 to 1997, developing countries paid out more to service debt (payments of interest and principal) than they received in new loans. In total there was a transfer from the poor developing world to the rich developed world of US$77 billion.
- The total external debt of the very poorest countries (the 'low income countries' that have an annual average income of less than US$875 per person) was US$412 billion at the end of 2005. During 2005, these countries paid nearly US$43 billion to the rich world in debt service (payments of interest and principal); that is, US$118 million a day.
- For all developing countries, total external debt owed at the end of 2005 was US$2.8 trillion. Over the course of that year they paid US$511 billion servicing those debts.
- Nigeria borrowed US$5 billion, has paid US$16 million to date and still owes US$32 billion.

ability of the colony to produce goods that were already produced by the colonial power, or to trade freely with countries other than the colonial power. Such arrangements were obviously designed to benefit the colonial power rather than the colony, and placed severe restrictions on the colony's economic activities. Many of these established trade relationships have continued with the wealthy countries, long after the demise of colonialism, continuing to dominate international trading relationships. The uneven distribution of wealth between countries is thus perpetuated by relationships established in the colonial era. Many of the former colonial countries still suffer from continued economic dependence on the more developed regions of the world.

While pre-colonial, colonial and post-colonial experiences may have contributed significantly to the problems of some poor countries, some developing countries, such as Thailand, remained independent and were never colonised. It is important to keep in mind that, in today's interdependent world, a complex mix of factors must be examined in relation to each country in order to understand its comparative wealth. It is too simplistic to argue that colonialism alone is the chief cause of the problems of the poor world.

Debt burdens

During the 1970s, oil prices increased dramatically. Huge amounts of money were generated through the sale of oil and then deposited in the world's commercial banks. At the same time, the developed world suffered an economic recession, which was generated, at least in part, by the increasing cost of oil. The recession in the developed countries meant that demand for credit from the commercial banks declined. Seeking to earn income on the reserves they held, the commercial banks began to look for new markets. They saw a potential market in the poor countries.

Eager to attempt to follow the road to industrialisation and increased national income, the poor countries were keen to borrow funds to build infrastructure and to assist their countries to industrialise and modernise. At the time, the loans available were attractive; surpluses meant that they were being offered at low interest rates. As a result of these factors, commercial lending and loans offered through official aid programs to developing countries grew dramatically.

However, rising interest rates in the 1980s had a devastating impact on the poor countries. Repayments on the debts began to cost more and more. At the same time, the export earnings of developing countries declined. This was because the recession experienced at that time in developed countries meant that poor countries were receiving lower prices for their exports of raw materials and goods. The recession in the developed world also meant that foreign investment in poor countries declined. Also Western countries became **protectionist** to try to support their own producers. These factors reduced the potential for developing countries to increase their incomes. So, developing countries were forced into a situation where their income was declining but at the same time they had increasing debts to service. It is arguable that the task of supporting the affluent countries through a worldwide recession was borne in large part by developing countries.

protectionist advocate of protectionism.

Under pressure to meet debt repayments, many developing countries attempted to increase export earnings by allowing the exploitation of natural resources, such as native forests and mineral deposits. For the same reason they concentrated their agricultural activities on the production of cash crops for sale to the wealthy countries. Many poor countries were financially strangled by the burden of debt repayments for many years. In recognition of the extent of the debt burden facing the poor world, there have been attempts in recent years to find solutions.

'Debt for nature swaps' are an innovative attempt to solve the problem of debt while ensuring the conservation of natural resources. The first 'swap' occurred in July 1987, when an organisation called Conservation International bought out US$650 000 of Bolivian debt for US$100 000. The money saved was to be used for the management of several biological reserves. Since then, other 'debt for nature swaps' have been successfully implemented in a number of other countries, including Ecuador and the Philippines.

Recognition of the burden that debt payments impose has led to concerted campaigns by nongovernmental development assistance organisations, **advocacy** groups, academics and the general public for debt forgiveness. Campaigning about this issue began in the 1980s. Some wealthy countries have elected to cancel the debts owed to them by smaller countries. For example, in 1995 Denmark cancelled the debts of five very poor countries: Angola, Ghana, Nicaragua, Zimbabwe and Bolivia. In 2000 the global Jubilee Campaign called for cancellation of the total debt of the most impoverished countries. Sponsored by nongovernmental organisations and churches, Jubilee 2000 aimed to link the biblical concept of debt forgiveness with the year 2000. More

advocacy active support of an idea or cause; especially the act of pleading or arguing for something.

FIGURE 2.5.32

> *Continued environmental degradation in all regions is unfairly shifting burdens onto future generations, and contradicts the principle of intergenerational equity.*
>
> *Global Environment Outlook*, 2007

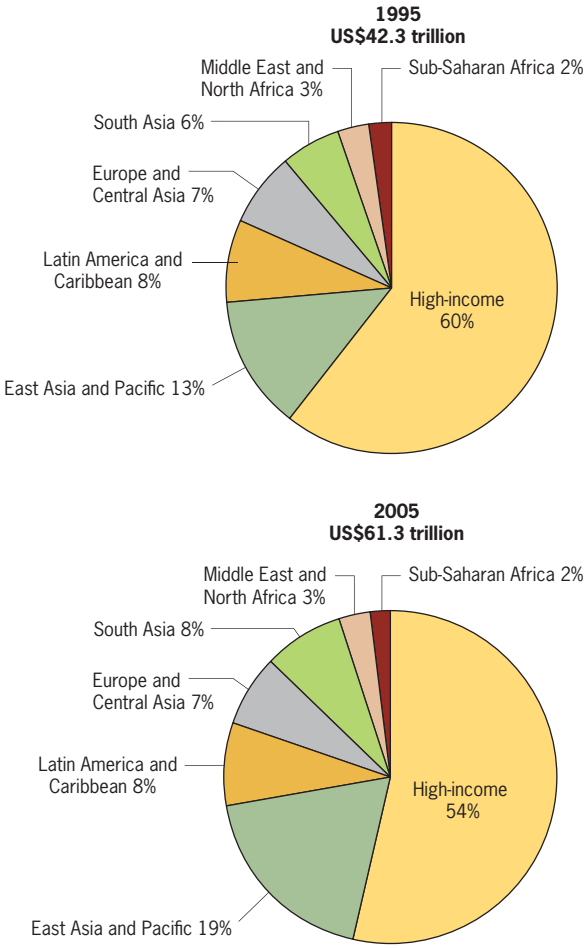


FIGURE 2.5.33

Developing economies increase their share of global output.

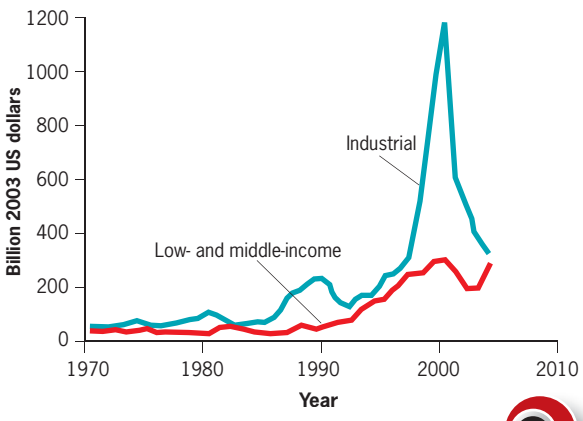


FIGURE 2.5.34

Inflows of foreign direct invesment to industrial and low- and middle-income countries, 1970–2004.

FIGURE 2.5.35

Oxfam's campaigning for debt relief.

recently, the global Make Poverty History campaign has continued the campaign for global debt relief. It was launched in 2005 and supported by public figures, such as Nelson Mandela, Nicole Kidman, rapper P. Diddy and Bono.

The Heavily Indebted Poor Countries (HIPC) initiative was set up in 1996 by the World Bank and the International Monetary Fund (IMF) to reduce the debts of poor countries. Under this initiative, if they meet certain conditions, heavily indebted poor countries are eligible for debt relief. Their debt will be reduced to a level deemed to be 'sustainable' by the World Bank and the IMF. In the last decade, 22 countries have completed the HIPC process, with more than US$40 billion worth of debt cancelled. An additional initiative, the Multilateral Debt Relief Initiative, was agreed to in 2005 to further broaden debt relief. It generated approximately US$490 million in debt service savings for African countries in 2006.

Trade imbalances

Most developing countries are still net importers of manufactured goods, while developed countries are mostly net exporters of manufactured goods. Manufactured goods have added production costs, and are more costly than the raw material exports that most developing countries are able to sell. Many poor countries are still dependent on the industrialised, wealthy countries for numerous high-cost imported goods. Meanwhile, they rely heavily on agricultural products for their export earnings. Developing countries have increased their share of global output, but developing countries are usually at a disadvantage in world trade: the value of their imports often exceeds the income earned from their exports. Consequently, they are likely to incur a debt rather than earn surplus income through trade.

Many poor countries have encouraged the conversion of farmland from subsistence production to production of cash crops (such as tea, coffee and flowers) in order to earn export income. This can have devastating effects on poor local farmers, who forgo more dependable subsistence farming systems in favour of cash cropping. In doing so, they become dependent on export income, which in turn depends on continued and consistent demand for cash crops. As well, countries become highly dependent on unreliable sources of export earnings.

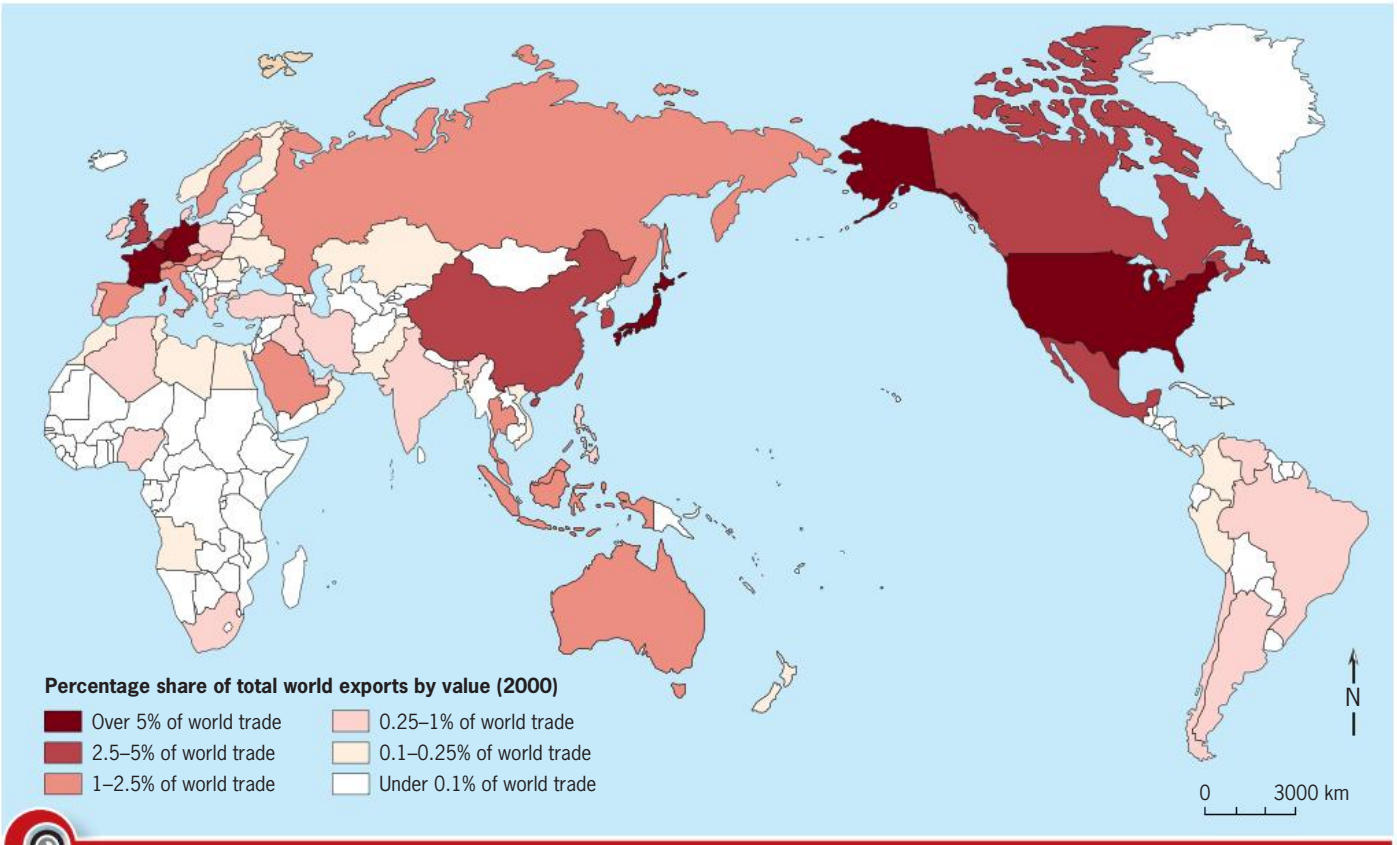


FIGURE 2.5.36

The global pattern of world trade.

Natural conditions (such as drought, floods and insect plagues) are likely to influence the supply of cash crops and raw materials, and therefore the incomes received from their sale. So too, prices of raw material products are prone to decrease in times of oversupply. For these reasons, the export income of developing countries can fluctuate greatly.

Transnational corporations

Transnational corporations (TNCs), which are sometimes known as multinational companies, are large organisations with operations in several countries. Usually they have the **parent company** based in a developed country, TNCs frequently operate **subsidiary companies** in developing countries. In the 1970s and 1980s many developing countries welcomed TNCs, believing they would bring employment, use raw materials and stimulate economic growth in the host country. For TNCs, developing countries are an attractive base because of their abundant supply of cheap labour, often accompanied by less stringent industrial relations laws regarding wages, hours of employment and working conditions. They also appeal because of the lower cost of inputs (such as land and services) and often because of the availability of cheap raw materials. After production, goods produced are sold at a profit, frequently in developed countries. The profit generated belongs to the parent company based in a developed country. In reality, TNCs frequently remove more capital from a poor country than they generate there. At the same time they ensure that consumers in wealthy countries (or the rich elite in poor countries) are able to purchase an abundance of consumer items manufactured cheaply in poor countries. These items are frequently beyond the financial reach of those employed to manufacture them.

"Because you've done it successfully your way for generations, it doesn't mean it works."

FIGURE 2.5.37

parent company the company owning the majority of the voting stock of another corporation.

subsidiary company a company that is completely controlled by another company.

did you know?

- In 2003, the value of the combined arms sales by the top 100 arms-producing companies in the world (excluding those in China) increased by 25% from the previous year to US$236 billion. This is roughly equal to the combined national output of the 61 lowest income countries during that year.
- In 2004, $1035 billion was spent on military forces and equipment worldwide. The United States expended 47% of this world total. Some creative redistribution of these amounts could significantly reduce poverty.
- Universal access to water and primary education in addition to reducing infant mortality by two-thirds by 2015 would cost the equivalent of 7.5% of world military expenditure for the next 10 years (US$760 billion).
- Providing more than three years of basic food, HIV/AIDS medication, childhood immunisation and clean water and sanitation for the world's neediest people is the same as the estimated cost of war and occupation in Iraq and Afghanistan as of June 2005 (US$230 billion).

concessional terms at less than a market return on the money invested or provided.

Militarisation

After World War II, many of the newly independent countries of the developing world became involved in international power politics. Without developed security and defence forces, the newly independent countries were faced with concerns about their security. This was reinforced by the insecurity felt by ruling elites, who often saw a strong military as a means of protecting their position of privilege. In response to these concerns, many developing countries accepted military and economic aid. Expenditure on armaments by developing countries has contributed to their debt burden and used resources that could have been devoted to meeting the basic needs of their peoples.

Dependency on development assistance

Many poor countries are heavily dependent on development assistance (or overseas aid) supplied by wealthy countries. Aid is a by-product of decolonisation. Before World War II, colonial governments gave grants or budgetary subsidies to colonies. It was only in the early 1950s that there were the beginnings of aid distribution in its present sense. Aid was promoted as the means to stimulate economic growth in the poor world. Aid, also known as 'development assistance' or 'development cooperation', is generally considered to be the provision of assistance on **concessional terms** for promoting development.

There are three major types of aid donation:

- *Bilateral aid.* This is development assistance provided by governments of wealthy countries to governments of developing countries.
- *Multilateral aid.* Multilateral aid is given by multilateral institutions, such as the World Bank, the IMF and the Asian Development Bank. This aid is frequently provided in the form of loans.
- *Nongovernmental aid.* This is distributed by nongovernmental, non-profit organisations (NGOs), which receive most of their income from voluntary donations from the general public. Some well-known Australian NGOs are Oxfam Australia, World Vision and Austcare.

There is considerable debate about how aid should be distributed. Some would argue that aid has had little impact in addressing the 'big issues', such as the imbalance in trade relationships, which perpetuate poverty. It can also be argued that most forms of aid are designed to meet donor rather than recipient interests, and that it merely offers a crutch, causing dependency of poor countries on outside assistance. Support of highly visible projects, such as grand infrastructure developments, has

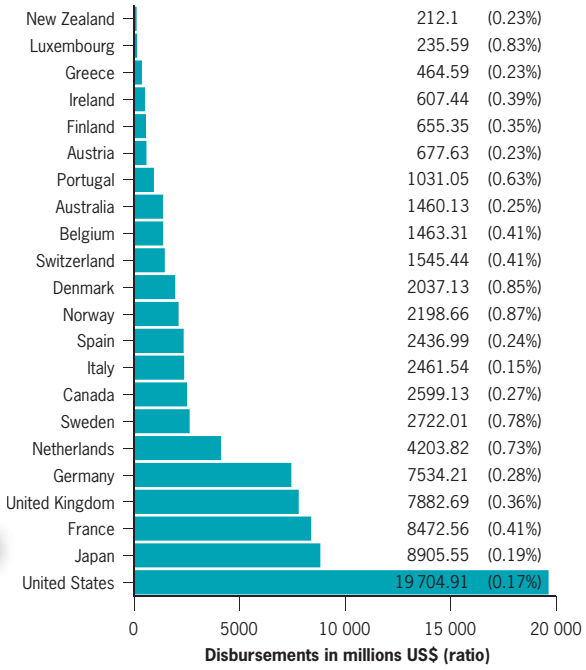
Look! Development

FIGURE 2.5.38

frequently been a feature of foreign aid programs. Such projects have often been undertaken without careful consideration of the impacts on the social fabric and the environment of the recipient country. It is also frequently alleged that foreign aid props up corrupt officials and governments whose priorities are not directed towards addressing the problems of poverty in their countries. You have probably heard media accounts of environmental disasters caused by aid projects, of goods and money intended for the needy being embezzled by corrupt officials or of inappropriate aid. (Inappropriate aid is aid that does not contribute to a country's capacity to enhance the well-being of its people; for example, lavish public buildings.) However, there has been a historical shift towards support of poverty focused projects that directly involve poor people in the design of projects intended to assist them to improve their own lives.

did you know?

OA (see table 2.5.5) stands for official aid. The Development Assistance Committee (DAC) is the OECD committee that deals with matters concerning development cooperation. Developed countries have committed to spending 0.7% of their GNI on official development assistance (ODA). This is often referred to as the 0.7% target.



Summary: Total Development Assistance Commitee (DAC): US$79 511.83 million ODA–GNI ratio: 0.26% Ave. country effort: 0.42%

FIGURE 2.5.40

Official development assistance (ODA) net disbursements and ODA–GNI ratio, by donor, 2004.

Gross bilateral ODA; 2005–06 average

TABLE 2.5.4

Australian ODA, 2005 and 2006

Net ODA	2005	2006	Change 2005–06
In Australian dollars (million)	2206	2819	27.8%
ODA–GNI ratio	0.25%	0.30%	0.05%

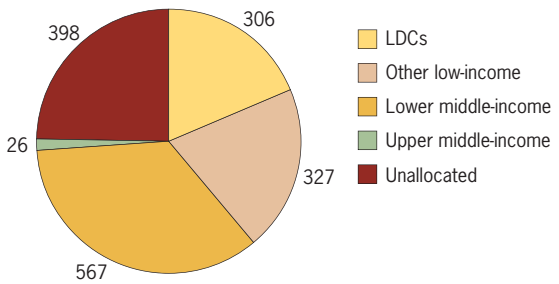
TABLE 2.5.5

Top 10 recipients of gross Australian ODA/OA

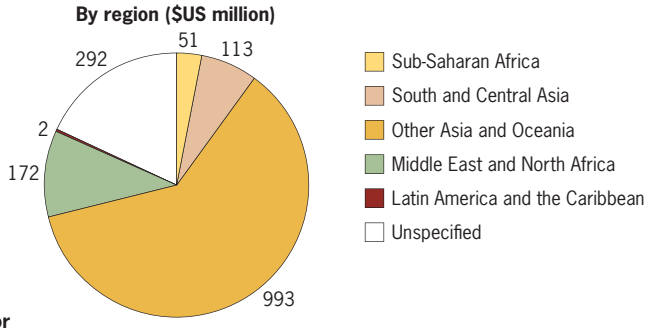
Rank	Country	US$ million	Rank	Country	US$ million
1	Indonesia	248	6	Philippines	48
2	Papua New Guinea	238	7	East Timor	42
3	Iraq	150	8	China	35
4	Solomon Islands	145	9	Sri Lanka	33
5	Vietnam	50	10	Cambodia	31

Gross bilateral ODA, 2005–06 average

By income group ($US million)



By region ($US million)



By sector

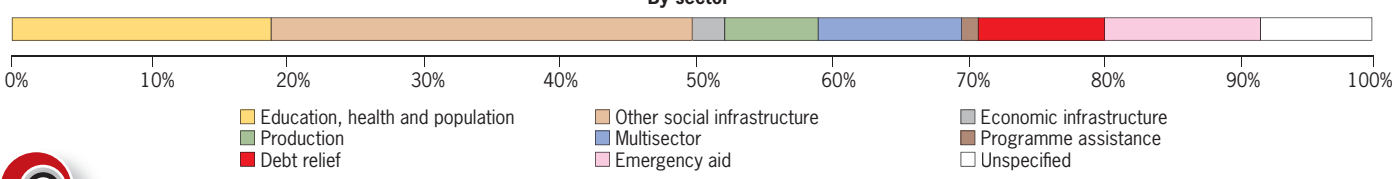


FIGURE 2.5.39

Australia's aid to the developing world, 2005–06.

understanding the text

1 **Outline** the ways in which the legacy of history can affect the nature and rate of development.
2 **Explain** how the debt crisis faced by many developing countries came about.
3 **Explain** why many developing countries found it increasingly difficult to service their accumulated debt.
4 **Outline** the ways developing countries have sought to increase exports to meet debt repayments.
5 **Explain** why developing countries are disadvantaged in world trade.
6 **Outline** the impacts of an expansion in export-oriented cash cropping in developing countries.
7 **Outline** the benefits that developing countries expect to gain from TNCs.
8 **Explain** why TNCs are attracted to countries in the developing world.
9 **Outline** how the activities of TNCs disadvantage developing countries.
10 **Explain** why developing countries seek to expand their defence forces.
11 **Explain** how militarism has contributed to the problems faced by developing countries.
12 **State** why aid is said to be a by-product of decolonisation.
13 **Distinguish** between bilateral aid and multilateral aid.
14 **Define** nongovernmental aid.
15 **List** the main points raised in debates about how aid should be distributed.
16 **Explain** what is meant by inappropriate aid.

working geographically

1 **Interpreting diagrams** Study figure 2.5.36 (p. 441).
   a With the aid of an atlas, name the countries whose share of world exports is:
      i over 1%
      ii under 1%.
   b Comment on the pattern evident.
2 **Interpreting diagrams** Study figure 2.5.36 (p. 441). With the aid of an atlas, compile a list of the countries whose percentage share of exports exceeds 1%.
3 **Interpreting diagrams** Use the information in figure 2.5.36 (p. 441) to write a report outlining the nature of world exports and how the present pattern of exports disadvantages developing countries.
4 **Interpreting diagrams** Study figure 2.5.40 (p. 443).
   a Which country is the largest aid donor:
      i based on ODA–GNI ratio?
      ii in terms of expenditure in US dollars?
   b How does Australia's ODA disbursements compare with those of the other developed countries listed?
5 **Interpreting cartoons** Study figures 2.5.37 (p. 441) and 2.5.38 (p. 442). Write an explanation of what constitutes 'appropriate aid'.
6 **Writing task** Write an extended response. Topic: The nature and rate of development experienced by a country is a product of the interaction between a range of factors, both internal and external to the country. Discuss.
7 **Interpreting diagrams** What does the information in figure 2.5.39 (including tables 2.5.4 and 2.5.5) on page 443 tell you about:
   a the motivations for the distribution of Australian aid
   b the benefits to Australia of Australian aid
   c trends in the distribution of Australian aid?
8 **Research task** Undertake library and Internet research. Find out what you can about one aid organisation. Describe its major aims. Write a description of one aid project funded by this organisation.
9 **Research task** Undertake library and Internet research into the impacts of colonialism in one country.

Equity issues and development

In the final part of this chapter we examine some of the attempts being made to foster development in the world's poorer countries, and some of the impacts of those changes on people and places. A number of these issues were briefly addressed earlier when we looked at the relationship between poverty and its causes. These include the problems of environmental degradation, rapid population growth, trade imbalances and debt burdens. This section focuses on equity issues associated with development, particularly those connected with ethnicity, gender, class, children and ownership of resources.

Economic development and change

The view that economic growth would provide the 'key' to the successful development of poor countries was widely held throughout the 1950s and 1960s. Such a view is still held by many. It was generally

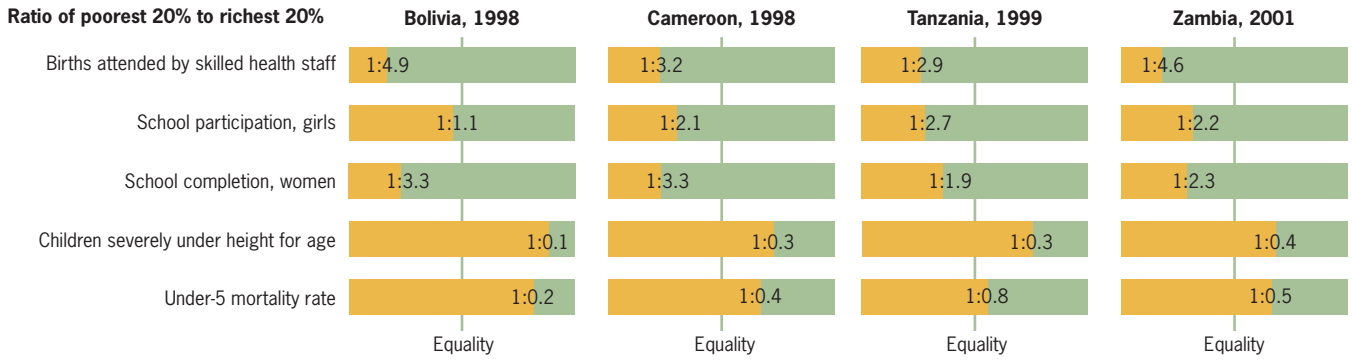


FIGURE 2.5.41

The cycle of inequality: from birth to young adulthood, the poor fare worse.

believed that, for poor countries to overcome problems of poverty and lack of development, their economic, political and social structures needed to be transformed. They had to change from structures that were considered to be traditional or underdeveloped to those that were modern or developed. Agricultural productivity seemed to offer limited prospects for the poorer countries to achieve prosperity. It seemed that industrialisation was the key to affluence for the poor countries, as it had been for the wealthier countries. Development theorists, governments and commentators from the industrialised countries, and local elites in the poorer countries all assumed that industrialisation was therefore a desirable process for the world's poorer countries. They believed that injecting resources (such as capital, technology and expertise), in the form of aid, into the economically poorer countries would stimulate the transformation of poor countries into industrialised economies.

These assumptions largely denied the possibility of any different forms of development. They also ignored the possibility that the changes associated with industrialisation and modernisation along Western lines may not always be appropriate or the best form of development. It was not fully appreciated that the traditional lifestyles of some peoples can be sustainable, and may enable them to live independently of others and to maintain value systems that are indispensable to the continued successful functioning of their communities.

The other underlying assumption of the push to encourage economic growth in poor countries, was (and still often is) that the benefits of economic growth in the form of increased income would eventually trickle down to the most needy. This is known as the **trickle-down effect**. In fact, as you will have realised after reading the earlier parts of this unit, the income generated by economic growth is rarely distributed equitably. In practice, economic growth in many countries has brought little improvement in the living conditions of the majority of the poor. Figure 2.5.41 reveals the extent of inequality facing people in some of the world's developing countries.

The drive to achieve 'development' by pursuing the path to industrialisation and economic growth has failed to reduce the poverty of the masses of the poor. Furthermore, it has often resulted in unintended consequences for some groups of people and for the environment. Some of the equity issues arising from these changes are considered on the following pages.

understanding the text

1 **Outline** the view that regards economic growth as the 'key' to successful development. According to this approach, what needs to be done to transform poor countries into industrialised economies?
2 **Explain** what an emphasis on industrialisation and modernisation fails to appreciate.
3 **Explain** the trickle-down theory. Describe its failings.

working geographically

1 **Interpreting diagrams** Study figure 2.5.41. Write a paragraph describing the trends shown in the graph.
2 **Using the media** Collect cartoons related to development issues. Select one development issue and draw your own cartoon to explain it.

Modernisation, land ownership and landlessness

Some countries inherited systems of plantation agriculture, or cash cropping, that had been introduced in the colonial period to provide commodities for the colonial powers. In the scramble to increase national income, other developing countries encouraged the introduction of cash cropping. Many government projects aimed to generate growth by the modernisation of agricultural production systems. This involved the introduction of new crops or crop varieties; fertilisers and other inputs; new cultivation and management practices; credit; and, frequently, new technology. Often these were all introduced in collaboration with foreign aid donors or **agribusiness**.

These changes rarely benefited poor farmers because the introduction of mechanisation brought greater benefits on large landholdings, and poor farmers could not afford the capital inputs necessary to purchase fertilisers, pesticides, machinery and new seed varieties. The wealthier farmers benefited from cash cropping, usually at the long-term expense of the poor. Poorer farmers frequently borrowed the capital to purchase these inputs, then concentrated on the production of cash crops. By doing this, poor rural farmers became increasingly dependent on income to purchase food, rather than being able to rely on subsistence production of basic foodstuffs. Income gained from cash crops was unreliable, dependent on crop yields and susceptible to fluctuations in world market prices. As a result of this unreliability, small farmers were often forced to sell their land in order to purchase basic necessities, such as food, or to repay debts. Without access to land, many either became labourers (often only seasonal agricultural labour was available) or joined the flood of migration to urban centres in search of work.

In addition, commercialisation of agriculture contributed to excessive landclearing, overuse of land, soil erosion and contamination of soils through the use of chemical inputs. As well, agriculture based on **monoculture** is more susceptible to pest attack. This has resulted in massive expenditure on pesticides, often with little measurable impact on the percentage of crops lost from pest attack. In response to the negative impacts of the modernisation of agriculture, in recent years there has been growing recognition of the value of traditional farming practices.

The Geofocus box below will introduce you to some of the pressures placed on small farmers by modernisation and the commercialisation of agriculture.

agribusiness the large-scale, organised production of food, farm machinery and supplies as well as the storage, sale and distribution of farm commodities, for profit.

bolls spherical-shaped fruits of cotton and flax.

paddy an irrigated or flooded field where rice is grown.

Bt cotton cotton that has been genetically engineered to control tobacco budworms, bollworms and pink bollworms.

geofocus

Of drought and debt

The small farmers of the Warangal district of northern Andhra Pradesh are vulnerable not just to drought and deluge, as they have always been—but, now, to the vagaries of commercial markets as well.

After two months of searing drought—the worst in 50 years—late rains deluged southern India in mid-October 2002. The hard earth, sealing in months of heat, releases it all at once as a fierce, humid mist. Water pours off surfaces and rudely breaks through the channels dug to contain it. Steam mingles with smoke and rises from the straw roofs of mud houses in the villages.

The rains come too late to save the harvests of millions of Indian farmers, watching the skies anxiously, waiting for the monsoon. Many of the crops they have managed to grow are destroyed in the downpour. Early cotton **bolls** are matted, soggy and unsellable. **Paddy** has already failed to germinate and is being fed to scrawny cattle—those that haven't already been sold to feed hungry families.

Since late summer hundreds of thousands of farmers have been pouring into the towns and cities, hungry and desperate. They can be seen in every major Indian city, squatting on pavements, waiting for daily labouring work at wages that, as the deluge of desperate human beings continues, drop slowly at first and then faster, until they reach a sixth of the minimum wage of US$2 per day.

On my way into Chinta Nekonda village, in the Warangal district of northern Andhra Pradesh, I pass paddy fields that are cracked and bare. Thin buffalo are ripping up what

FIGURE 2.5.42

The location of Andhra Pradesh.

FIGURE 2.5.43

Young boy engaged in weed spraying.

remains of the rice crop. As is customary when a stranger comes, a crowd gathers in the village, with its dusty streets, tiny mud houses, walls plastered with adverts for pesticides and fertilisers. Half the houses here are locked: two-thirds of the villagers have left for the city to look for work.

A farmers' conference rapidly assembles on the porch of the village *sarpanch* (leader)—who is a woman. Positive-discrimination policies have had some effect—but she is making the tea whilst her husband assumes her powers and directs proceedings. The electricity is off, the crickets chirrup in the night. The only light flickers from a television set run on a generator.

'We don't have any subsistence living. There is full drought,' says one farmer.

'We don't have any wells and tanks, and all of the bore wells have dried up,' adds another.

The farmers aren't above exaggeration—this, after all, is the tradition when officials come from the city. But nothing has quite prepared me for the palpable sense of desperation.

A woman seated behind the *sarpanch* speaks up: 'How should we live? Tell us!'

It's not just this year, though, or this drought, that is creating enormous pressure on the farming community. Small farmers are increasingly vulnerable to the vagaries not just of the weather—but of commercial markets as well.

This district, Warangal, made the news in 1998 as the centre of a spate of farmer suicides. It has one of the highest levels of pesticide consumption in India. Murali, author of a report on the farmer suicides, *Debt and Deep Well*, explains to me how a corporate push created a sudden upsurge in commercial, pesticide-intensive cotton grown by small and marginal farmers. As they got deeper into debt to pay for the seed and pesticides, the cotton harvest failed. Across the state, thousands committed suicide because they could not pay back the moneylenders.

Government subsidies for agriculture have been slashed, pushing up costs even as market rates for crops have been going down. While larger farmers are better able to cope with commercial agriculture, for the 77% of landholders in Andhra Pradesh who are small farmers the cycle of debt and dependency, and the building blocks of a gathering agrarian crisis, seem only to deepen. There's no safety net from drought, nor debt.

Now Murali is worried by the most recent development—genetically modified **Bt cotton**. He's concerned that it will exacerbate existing trends: 'When farmers are in a desperate situation, it is easy for the market to exploit them.'

New Internationalist, January–February 2003

Urbanisation and the urban poor

One of the most striking **demographic changes** of this century has been the remarkable growth in urbanisation. Urbanisation refers to the increasing proportion of national populations living in urban areas; that is, towns and cities. The world's urban population has been growing at four times the rate of the rural population. Between 1990 and 2025, the number of people living in urban areas is projected to double to more

geofocus

The Green Revolution

In the 1960s and 1970s a wave of high-yielding seed varieties, chemical fertilisers and pesticides transformed Indian agriculture. This was the Green Revolution—but some say it is turning yellow. Initially, it boosted yields but it has brought problems in its wake. It has degraded soil, leading to falling yields and a loss of local crops. Once the farmers in Warangal might have grown more drought-resistant varieties of millet and sorghum. Now even the **marginal** farmers are growing monocultures of commercial crops like cotton, chilli, rice and groundnut, in the hope of potential profit. Dependent on expensive inputs, the costs of farming have risen dramatically and left many poor farmers in debt.

Water-harvesting skills, so crucial to surviving the drought seasons, were lost as intensive, irrigated agriculture came in. Farmers borrowed thousands of rupees to sink bore wells for irrigation. As a result, the groundwater level is dropping dramatically.

The state is withdrawing agricultural support, creating huge pressure on farmers and forcing them to borrow at crippling interest rates from ruthless moneylenders. Many of these are agents of seed and pesticide corporations, lending farmers inputs on credit at inflated cost. Some moneylenders take part of the farmers' harvest as payment, and wield huge power over their lives. A farmer who doesn't repay can earn a bad credit rating for the whole village. Many of those who have committed suicide rather than face shame and destitution are from the lowest castes.

As a purely technological solution, the Green Revolution has not only failed to tackle issues of poverty, caste and access to land, it may have exacerbated them.

New Internationalist, January–February 2003

marginal barely adequate or within a lower limit.

understanding the text

1 **Identify** reasons for the popularity of the introduction of cash cropping systems in developing countries.
2 **List** the disadvantages of commercial agriculture.
3 **Explain** how traditional subsistence agriculture could be regarded as 'more developed' than commercial cash cropping?

working geographically

Interpreting text Study the Geofocus box 'Of drought and debt' (pp. 446–7).

a Outline the problems that have been associated with the introduction of Western farming practices in Warangal.
b Explain how the traditional system of agriculture could be regarded as a risk-minimising system compared with commercial agricultural systems.
c Conduct some web-based research and write an extended response that outlines the benefits of traditional agricultural systems.

than 5 billion. At some point in 2008, it is estimated by the Worldwatch Institute that more than half the people on the planet—roughly 3.2 billion humans—will live in cities. Over 50 million people are being added to the world's cities and suburbs each year. This is as a result of population growth through natural increase and of the unprecedented wave of rural–urban migrants moving to the cities. An estimated 90% of the increase will occur in developing countries. By 2030, it is expected that four out of five urban residents will be in what is now known as the developing world. **Rural–urban migration** is significant in the world's poorer countries because of a mixture of what are known as 'push' and 'pull' factors. You read about some of the factors that push people away from rural areas in the Geofocus box about Warangal (pp. 446–7).

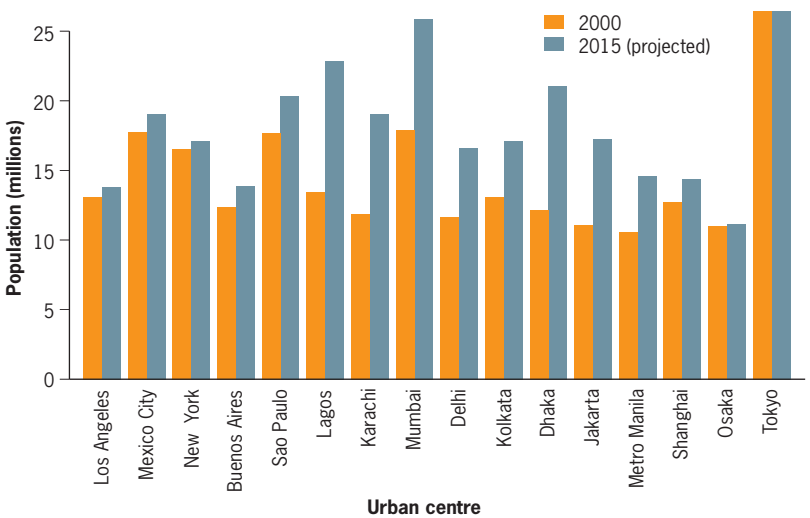


FIGURE 2.5.44
Major urban centres, 2000 and 2015.

The push factors that encourage rural–urban migration include:

- loss of land, due to indebtedness, population increase and land degradation
- loss of job opportunities, because labour is displaced by mechanisation
- rural poverty
- famine
- crop failure
- natural or climatic disasters
- war and civil unrest.

Meanwhile, people are attracted to large urban centres in the hope of:

- finding employment—usually as unskilled labourers in developing industries
- achieving a higher material standard of living
- securing better access to educational opportunities and health care facilities
- enjoying entertainment facilities and the 'bright lights' (often known as the 'bright lights syndrome').

The push to modernise agriculture in many countries, and the introduction of commercial cash cropping have displaced many subsistence farmers and rural labourers. This has added to the flow of migrants flocking to urban areas. At the same time, attempts to follow the Western model of development—by promoting industrialisation—led to a growing demand for unskilled labour in factories. This has contributed to the attraction of cities to the rural landless and unemployed. These population movements have resulted in the creation of a growing class of urban poor. As the Geofocus box 'Cities out of balance' reveals, the rapidity of urban growth has created problems for the urban poor.

geofocus

Cities out of balance

The biggest toll of urbanisation has been concentrated on the poorest residents of a city. In the absence of amenities such as spacious housing, flushing toilets, running water and regular garbage collection, shantytown dwellers around the world spend their days maintaining cramped homes, walking long distances to a menial job, accepting contaminated water when they have to, and living day-to-day in some of the planet's least secure and dirtiest neighbourhoods.

Often they must also tolerate sharp inequalities of wealth and influence. Residents of *villas de emergencia* (**squatter settlements**) in Buenos Aires, for example, are compelled out of desperation to inhabit the polluted banks of the Reconquista and Matanza Rivers, which are 'overrun with rats, mosquitoes, flies, and other insects'. Less than 2 km away, some of the wealthiest residents of the city live in gated communities of lawns, swimming pools and security guards.

One effect of living in such unequal societies is that the poorest people must live in environments that concentrate hazards and multiply health problems. In Dhaka, Bangladesh, for example, the wealthy can afford to buy land at prices inconceivable to most of the city's population. As a result, 40% of the people are crammed onto just 5% of the land area. Some of the most desperate of these settlers, victims of eviction or floods elsewhere, live on a ledge precariously situated between a toxic factory and a poisoned lake.

Adapted from The Worldwatch Institute, *State of the World 2007: Our Urban Future*

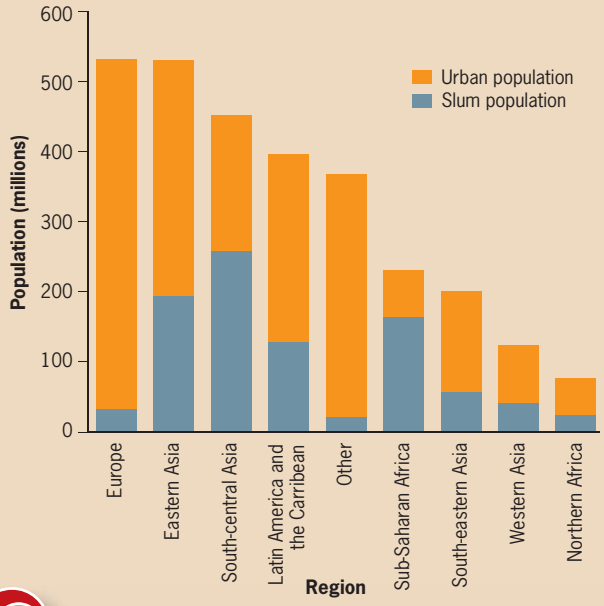


FIGURE 2.5.45

Slum population by region, 2006.

geofocus

The future for the urban poor

The women of Vikas Sagar still live in one-storey huts hacked into the steep hillside above Mahim Bay. They still worry about floods and landslides. They are still concerned about having enough money to make ends meet. But today their homes are permanent: made of concrete instead of mud. Their walkways are now paved with cement and tile to prevent erosion. And they have pooled their resources to create a communal savings plan—a small-scale bank, giving each of them the ability to get loans. They have transformed their lives and their community.

How did they make these improvements? Instead of agonising, they organised. Vikas Sagar is a tiny squatter community in Mumbai, India. It was founded decades ago. But the nine women sitting on the floor of Mumtaz Sadik Shaikh's house know that no matter how long they have been living here, the Government still considers them illegal. 'Unless we take action, nothing will be granted to us,' says Lali Penday. Her neighbours nod approvingly.

It wasn't always this way. Little more than a decade ago the women of Vikas Sagar were traditional housewives so controlled by their husbands that they seldom left their community. 'When we started,' remembers Sangita Duby, 'we were not able to go out of our houses. We were illiterate and signed our names with a thumbprint. Now we are literate and sign our names in Hindi and English.' The women of Vikas Sagar know who the local politicians are. And, more importantly, the politicians know who they are.

There are a billion squatters in the world today: almost one in six people on the planet. And their numbers are on the rise. Every day close to 200 000 people leave the world's rural regions and head for the cities. That's 130 people arriving every minute; two every second. They all face the same struggle. They come in search of work. And they find work, too. But then they can't find a place to live. No developer is building for them. No government seems willing to make the investment required to provide decent homes they can afford. So they become squatters, invading unused turf or joining communities established by people who made the same journey before them. By 2050 there will be 3 billion squatters—a third of the people on the globe.

Most governments have responded to this massive migration with outrage, attempting to drive squatters out of the city. A year ago Mumbai embarked on a drive against squatters. It was part of a campaign that was marketed with the slogan 'from Mumbai to Shanghai'—sending the message that crowded Mumbai was a city open for development. Local officials sent the police to flatten 90 000 homes, leaving hundreds of thousands homeless.

More recently, in November 2005, Kolkata (Calcutta) started its own effort to evict squatters. A panel of judges ordered the ejection of 20 000 families from a well-established squatter village alongside one of the city's commuter rail lines. The squatters are resisting by demonstrating and interrupting traffic on major roads.

These government-sponsored **pogroms** are based on a fundamental misunderstanding of squatters and their communities. Most outsiders see these neighbourhoods solely as outposts of misery, lawlessness and criminality. And—around the world—go to any one of these communities and it's certainly true that you will find hunger, poverty and disease. But you will also find health clinics, beauty salons, grocery stores, bars, restaurants, tailors, clothiers, churches and schools. In most squatter communities, the residents build and rebuild and build again—often one wall at a time—to make their homes better. In the midst of the squalor and open sewerage, you'll find commerce, thrift, energy and hope.

The way forward for the world's cities is not to muscle out the squatters, but to tap their energy. With a guarantee that they won't be evicted and the ability to participate, squatters will rebuild their communities and their cities. The women of Vikas Sagar are ready.

In a city with 12 million residents and 6 million squatters, Mumbai is the headquarters of a worldwide squatter organising effort called Slum/Shack Dwellers International (SDI). SDI got its start under a different name back in the 1970s. The movement is now international with chapters in 14 countries. As with the women of Vikas Sagar, SDI bases its mobilisation on communal savings

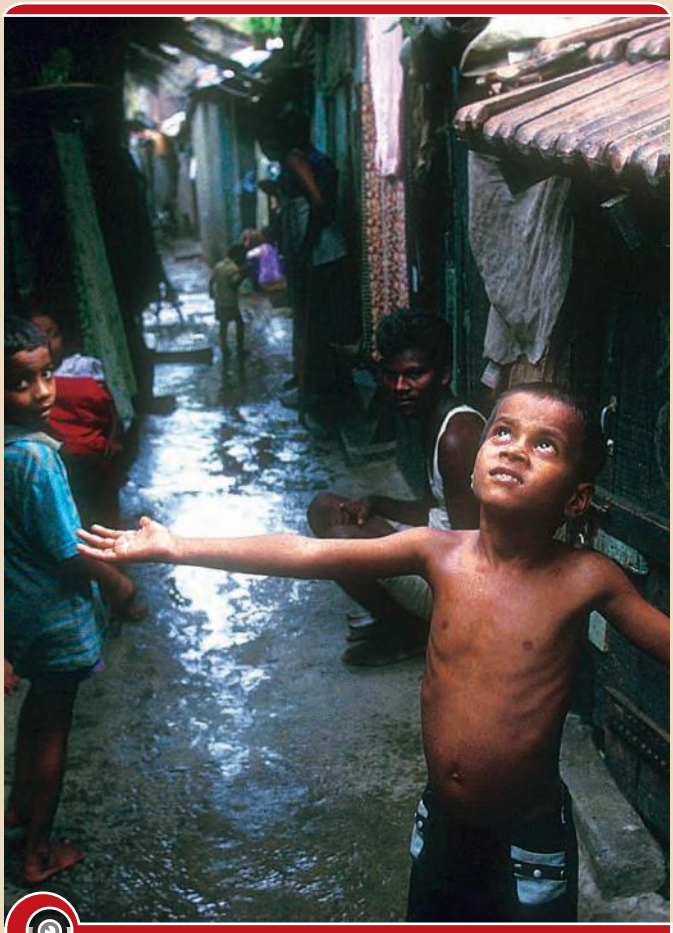


FIGURE 2.5.46

The squatters of Mumbai face a constant struggle to sustain their communities.

groups, and its 5.6 million members round the globe have amassed nearly US$32 million in savings. The principle is simple: each squatter community that joins SDI creates a savings association. Any family can join if they are willing to contribute a small amount every day. The pooled money is returned to the community in the form of small loans. 'Through savings, we don't have to demand that the politicians improve living conditions or economic conditions or homes,' says Jockin Arputham, a long-time squatter activist in Mumbai who is the founder and president of SDI. A slight man with thinning hair, a sparse grey moustache and the suggestion of a Buddha belly, Jockin might be called the philosopher-king of squatter activism. A firebrand organiser before he became a devotee of savings (he once locked a government official in a latrine to win the promise of new toilets for his community), Jockin now sees savings as a more efficient way of getting things done. 'Because of savings, you empower yourself.'

So far, the group's strategy has led to the construction of almost 80 000 permanent homes. In addition it has helped secure land for 125 000 squatter families. In a sense, Jockin and his allies are developing a parallel government: one that—perhaps when money and capacity meet—will be able to provide services that governments currently refuse to squatter areas.

Jockin is a master of media relations. After authorities insisted that the poor who flock to the city return to their former rural homes, Jockin told one interviewer: 'I'm willing to give Mumbai's middle class a plane ticket to go back to their villages. They have acres to go back to. Will they?'

Sitting cross-legged on the floor of his office in a former garage behind Mumbai's Byculla municipal infirmary, Jockin sums up this thinking: 'We very strongly believe that the problems of the urban poor can only be solved by the urban poor, not by anybody else. The urban poor will be the change-agents of the city.'...

New Internationalist, January 2006

understanding the text

1 **Outline** the difficulties faced by the residents of Vikas Sagar.
2 **Outline** the ways in which the people living in Vikas Sagar have adapted to the circumstances they face.

working geographically

1 **Class discussion** Conduct a class discussion. Why do the 'rich get richer and the poor get poorer'?
2 **Research task** Undertake library or Internet research. Find some background information about India and its history of development. Then answer the following questions:
   a What underlying issues do you think may be responsible for the social and environmental problems of Mumbai?
   b Can you suggest any solutions to the problems facing the city and its people?
3 **Research task** Undertake library and Internet research. Find out what is meant by the term dual economy. Use this information to write a report describing the dual economy.
4 **Interpreting diagrams** Study figure 2.5.44 (p. 448). Identify the cities expected to show the greatest rate of population increase between 2000 and 2015. What do they all have in common?
5 **Interpreting diagrams** Study figure 2.5.45 (p. 449). Which regions of the world have the highest proportion of their urban population living in slums.

pogrom an organised persecution or extermination of a national, religious or ethnic minority.

Gender issues and development

Generally, women in the developing world have low status in an economic, legal, political and social sense. Particularly in developing countries, the majority of the poor are women. Literacy rates and educational levels are significantly lower for women than for men in poor countries. In addition, the civil rights of women are often limited: women's rights to property, in divorce, in custody of children, in employment and so on are, in many countries, second to those of men. Female children frequently receive less of their family's resources: less and poorer quality food, less education and less medical care.

Gender equality is more than a goal in itself. It is a precondition for meeting the challenge of reducing poverty, promoting sustainable development and building good governance.

Kofi Annan, former Secretary-General of the United Nations

household subsistence work growing just enough food for your own needs with nothing left over to sell.
piecework work paid for according to the quantity produced.

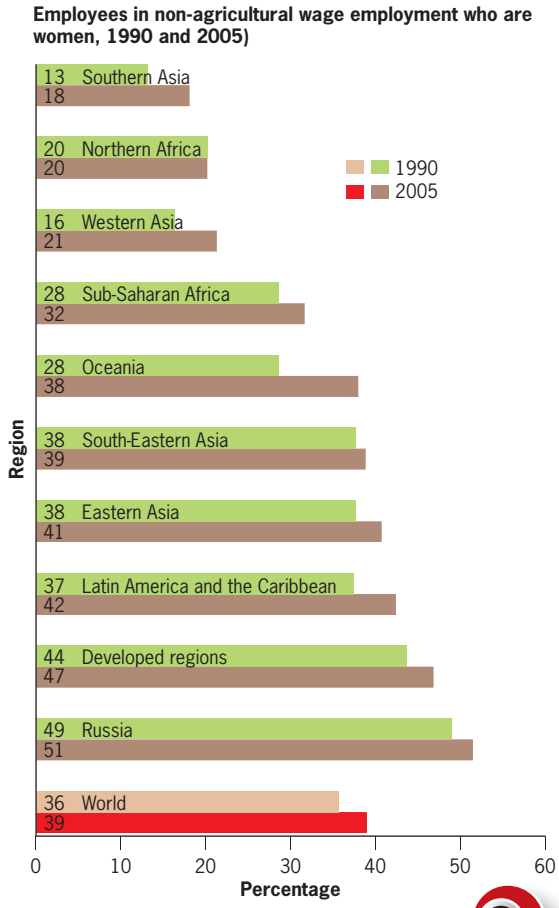


FIGURE 2.5.47

Doors are opening slowly for women in the labour market.

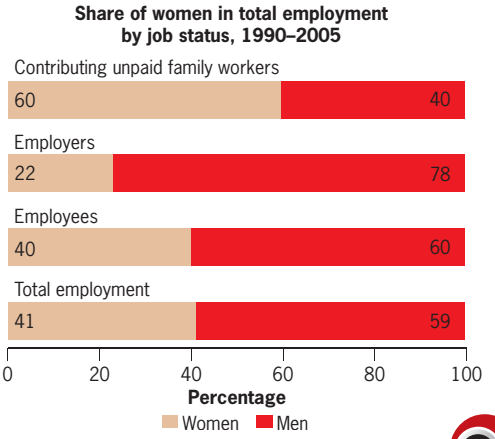


FIGURE 2.5.48

Women's labour is more likely than men's to be unpaid.

Women in the poor world consistently work harder and longer than men from the same households and perform the bulk of **household subsistence work**. Where poverty forces men to seek paid employment, women can be left doing the bulk of the ploughing and land-preparation tasks. Frequently, women bear the burden of environmental degradation, having to work harder to produce food on poorer soils, to walk further to collect uncontaminated water and to search further for firewood. Commonly, in areas influenced by the introduction of cash cropping and labour-saving technologies, women and their children have been displaced from subsistence agriculture. This often forces women to seek income in other ways; for example, in domestic service, as exploited factory labourers, doing **piecework** or, to a lesser extent, in prostitution. Women's wages are consistently lower than those of men.

Women play an essential role in survival tasks (such as growing food, gathering fuel and finding water), household tasks (food preparation and child rearing) and income generation (handicraft production and trading of produce). Despite this, they generally have very limited access to, and control over, income, credit, land, education, training and information. In most societies throughout the world, women do not share equally in their country's resources and do not enjoy status equivalent to that of men.

Women have often been disadvantaged by development policies and projects. These policies have usually focused on **export-oriented growth**, encouraging the production of cash crops, extraction of minerals and production of industrial goods. Reflecting the dominant values of industrialised countries, it was frequently deemed appropriate to direct any improvements in agricultural technology or employment in new industries towards men. Often little attempt was made to understand the traditional role of women in the community targeted for change. Western-style systems of male employment were developed, which frequently excluded women from paid employment.

Conventional planning for development also frequently undervalued the contribution made by women to their families and communities. Indicators of economic success (such as GNI) have been, and still are, frequently used as a tool to measure development. However, national measures based on income ignore the value of unpaid work. Activities of women related to their reproductive role, to caring for children, to home-based forms of production and to informal sector activities (such as street vending) are not easily quantified. Therefore, they are generally not included in national aggregates. It is difficult to calculate the economic contribution of women's unpaid labour but, overall, globally about 60% of unpaid family workers are women. As the work that women do is usually not assigned an economic value, it was neglected in the planning for change. Such plans are usually based on the premise that economic growth, or increasing monetary income, would result in reduced poverty for the poor.

It was also assumed that women have plenty of spare time to devote to new projects. Therefore, many development projects aimed to involve women in income-earning activities, such as sewing or handicrafts, adding to their existing burden. Many aid projects and development programs did not consider the needs of women. Frequently they contributed to worse standards of living for the women affected by them. Women's status, needs and personal aspirations vary tremendously within the poor world. However, it is clear that, in general, the benefits of development have frequently bypassed women. The Geofocus box 'Women's workloads' will introduce you to a real-life example of the circumstances facing one group of women living in Burkina Faso.

geofocus

Women's workloads

FIGURE 2.5.49

Chat, support and income: the Kobenka Women's Group under their spreading tree.

'A man cooking a meal? You're joking—he wouldn't know where to start!'

I am sitting in the spreading shade of a tree with the 22 members of the Kobenka Women's Group. Ten years ago I met a recently formed women's group in the Bidiga district [of Burkino Faso], but there was then no such equivalent in Sabtenga proper; the Kobenka group started meeting under this tree twice a month about seven years ago.

Women's groups here tend to come about less through an awareness of marginalisation or oppression by men than through manifest practical need. Men take primary responsibility for the main food crops—mainly millet, but also some sorghum and rice—that will see the family through the year, and will tend to regard a depleted granary in a drought year with a sense of some shame, as if their own masculinity has thereby been challenged.

Women are also required to work in the fields on these crops, in addition to taking responsibility for gathering water, pounding and **winnowing** grain, preparing food. These domestic duties are well known but it is less recognised that in a subsistence farming community it is generally the women who need to find the money for all the small expenses required to keep a family going, from bits of meat or condiments to enliven the basic food, to money for clothes and even school fees...

This is why so many women are now interested in income-generating opportunities. The Kobenka women pay 50 francs (about 9 US cents) a month to be members, which effectively gives them access to microcredit, and all of them have used this to fund their own business activities—usually selling a foodstuff like peanuts or haricot beans in the market.

The motivation for coming together may be individual need but that does not mean the group has no collective life. The women have planted a hectare of trees in the village, for example, up near Bidiga, evidence of the relatively recent awareness in the village that 'trees bring the rain'. And any regular meeting of women under a tree for the afternoon is bound to involve some sharing of gripes about men as well as sheer enjoyment of each other's company.

Their goal, they say, is to cultivate their own field of peanuts—perhaps in two years' time—and thereby generate more significant amounts of money that will make their lives easier. To make this happen, they will have to ask the Chief for a patch of land. Might he refuse, I ask? 'Just let him try,' they say, with heartening faith in their own collective power.

They will also have to hire two oxen from one of their menfolk, and plan to work the field on Fridays, a day on which the Muslim men tend not to work the land because they need to pray so often—not that women are not also devout, but formal prayer is definitely seen in the village as more of a male preserve. I suggest that they will perhaps be able to see their work on the peanut field as a labour of Allah, which they find an amusing idea.

The Kobenka group is another sign of significant progress compared with 1985 and 1995. Twenty years ago the main theme of our film was the crushing nature of women's work—it was a dramatic visualisation of statistics that showed women in Burkina were spending an average of four hours a day fetching water, two to three hours a day pounding grain and another four hours every two or three days gathering firewood. One memorable shot from the film showed a woman from a distance, labouring under the most immense load of firewood carried on her head—one that was twice as wide and almost as tall as she was.

Today, donkey carts have reduced women's workload hugely, bringing back crops from the fields and water from

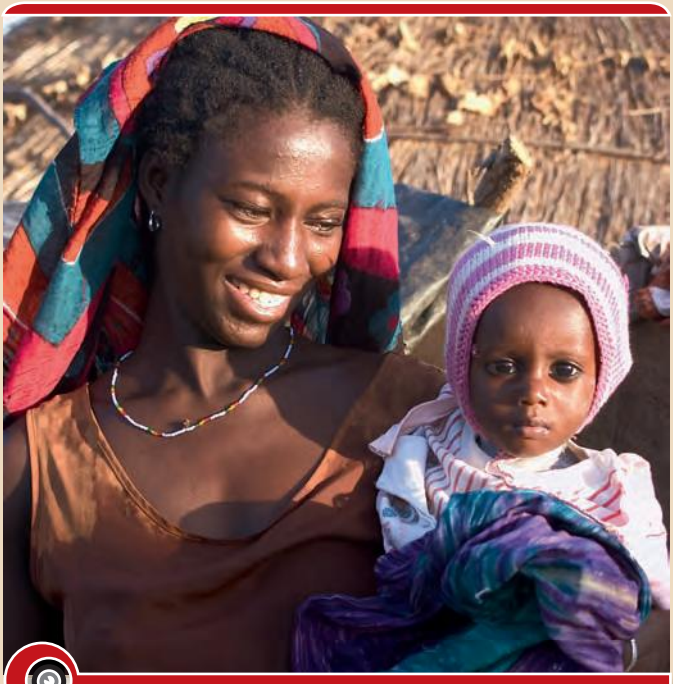


FIGURE 2.5.50

Seven-month-old Nasiru and proud mother Bintu.

the pump as well as firewood. Even the time spent pounding and winnowing grain has been potentially reduced by the presence of mechanised mills in the villages, though many women still choose to do this work themselves rather than hand over a fee to the miller.

It is effectively this reduced time spent on routine daily work that has made it possible for women to pursue their own income-generating activities—and earn themselves a measure of material autonomy.

Small wonder, then, that when I ask the Kobenka group if women's position is better than it was 10 years ago there is a vigorous nodding of heads. None of the women, though, is young enough to have benefited from another major revolution in the lives of girls and women in the village—one that was already well under way on my last visit. The vast majority of girls in Burkina Faso still suffer genital mutilation – the removal of the clitoris (and sometimes also the labia minora) by a razor cut—as they enter adolescence. In 1985 I found that Mariama was the first woman in the village to have taken a stand against clitoridectomy and was refusing to let her eldest daughter Memnatu go under the knife. When I returned in 1995 it was with my heart in my mouth—would she have been forced to conform by pressure from traditional forces in the village?

Instead I found what seemed like a miracle—though one with very practical, political roots. Far from caving in, I found that Mariama and other women like her had effectively won the argument. A mixture of their persuasion and the Government's radio campaigns had convinced the Chief that the practice urgently needed to be discontinued (mainly because of its dreadful implications for health, which can leave girls infertile, disabled or even dead). He had held village-wide meetings to announce his conversion and promised that he would notify the authorities if he heard of any further cases in the area under his jurisdiction. By the time I appeared on the scene the whole community seemed to have been won round—with the single exception of the ancient imam, who refused to be swayed by this new orthodoxy...

Relations between men and women are changing very slowly—*peu à peu* (bit by bit)—the Kobenka women conclude. Women's daily work burden has been reduced, though they are inevitably tending to fill the time with other kinds of work that will benefit their families. But there is no sign at all that men are sharing any more of the duties around the home. I tell them that if I return in a further 10 years' time I shall expect not only to see their own peanut field but also to eat a meal cooked by one of their husbands. They laugh—and it is not at the idea of the peanuts.

New Internationalist, May 2006

winnow the process of separating the chaff (waste) from grain by casting it into the air.

FIGURE 2.5.51

A young Bangladeshi flower vendor touts for customers during a downpour in Dhaka, Bangladesh.

understanding the text

1 **Outline** the disadvantages experienced by poor women living in many developing countries. How do these prevent women from improving their status?

2 **Explain** why development projects often contribute to the feminisation of poverty.

working geographically

1 **Interpreting diagrams** Study figures 2.5.47 and 2.5.48 (p. 452). Write an extended response in which you discuss what they reveal about the status of women and how their status differs throughout the world's major regions.

2 **Interpreting text** Study the Geofocus box 'Women's workloads' (pp. 453–4).
   - **a** Locate Burkina Faso on an atlas map.
   - **b** Outline the ways in which the lives of the women in the Bidiga district in Burkina Faso differ from the lives of Australian women.
   - **c** Describe the ways in which life has improved for the women described in the box.
   - **d** Decide whether it is possible to regard the processes of change for the Kobenka women as development. Give reasons for your answer.
   - **e** Conduct a class discussion. How do you think the processes of change will affect the women living in the region in the long term?
   - **f** Put yourself in place of a Kobenka women. Do you have any ideas about how your life and the lives of your people could be improved?

3 **Interpreting diagrams** Study figure 2.5.47 (p. 452). Write a paragraph highlighting the key features of the rate at which women are accessing the labour market in various parts of the world.

4 **Interpreting diagrams** Study figure 2.5.48 (p. 452). Identify the key features of the share of women in total employment by job status.

Child labour

Children in the world's poor communities rarely have access to the opportunities available to most children living in the world's wealthy countries. In poor rural areas, children, particularly female children, work from an early age. They collect firewood, carry water, mind animals, assist in agricultural tasks, care for siblings and complete domestic duties. Many children labour in **cottage industries** alongside the whole family: weaving carpets, making handicrafts, or assisting in simple food-processing or manufacturing activities. Children from urban slum areas are frequently forced to labour in factories for long hours and for little pay. Others are involved in street vending, domestic service, child prostitution, and collecting, recycling and selling refuse. Following is an example of the daily activities of a young girl from Zimbabwe:

*Consider Tendai, a young girl in the Lowveld, in Zimbabwe. Her day starts at 4 a.m. when, to fetch water, she carries a 30-L tin to a borehole about 11 km from her home. She walks barefoot and is home by 9 a.m. She eats a little and proceeds to fetch firewood until midday. She cleans the utensils from the family's morning meal and sits preparing a lunch of **sadza** for the family. After lunch and the cleaning of the dishes, she wanders in the hot sun until early evening, fetching wild vegetables for supper before making the evening trip for water. Her day ends at 9 p.m., after she has prepared supper and put her younger brothers and sisters to sleep. Tendai is considered unproductive, unoccupied, and economically inactive. According to the international economic system, Tendai does not work and is not part of the labour force.*

Marilyn Waring, 2006, UNPAC

For many families, living in countries without established welfare systems, the income earned by their children or the labour they contribute to subsistence activities is essential for survival. The example above describes a fate common to many children from impoverished families in the poor world.

FIGURE 2.5.52

Eight-year-old John Karanja carries firewood the traditional way—on his back. Kenya's Kikuyu women and girls carry firewood, water and even children for long distances.

Indigenous minorities and the impacts of change

The peoples who inhabited a land first are the indigenous people. In many countries today, indigenous peoples are a minority group whose lives have been disrupted by a succession of invasions of their lands. It is estimated that today there are about 370 million indigenous peoples living in about 70 countries. Like the Aboriginal people of Australia, many of these peoples traditionally lived in harmony with their land, depending on the land for survival.

Indigenous peoples are frequently minority groups within national populations, forced to live in a fraction of their former territory. Contact with the dominating culture and the changes it has brought mean that the traditional ways of living of indigenous minority groups have been irrevocably altered. Invasions wiped out many groups whose traditional systems of defence were inadequate to protect them from the colonisers. Imported diseases also had disastrous effects on many indigenous communities. Today, **assimilation** of indigenous peoples into the dominant culture of the country of which they are part is a continued threat to their survival. In many areas, the very survival of their culture, traditional knowledge and belief systems is under threat.

There has been increasing recognition of the failings of Western development, particularly of the impact of industrialisation and commercialisation of agriculture on the environment, the resulting reduction in life quality and the threat to global biodiversity. Ironically, recognition of these failings has led to renewed interest in the traditional knowledge of indigenous peoples. It is increasingly recognised that indigenous peoples lived in harmony with the biophysical environment in an ecologically sustainable manner, and that the industrialised world can learn much from their land-management skills.

sadza cooked, pulverised grain meal that is the staple food in Zimbabwe.

assimilation the adaptation to a majority group's cultural ways.

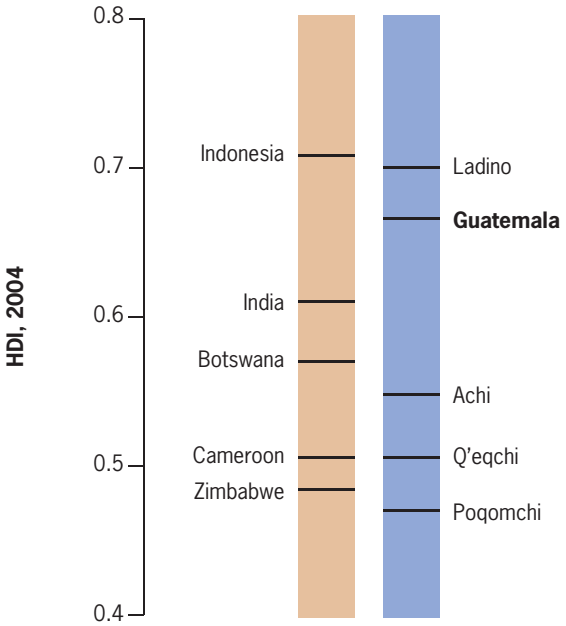


FIGURE 2.5.53

Large ethnic differences in the Human Development Index (HDI) in Guatemala. This graph compares the HDI of Guatemala (set bold at right) with that of selected countries (left) and Guatemalan ethnic groups (right).

Despite this knowledge, where indigenous peoples form a minority group in the country of which they are now part, they wield little political power. Their claims to traditional lands were usually based on community rather than individual ownership. These claims often remain unacknowledged by national governments and the dominant population group. So, too, the interests of indigenous peoples are usually secondary to the national interest of export-oriented industry, agriculture and resource extraction. In some countries, indigenous minorities are still being displaced, disadvantaged, intimidated, forcibly assimilated and even systematically exterminated in the name of national development. In many countries, inequality in access to income and resources between different ethnic groups is evident.

geofocus

The new global divide: the impacts of climate change

In recent years, a new form of global inequity has become apparent, based on the ability of countries to adapt to problems caused by global climate change. Development in the form of heightened economic activity, such as industrial growth and increased energy consumption, contributes to environmental damage. It has become increasingly apparent that any development cannot be divorced from ecological and environmental concerns. As the noted development theorist Amartya Sen wrote in the *Human Development Report, 2007–08*: 'Important components of human freedoms—and crucial ingredients of our quality of life—are thoroughly dependent on the integrity of the environment, involving the air we breathe, the water we drink, the epidemiological surroundings in which we live and so on. Development has to be environment-inclusive'. Any consideration of development now has to consider adaptation to likely future changes resulting from environmental degradation as urgent action being given to mitigation measures. Again, though, the ability to do either is inextricably linked to broader issues of poverty, global inequity and development. Bishop Desmond Tutu from Cape Town has recently described a new form of global inequity that he has called adaptation **apartheid**. Thus:

For most people in rich countries adaptation has so far been a relatively painfree process. Cushioned by heating and cooling systems, they can adapt to extreme weather with the flick of a thermostat. Confronted with the threat of floods, governments can protect the residents of London, Los Angeles and Tokyo with elaborate climate defence systems. In some countries, climate change has even brought benign effects, such as a longer growing season for farmers.

Consider what adaptation means for the world's poorest and most vulnerable people—the 2.6 million living on less than US$2 a day. How does an impoverished woman farmer in Malawi adapt when the more frequent droughts and less rainfall cut production? Perhaps by cutting already inadequate household nutrition, or by taking her children out of school. How does a slum dweller living beneath plastic sheets and corrugated tin in a slum in Manila or Port-au-Prince adapt to the threat posed by more intense cyclones? And how are people living in the great deltas of the Ganges and the Mekong supposed to adapt to the inundation of their homes and lands?

*Adaptation is becoming a **euphemism** for social injustice on a global scale. While the citizens of the rich world are protected from harm, the poor, the vulnerable and the hungry are exposed to the harsh reality of climate change in their daily lives. Put bluntly, the world's poor are being harmed through a problem that is not of their making. The footprint of the Malawian farmer or the Haitian slum dweller barely registers in the earth's atmosphere… We are drifting into a world of 'adaptation apartheid'.*

Bishop Desmond Tutu, UNDP 2007, *Human Development Report, 2007–08*

apartheid a policy of racial segregation maintained in South Africa from 1948 to 1991. The policy established the doctrine of 'separate development' whereby South African blacks were segregated into reserves known as 'homelands' and subjected to residential and occupational restrictions.
euphemism an innocuous or rather bland term substituted for one considered to be offensive or socially unacceptable.

geofocus

How global climate change threatens developing countries

Global climate change is expected to increase the economic **disparities** between rich and poor countries, especially as temperatures increase. The estimated damage for poor countries partly reflects their weaker adaptive capacity. Hence climate change is a major development issue.

Climate change could lead to large-scale, possibly irreversible, changes in earth systems, with effects at the global and continental levels. Though the likelihood and scope of these effects are not well known, they will be significant and so must be reflected in policy-making. Potential effects include:

- reduced crop yields in most tropical and sub-tropical regions and increased variability in agricultural productivity due to extreme weather conditions (droughts and floods)
- increased variability of precipitation during Asian summer monsoons, which could reduce food production and increase hunger
- reduced water availability in many water-scarce regions, particularly subtropical regions and increased water availability in some water-scarce regions—such as parts of South-East Asia
- increased destruction of coral reefs and coastal ecosystems and changes in ocean-supported weather patterns
- increased exposure to vector-borne diseases (such as malaria and dengue fever) and water-borne diseases (cholera)
- rising sea levels. With a 1-m rise in sea level, partly due to global warming, Egypt could see 12% of its territory—home to 7 million people—disappear. Rising seas threaten to make several small island countries—such as the Maldives and Tuvalu— uninhabitable, and to swamp vast areas of other countries.

UNDP Human Development Report, 2003

Conclusion

Processes of change have affected, frequently adversely, women, children, indigenous minorities, the rural poor, the growing numbers of urban poor, the environment, and the quality of life in urban and rural places. These changes have given priority to the generation of export income through industrialisation and commercialisation of agriculture, particularly the introduction of modern forms of monoculture. Such changes have frequently resulted in the destruction of traditional communities, with their in-built systems of sharing, cooperation and support. On the other hand, as table 2.5.3 (pp. 430–1) illustrates, there have been some collective overall gains for the world's poorer countries.

However, gains measured on a national basis are not being distributed equitably. Gains for some also often have adverse consequences for others. Frequently, the poor are the losers. National governments are caught in the trap of having to produce income to service debt, to generate income for public service provision and to maintain costly defence and security systems. As a result, the processes of attempting to achieve development at the national level may increase impoverishment at the local or regional level.

For many local communities, subsistence lifestyles have been irrevocably disrupted, environments degraded and resources exploited in the name of development. Yet, some initiatives at the local level are based on recognition of the worth of traditional values. For some communities, lower levels of material affluence, accompanied by a return to traditional values of sharing, cooperation and harmonious existence with and within the biophysical environment, may be an appropriate development path. How to balance the priorities of poor communities at the local level with the interests of the country, of the powerful, of desires by some for material affluence and of the need to meet international debt obligations, will be a major development challenge for the future.

Recently, it has been recognised that perhaps the greatest challenge now facing the world's poorer countries is how they will be able to adapt to the threat posed by predictions about global climate change. Although they have contributed the least to the problem, it is likely that

disparity inequality or difference in some respect.

did you know?

The HDI

Created by the United Nations Development Program (UNDP), the Human Development Index (HDI) is a summary, composite index that measures a country's average achievements in three basic aspects of human development: longevity, knowledge and a decent standard of living.

What begins with the failure to uphold the dignity of one life all too often ends with a calamity for entire nations.

Kofi Annan, former Secretary-General of the United Nations

their peoples, least able to afford to mitigate the damage, will suffer the most from the ravages of altered weather patterns.

Future development paths for the world's poorer countries depend in part on the wealthy countries. Their interdependence with poor countries through historical colonial relationships, through trade relationships, transfers of aid, and the international financial system suggests that they too could (and should) play a major part in addressing problems of global poverty and in stimulating ecologically sustainable development.

understanding the text

1 **Outline** the major threats to the survival of indigenous peoples and their cultures.

2 **Explain** how developed countries would benefit from the preservation and greater understanding of indigenous peoples and their ways of life.

working geographically

1 **Class discussion** As a class, discuss the proposition that the poor rarely benefit from changes based on the assumptions of the 'trickle-down' theory.

2 **Class discussion** Conduct a class discussion. What actions by the affluent countries may be necessary to overcome some of the imbalances in the distribution of world resources?

3 **Research task** Not all countries have elected to pursue development paths based on economic growth. Some have pursued strategies of self-reliance. Select a country that has chosen to pursue the path of self-reliance.
   - **a** What are its aims and how have they been pursued?
   - **b** In what ways have they been successful?
   - **c** What have been their failings?

4 **Class debate** Prepare and conduct a class debate. Topic: In the interests of the common good, the rights of the majority must transcend the rights of indigenous minorities.

5 **Writing task** Study the Geofocus box 'How global climate change threatens developing countries' (p. 457). Write a report outlining the potential impacts of climate change on developing countries.

6 **Research task** Undertake library and Internet research. Find out what you can about the development theories of Walter Rostow. How did his theories claim development could be stimulated? What were the shortcomings of these theories?

7 **Research task** Complete one of the following tasks:
   - **a** Select a major urban centre in a developing country. Conduct some research to find out about the nature and extent of problems associated with rapid urban growth.
   - **b** Conduct some research to find out what strategies different national governments have employed to deal with the problems of squatter settlements.
   - **c** Use web-based research to write a research report in which you outline the ways in which climate change threatens developing countries.

8 **DVD study** View the movie *City of Joy*. The movie will give you an insight into the difficulties facing rural–urban migrants, through the story of an Indian family that has been forced away from a traditional subsistence farming lifestyle to search for a means of survival in a city.

Index

q

r

s

t

u

v

w

y

z

Acknowledgements
The publishers wish to thank the following organisations who kindly gave permission to reproduce copyright material in this book:

Photographs
AAP Image, pp. 13, 43 right, 172 top, 191, 292 right, 300, 396; AP, p. 364, Katherine Ainger, p. 447; Airview Online, p. 160 bottom; Alamy, pp. 4 second from left, 53 right, 138, 153 top; ANT Photo Library, pp. 199 middle, 203 left, 209 bottom, 211 bottom; Auscape International, pp. 115 bottom, 160 middle, 203 right, 210 top left, 210 bottom right, 266 bottom, 302; Australian War Memorial, p. 388 bottom right; Big Stock Photo, p. 263 bottom; Billabong, p. 319 top; Bureau of Meteorology, pp. 24 top left, 24 top right, 24 bottom left; Coo-ee Picture Library, p. 124; Corbis, pp. 4 third from left, 95 bottom right, 141 bottom, 167, 196, 270, 324 top, 345, 368 left, 369 bottom, 371, 373, 374, 376, 379 bottom, 383 top, 383 bottom left, 383 bottom middle, 383 bottom right, 384 top, 385, 392, 402, 403 top, 440, 455; Corbis royalty-free, pp. 2 second from top, 2 third from top, 2 third from bottom, 3 second from top, 3 third from bottom, 18, 25, 31, 34, 35, 55 middle left, 55 right, 58, 94, 97 bottom right, 110 middle, 115 middle, 118, 121 third from top, 123, 133 top left, 133 top right, 133 bottom right, 140, 142, 146 top left, 146 top right, 146 bottom right, 173 bottom, 179 top, 180 bottom left, 184 middle, 192, 263 top, 264, 265 middle, 267 bottom, 268 bottom left, 269 top, 269 middle, 274 top left, 274 bottom, 343 bottom left, 357 right, 378 top, 401; Department of Lands NSW, pp. 162 top left, 171, 177 left; Department of Natural Resources, p. 171; Digital Vision, pp. 1 third from top, 2 top, 3 top, 8, 9 left, 12 top left, 12 top right, 12 bottom left, 12 bottom middle, 43 left, 101 bottom, 111, 157, 158 top, 158 bottom, 265 top right, 268 top, 285; David Eddy, pp. 134 both, 135, 136 both; Fairfax Photos, pp. 185 left, 197 bottom, 346 bottom right; Getty Images, pp. 3 fourth from top, 3 second from bottom, 46 top, 52, 57, 59, 60, 61, 62, 63, 65, 72, 88 bottom left, 88 bottom right, 89, 91, 93 top, 105, 109 right, 116, 127, 131, 139 right, 149, 195, 197 top, 200 left, 214–15, 216, 217 right, 219, 228, 234, 239, 244, 245, 247 left, 247 right, 249, 256, 258 left, 258 right, 265 top left, 267 middle, 278, 288, 292 left, 309 right, 312 right, 317 bottom, 320, 322 left, 322 right, 324 bottom, 325 top, 333, 336, 344, 348, 351 bottom, 356, 359 left, 359 right, 360 top, 360 bottom, 361 top, 361 bottom, 368 right, 369 top, 378 bottom, 379 top, 386, 387, 388 top, 395, 397, 403 bottom, 404 top, 404 bottom, 411, 412, 414, 419 top, 427, 435, 438, 454; Great Southern Stock, p. 96 bottom; David Hamper, p. 168 top right; INKCINCT cartoons, p. 429; Grant Kleeman, pp. 2 bottom, 3 third from top, 3 bottom, 98 top, 115 top, 126, 151 top, 151 bottom, 159 top, 162 top right, 162 bottom left, 162 bottom right, 163 bottom, 168 top left, 172 bottom, 173 top, 174 left, 174 right, 182, 185 right, 248, 309 left, 312 left, 315 top, 319 bottom, 325 bottom, 326, 340, 346 top, 346 bottom left, 347, 351 top, 408; Christo Komarnitsky, p. 439; iStock Photo, pp. 110 left, 184 bottom, 294; Kobal Collection/Lawrence Bender Productions, p. 15 right; Rod Lane, pp. 316, 317 top, 317 middle, 318 left, 318 right, 349; Murray-Darling Basin Commission, p. 210 top right; NASA, pp. 6–7, 10, 42, 43 left, 44 top right, 44 bottom, 81 right, 83, 86 top, 86 bottom, 98 bottom, 160 top, 165, 179 bottom, 180 top, 273; National Library of Australia, pp. 205, 375; National Library of Australia/Olegas Truchanas, p. 290; Nature Picture Library, p. 375; New Internationalist, pp. 453 top, 453 bottom; Newspix, pp. 28, 200 right, 244, 297, 365, 388 bottom left, 393 bottom, 399; Nicholson Cartoons, pp. 287, 334, 381, 382, 384 bottom, 393 top, 398; National Oceanic and Atmospheric Administration, p. 148 left; Northside Productions, pp. 2 second from bottom, 209 top; NSW Dept of Lands, pp. 177 left, 180 bottom right; Tim O'Brien, p. 210 bottom left; Pearson Education/Alice McBroom Photography, used with permission of Charlie Carp, p. 212; PhotoDisc, pp. 1 second from top, 1 fourth from top, 1 second from bottom, 1 bottom, 2 fourth from top, 4 left, 12 top middle, 12 bottom right, 14, 15 left, 17 top, 17 bottom, 23, 30, 36, 46 bottom, 53 left, 55 left, 55 middle right, 70, 80, 81 left, 82, 90 top, 90 bottom, 92, 93 bottom, 95 top, 95 bottom left, 96 top, 100, 101 top, 108, 109 left, 110 right, 112, 113, 114, 120, 121 all except third from top, 133 bottom left, 139 left, 144, 146 bottom left, 155, 159 middle, 159 bottom, 184 top, 193 top, 194 top, 198 top left, 198 top right, 198 bottom left, 217 left, 260, 261 left, 261 right, 263 middle, 265 bottom, 266 top, 266 middle, 267 top, 268 bottom right, 269 bottom, 277 top, 286 top, 286 bottom, 303, 309 left, 357 left, 409; Photolibrary.com, pp. 9 right, 37, 97 bottom left, 99, 119, 132, 152, 153 bottom, 163 top, 168 bottom, 169, 170, 177 right, 193 bottom, 197, middle, 199 top, 202, 207, 208, 211 top, 275, 308, 315 bottom, 343 top, 343 bottom right, 390; Reuters, p. 353; Barbara Rugendyke 419 middle, 419 bottom; Shutterstock, pp. 194 bottom, 274 middle; Suresh Sawant, p. 413; Ken Stepnell, pp. 1 top, 1 third from top, 11, 97 top; Still Pictures, pp. 277 bottom, 450; Steve Tickner, pp. 421 left, 421 right; UNEP/GRID-Arendal Maps and Graphics Library, pp. 44 top left, 57 top, 58 right; US Geological Survey, p. 148 right; Wildlight, pp. 24 bottom right, 199 bottom, 176.

Text
Cambridge University Press for 'Globalisation: the human dimension' from 'Global Nation? Australia and the Politics of Globalisation' by John Wiseman, reproduced by the kind permission of Cambridge University Press, Melbourne, 1998, pp. 13–14, p. 311 top; Ariana Eunjung Cha/The Washington Post for 'West rises in China's backyard: developers model European, American cities for new middle class', The Washington Post, April 11, 2007, p. 345; David Crawshaw/AAP for 'Murray-Darling a threatened river: WWF', AAP General News March 20, 2007, p. 212; Philip Derriman/Sydney Morning Herald for 'Man and his environment: the Aboriginal experience', Sydney Morning Herald, January 8, 1993, p. 127; David Eddy/Monaro Grassland Conservation Management Network for 'Temperate Grasslands: the Monaro' adapted with permission from Life and Death in the Grass, Native Vegetation Management, Australian Native Conservation Agency, p. 134 and 'Temperate Grasslands: the Monaro' from Monaro Remnant Native Grasslands Project, World Wide Fund for Nature and Upper Murrumbidgee Catchment Co-ordinating Committee. Grassland Management Field Day Information Sheet, p. 136; Ross Gittens/Sydney Morning Herald for 'Trade beats aid when it comes to helping poor', Sydney Morning Herald, September 15, 2007, p. 409; Daniel Lewis/Sydney Morning Herald for 'Drought leaves Snowy scheme gasping', Sydney Morning Herald, p. 7, May 7, 2007, p. 64; N. MacKay and D. Eastburn for table 'Comparison of water yields', The Murray, Murray-Darling Basin Commission, Canberra, 1990, p. 203; Rhett Butler/Mongobay for table 'Corporations versus countries, 2007', p. 333; Allan Moss/Sydney Morning Herald for 'Innovation in education is the key to ongoing success', Sydney Morning Herald, July 19, 2007, p. 13, p. 311 bottom; Murray-Darling Basin Commission for table 'Threats to the native fish species in the River Murray', from Native fish strategy for the Murray Darling Basin 2003–2013, p. 211; Robert Neuwirth/New Internationalist for 'Architects of our future', New Internationalist, January 2006, Issue 386, p. 451; New Internationalist for 'Of drought and debt', pp. 446–7 and 'The Green Revolution', p. 449, New Internationalist 353, January–February, 2003; New Internationalist for 'Wives and Daughters', May 2006, Issue 389, pp. 453–4; New York Times for 'China seeks known brands to go global' by David Barboza. From the New York Times , June 30, © 2005. The New York Times All rights reserved. Used by permission and protected by the Copyright Laws of the United States. The printing, copying, redistribution, or retransmission of the Material without express written permission is prohibited, p. 314; OECD for table 'Australian ODA, 2004 and 2005 and 'Top 10 recipients of gross Australian ODA/OA, p. 443; Oxfam for 'Defining development', Oxfam website, 2007, p. 412 second from bottom left; Oxford University Press for 'How global climate change threatens developing countries', UNDP Human Development Report, 2003, p. 124, p. 457 and table 'Population and population land resources' adapted and updated from UNDP, Human Development Report, 2000, Oxford University Press, NY, 2000, p. 274; Sian Powell/Weekend Australian Magazine for 'Manusau Village, East Timor—Erica De Araujo', Weekend Australian Magazine, August 25–26, 2007, pp. 22–6, p. 421; Ian Sample/ The Guardian for 'Yangtze river dolphin driven to extinction: Intensive survey reveals disappearance of species: Scientists blame shipping, hunting and fishing', © Guardian News & Media Ltd, August 8, 2007, p. 129; Sierra Club Books for 'Sustainable Development' adapted from International Banks and the Environment, Sierra Club Books, San Francisco, 1992, p. 269; Dr Paul Sinclair/The Age for 'Water down the drain—why we don't need more dams', The Age, May 5, 2007, p. 201; The International Bank for Reconstruction and Development/The World Bank for tables: 'Millenium Development Goals: 2007 progress chart', pp. 430–1 and 'Profile of East Timor—the East Timorese, Population, Health, Housing, Education, Economic Activity' p. 423; The World Bank for 'Defining Poverty', World Bank website, 2007, p. 412 top left; UNDP/ Bishop Desmond Tutu for 'The new global divide: the impacts of climate change', UNDP 2007, Human Development Report, 2007–08, p. 456; UNDP/ Chen and Meisal/ Mousseau and Mittal, 2006, MSF 2005, Section 2007a in Human Development Report, 2007–08, p. 85, 'Drought and food insecurity in Niger', reproduced with the kind permission of Palgrave MacMillan, p. 435; UNDP/Denning and Sachs 2007, DFID 2007/UNDP in Human Development Report, 2007–08, p. 182,'Reducing vulnerability through agriculture in Malawi', reproduced with the kind permission of Palgrave MacMillan, p. 436; UNDP for 'Fresh water: a vital resource' from United Nations Chronicle, 1997, no. 2, p. 24, p. 278; UNDP for extract from 'Human Development Report, The Human Development Concept' from UNDP, 2007 and 'What is the human poverty index (HPI-1 and HPI-2)' from Human Development Report, 2007, reproduced with the kind permission of Palgrave MacMillan, p. 412 top right, bottom left; UNDP marta Sen, 2007, from UNDP Human Development Report, 2007–8 flyer, reproduced with the kind permission of Palgrave MacMillan, p. 412 second from top left; UNDP for extract from 'Meeting the Challenges of a Changing World', Annual Report of the Secretary-General on the Work of the Organisation, 2006, p. 413; UNPAC/Marilyn Waring for 'Consider Tendai' from website 'Women & The Economy—Women and Unpaid Work', a project of UNPAC, p. 455; Wiley and Sons for 'Conservation' adapted from Exploitation, Conservation, Preservation, by S. Cutter et al, Wiley and Sons, New York, 1991, p. 266; Worldwatch Institute for 'Cities out of balance', State of the World, 2007: Our Urban Future, p. 136, p. 450; World Population Data Sheet 2007, Population Reference Bureau for tables: 'Average annual rate of population increase, 2000–05', p. 223 top, 'Changing distribution of the world's population, 1750–2150', p. 231, 'Countries with the highest and lowest life expectancy', p. 226 top, 'Distribution of the world's population, 2007', p. 230 top, 'Population density', p. 230 bottom, 'Population projections for 2005–50 based on various assumptions regarding fertility' p. 229, 'Projected population change 2005–50', p. 224 top, 'Trends in birth and death rates, worldwide, 1950–55 to 2007', p. 225, 'World demographic trends by region, 2007', p. 223 bottom, 'World pattern of fertility, 2007', p. 226 bottom, 'World pattern of mortality, 2007', p. 228, 'World population growth rates (actual and projected), 1950–2050', p. 233, 'World's 10 largest countries by population, 2007 and 2050', p. 224 bottom; World Resources Institute for table 'Percentage changes in CO^2 emissions agreed to at the Kyoto conference', World Resources, 1998–99, pp. 174–5, p. 299; Zed Books for 'Global resource management: linking economics to environmental issues' from Group of Green Economists, Ecological Economics, Zed Books, London, 1992, p. 297; ZNet/Z Communications/Chris Spannos for 'The Opposition to Coca-Cola and Water Privatisation: Activists in Medhiganj, India, Rise Up' by Gina Drew and Mike Levien, published on ZNet, July 25, 2006, p. 354.