PEARSON geography

S.B.



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We hope you enjoy the journey you are about to take as much as we have enjoyed preparing for it. We look forward to working with you to implement the Australian Curriculum and to helping you manage your digital aspirations.

We would like to thank our authors for their extraordinary dedication and their contribution to the development of this project.

A temperate Australian rainforest and its animal inhabitants

Illustrator: Bex Glover

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PEARSON Australian Curriculum

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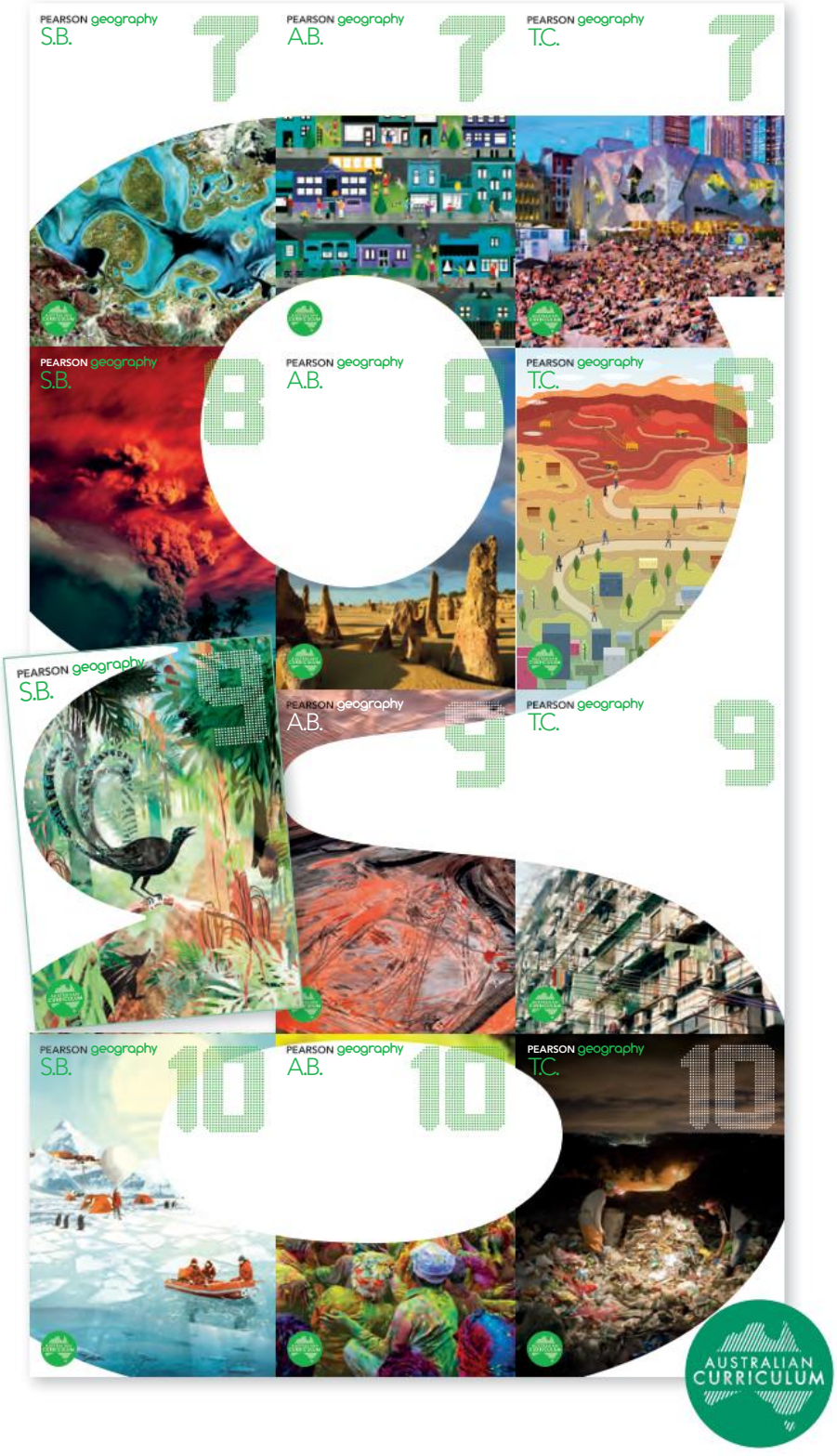
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PEARSON geography



Built from the ground up

Pearson Geography has been created from the ground up for the Australian Curriculum: Geography, Years 7–10. It has been written and reviewed by a team of over 20 trained and qualified geography teachers from across Australia, ensuring its currency to teach students in the 21st century.

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Did you know that Pearson also offer teachers a diverse range of professional learning programs? We are dedicated to supporting your implementation of **Pearson Geography**, but it doesn't stop there. We offer specific training for the Australian Curriculum and beyond, in the form of workshops, conferences and seminars. Find out more about Pearson Professional Learning at **www.pearson.com.au/pl**.

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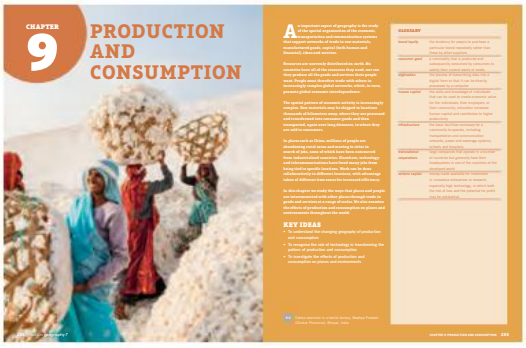
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How to use this book

Pearson Geography has been designed for the Australia Curriculum: Geography course. It includes content and activities that enhance the development of the Year 9 achievement standards within the two interrelated strands of Geographical Knowledge and Understanding and Geographical Inquiry and Skills.

Pearson Geography units are either two or four pages in length, designed to be completed in a lesson. Content is presented through a range of contexts to engage and assist students. Pearson Geography has an engaging design and it uses clear, easy-to-understand language, which makes this a valuable resource for students of all interests and abilities.

Chapter opener



The chapter opener image is designed to engage students and provide a visual stimulus to the chapter themes. Also included is an introduction to the chapter and Key Ideas that link the chapter to the Australian Curriculum: Geography. A glossary provides a ready reference for students to the key concepts and terms in the chapter.

Units

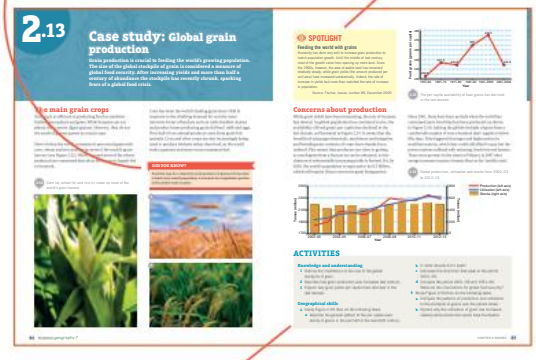
Each chapter of the Student Book is divided into units. Units have been written to develop students' knowledge and understanding of the concepts, skills and processes central to the study of Geography at this level. Unit are written to ensure both strands—'Knowledge and Understanding' and 'Inquiry and Skills' are interrelated as specified by the Australian Curriculum: Geography.

Did you know?

Throughout the Student Book, these boxes give additional information and are designed to engage curious learners.

Spotlight

These features focus attention on a place, an issue or a concept relating to the unit.

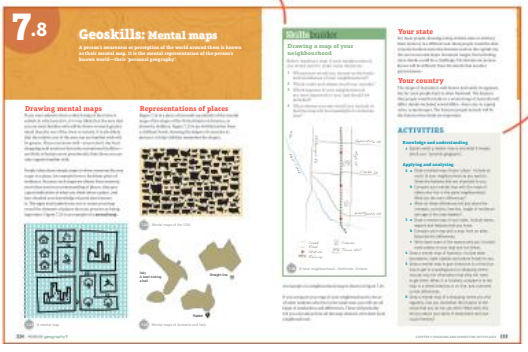


Skills builder

Skills builders are embedded in selected units and concentrate on key geographical skills.

Activity Book link

Use this icon to access an Activity Book worksheet that will consolidate and extend students' learning.

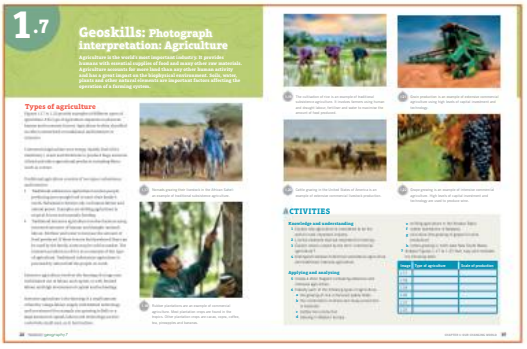


Activities

Each unit ends with a set of activities under selected headings from Bloom's Taxonomy of Cognitive Processes.

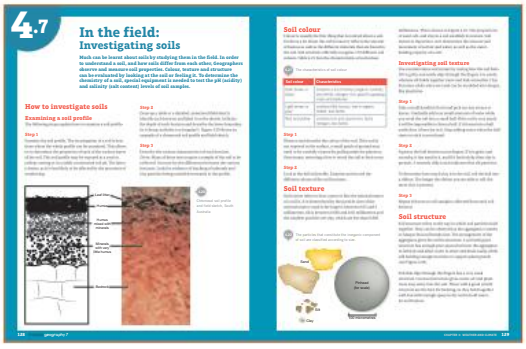
The activities include questions that guide students towards an understanding of the material covered and will extend them in a variety of learning experiences. The activities have been carefully selected to cater for the full range of students. The activities provide an opportunity for students to engage with important geographical issues from a range of perspectives.

Geoskills



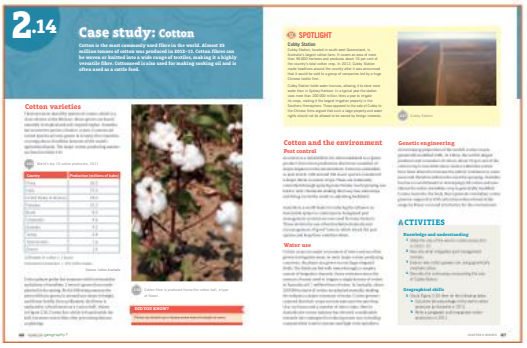
Geoskills units are designed to improve students' geographical skills: mapping, graphing, interpreting satellite images and using ABS data online. These skills relate to the Australian Curriculum: Geography Inquiry and Skills strand.

In the field



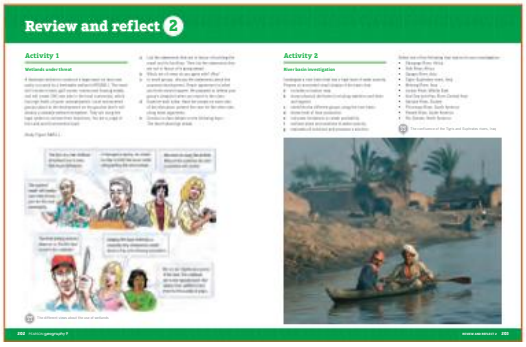
'In the field' units provide a step-by-step guide to undertaking and evaluating fieldwork. 'In the field' units have been written as a guide and are not tied to a specific location. Depending on the fieldwork task, some 'In the field' units can be conducted within school grounds.

Case studies



Case study units relate to a specific event or location. The units are written to extend students' knowledge and understanding. Case studies include examples from around Australia and world examples as specified in the Australian Curriculum: Geography.

Review and reflect



At the end of each of the three sections of the Student Book, 'Review and reflect' activities enable students to revise the key concepts and skills developed the text and complete higher order tasks. Students are encouraged to reflect on their own learning—to challenge their existing thinking and to refine their values and attitudes.

Directive terms

The following directive terms, grouped in a manner consistent with Bloom's Taxonomy, help you to identify the level or type of response required for a question or activity and provide a common language and consistent meaning in Australian Curriculum documents.

Remembering	
Define	State meaning and identify essential qualities
Label	Add annotations to a diagram or drawing
List	Write
Name	Present remembered ideas, facts and experiences
Present	Provide information for consideration
Recall	Present remembered ideas, facts and experiences
Specify	State in detail
State	Provide information without further explanation
Understanding	
Account	Account for: state reasons for, report on. Give an account of: narrate a series of events or transactions
Calculate	Ascertain/determine from given facts, figures or information
Clarify	Make clear or plain
Construct	Make; build; put together items or arguments
Describe	Provide characteristics and features
Determine	Find out the size or extent by measuring, counting or estimating
Discuss	Identify issues and provide points for and/or against
Explain	Relate cause and effect; make the relationships between things evident; provide why and/or how
Extract	Choose relevant and/or appropriate details
Gather	Collect items from different sources
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, suggestion) for consideration or action
Rank	Place in order of size, age or as instructed
Recount	Retell a series of events
Summarise	Express, concisely, the relevant details

Applying	
Apply	Use, utilise, employ in a particular situation
Calculate	Ascertain/determine from given facts, figures or information
Demonstrate	Show by example
Examine	Inquire into
Identify	Recognise and name
Analysing	
Analyse	Identify components and the relationship between them; draw out and relate implications
Classify	Arrange or include in classes/categories
Compare	Show how things are similar or different
Contrast	Show how things are different or opposite
Critically analyse/evaluate	Add a degree or level of accuracy, depth, knowledge and understanding, logic, questioning, reflection and quality to analysis/evaluation
Discuss	Identify issues and provide points for and/or against
Distinguish	Recognise or note/indicate as being distinct or different from; note differences between
Interpret	Draw meaning from
Evaluating	
Appreciate	Make a judgement about the value of
Assess	Make a judgement of value, quality, outcomes, results or size
Conclude	Come to a judgement or result based on the reasoning or arguments that you present
Critically analyse/evaluate	Add a degree or level of accuracy depth, knowledge and understanding, logic, questioning, reflection and quality to analysis/evaluation
Deduce	Draw conclusions
Evaluate	Make a judgement based on criteria; determine the value of
Extrapolate	Infer from what is known
Justify	Support an argument or conclusion
Predict	Suggest what may happen based on available information
Propose	Put forward (for example, a point of view, idea, argument, suggestion) for consideration or action
Recommend	Provide reasons in favour
Select	Select one or more items, features or objects
Creating	
Construct	Make; build; put together items or arguments
Investigate	Plan, inquire into and draw conclusions about
Synthesise	Put together various elements to make a whole

CHAPTER

1

OUR CHANGING WORLD



As adults you will inherit a world even more crowded than it is today. The biophysical environment will be more threatened and the global economy will be even more competitive and interconnected. Change is something that we must all embrace. We cannot ignore it. As geographers you have the knowledge and skills required to understand the nature, causes and consequences of these changes. You can also shape the process of change if you choose to be informed and active global citizens. You can make a difference. You can help make the world more socially just and our collective relationship with the environment more sustainable.

In this chapter we explore some of the main themes addressed in Year 9 Geography. These are 'ecosystems and biomes', 'food security', 'sustainability', 'transforming technologies' and 'global interconnections'.

KEY IDEAS

- To develop a knowledge and understanding of the key concepts central to the study of Geography in Year 9
- To develop an understanding of biomes and ecosystems, and the concept of sustainability
- To appreciate the challenge of meeting the food needs of a growing world population
- To develop an appreciation of the role technology plays in enhancing interconnectedness

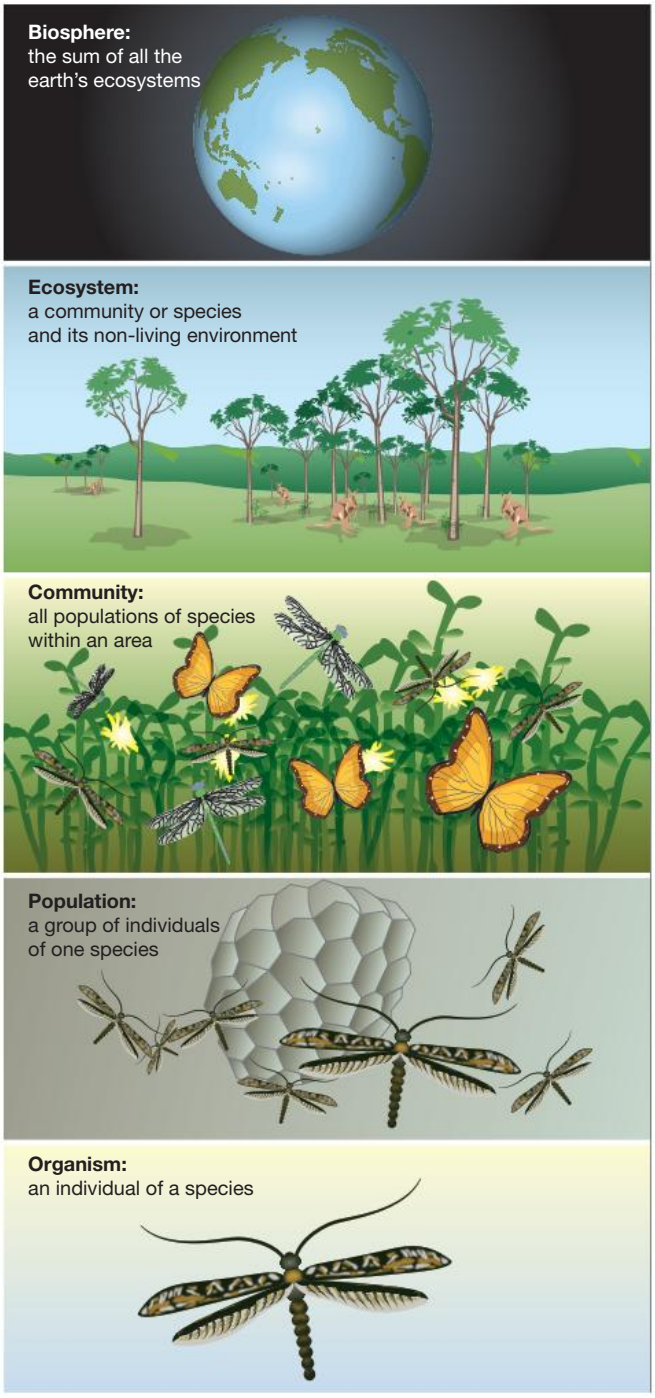
GLOSSARY

aquatic ecosystem	a water-based community of plants and animals
biosphere	the global sum of all ecosystems; can also be called the zone of life on earth
cross-section	a side view or profile of a landscape; a visual impression of the shape of the land
culture	the shared attitudes, values, goals and practices characteristic of a group; their customs, art, literature, religion, philosophy and so on; the pattern of learnt and shared behaviour among the members of a group
e-commerce	the buying and selling of goods or services conducted over electronic systems such as the internet, or other computer networks
ecologically sustainable development	an approach to environmental management that involves using, conserving and enhancing the resources available to people. It ensures that the ecological processes on which all life depends are maintained and the quality of life improved for both present and future generations
ecosystem	a community of interacting plants and animals and their physical surroundings
food security	the availability of food and a person's access to it
global village	a view of the world as having contracted into a village by the speed and reach of information and communication-based technologies
globalisation	the increasing economic, political and cultural interconnectedness of countries through the mass consumption of mainly Western culture, technology and trade
infrastructure	the basic facilities that are necessary for a community to operate; these include transportation and communication networks, power and sewerage systems, schools and hospitals
location	the position of a feature or place on the earth's surface; geographers refer to absolute location (latitude and longitude) and relative location (where the site is in relation to other things, for example, a hilltop or another place)
relief	the shape of the land
species	a group of organisms capable of interbreeding and producing fertile offspring
terrestrial ecosystem	a community of organisms and their environment that is found on the landmasses of continents and islands
transect	a straight line or narrow section through an object or natural feature or across the earth's surface, along which observations are made

1.0 Canola fields in Manitoba, Canada

1.1 Key theme: Ecosystems and biomes

Life can be created and sustained only in the presence of moisture, sunlight and nutrients. These elements occur together only on or near the surface of the lands and in the sea. No organism can live in isolation, including humans. Yet the ecosystems that we depend on for survival are being significantly altered by our actions.



The biosphere

The **biosphere** encompasses all living things, from the creatures on the ocean floor and the animals burrowing into the soil to the plants anchored to the earth's surface and the insects floating high in the atmosphere. It includes all the living organisms and their excrement (waste) and dead remains. It also includes the non-living environment, which is made up of rocks, water and air. The levels and components of the biosphere are shown in Figure 1.1 and outlined in Table 1.2.

Ecosystems

An individual of a **species** is intimately related to others of the same species and the environment in which it lives. Individuals must come together and usually touch in order to mate and nurture their young. Feeding territories are established, with different species sharing the available resources (water and nutrients). These species interact in many curious and interdependent ways. There is also competition and predation, as some animals hunt and feed on others for survival, but this is all part of the natural balance.

Each individual 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 stretching across thousands of kilometres represents an ecosystem, although on different scales. Each ecosystem has a characteristic community of plants and animals that has adapted to that ecosystem.

Ecosystems can be divided into two broad groups: aquatic and terrestrial. Those associated with water are known as **aquatic ecosystems** and the major land ecosystems are called **terrestrial ecosystems**.

1.1 Levels within the biosphere

Component	Characteristics
Organism	Simply any form of life. There are a number of ways of classifying organisms, but a very important distinction needs to be made between producers (plants), consumers (most animals) and decomposers (bacteria and fungi that break down organic matter for recycling). Plants range from microscopic single-cell phytoplankton that float in water to the giant sequoia trees growing along the coast of California. Animals range in size from microscopic zooplankton, also living in water to the 30-metre blue whale. While most decomposers such as bacteria are microscopic, others can grow to a metre in diameter, such as the rafflesia (also known as the 'corpse flower' because it smells like rotting meat).
Species	A single type of organism that is able to reproduce its own kind. The majority of species on earth are insects, mites and nematodes (worms). So far, only 2 million have been identified and named. Scientists estimate that there could be anywhere between 5 and 100 million species on the planet.
Population	A group of organisms of the same species living together in the same area. As the environmental conditions change in this area, so do the number of organisms. In good times, when plenty of food and water are available, populations soar, and when they are scarce, numbers drop.
Habitat	The area within which an organism or population lives.
Community	Several populations that live together within a particular habitat. Caves will often have several species of spiders, moths and bats.
Environment	The non-living or physical attributes of an area such as temperature, precipitation, soils and topography on land or the temperature, clarity and salinity of water.
Ecosystem	A community of organisms that interact with each other and their non-living environment.
Biosphere	The zone of habitation containing all the earth's ecosystems.

Biomes

Within terrestrial ecosystems, the largest recognisable subdivision is the biome, a very large ecosystem made up of specific vegetation types and their associated fauna. Biomes occur on different continents in areas with similar climates.

Although the biome includes all organisms interacting within the biosphere, the vegetation with its enormous biomass forms the most visible part of the biome. Biomes are classified according to the characteristic vegetation within the ecosystem, which is a response to the availability of soil water and heat:

- forest—abundant soil water and heat
- savanna—transitional between forest and grassland
- grassland—moderate shortage of soil and water; adequate heat
- desert—extreme shortage of soil and water; adequate heat
- tundra—insufficient heat to sustain vegetation growth throughout the whole year.

Just as climates across the earth transition from one type to another, so do vegetation types. The concept of biomes is an attempt to describe on a global scale how similar climates in different places support similar vegetation types.

One of the most well-known examples of a biome is the tropical rainforest, which grows in hot, wet climates such as those found in Brazil, the Democractic Republic of the Congo, Kalimantan in Indonesia and parts of coastal Queensland.

1.2 Main components of the biosphere

Changes to the natural world

Humans possess intelligence and through technology have sought to control nature, perceiving their needs as paramount, no matter what the cost to other species. The imprint of humans is evident and growing. In their efforts to exploit resources and secure water and food supplies, they have altered many ecosystems and biomes.

ACTIVITIES

1.1

Knowledge and understanding

1 Describe the biosphere.
2 Explain why no organism can live in isolation.
3 Identify the two main identifiable features of a biome.
4 Explain why biomes alter in response to changes in climate.

Applying and analysing

5 Study Figure 1.1. Select a different organism and draw your own annotated diagram showing levels within the biosphere.
6 Working in pairs, consider the following question and then share your thoughts with the rest of the class. Why do plants and animals change when they move from one biome to another?

1.2 Key theme: Food security

Like other species, humans eat to live. While it is fundamental to life, securing enough food is also considered a fundamental human right. There are concerns that the struggle for food could well become the next battleground and that global food security lies at the heart of both political and social stability right across the world.

Defining food security

The United Nations Food and Agriculture Organization's 2009 Food Summit defined food security as a situation in which:

> … all people, at all times, have physical, social and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and healthy life.

Food security means that the following conditions are met.

- Enough good-quality food is available. Food supplies can be affected by adverse weather (hailstorms, heatwaves), natural hazards (droughts, floods, tropical cyclones and tsunamis), conflict (civil unrest, wars), population growth, unsuitable agricultural practices, environmental degradation, trade barriers and inequalities within societies.
- Food is affordable and within the reach of all. When food supplies are interrupted and become expensive, wealthy people can still afford to buy them, but poorer people do not have the means to do so.
- The food available is the right sort of food. A variety of food types is essential for a balanced diet that ensures normal growth and development and good health. Such food needs to be stored safely and prepared hygienically.



1.3 Somali refugees arrive at the Dagaley refugee camp in Dadaab, Kenya, 2011. Hundreds of thousands of people fled the hardship and civil war in Somalia to Dadaab. A severe drought added to the misery and hardship. Some refugees walked for up to 30 days to reach the camp, and some children died on the way, due to lack of food and water.

Australia's food plan

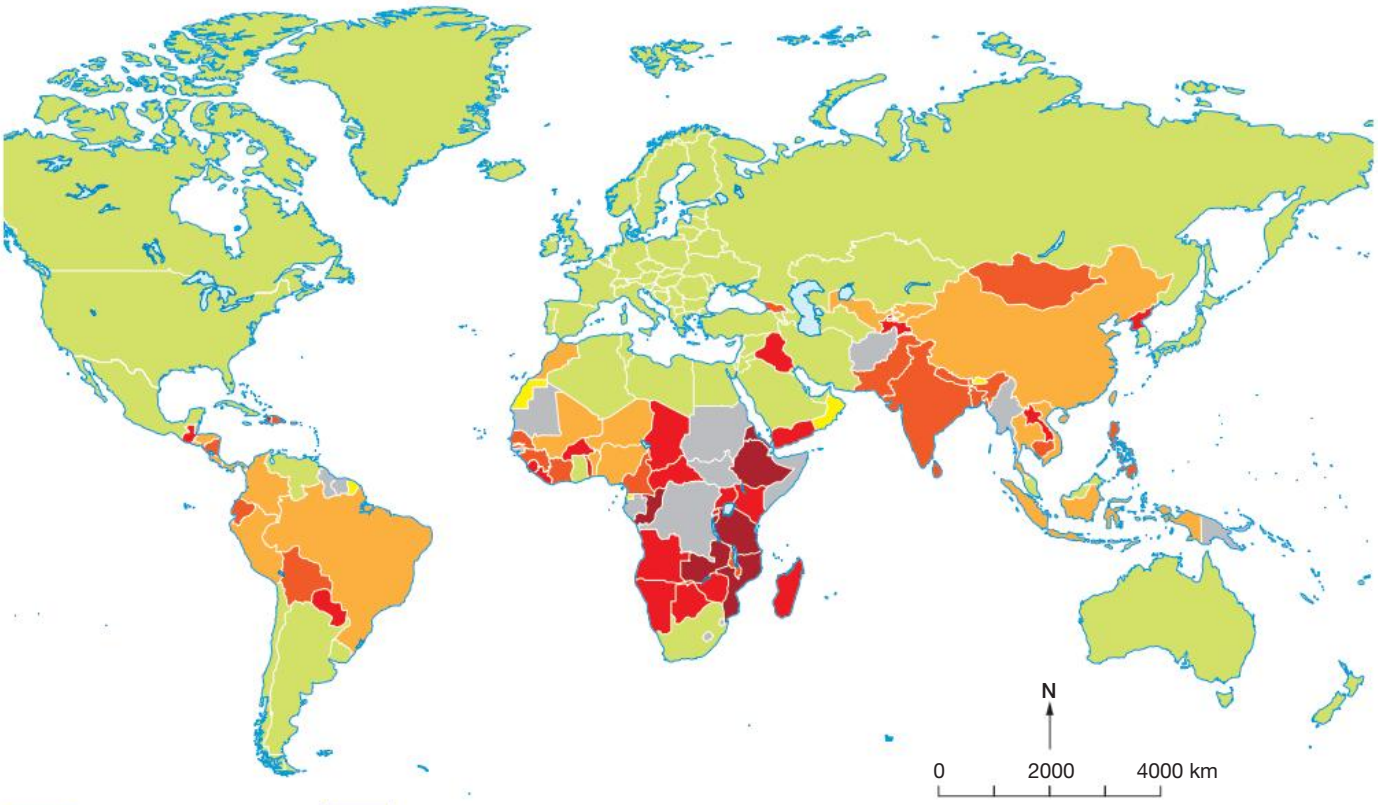
When developing a national food plan in 2011, the Australian Government identified a number of levels within which the discussion of food security operates:

- the global level, at which the issue is the capacity of the world as a whole to produce and effectively and fairly distribute sufficient supplies of food
- the national level, at which the issue is the capacity of each country to secure sufficient food to meet the needs of its population in general
- the community level, at which the issue is the difficulty that communities, for geographical or other reasons, may have in accessing food in a country that has sufficient access to food overall
- at the individual level, at which personal income is one factor that affects food security.

Global food security

In 2011, the countries of Somalia, Djibouti, Ethiopia and Kenya were hit by the worst drought in 60 years. This caused a severe food crisis as famine took hold in the worst-affected areas and thousands of people, including the woman and children shown in Figure 1.3, fled in search of food and water.

While there have been significant advances in global food production, many people still suffer chronic hunger because of the inequalities that exist. There is actually enough food in the world for all, but it is not reaching everyone.



1.4 From Africa and Asia to Latin America and the Near East, there are 870 million people in the world who do not get enough food to lead a normal, active life.

Over half of the world's population live in low-income, food-deficit countries that are incapable of producing enough food for their people and cannot afford to import food. The inequitable distribution of hunger is shown in Figure 1.4.

Challenges in securing global food security

The world is rapidly changing and there is an obvious need to increase food production and provide access to food for everyone. The world's food supply is being put under pressure from:

- population growth, especially in Asia and Africa
- increased demands on land and water resources
- conflict between competing landuses, such as food crops and biofuels
- possible impact of climate change, with shifting climate belts and extreme weather events
- changing consumption patterns as nations become more economically developed.

ACTIVITIES

1.2

Knowledge and understanding

1 Define food security.
2 Explain what is necessary for food to be 'secure'.
3 Assess current global food security.
4 Identify the challenges in securing global food security.

Applying and understanding

5 Evaluate the Australian Government's national food plan.

Geographical skills

6 Study Figure 1.4.
- **a** Name the continent that is experiencing very high undernourishment in some parts.
- **b** List the continents not experiencing very low undernourishment.
- **c** Name the continent experiencing the greatest differentiation, from very high undernourishment to very low undernourishment.
- **d** Describe the spatial distribution of undernourishment on this continent.
- **e** Can you suggest reasons why there is great differentiation?

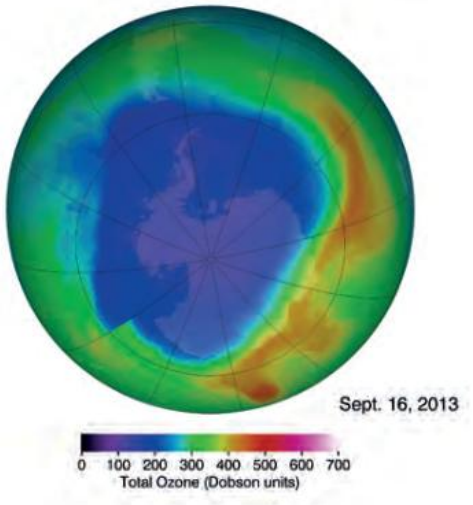
1.3 Key theme: Sustainability

Sustainable ways of living are those that meet the needs of the present without affecting the ability of future generations to meet their needs. Examples of this include not cutting down forests at a rate faster than they can regrow and using farming methods that maintain and improve the fertility of the soil.

Ecologically sustainable development

Ecologically sustainable development involves the application of the idea of sustainability to economic development. It requires us to develop economic activities (for example agriculture) in ways that safeguard the interactions of organisms and the environment. The aim of sustainable development is to achieve improvements in people's quality of life while protecting the environment.

Sustainability is a future-focused concept. It involves protecting environments and creating a more ecologically and socially just world through informed action. Actions that support more sustainable ways of living require a knowledge of the ways environmental, social, cultural and economic systems interact. This is at the heart of geography.



1.5 The ozone hole over Antarctica. It was slightly smaller in 2013 than the average over recent decades, according to data from the Ozone Monitoring Instrument (OMI). The average size of the hole in September–October 2013 was 21.0 million square kilometres. The average size since the mid-1990s has been 22.5 million square kilometres.

Environmental development

Sustainable development and good environmental management go hand in hand. If we are to put sustainable development into practice we must:

- protect earth's life-supporting systems and its biodiversity
- improve people's quality of life. Experience has shown that as people's quality of life (especially their access to healthcare, education and clean water) improves they have fewer children. This, in turn, reduces the demands placed on the earth's resources
- use the earth's renewable resources (especially its fresh water, soil, forests and fisheries) in ways that do not reduce their usefulness for future generations
- avoid making decisions that limit the prospects for maintaining or improving future living standards
- involve people in making the decisions that affect their lives, their children's lives and their environment
- develop technologies that are cleaner, use less energy and require fewer natural resources
- make products that last longer and are easy to recycle and repair
- reduce the waste we produce and the amount of energy we use
- encourage the development and use of renewable energy from the sun, wind and flowing water
- take steps to prevent further environmental damage
- share the benefits of economic growth evenly
- promote international understanding and support the alliances needed to address the challenges facing humanity.

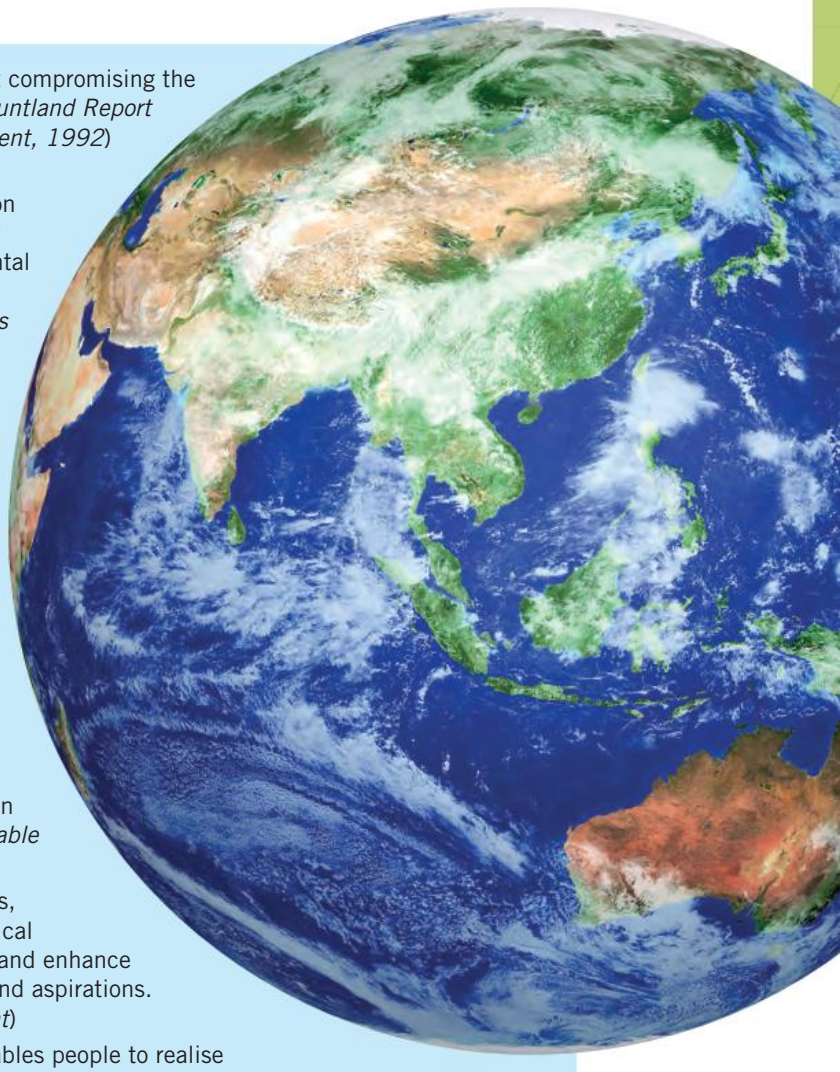
The ozone hole

It is very difficult for governments to achieve good environmental management and successful promotion of sustainable development. Countries have their own needs and agendas; however, there have been some successful initiatives.

In 1989, the Montreal Protocol came into law. It was signed by the majority of countries around the world and set out a mandatory timeline for the phasing out of ozone-depleting substances (see Figure 1.5).

Definitions of sustainable development

- Development that meets the needs of the present without compromising the ability of future generations to meet their own needs. (*Bruntland Report for the World Commission on Environment and Development, 1992*)
- In essence sustainable development is about five key principles: quality of life; fairness and equity; participation and partnership; care for our environment and respect for ecological constraints—recognising there are 'environmental limits'; and thought for the future and the precautionary principle. (*Making London Work by Forum for the Future's Sustainable Wealth London project*)
- The environment must be protected … to preserve essential ecosystem functions and to provide for the wellbeing of future generations; environmental and economic policy must be integrated; the goal of policy should be an improvement in the overall quality of life, not just income growth; poverty must be ended and resources distributed more equally; and all sections of society must be involved in decision making. (*The Real World Coalition 1996, a definition based on the work of the World Commission on Environment and Development*)
- A sustainable future is one in which a healthy environment, economic prosperity and social justice are pursued simultaneously to ensure the well-being and quality of life of present and future generations. Education is crucial to attaining that future. (*Learning for a Sustainable Future—Teacher Centre*)
- A process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional change are all in harmony and enhance both current and future potential to meet human needs and aspirations. (*The World Commission on Environment and Development*)
- Sustainable development is a dynamic process which enables people to realise their potential and improve their quality of life in ways which simultaneously protect and enhance the earth's life support systems. (*Forum for the Future*)



1.6 Definitions of sustainable development

ACTIVITIES

Knowledge and understanding

1. Define the term 'sustainability'.
2. Explain what sustainable development is.
3. Outline the things we must do in order to achieve a more sustainable way of living.

Applying and analysing

4. Identify the ways in which you and your family contribute to a more sustainable future. Share your thoughts with others in the class. Are there any changes that you and your family could adopt to live more sustainably?
5. Study the definitions of sustainable development in Figure 1.6. Identify the words, ideas or themes that these definitions have in common.
6. Write your own definition of sustainable development.

Investigating

7. Undertake internet research to find definitions of 'social justice', 'intra-generation equity' and 'inter-generational equity'.
8. Undertake internet research about the Montreal Protocol. Find out why the Protocol has been regarded as the most successful environmental protection agreement.

1.4 Key theme: Transforming technologies

Recent developments in communications and transport technologies have transformed the way that economies operate and cultures interact. These developments have helped to break down many of the barriers that once divided the world, due to the great distances between countries and the high cost of communications.

Global village

New transport and communication technologies, has created a more closely linked world, or what some geographers now refer to as a **global village**. People in developed countries travel more than ever before, communicate with others more often and use the internet to purchase goods and services from suppliers on the other side of the globe. In this unit we look at some of the technological developments that have made these changes possible.

Advances in technologies

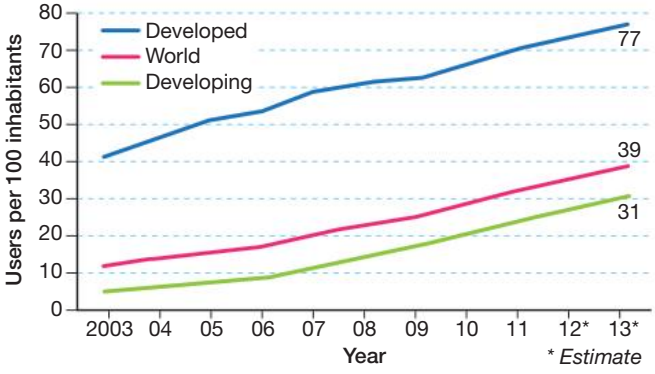
The microprocessor

In 1997, *Time Magazine* named Andrew Grove its Man of the Year. You may not have heard of Andrew Grove but the company he helped establish and later led—Intel—helped transform the way we live. Intel developed the microprocessor (or microchip)—a small electronic device, made up of millions of electronic components on a single thin rectangular piece of silicon. These microprocessors are capable of storing all the world's information and entertainment in digital form: processing it, and then transmitting it around the globe. The invention of the microprocessor revolutionised international communications by making technology much smaller, faster and less expensive.

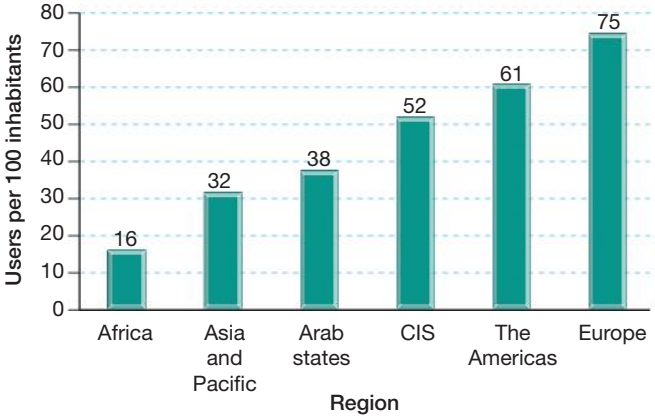
The internet

Networked computers make it possible for individuals to transfer large amounts of information around the world 24 hours a day, at high speed and for a low cost. The number of internet users worldwide is expected to increase from 242 million in the year 2000 to more than 3 billion by 2015 (over 40 per cent of the world's population). Recent worldwide growth in internet usage and access is shown in Figures 1.7 and 1.8. The internet is an important tool promoting the **globalisation** of trade, investment and culture.

1.7 Internet users by development level, 2003–13 (top) and by region, 2013 (bottom)



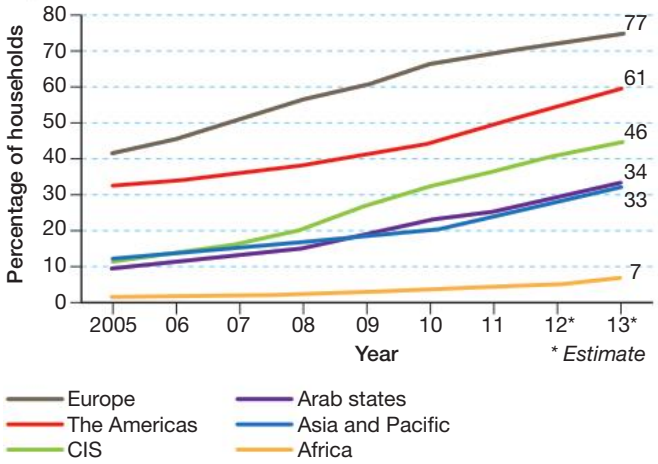
Source: ITU World Communications



Satellite technology

Today we are dependent on satellites for many aspects of our daily lives. They relay and transmit much of the information we use every day, for example through television transmission, telephone calls, weather data collection and military intelligence. Until the early 1990s most satellites launched into orbit were used for military purposes. Since then, however, the number of satellites orbiting the earth has increased significantly and the cost of using them has decreased.

1.8 Households with internet, by region, 2005–13



CIS = Commonwealth of Independent States (Russia and former Eastern European states)

Source: ITU World Communications

Advances in transport

Air transport

Developments in aviation technology, especially the introduction of the Boeing 747, have led to lower travel costs and increased volumes of international tourism and business activity. In addition to cost savings, coordination between different types of transportation (air, road, rail and shipping) has helped to reduce the time lost in the movement of people and cargo. The result has been a rapid increase in world trade and international tourism. These, in turn, have had an impact on our cultural identity. When we are exposed to new customs and traditions, we often integrate aspects of these into our own way of life.

SPOTLIGHT

The Monsterbus

The aviation industry has taken a technological leap forward with the introduction of the giant Airbus A380. The double-decked aircraft is capable of carrying 550 passengers—25 per cent more than the Boeing 747.

Source: Qantas



1.9 Airbus A380

Land transport

Increased levels of investment in rail and road **infrastructure** have made land transport faster and more competitive over longer distances. The introduction of high-speed rail systems and new cargo handling equipment has, for example, cut delivery times and increased efficiency. Likewise, the development of refrigerated road and rail transport has enabled fresh produce to be transferred over long distances.

Sea transport

Technological developments in shipping and cargo handling have been central to the expansion of international trade. As ships have increased in size, the cost of transporting goods has declined. Specialised bulk carriers, oil tankers and container ships lower costs and reduce the amount of time that ships spend in port being loaded and unloaded. Containerisation has revolutionised the way cargo is handled. Containers are capable of being carried by road, rail or ship, eliminating the need for multiple handling of goods.

ACTIVITIES

1.3

Knowledge and understanding

1 What is a 'global village'?
2 Explain how recent changes in technology helped to create a global village.
3 What is a microprocessor? Explain how have microprocessors changed international communications.
4 How have the availability and cost of satellite communications changed over time?
5 Describe the impact of recent developments in air, sea and land transport on the cost of transporting both freight and passengers.

Applying and analysing

6 What do you think international transport and communications will be like in 2050? Prepare a talk, poster or comic strip outlining your vision.

Geographical skills

7 Study Figure 1.7. Name the region with the greatest percentage of internet growth per 100 inhabitants between 2003 and 2013. Can you suggest reasons for this growth pattern?
8 Study Figure 1.8. Rank the regions from the highest to lowest percentage growth of households with internet access between 2005 and 2013.

Investigating

9 Interview three older people to find out what you can about changes in transport and communications technology over time. In small groups, create a timeline to illustrate your results.

1.5 Key theme: Global interconnections

Today, because of technologies such as the internet, everything is connected to everything. We are now interdependent. We are linked as nations, and as individuals, as never before. These developments have helped to bring about, and reinforce, the process of globalisation.

Globalisation

Globalisation is the term given to the process by which the economies and cultures of countries (and peoples) are becoming more integrated or independent. It involves the global spread of products, ideas and other aspects of culture. Globalisation can either erode or make universal the characteristics of local cultures. For example, local cultural traditions might be lost while distant traditions are embraced. Traditional Australian slang terms such as 'cobber', 'grouse', 'galah', 'jumper' and 'ridgy-didge' are falling into disuse, while we increasingly use US slang terms such as 'guys', 'sweater', 'bling', '24/7' and 'hoodie'—terms that we have become familiar with as a result of our television viewing.

While globalisation is not new, advances in transport and telecommunications technologies, including the rise of the internet, are major factors in its acceleration. Each new advance increases the interdependence of economic and cultural activities. It strengthens the connections between people and places.

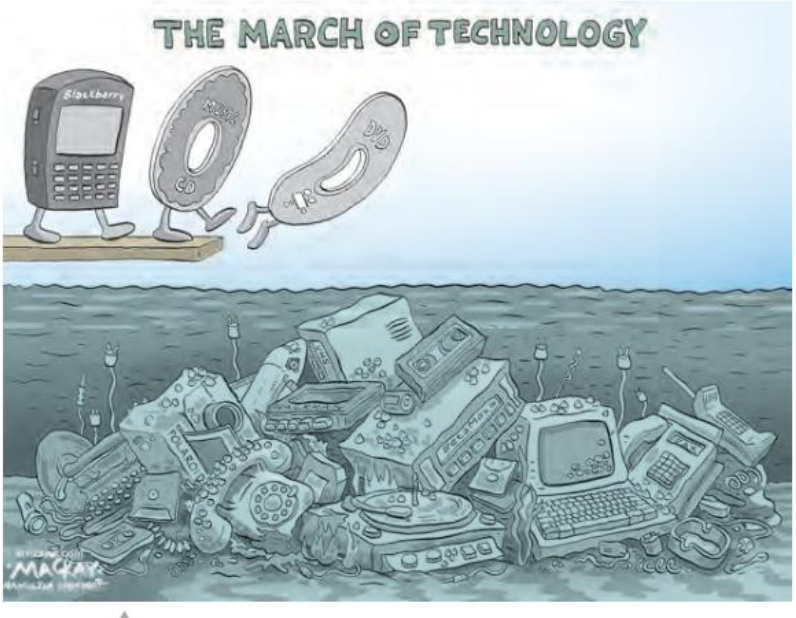
Connections between producers and consumers

Advances in transport and communications technologies have transformed global patterns of production and consumption. In recent decades, labour-intensive manufacturing has moved to those parts of the world where the labour costs are lowest, especially the countries of East and South Asia and South and Central America. These manufactured goods are then shipped to a worldwide market in which consumption habits are shaped by media-based, global advertising campaigns. It is now possible to make a product almost anywhere in the world, using resources from anywhere, by a company located anywhere, to be sold anywhere. This has put businesses in one country in direct competition with businesses in others, and results in workers in different parts of the world competing against each other for jobs, wages and working conditions.

As a result of labour-intensive manufacturing abandoning the high-cost countries of the developed world, new forms of wealth generation have emerged. In the developed world the main focus is now on high value-added manufactured goods and service industries. High value-added manufactured goods include pharmaceuticals, aircraft and wine—goods that cannot be easily made without the necessary expertise and infrastructure. Service industries include financial management, education and healthcare.

e-commerce

Electronic commerce or **e-commerce** is the buying of goods and services using the internet or other electronic systems. Fewer people are using cash to purchase goods and services. In 2012, the value of e-commerce exceeded a trillion US dollars in a single year for the first time. Australia's share of this was US$36.2 billion.



1.10 Technology is continuously evolving.



1.11 Changing communications technology

More than 10 million Australians, or almost half the population, bought something online in 2012, spending an average of $3547 per person. This average expenditure per online consumer is 54 per cent higher than expenditure in the United States of America and the highest in the world, except for the United Kingdom, which came in at number one.

Technological innovation

As the world moves towards a global economic marketplace the same process is occurring in telecommunications. A single worldwide network of information networks with everything linked to everything else is being developed. Technological innovation continues at an ever-accelerating rate, with each technological advance compounding the speed and capabilities of advances that came before, as illustrated in Figure 1.10. The sum of all human knowledge is doubling every four years.

Connections between people

Our online networks allow us to send and receive messages to and from people spread across the planet. As we become more connected, information circulates more efficiently, we interact more easily, and we manage more and different kinds of social connections. Figure 1.11 provides a satirical depiction of the evolution of communication.

Social media

Online political activism through blogs, Facebook, Twitter and other forms of social media has allowed people to engage in a public sphere that would have otherwise been unreachable to them due to repression in the countries in which they live. In Tunisia and Egypt, social media were used to coordinate and disseminate information quickly, enabling protests to begin and expand. The new information and communication tools have been influential in accelerating the revolutionary processes across the Arab world.

Cultural change

Cultures have evolved as a result of contact with other cultures for thousands of years, but the pace today has changed. In the past the influences of distant cultures spread slowly, delayed by long journeys. Today, because of television, the internet, telecommunications satellites, migration, world trade and long-distance travel, cultural influences can spread from one place to another as fast as the click of a mouse. No culture is, therefore, resistant to change. When ideas, technologies, products and people move from one place to another they influence each other. Sometimes, say critics of globalisation, one culture can invade another like a fast-growing weed.

ACTIVITIES

Knowledge and understanding

1 Explain what the term 'globalisation' means and identify the two main areas of growing interdependence.

2 a Outline how the global pattern of production and consumption has changed in recent decades.

b What impact has this had on the distribution of manufacturing and labour-intensive employment?

3 Outline the role of technological innovation in promoting interconnectedness.

4 Outline the nature of cultural change.

Applying and analysing

5 Study Figures 1.10 and 1.11. Write a sentence or two outlining the point the cartoonist is seeking to make in each cartoon.

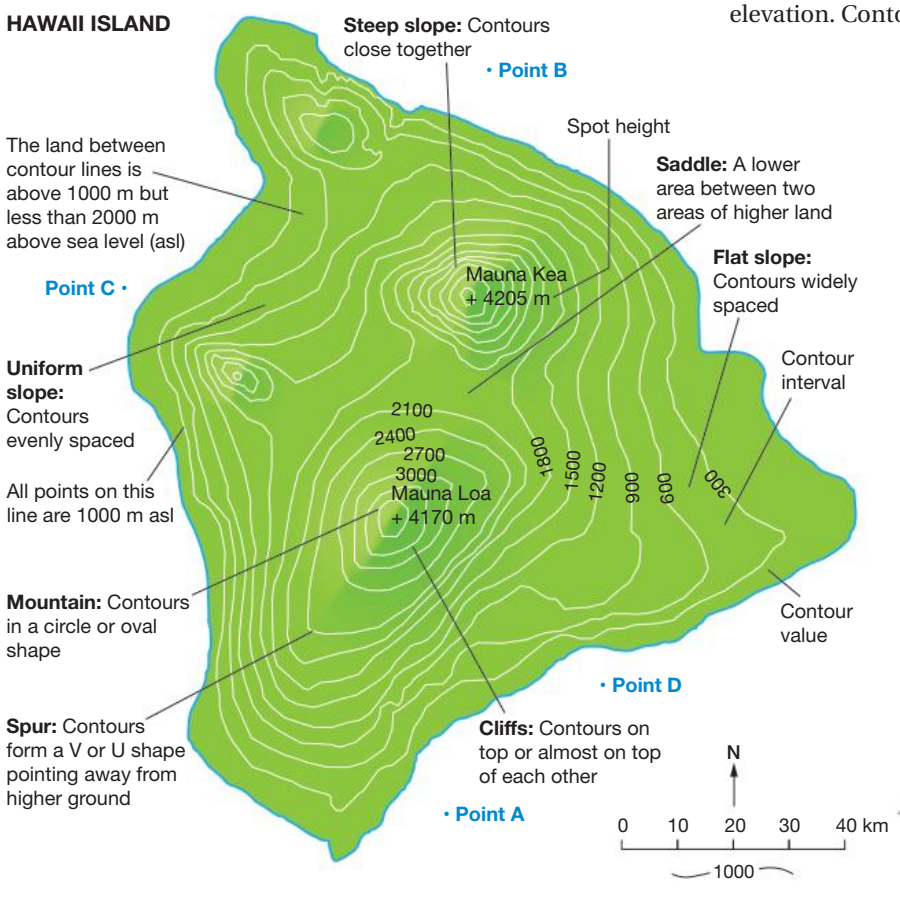
1.6 Geoskills: Analysing topographic maps

A topographic map is a detailed, large-scale representation of part of the earth's surface. Topographic maps show selected features of the biophysical, managed and constructed environments: the height, relief and slope of the land; drainage patterns and vegetation; and a range of human features including agricultural land uses, settlements and transport linkages.

Analysing maps

Interpreting and analysing **topographic maps** allows you to:

- locate and describe the biophysical environment
- recognise, describe and explain elements of the managed and constructed environments, for example settlement patterns, patterns of transport infrastructure, and the distribution of agricultural and industrial landuses
- identify, describe and explain the relationship between biophysical features and the managed and constructed elements of environments
- determine the distance between places, and the area of features such as lakes, using a linear scale.



1.12 Reading contour lines can tell us a lot about the nature of landforms.

'Reading' the landscape

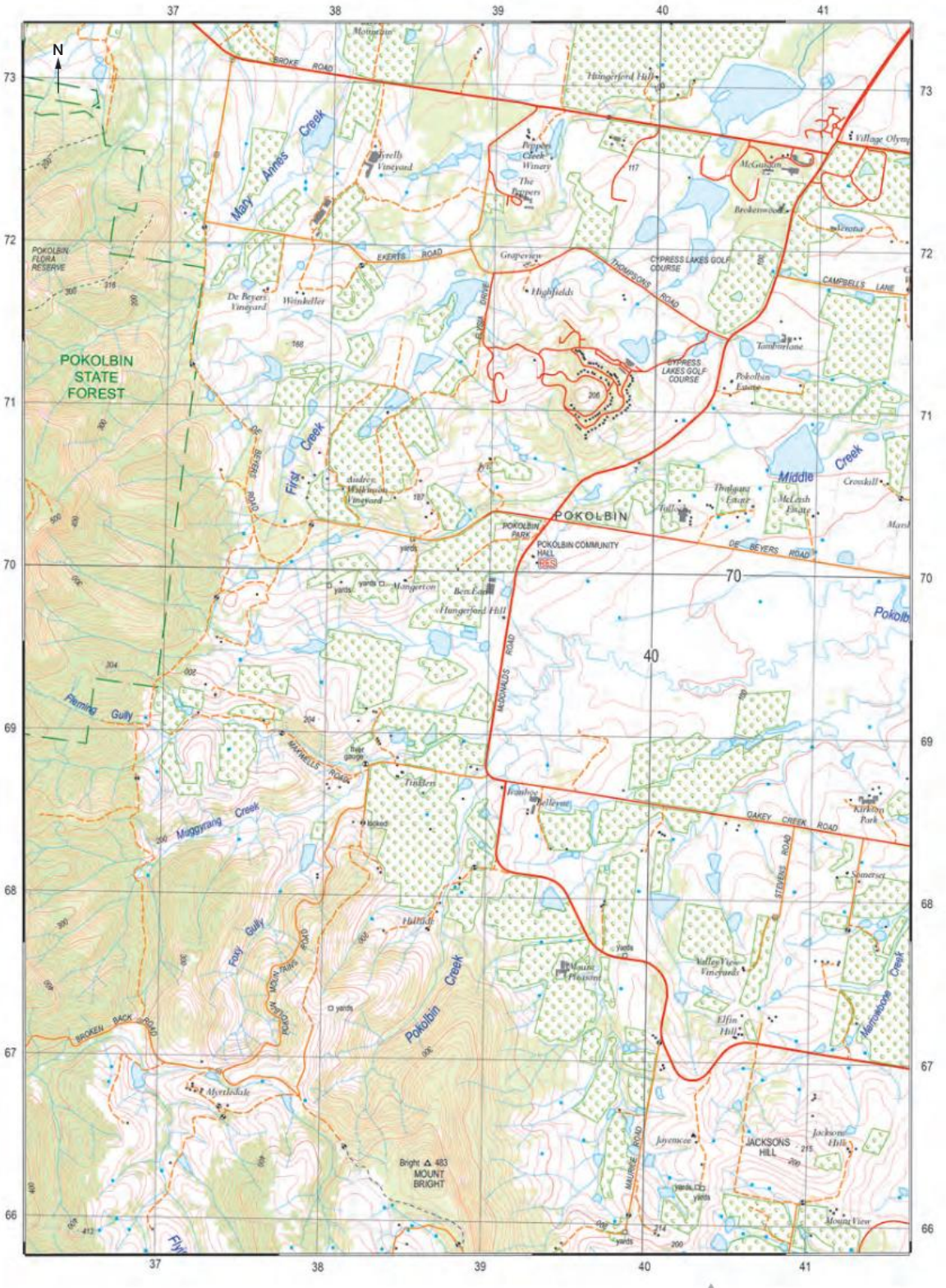
Relief is a general term describing the shape of the land, including height and steepness. The main techniques used to show relief are spot heights and contour lines and patterns. Layer colouring and landform shading are also used.

The elevation of a prominent landform feature is often shown using a spot height—a black dot or cross with the height written next to it. Spot heights give the exact height above sea level of the particular **location** or feature.

Contour lines are lines joining points of equal height above sea level. Every point along the line has the same elevation. Contour lines provide geographers with information about the shape and slope of the land and the height of features above sea level. The contour interval, or vertical interval, is the difference in height between two adjacent contour lines. This interval is normally stated in the map's legend or near the edge of the map.

Each type of topographic feature is represented by its own distinctive contour pattern, such as the shield volcano depicted in Figure 1.12. Figure 1.13 is an example of a topographic map.

When the spacing of contour lines, reading from high to low, decreases, the slope is convex; that is, curved like the outside shape of a circle. When the spacing of contour lines, reading from high to low, increases, the slope is concave; that is, like the inside shape of a circle.



0 km 0.5 1 2 km

- Secondary road: paved, unpaved
- Minor road: paved, unpaved
- Vehicular track: Stock grid.
- Four-wheel drive track: Gate
- Walking track
- silo, yards — Landmark feature. Stockyards. Mine
- Water tank or reservoir. Ground tank or dam
- 123 — Ancillary contour. Spot height
- 1000 — Contours. Depression contour
- Closed forest: 80-100% crown cover. Open forest: 50-80% crown cover
- Woodland: 20-50% crown cover. Pine forest
- Orchard, plantation or vineyard. Mangrove

- Perennial lake. Intermittent lake. Mainly dry lake
- Intermittent stream, with waterfall
- Mainly dry stream. Perennial stream
- Large dam or weir
- Lauren — Building, small. Building, large. Homestead
- Z, RFS — Wind generator. Windpump. Rural fire station

BOUNDARIES

- State Forest

1.13 Pokolbin topographic map extract

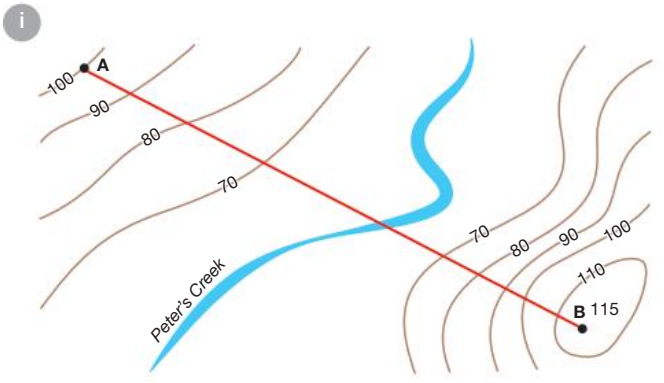
Cross-sections

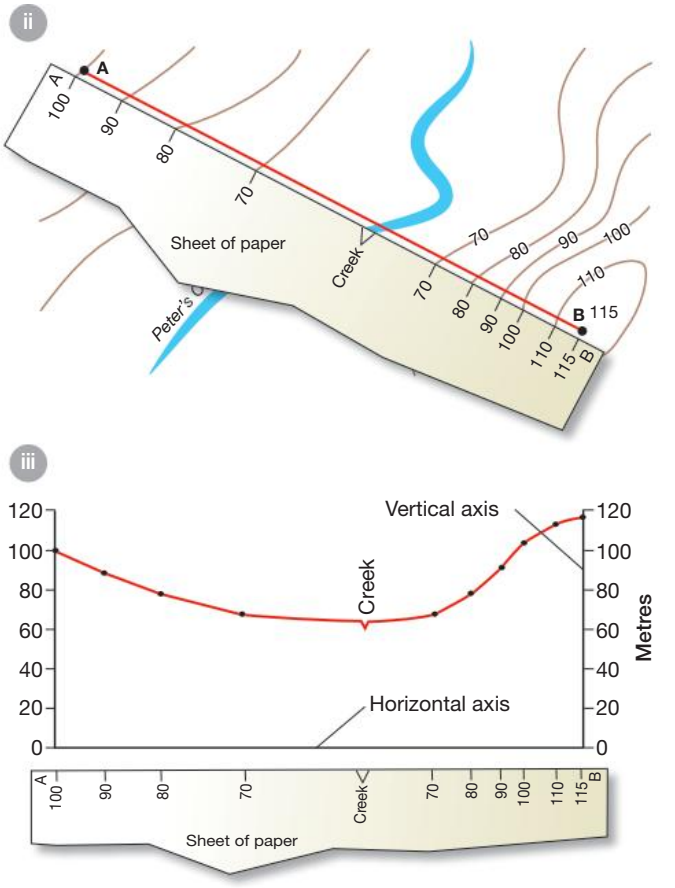
A **cross-section** is a side view, or profile, of a landscape and provides a visual impression of the shape of the land. Information about landuse, settlement, drainage and vegetation can be added to cross-sections. This provides a means of seeing how the shape of the land influences these features.

Drawing a cross-section

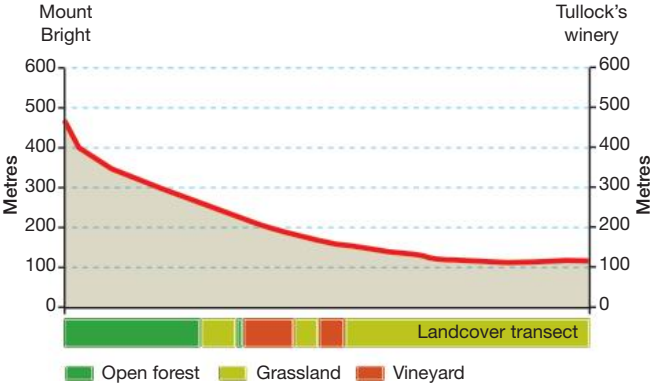
To draw a cross-section, follow the steps below and refer to Figure 1.14.

1. Locate the two points on the map between which the cross-section is to be made. Label these points 'A' and 'B' (see drawing i).
2. Place the straight edge of a piece of paper along an imaginary line joining points A and B. Mark points A and B on your paper (see drawing ii).
3. Mark the position where your paper crosses each contour line. Write the value of each contour line on your piece of paper (see drawing ii).
4. On graph or squared paper, draw the horizontal and vertical axes for your cross-section (see drawing iii). The length of the horizontal axis should equal the distance between A and B. The vertical axis should use a scale that does not over-exaggerate your vertical scale.
5. Place your piece of paper along your horizontal axis. Lightly plot, in pencil, the contour points and heights as if you were drawing a line graph (see drawing iii).
6. Join the dots with a fine, single, smooth curved line.
7. Label any features intersected by your cross-section.
8. Finish off your cross-section by:
   - **a** shading in the area below the landform
   - **b** labelling the scale on the horizontal and vertical axes
   - **c** giving it a title.





1.14 Steps involved in constructing cross-sections and an associated transect



1.15 A cross-section from Mount Bright to Tullock's winery (GR402704) and an associated land cover transect

Transects

Transects are used to demonstrate the relationship between different features of the biophysical, managed and constructed environments along a cross-section or line of latitude (see Figure 1.15).

Drawing a transect

To draw a transect, follow the these steps:

1. Identify the two points between which you will use to construct your transect. It may be along a cross-section.
2. Decide on the element of the biophysical, managed or constructed environments you wish to highlight on your transect.
3. Place the edge of a piece of paper along the line of the proposed transect on the topographic map. Mark on the spread of the selected element.
4. Draw in the distribution of the feature along your transect.
5. Label each area or construct a legend that identifies the features numbered or shaded on your transect.
6. Give your transect an appropriate title.

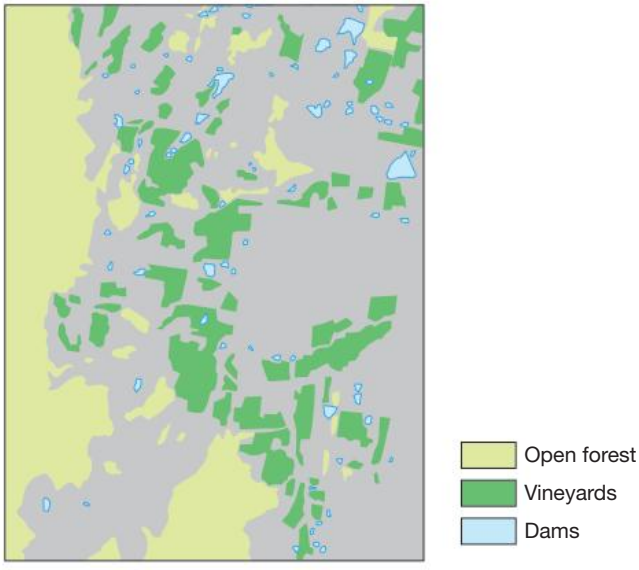
Précis maps

A précis map (see Figure 1.16) shows the main features of a topographic map. By comparing précis maps it is often possible to identify the relationship between two features, for example between landform and settlement patterns. Précis maps are sometimes referred to as single-feature maps.

Drawing a précis map

To draw a précis map, follow the these steps.

1. Identify the feature or pattern to be studied, e.g. landforms, drainage, vegetation, settlement, transport or landuse.
2. Examine the distribution of the features on the map and the pattern created.
3. Draw in the distribution of the feature.
4. Label each area or construct a legend that identifies the features numbered or shaded on the map.



1.16 Sample précis map showing the drainage pattern on the Pokolbin topographic map extract (drawn from Figure 1.13)

ACTIVITIES

Geographical skills

1. Study Figure 1.12. Construct the cross-sections A–B and C–D.
2. Study Figure 1.13 then answer the following questions.
   - **a** What is the scale of the map?
   - **b** What is the contour interval used?
   - **c** Identify the feature of the biophysical environment located at:
     - GR387664
     - GR409665
   - **d** Identify the feature of the managed environment located at:
     - GR400715
     - GR404677
   - **e** Identify the features of the constructed environment at:
     - GR400715
     - GR382725
   - **f** Name the drainage feature found in AR3768.
   - **g** Name the type of vegetation found in AR3670.
   - **h** What is the direction of Mount Bright (GR387664) from the Brokenwood Estate (AR4072)?
   - **i** In what direction is First Creek flowing in AR3871?
   - **j** What is the aspect of the slope in AR3770?
   - **k** What is the bearing of Jacksons Hill (GR409665) from Mount Bright (GR387665)?
   - **l** What is the bearing of Mount Bright from Tullock's winery (GR402704)?
   - **m** What is the straight-line distance between Mount Bright and the summit of Jacksons Hill?
   - **n** Identify the main agricultural landuse in the area covered by the Pokolbin topographic map extract.
   - **o** In what ways have people modified the water cycle in the area covered by the Pokolbin topographic map extract?
   - **p** What evidence is there that Pokolbin is also an important tourist destination in addition to being a centre of wine production?
   - **q** What is the relationship between topography and agricultural landuses?

1.7 Geoskills: Photograph interpretation: Agriculture

Agriculture is the world's most important industry. It provides humans with essential supplies of food and many other raw materials. Agriculture accounts for more land than any other human activity and has a great impact on the biophysical environment. Soils, water, plants and other natural elements are important factors affecting the operation of a farming system.

Types of agriculture

Figures 1.17 to 1.22 provide examples of different types of agriculture. The type of agriculture depends on physical, human and economic factors. Agriculture is often classified as either commercial or traditional, and intensive or extensive.

Commercial agriculture uses energy (mainly fuel oil for machinery), water and chemicals to produce huge amounts of food and other agricultural products, including fibres (such as cotton).

Traditional agriculture consists of two types: subsistence and intensive.

- Traditional subsistence agriculture involves people producing just enough food to meet their family's needs. Subsistence farmers rely on human labour and animal power. Examples are shifting agriculture in tropical forests and nomadic herding.
- Traditional intensive agriculture involves farmers using increased amounts of human and draught (animal) labour, fertiliser and water to increase the amount of food produced. If there is more food produced than can be used by the family, some may be sold at market. The intensive production of rice is an example of this type of agriculture. Traditional subsistence agriculture is practised by almost half the people on earth.

Extensive agriculture involves the farming of a large area with limited use of labour and capital, or with limited labour and high investment of capital and technology.

Intensive agriculture is the farming of a small amount of land by a large labour supply with limited technology and investment (for example rice growing in Bali) or a large amount of capital, labour and technology used in a relatively small area, as in horticulture.



1.17 Nomads grazing their livestock in the African Sahel: an example of traditional subsistence agriculture



1.18 Rubber plantations are an example of commercial agriculture. Most plantation crops are found in the tropics. Other plantation crops are cacao, copra, coffee, tea, pineapples and bananas.



1.19 The cultivation of rice is an example of traditional subsistence agriculture. It involves farmers using human and draught labour, fertiliser and water to maximise the amount of food produced.



1.20 Cattle grazing in the United States of America is an example of extensive commercial livestock production.



1.21 Grain production is an example of extensive commercial agriculture using high levels of capital investment and technology.



1.22 Grape growing is an example of intensive commercial agriculture. High levels of capital investment and technology are used to produce wine.

ACTIVITIES

1.4

Knowledge and understanding

1 Explain why agriculture is considered to be the world's most important industry.
2 List the elements that are important for farming.
3 Explain what is meant by the term 'commercial agriculture'.
4 Distinguish between traditional subsistence agriculture and traditional intensive agriculture.

Applying and analysing

5 Create a Venn diagram comparing extensive and intensive agriculture.
6 Classify each of the following types of agriculture:
   a the growing of rice in terraced paddy fields
   b the combination of wheat and sheep production in Australia
   c battery hen production
   d dairying in Western Europe
   e shifting agriculture in the Amazon Basin
   f rubber plantations in Malaysia
   g viticulture (the growing of grapes for wine production)
   h cotton growing in north-west New South Wales.
7 Analyse Figures 1.17 to 1.22 then copy and complete the following table.

Image	Type of agriculture	Scale of production
1.17		
1.18		
1.19		
1.20		
1.21		
1.22		

Review and reflect 1

Activity 1

Investigating the news

Access the Newsmap website. Newsmap is a news aggregation tool that organises news stories, by popularity and volume of reporting, as a treemap—making it easy to see what's going on and how much coverage stories are receiving.

a List the areas the news stories are divided into.
b What are the main stories featured?
c Identify the nature of news stories published in Australia.
d What other countries get a mention?
e Select one of the new stories in Australia and compare its popularity around the world.
f What do you notice about the popularity of the news story?

Activity 2

Industrial Revolution

During the Industrial Revolution, a group of protestors called 'Luddites' formed in Britain. They resented the replacement of human labour and manual skills with machines. In a number of factories they smashed machinery. Write a paragraph for a political pamphlet on behalf of the Luddites, putting forward their point of view. Then write a letter to a newspaper, putting forward the point of view of a factory owner.

Activity 3

Information technology

In 2013, United States President, Barak Obama, pledged $7 billion over 5 years to improve and expand electricity supplies in Africa. What infrastructure and knowledge do you think are necessary to ensure the spread of information technology across Africa and South America. (Hint: think about things such as batteries and IT support, which we take for granted.)

Activity 4

Wetland topographic map

Study Figure R&R1.1.

a What type of wetland ecosystem lines Saltwater Lagoon in the north-west quadrant of the topographic map extract?
b Name two vegetation types found in AR0680.
c Into what waterway does Saltwater Lagoon drain?
d Identify the feature of the biophysical environment found at each of the following grid references.
- 069797
- 043835
- 040835
- 074818
- 045817
- 077813

e Identify the feature of the constructed environment found at each of the following grid references.
- 042831
- 072828
- 047818
- 062824

f What is the direction of South West Rocks (AR 0483) from the summit of Big Smoky (AR0679)?
g In what direction is Saltwater Creek flowing in AR0582?
h What is the bearing of the summit of Big Smoky from South West Rocks (AR0483)?
i What is the straight-line distance between the bridge at GR042831 and the bridge at GR053826?
j What is the elevation of Little Smoky (AR0781)?
k What is the difference in elevation between Big Smoky (AR0679) and Little Smoky (AR0781)?
l Using information from the map, account for the existence of wetlands in the area covered by the topographic map extract.



Source: Land and Property Information NSW, 2002


SCALE 1: 25000
Kilometres 0 0.5 1 2
CONTOUR INTERVAL 10 METRES
N
Trial Bay
Back Beach
Point Briner
Monument Point
Horseshoe Cove
South West Rocks
Laggers Point
TRIAL BAY GAOL
The Gutter
MERMAID POOL
MONUMENT HILL
ARAKOON STATE RECREATION AREA
ARAKOON
Front Beach
Saltwater Creek
Little Bay
SOUTH WEST ROCKS
SOUTH WEST ROCKS GOLF COURSE
wetlands
sewage works
HAT HEAD NATIONAL PARK
Saltwater Lagoon
LITTLE SMOKY
SMOKY CAPE RANGE
Waldren Park
Spencerville
shopping centre
reservoirs
rubbish tip
ARAKOON CEMETERY
LIGHTHOUSE ROAD
WONGA PL
GREEN ISLAND FIRE TRAIL
Gap Beach
BIG SMOKY
Big Smoky 311
camping ground
33kV
Built-up area
Major road: paved (with Metroad marker), unpaved
Secondary road: paved, unpaved
Minor road: paved, unpaved
Vehicular track: Stock grid. Floodway
Four-wheel drive track: Gate
Walking track
Road tunnel. Culvert. Bridge
silo yards
Landmark feature. Stockyards. Mine
Water tank or reservoir. Ground tank or dam
Survey landmark (with height)
Spot height
Contours. Depression contours
Quarry or gravel pit. Levee or dyke
Closed forest: 80–100% crown cover. Open forest: 50–80% crown cover
Woodland: 20–50% crown cover. Pine forest
Power transmission line (33kV and above)
Perennial lake. Intermittent lake. Land subject to inundation
Wet swamp. Dry swamp
Intertidal flat. Sand
Intermittent stream, with waterfall
Perennial stream
Large dam or weir
Lighthouse or beacon. Breakwater
Jetty or wharf
Slipway. Anchorage. Wreck
Rock shelf. Reef
Rocky shoreline. Rock, bare or awash
Lauren
Building, small. Building, large. Homestead
H T W
Hospital. Telephone exchange. Place of worship
A P E
Ambulance station. Police station. Emergency headquarters
FS S PO
Fire station. School. Post office

CHAPTER

2

BIOMES



The earth's major ecosystems are often referred to as biomes—areas with the same kind of abiotic and biotic factors spread over a large area. Biomes are defined by factors such as plant types (for example trees, plants and grasses), leaf type (broadleaf or needle-like), plant spacing (forest, woodland or savanna) and climate (for example deserts). The main world biomes are deserts, forests (equatorial and tropical rainforests; deciduous and evergreen forests; and coniferous forests), grasslands and tundra.

In this chapter we examine the distribution and characteristics of biomes as regions in terms of climate, soil, vegetation and productivity. We also examine human alterations to biomes, especially those related to agriculture.

KEY IDEAS

- To develop an appreciation of the diversity of the earth's biomes and the impact of humans on them
- To know the factors affecting the global distribution of aquatic and terrestrial biomes
- To understand the flow of energy and matter within biomes and ecosystems
- To appreciate the relationship between biomes and food security
- To describe the global distribution of agriculture

GLOSSARY

annual	a plant that completes its life cycle in one year; this means it goes from seed to seed and then dies off, during the course of one year
aquatic ecosystem	a water-based community of plants and animals
biome	a vegetation community occupying a large area of the earth's surface
commercial agriculture	the use of energy, water and chemicals to produce food and other agricultural products for sale
consumer	an organism that gains its energy requirements by eating plant or animal matter
decomposer	an organism that breaks down the remains of other living things
ecosystem	a community of interacting plants and animals and their physical surroundings
estuary	an area near a river's mouth where the tide ebbs and flows
intertidal wetlands	areas covered with fresh water permanently or periodically
mangrove	a salt-tolerant tree that can cope with being partly submerged in water
nutrient cycle	the uptake, use, release and storage of nutrients by plants and their environments
photosynthesis	a process by which green plants make carbohydrates such as sugar, using water, carbon dioxide and sunlight
pneumatophore	a porous, woody branch growing upright into the air from the buried roots of a mangrove tree, giving the plant access to the atmosphere
primary productivity	the rate of energy accumulation, usually through photosynthesis
producer	an organism (plant) that produces its own food via the process of photosynthesis
resilience	the capacity of an ecosystem to respond to a disturbance by resisting damage and recovering quickly
shifting cultivation	a farming system that involves moving from site to site as soil fertility declines due to leaching
terrestrial ecosystem	a land-based community of plants and animals
traditional agriculture	subsistence and intensive forms of agriculture (such as intensive rice cultivation) practised in many developing countries

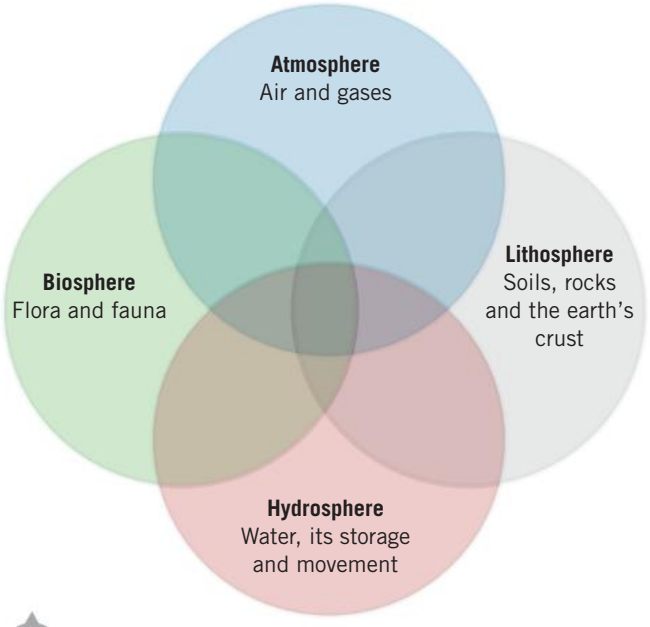
2.0 Adélie penguins crowding on a melting summer ice floe, Possession Island, Ross Sea, Antarctica

2.1 Ecosystems

Ecosystems are the result of the interactions of the biotic and abiotic. The biotic elements are the living elements; that is, plants and animals (flora and fauna). The abiotic elements are the non-living elements; that is, the soil, rocks, water and atmosphere.

Spheres

Ecosystems are also the result of interactions between the four spheres of the biophysical environment. Figure 2.1 details these four spheres. The way that these spheres interact with each other determines the nature of an ecosystem. The high level of rainfall in a tropical rainforest, for example, has led to the evolution of flora and fauna that are very different from those in desert areas, where there is very low rainfall.



2.1 Ecosystems are the result of the interaction of the four spheres of the biophysical environment.

While there is a great diversity of ecosystems on earth, they all have one elements in common: the sun. Solar energy is the key to all life on earth. Ecosystems capture solar energy and use it to support the life forms within the system. Plants, including those found in the sea, use a process called **photosynthesis** to convert solar energy into food, which the plant then consumes. In turn, the plant is eaten by animals and provides food for them. This is known as the **nutrient cycle**.

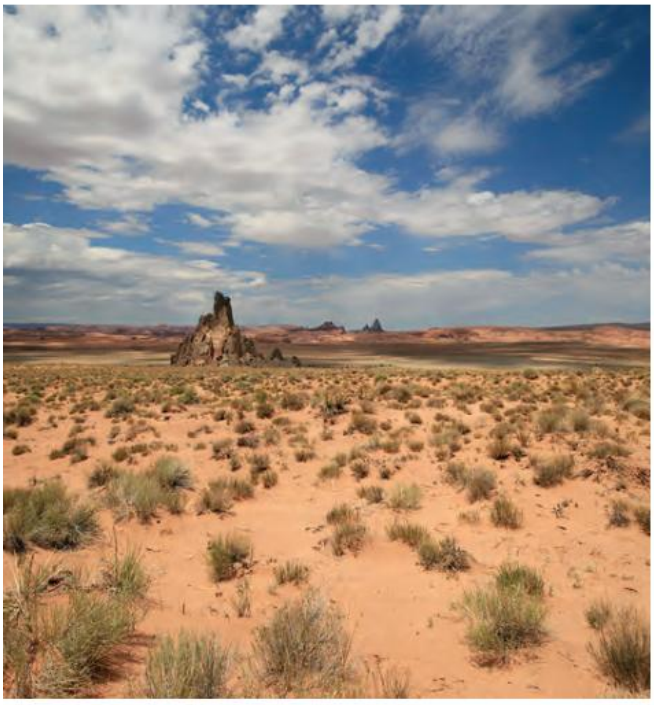
Classifying ecosystems

Ecosystems are classified according to their most dominant feature.

- ***Climate:*** A polar ecosystem, shown in Figure 2.2, is given this name because the single most important factor in this ecosystem is the climate. A desert ecosystem, shown in Figure 2.3, is classified according to its climate—lack of rainfall.
- ***Elevation:*** An alpine ecosystem, shown in Figure 2.4, is given this name because the most dominant factor is elevation.
- ***Vegetation:*** A tropical rainforest ecosystem, shown in Figure 2.5, is defined by the dominant vegetation—the rainforests that grow.



2.2 A polar ecosystem



2.3 A desert ecosystem



2.4 An alpine ecosystem



2.5 A tropical rainforest ecosystem

Flora and fauna

The flora and fauna within an ecosystem are also classified into three categories.

- ***Community:*** This is the collection of animals or plants that are found in an area. For example, the animals that live on the great savannah grasslands of southern Africa—such as zebras, elephants, giraffes, lions, cheetahs and warthogs—make up the community of species.
- ***Population:*** This is a group of the same animals or plants living in an ecosystem. For example, the zebras of the savannah are the population of zebra.
- ***Organism:*** This is an individual animal in a population, such as a single zebra living on the savannah.

To manage and protect a species within an ecosystem it is important to consider not just the organism or population, but the whole ecosystem. If the aim is to protect lions on the savannah, it is important to protect the whole ecosystem in which they live, because each organism is dependent on the population, which is dependent on the community, which is dependent on the ecosystem as a whole. This means that soils, air and water are just as important to consider as the plants and animals, as they all rely on each other.

ACTIVITIES

Knowledge and understanding

1. Distinguish between the biotic and abiotic elements of an ecosystem.
2. Explain why the sun is such as an important part of all ecosystems.
3. How are ecosystems classified?
4. Explain the difference between a community and a population.
5. What is an organism?

Applying and analysing

6. Formulate your own definition of an ecosystem. Share your definition with a partner and then collectively agree on a shared definition. Share this shared definition with the class.
7. Study Figure 2.1. Describe the spheres that make up the biophysical environment.
8. Study Figures 2.2 and 2.3. Create a Venn diagram outlining the similarities and differences of each climate ecosystem.

2.2 Energy flows within biomes and ecosystems

Ecosystems obtain their energy from the sun. The sun gives light and warmth to plants and powers the processes that give us our weather and climate.

Energy flows

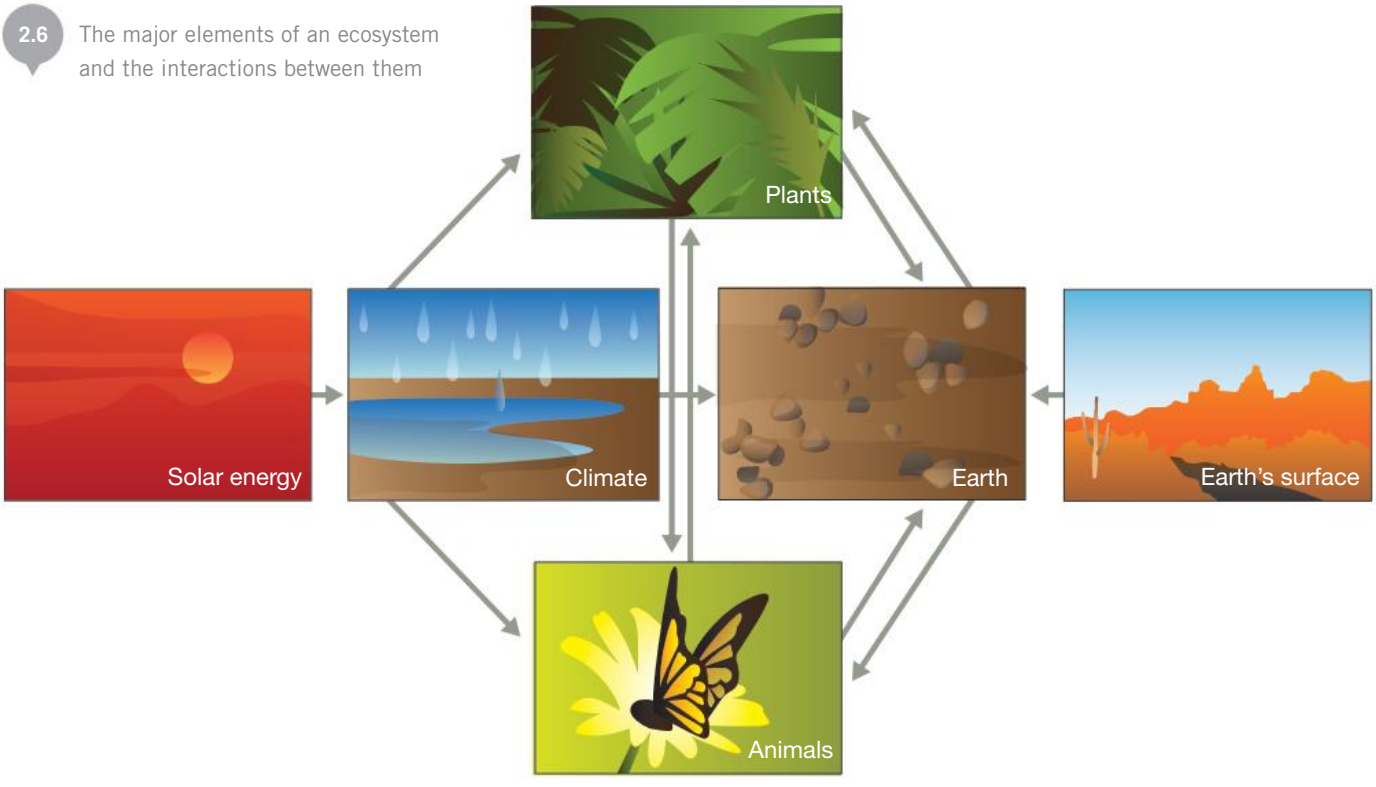
Figure 2.6 shows the links between climate, plants, animals and soil, as well as with solar energy and the earth's surface. Each arrow in this illustration represents one set of interactions, and shows the effect that one element has on another. Plants influence the type of soil found in an area. In turn, the soil type found in an area may favour certain plants and particular plant communities. An ecosystem may also include birds that distribute the seeds of a plant, which, in turn, provides food and shelter for other species of birds.

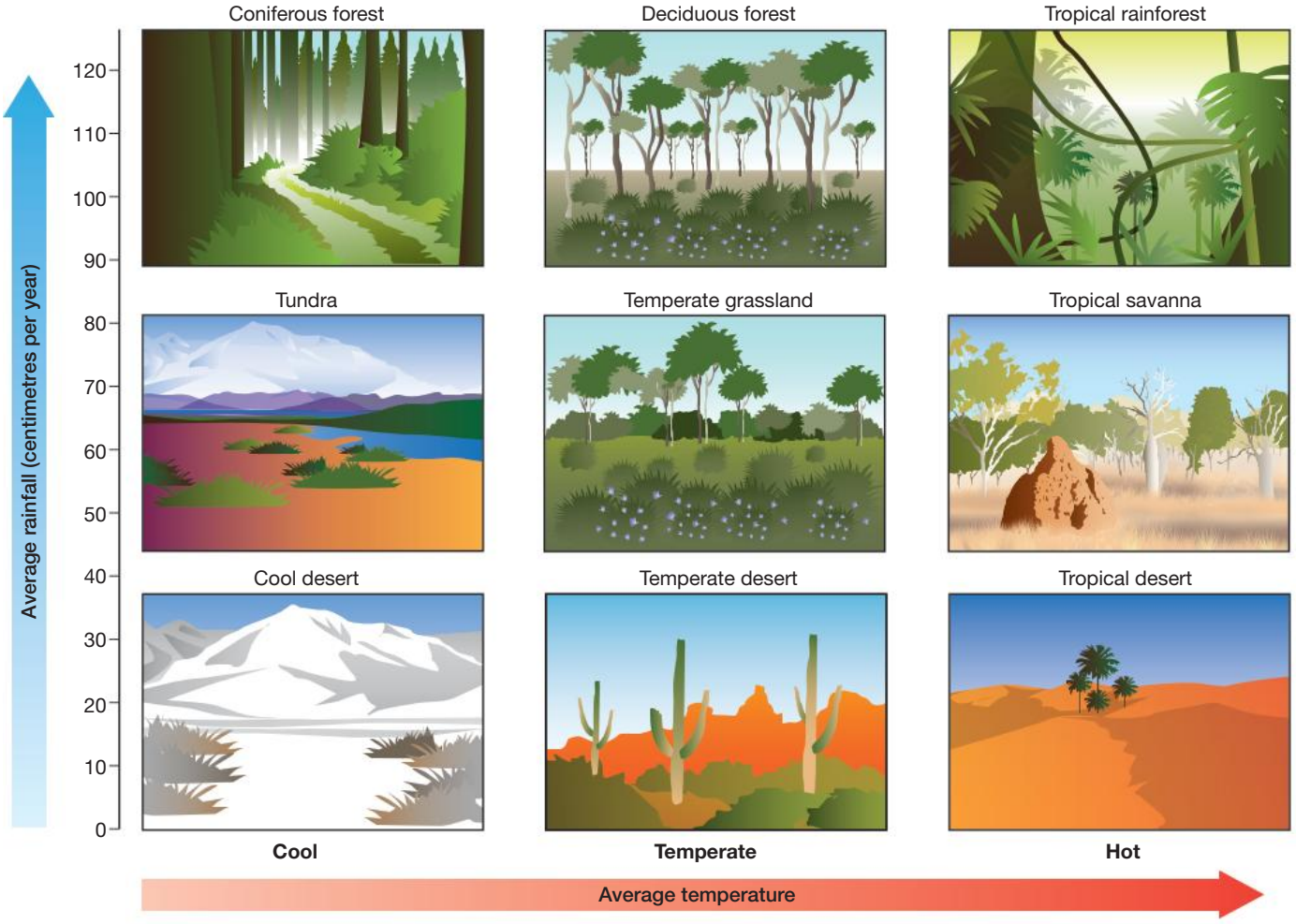
Living organisms interact with each other and their non-living environment. The nature of these interactions determines the variety of ecosystems. Each ecosystem has its own characteristic community of plants and animals that are adapted to a particular set of environmental conditions. Ecosystems can exist:

- on a local scale, for example a small area of wetland
- on a global scale, for example a forest community dominated by a particular type of tree, such as conifers or eucalypts.

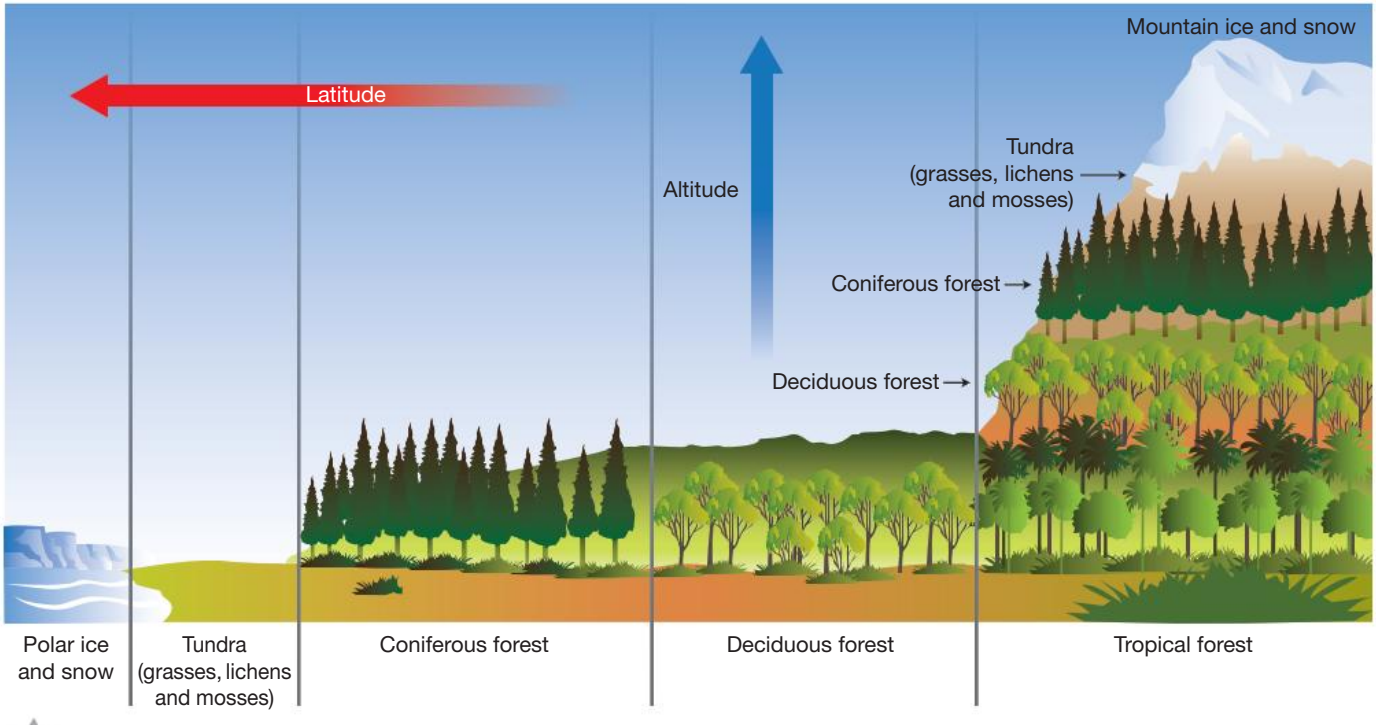
Global ecosystems are often referred to as biomes. The variety of ecosystems on the earth's surface depends mostly on climatic differences. The main types of ecosystems on land are forests, grasslands and deserts. In general, areas of high rainfall have forest, areas of medium rainfall have grasslands and areas of low rainfall have deserts. Figure 2.7 shows how rainfall and temperature interact to produce different types of ecosystems. Figure 2.8 shows how latitude and height above sea level influence ecosystems.

2.6 The major elements of an ecosystem and the interactions between them

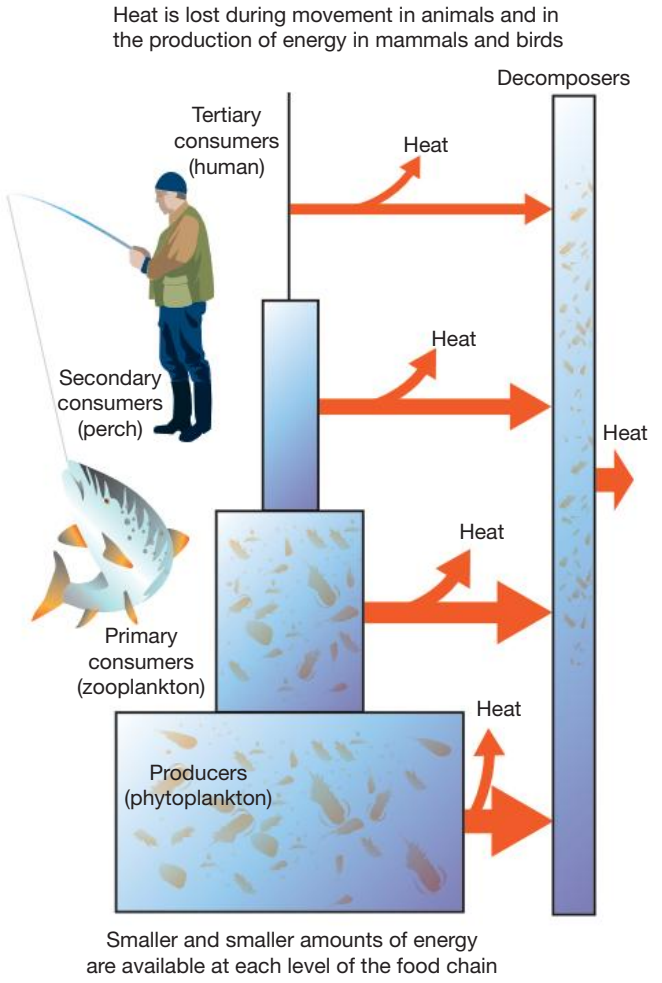




2.7 Temperature and rainfall interact to produce different types of ecosystems.



2.8 Latitude and height above sea level are important factors in producing different ecosystems.



2.9 This food chain shows the transfer of energy and nutrients. The sun is the source of energy for all the levels of the biosphere, including the decomposers, which return the minerals to the producers.

Food chains

Within every ecosystem there are food chains, made up of **producers**, **consumers** and **decomposers**. A food chain, such as the one shown in Figure 2.9, indicates the flow of energy from the sun through to the various kinds of animals in the ecosystem.

Producers

Plants are called the producers in an ecosystem because they produce their own food. They do this by photosynthesis. They use energy from the sun to convert carbon dioxide and water into sugars, starches and cellulose (carbohydrates), producing oxygen as a by-product.

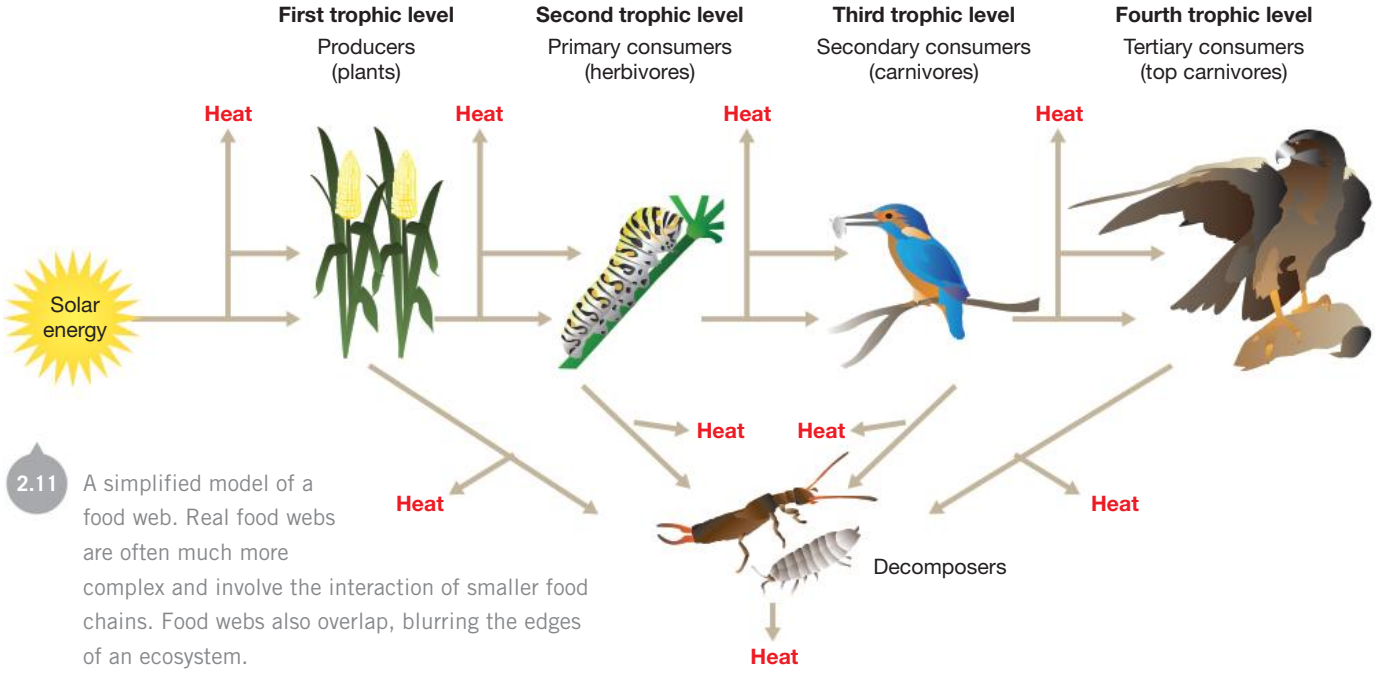
Only plants and a few bacteria can produce their own food. All other organisms are either consumers or decomposers. Animals and humans are the most obvious examples of consumers.

Consumers

Herbivores are primary consumers—they eat only plants. Herbivores include animals that graze on grass, birds that eat seeds, and animals that browse on leaves. These herbivores are eaten by the secondary consumers—carnivores (meat eaters). Some carnivores eat only herbivores; others eat only other carnivores. Those animals and birds that feed on other carnivores are called higher-level, or tertiary, consumers. Examples of these are sharks, hawks and lions. They are said to be at the top of the food chain. This is because the energy from the sun has worked its way through the producers, the herbivores and the lower-order carnivores before it reaches them.

2.10 An owl eating a mouse





2.11 A simplified model of a food web. Real food webs are often much more complex and involve the interaction of smaller food chains. Food webs also overlap, blurring the edges of an ecosystem.

Some animals (including pigs, cockroaches and humans) are both herbivores and carnivores. They eat a mixture of plants and animals and so are called omnivores.

Decomposers

Decomposers include many kinds of bacteria and fungi. Their function in the food chain is to break down (decompose) the wood, leaves and dead bodies of other living things, so that every living thing is recycled. This recycling means that there is no waste in an ecosystem. For example, a mouse eats grains; an owl eats the mouse (see Figure 2.10); a fox eats the owl. Other grains, owls and foxes die naturally and their remains are broken down by decomposers.

Food webs

Although a food chain shows in a simple way how energy moves through different feeding levels in an ecosystem, it does not show all the relationships. Each animal does not eat one type of plant or one type of animal only. A food web shows the more complex interactions between different food chains within an ecosystem. Figure 2.11 shows a simplified model of a food web.

At each level of the food chain or food web, energy passes from one organism to another. The energy for plants comes from the carbohydrates produced by photosynthesis; the energy for animals comes from eating plants and other animals. Most of the energy taken in by an animal is used in the process of living, but a small percentage is passed on to the next-level consumer when the animal is eaten, or to the decomposers when the animal dies.

At each level of the food chain, most of the energy is used up in living; only a little goes to the next level. This means that less energy is available at each higher level of the food chain. For example, of 100 units of energy produced by plants, only 0.1 unit is available to humans, who are at the top of the food chain and eat carnivores that have eaten herbivores that have eaten plants. More people can be supported if they eat grains and vegetables than if they feed grains and vegetables to animals and then eat the animals.

ACTIVITIES

2.1

Knowledge and understanding

1. Outline the factors that interact to produce the variety of ecosystems on earth.
2. Explain how ecosystems get their energy.
3. Explain the difference between a producer and a consumer in a food chain.
4. Outline how green plants manufacture their own food.
5. a Explain the difference between a herbivore and a carnivore.
   b What is an omnivore?
6. Outline the role of decomposers in the food chain.

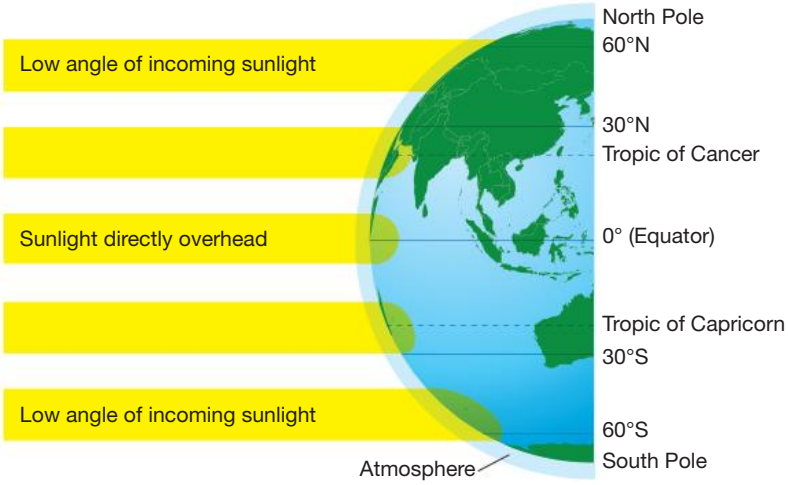
Applying and analysing

7. Discuss why there is no waste in an ecosystem.
8. Differentiate between a food web and a food chain.
9. Explain what happens to the energy that is taken in by an animal when it eats some grass?
10. Study Figure 2.9. Write a short report describing the flow of energy within an ecosystem.

2.3 The global distribution of biomes

There are many factors that affect the types of ecosystems found across the earth's surface. These factors operate on both local and global scales. The type of ecosystem at the bottom of a steep-sided valley is usually different from the ecosystem at the top due to factors such as shade, wind and moisture. At the global level, climate factors have the most significant impact on the distribution of ecosystems.

2.12 Solar insolation is the amount of solar energy that reaches the surface of the earth. It is greatest at the Equator.



2.13 Impact of latitude on solar insolation

Latitude (°)	Insolation (%)
0 (Equator)	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 (poles)	41.6

Latitude

Latitude plays a crucial role in determining climate on a global scale. Latitude is a measure of the distance from the Equator—the imaginary line that runs around the earth at its widest circumference. At the Equator the earth presents the greatest landmass towards the sun, as shown in Figure 2.12. The amount of solar energy that reaches a particular part of the earth is referred to as solar insolation. Solar energy is greatest at the Equator and lowest at the poles. Table 2.13 shows the relationship between latitude and the amount of solar insolation.

Solar insolation is important to ecosystems because it is from the sun that ecosystems derive their energy. Without the sun, plants are unable to photosynthesise and therefore are unable to produce the energy to grow and survive. Without plants, there could be no animals, and ecosystems could not function. Ecosystems close to the Equator have the most amount of energy and are therefore able to support the greatest diversity of life. Tropical rainforests, such as the one shown in Figure 2.14, grow in the world's equatorial region and are thought to contain about 50 per cent of all the plants and animals on earth.



2.14 Tropical rainforests grow at the Equator and are the most productive of ecosystems.

At the other extreme, the polar regions receive the least amount of solar insolation. They have almost 24 hours of total darkness in winter. Such ecosystems are the harshest places of all to survive in and have the least diverse ecosystems. Antarctica, shown in Figure 2.15, is the coldest, driest and windiest place on earth.



2.15 Along with the Arctic, Antarctica receives the least amount of solar energy and therefore has little energy to support diverse life.

Precipitation and temperature

Rainfall is the main component of precipitation (sleet, snow, hail and dew are the other forms). Water is critical for plant growth and is essential for animals. In areas with low levels of precipitation, such as deserts, life is limited. Plants and animals have to become highly specialised and diversity is limited, as shown in Figure 2.16.

Temperature is another key factor in determining the distribution of ecosystems on a global scale. Most plants prefer a temperature range of between 10°C and 35°C.



2.16 Desert plants have had to adapt to a lack of precipitation.

Outside this range, photosynthesis is more challenging and plant growth is limited. Less plant growth means less food available for animals.

There is a strong link between precipitation, temperature and latitude. Solar energy is a key factor in determining temperature, and the Equator has the most constantly warm temperatures. Precipitation is also affected by solar insolation. When solar energy is high, the amount of evaporation increases and rain is more likely.

ACTIVITIES

Knowledge and understanding

1. State what solar insolation is.
2. Explain the importance of solar insolation to ecosystem formation.
3. Describe the importance of precipitation on ecosystems.
4. What is the optimum temperature range for plant growth?

Applying and analysing

5. Examine Figure 2.12 and Table 2.13. Demonstrate how latitude affects solar insolation.
6. Write a short report explaining the importance of latitude in determining the global distribution of ecosystems.
7. Using the information in the text, create a Venn diagram comparing polar and tropical rainforest ecosystems. Are there any similarities? Explain.
8. Using Table 2.13 and an atlas or online map, find the latitude where you live and the nearest solar insolation percentage.

2.4 The world's major biomes

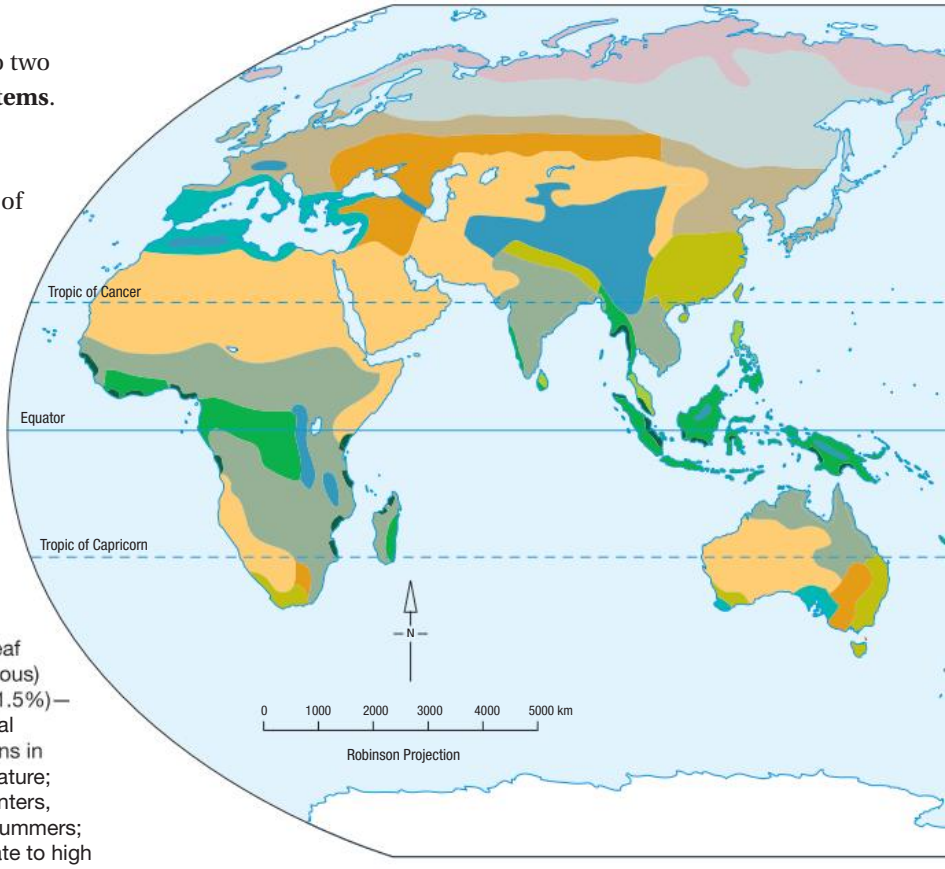
One way to classify the earth's biophysical environments is to look at the different types of ecosystems found on the earth's surface.

Ecosystems

The many ecosystems that exist can be divided into two groups: **aquatic ecosystems** and **terrestrial ecosystems**.

Aquatic ecosystems are water-based ecosystems. They include open oceans, river estuaries (the part of a river influenced by the sea) and coastal wetlands.

Terrestrial ecosystems are land-based ecosystems. The earth's major terrestrial ecosystems are shown in Figure 2.17. The earth's terrestrial ecosystems are usually named after the type of vegetation that dominates the area. The type of vegetation, in turn, depends mainly on climate.





Broadleaf (deciduous) forest (1.5%)—seasonal variations in temperature; cold winters, warm summers; moderate to high precipitation

Deserts (21%)—very dry, low humidity, both hot and cold; large daily range in temperatures



Mediterranean shrubland (1%)—wet winter, dry summer



Tundra (5%)—long severe winters, short cool summer



Mountains (alpine) (11%)—temperatures decrease with elevation



Tropical rainforest (2%)—warm to hot temperatures throughout the year; high rainfall



Tropical savanna (24%)—distinct wet and dry seasons; high temperatures in summer

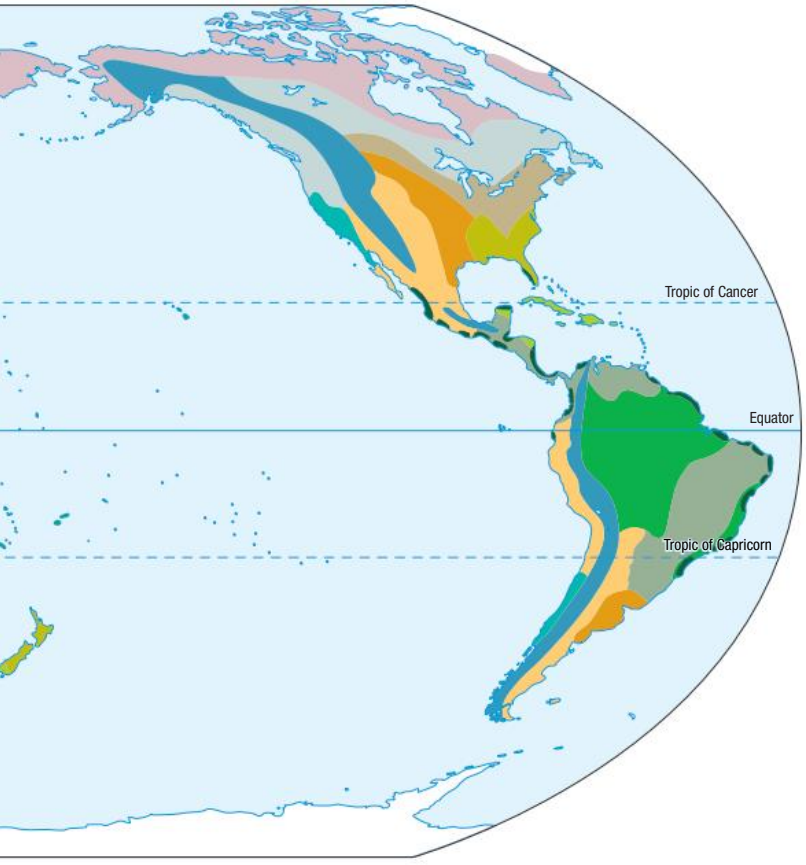


Temperate grassland (9%)—warm to hot summers, cold winters; relatively low rainfall



Broadleaf (evergreen) forest (9%)—cool wet winters and dry mild summers







Coniferous (taiga/boral) forest (14%)—long cold winters, short cool summers



Mangroves (<1%)—variable rainfall, temperate climates

2.17 The earth's major terrestrial (land-based) ecosystems

Polar (11%)—very cold, low precipitation



ACTIVITIES

2.2 2.3

Knowledge and understanding

1 Distinguish between aquatic and terrestrial ecosystems.
2 After what characteristic are most terrestrial ecosystems named?
3 Explain the role of climate in determining the type of ecosystems that exist in an area.

Geographical skills

4 Study Figure 2.17. With the aid of an atlas, write a report describing the distribution of the earth's major terrestrial ecosystems.

2.5 Case study: Intertidal wetlands

Intertidal wetlands are among the most productive ecosystems on earth. For many years they were viewed as smelly, mosquito-infested wastelands only good for draining. Little thought was given to the impact of their destruction. Today they are valued for the wealth of life they support and many vital roles they play in protecting shorelines.

Life in the intertidal zone

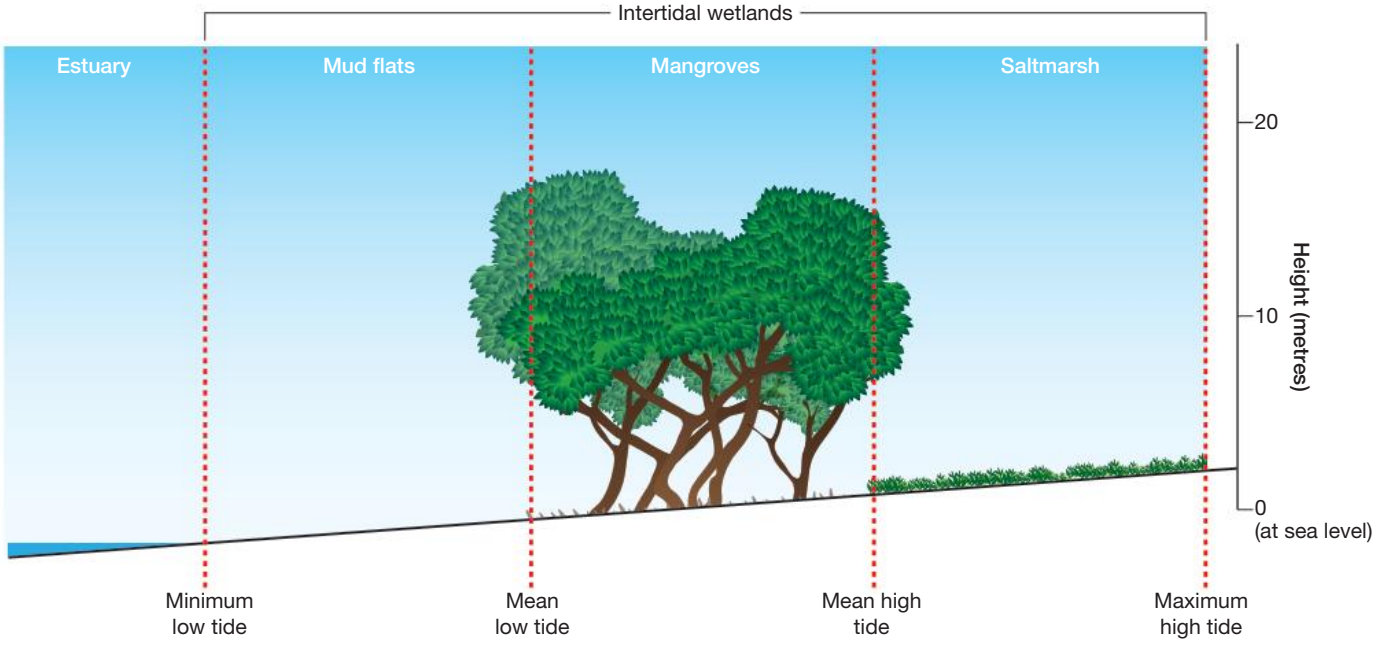
Coastal areas include a number of different habitats. The most productive are found in the estuaries, where rivers meet the sea. They are partially enclosed bodies of water, where sea water mixes with the fresh water that drains from the land. These waters are shallow, warm, calm and rich in nutrients. Extending inland from the estuaries are the **intertidal wetlands**. They cover the shoreline and are periodically inundated by salt water as the tide changes. The gravitational pull of the sun and the moon causes the tides to rise and fall about every 6 hours.

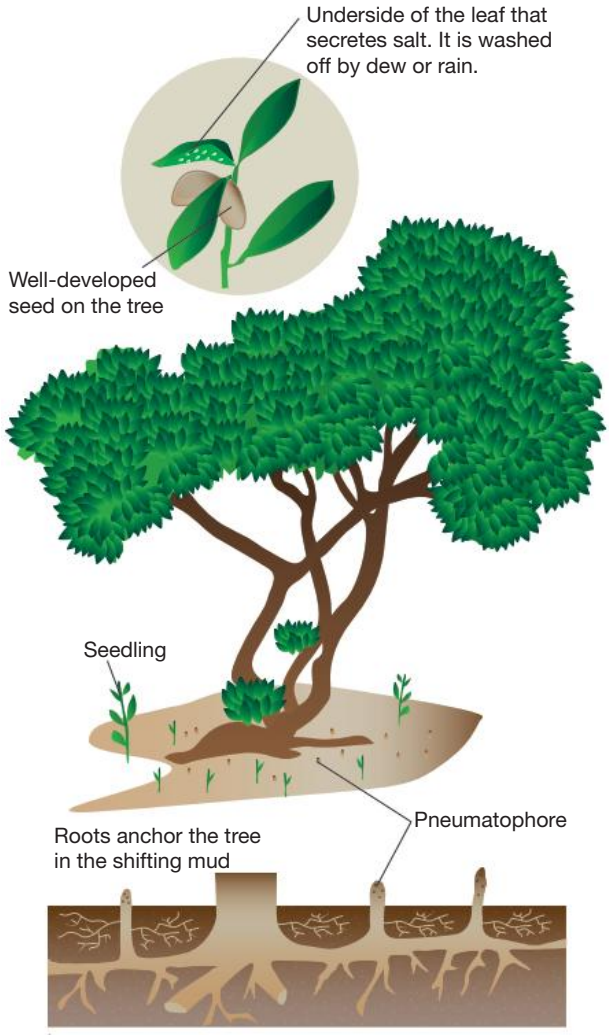
Seagrass beds are an important component of the estuarine environment. They consist of plants that grow underwater in the shallows and are anchored to the muddy bottom, while their leaves float in the water. They stabilise the shoreline and capture the sediment flowing in from the land. Over time this trapped sediment gradually develops into mud flats.

The variation in tidal levels determines the life forms that are able to survive in the intertidal wetlands. There are distinct zones within an intertidal wetland, as illustrated in Figure 2.18.

The mud flats are found between the minimum low tide and the mean low tide, so they are under water for a considerable amount of time. While this inhibits the growth of vegetation, the mudflats teem with organisms that are immersed in the nutrient-rich mud. In suitable climates, mangrove trees are found between the mean low-tide and the mean high-tide mark. They are a highly specialised salt-tolerant species that have an extensive root system that both anchors them in the shifting mud and enables them to obtain oxygen. Beyond the mean high-tide mark and up to the maximum high-tide mark is the environment of the saltmarsh, where hardy plants cover the ground.

2.18 The distinct zones within an intertidal wetland are a result of different tide levels.





2.19 The mangrove tree has various adaptations that enable it to cope with a hostile environment.

Mangrove forests

A mangrove is a salt-tolerant plant that grows between the land and the sea, where the mud on the shoreline is regularly covered and uncovered by the tides. In all, there are sixty-nine species of mangrove worldwide. Mangroves line about 70 per cent of the gently sloping coastlines in tropical and subtropical regions, particularly South-East Asia.

Mangroves have to cope with a hostile and constantly changing environment with:

- high levels of salinity, as they live in sea water
- waterlogged soils that are oxygen-deficient
- the daily rhythm of the tides moving in and out
- shifting, soft mud below them
- unpredictable flows of fresh water after heavy rain and run-off from the land, which alters the salinity of the water.

Mangroves have a number of adaptations, shown in Figure 2.19, that enable them to grow successfully. They have an extensive root system that provides support for the tree and enables them to obtain oxygen. Some species have **pneumatophores**, which are a special type of root that extends upwards from the main root system, enabling them to absorb oxygen when exposed at low tide, as shown in Figure 2.20.

2.20 Pneumatophores acts like snorkels and enable the mangrove tree to obtain oxygen.





2.21 Salt crystals on the underside of a mangrove leaf

Mangroves are also able to prevent most of the salt from entering their roots; any salt that does enter is generally secreted through the leaves, as in Figure 2.21.

Some mangroves have also developed specialised forms of reproduction, with the mangrove seed remaining on the parent plant, where it germinates and grows stems and roots before it falls down into the water and floats away. Once it become lodged in the mud it quickly produces additional roots and begins to grow.

The saltmarsh

Beyond the mangroves, the hypersaline conditions of the saltmarsh make for an even harsher environment. The salt concentration is 105 milligrams per litre, compared to sea water, which is 35 milligrams per litre. The reason for it being is so high it that the saltmarsh is covered by king tides only twice a month and when they recede the shallow water quickly evaporates, leaving the salt to accumulate in the soil over time.

DID YOU KNOW?

Wetlands are areas of land that are periodically or permanently inundated by water.

The saltmarsh is covered with low-growing plants that can tolerate the high soil salinity and tidal inundation. They survive the saline conditions by largely excluding the salt at their roots. Some accumulate salt in their fleshy stems, which eventually drop off. The succulent nature of such plants also enables them to store water. They have tiny leaves to reduce water loss through transpiration, as freshwater is not readily available.

A highly productive biome

The intertidal wetlands are among of the earth's most productive biomes for a number of reasons:

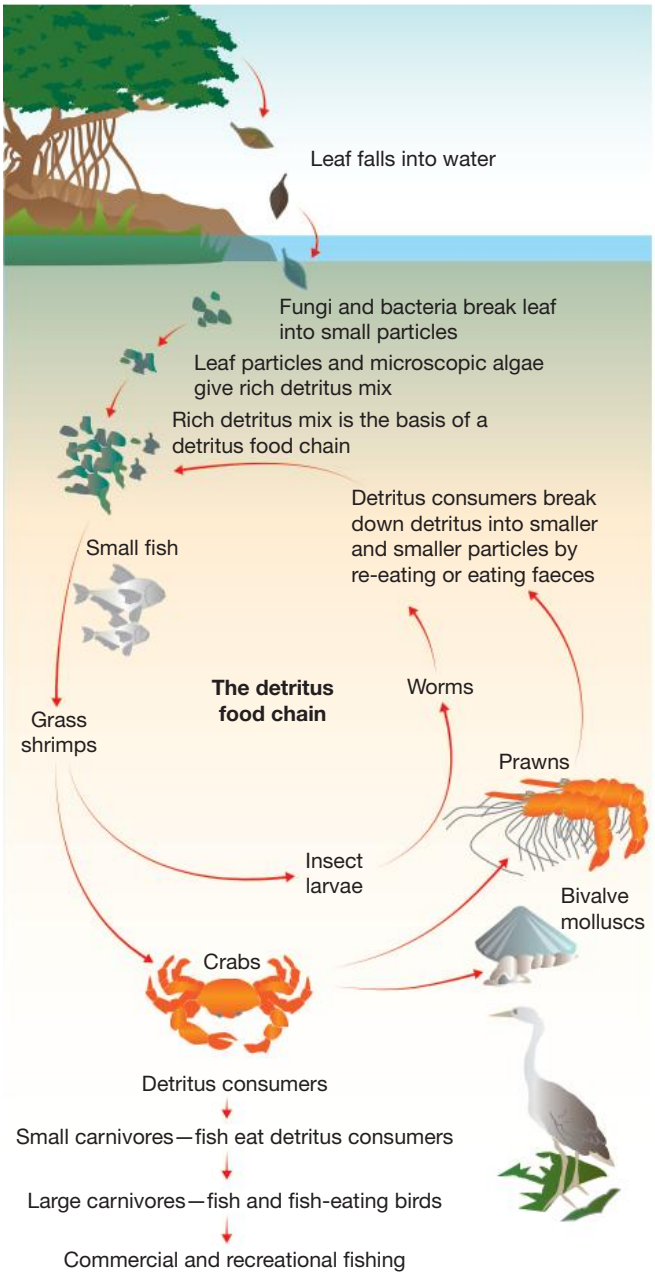
- high-nutrient run-off from rivers and nearby land drains into estuaries. Most nutrients are attached to the sediment that builds up on the mudflats
- rapid circulation of nutrients by tidal flows
- an efficient detritus food chain, as shown in Figure 2.22
- ample sunlight penetrating the shallow waters
- multiple primary producers.

Multiple producers

Three types of producers provide new organic matter within ecosystems: macrophytes, phytoplankton and benthic organisms.

- ***Macrophytes*** are terrestrial plants that grow on land and produce plant food through photosynthesis. The mangroves and plants that cover the saltmarsh are macrophtyes.
- ***Phytoplankton*** are free-floating microscopic organisms in the water that also photosynthesise. In the intertidal wetlands, algae not only float in the water, but are also attached to the roots of mangroves.
- ***Benthic organisms*** are tiny organisms such as diatoms and bacteria that live in the sediments. They produce nutrients by anaerobic means (without oxygen). As they are not dependent on light, they continue producing during the night and are responsible for the unpleasant smell in wetlands.

Most ecosystems have only one or at most two of these producers supporting the food chain. However, estuaries and intertidal wetlands have all three types of producers, which accounts for their high net primary productivity. They are so productive that they are net exporters of nutrients and support multiple food chains in nearby coastal ecosystems.



2.22 Detritus food chain in a mangrove ecosystem

Importance of intertidal wetlands

Intertidal wetlands are immensely important ecosystems. In terms of global food production they form the basis of marine food chains and sustain fisheries providing the breeding grounds for two-thirds of the world's fish catch. Their still waters are a nursery for eggs and fry (younger, hatched fish) as well as a rich source of food.

They also protect the environment in many ways by filtering the sediments that are loaded with excess nutrients and toxic pollutants. The tangle of roots and dense vegetation also act as shock absorbers to reduce the impact of large waves whipped up by storms or resulting from a tsunami. They are also important habitats for migratory birds.

Mangrove destruction

Researchers believe that almost half of the world's mangrove forests have been destroyed, mostly for coastal development projects such as canal estates and prawn farms. This destruction is most noticeable in countries such as Bangladesh and the Philippines, where 75 per cent have already gone.

High-value mangrove forests

According to a United Nations Environment Programme, intact coastal mangrove forests are worth US$200 000–$900 000 per square kilometre per year, depending on location. This estimate is based mostly on their sustainable use for fishing and fuelwood and does not include the much larger value for their ecological services. This is 10–45 times more than the income of about $20 000 per hectare when mangroves are cleared for aquaculture. Protecting mangroves costs only about $1000 per square kilometre per year (from G Tyler Miller, *Living in the Environment*, fifteenth edition, Thomson Brooks/Cole, Belmont, 2007).

ACTIVITIES

Knowledge and understanding

1. Define the term 'estuary'.
2. Identify the location of an intertidal wetland in an estuary.
3. Explain how changing tides create different zones.

Applying and analysing

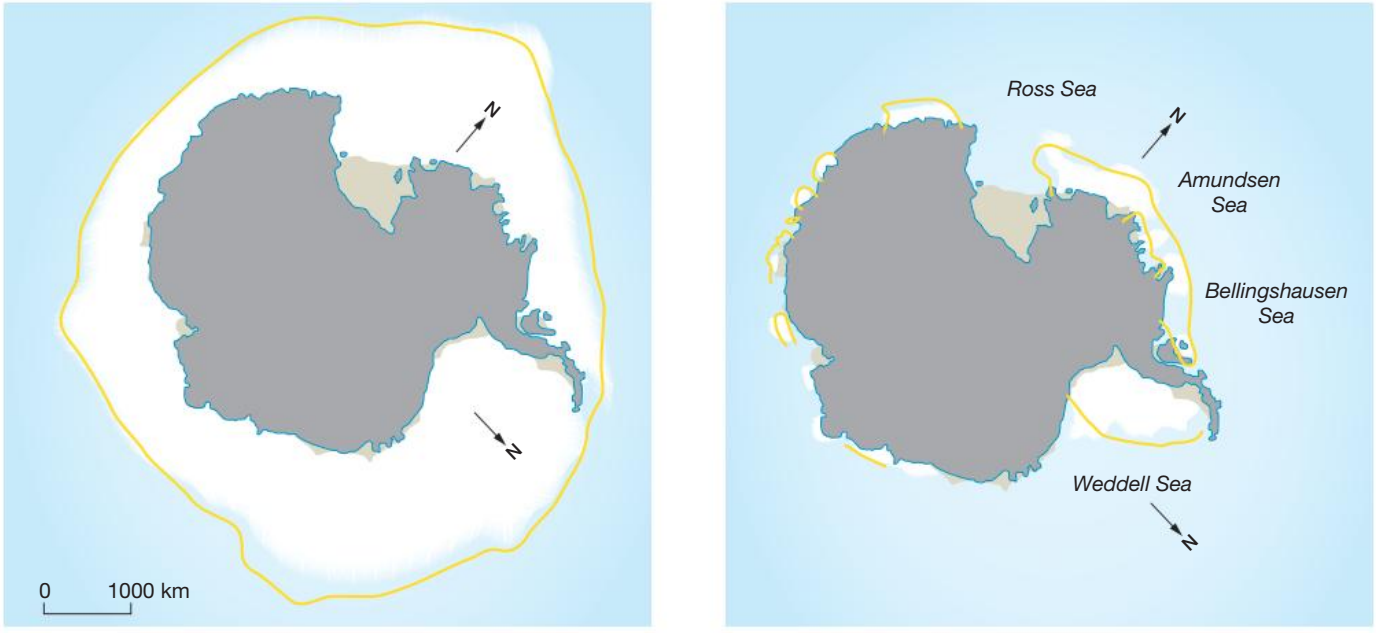
4. Write an extended response accounting for the productivity of intertidal wetlands.
5. Justify the protection of intertidal wetlands.

Investigating

6. Research information about the organisms that live in the mud of the wetlands and present your findings in an annotated visual display.

2.6 Case study: Antarctica

Antarctica is one of the last great wilderness areas left on earth. This vast continent covers almost 14 million square kilometres. Antarctica is the world's largest desert as it receives on average less than 200 mm of rainfall per year.



2.23 Sea ice cover in winter (left) and summer (right)

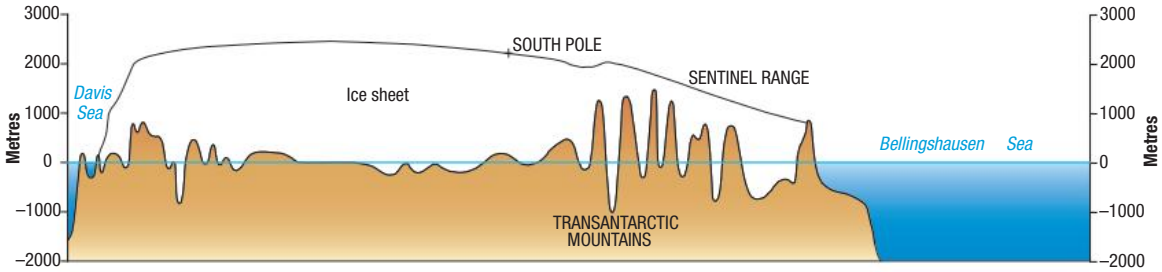
Ice

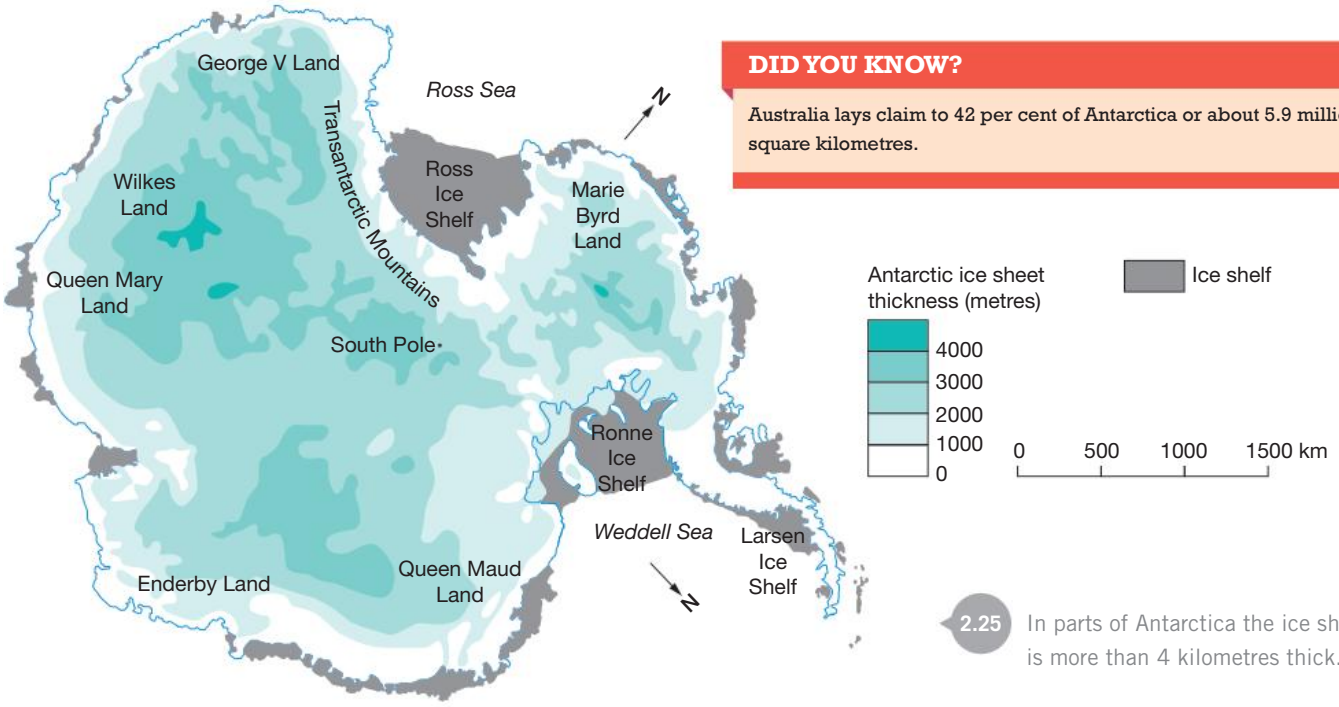
Ice is the dominant feature of the Antarctic landscape. Ice covers more than 98 per cent of the landmass. During the depths of winter the ice mass swells to around 20 million square kilometres as the surrounding seas freeze, forming huge ice sheets as shown in Figure 2.23. A vast mass of ice, illustrated in Figure 2.24, lies on top of the landmass at an average depth of 2300 metres. In some places it is more than 4000 metres thick, as shown in Figure 2.25. The weight of all this ice mass is so great that it has depressed the earth's crust below Antarctica by about 600 metres, pushing it into the molten magma below.

2.24 Cross-section of Antarctica along the 90° line of latitude

Cross-section along the 90° east and west line of longitude

Vertical scale is exaggerated 250 times the horizontal scale.





DID YOU KNOW?

Australia lays claim to 42 per cent of Antarctica or about 5.9 million square kilometres.

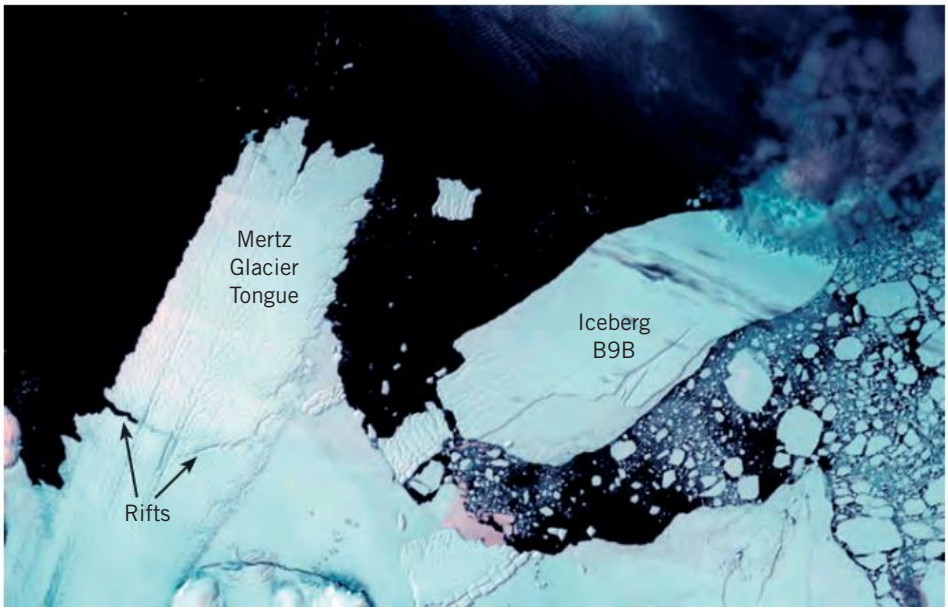
2.25 In parts of Antarctica the ice sheet is more than 4 kilometres thick.

Impact of climate change

Antarctica plays a critical role in the world's climate and much of the research into climate change has focused on this frozen continent. The Intergovernmental Panel on Climate Change, the United Nations body of scientists responsible for researching climate change, has reported that the gradual melting of the Antarctic ice sheets is contributing to sea level rise globally of about 25 millimetres per year. Since detailed measurements started in 1993 it is estimated that around 100 billion tonnes of ice have been lost each year.

It is mostly around the coastal areas of western Antarctica that this loss is occurring. Here the landmass below the ice sheet is actually below sea level. Such geology makes the ice more unstable and results in the ice sheet disintegrating more easily, as shown in Figure 2.26. However, research has also shown that the ice sheet over much of eastern Antarctica and in the centre of the continent has thickened over the last few decades, and this may offset some of the loss closer to the coast.

The Australian Antarctic Division estimates that Antarctic sea ice will reduce by about 24 per cent by 2100. At the same time it will become less dense, resulting in its total volume shrinking by up to 34 per cent. The reduction in sea ice will have a significant effect on ocean currents that push cool water northwards towards the Equator. This, in turn, will increase sea temperatures in the Southern Hemisphere, further disrupting global climatic patterns.



2.26 In 2010, B9B, a massive iceberg more than 100 kilometres long, detached from the western Antarctic ice sheet.

Life on the frozen continent

Flora

Less than 0.5 per cent of Antarctica is ice-free, making it the least hospitable continent for plant life. There are just a few tiny pockets of land on which plants have established some of the rarest ecosystems on earth. One such pocket is found around the Australian Antarctic Division base at Casey. Mosses, shown in Figure 2.27, are the largest plants around Casey. These ancient plants were some of the first to evolve to grow on land.



2.27 Moss growing in the Casey region of Antarctica. This is one of the few areas on the continent where plants can grow

Fauna

There are virtually no terrestrial animals on Antarctica. A few species of tiny invertebrates, such as the Belgia Antarctica, a type of fly, survive on the algae and mosses. In contrast to the very sparse life on land, Antarctica's seas are highly productive and support an abundance of animal life.

The Southern Ocean, which encircles the continent, is rich in phytoplankton. Zooplankton, tiny animals that feed on the phytoplankton, form the basis of the Antarctic food chain.

Krill is the most common form of zooplankton and is the primary source of food of much of Antarctica's fauna, including the giant squid, several fish and bird species and even the enormous blue and humpback whales.

Survival in Antarctica requires a number of special adaptations. These include insulation from the extreme cold. For some species, such as whales and seals, thick layers of fat act like a blanket trapping body warmth. Some fish species, such as the Antarctic tooth fish, have special proteins in their blood that stop it from freezing, just as antifreeze is added to cars in freezing conditions.

Whales

The whales are the largest animals of the Antarctic ecosystem. Several species are found in the Southern Ocean and seas of Antarctica. Baleen whales use the Antarctic waters for feeding during the warmer summer months,

SPOTLIGHT

Emperor penguins

Emperor penguins are the largest of all the penguin species. Fully grown males can be as tall as 1.2 metres and weigh up to 40 kilograms. The emperor penguin holds a special place among the Antarctic animals in that it is the only animal to breed on the continent during the harsh winter. From April to May each year the emperors journey from their feeding grounds on the edge of the sea ice to breeding grounds inland, gathering into colonies as large as 25 000 breeding pairs.

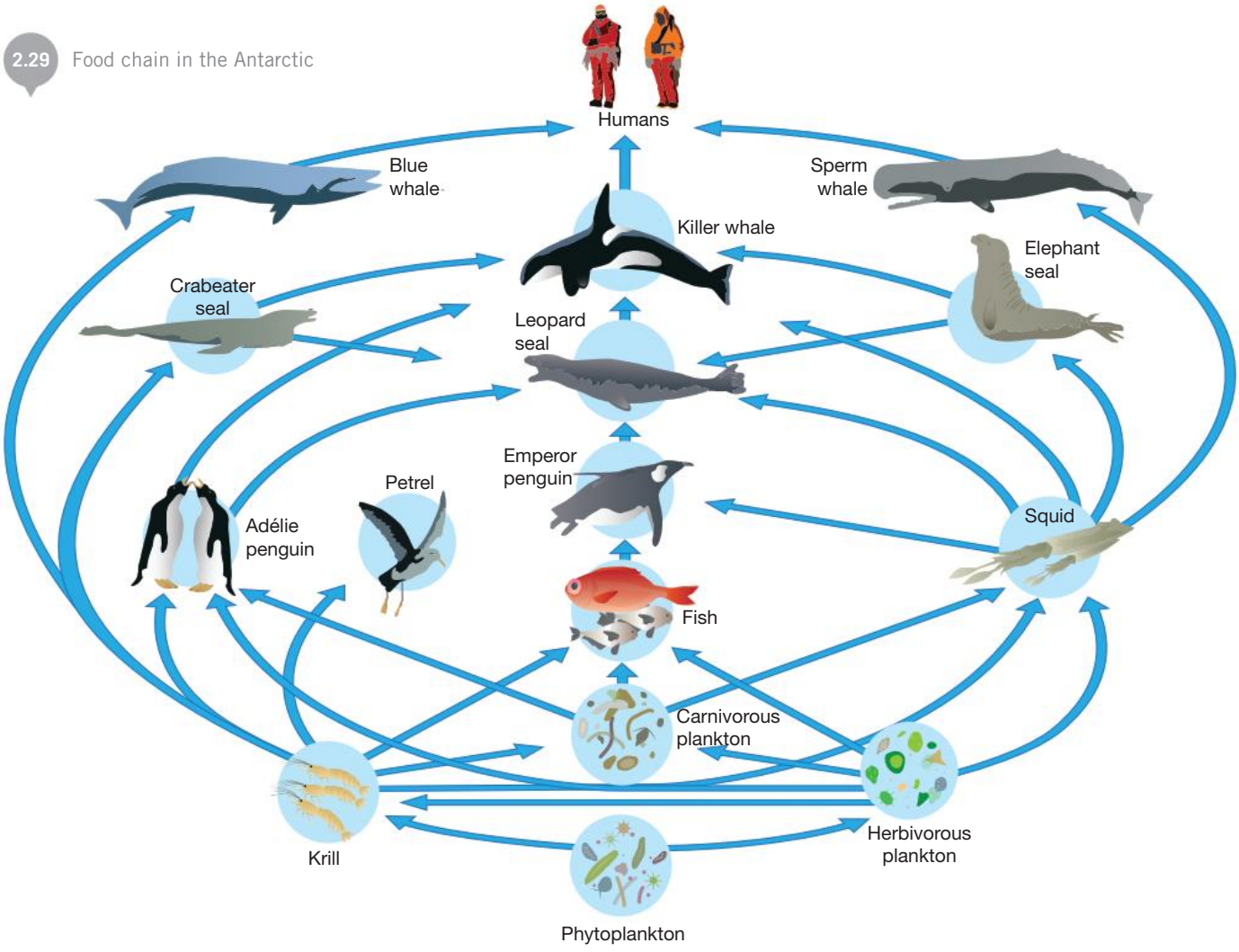
The female lays a large egg and passes it carefully to her mate, who holds the egg on his feet, ensuring it does not touch the freezing ground. The female then returns the feeding grounds, leaving the males huddled together for warmth as the long dark Antarctic winter sets in. It is estimated that by huddling together the penguins reduce the amount of heat lost by 50 per cent. In a remarkable display of cooperation, individual penguins take turns in being on the outer edge of the huddle, taking the brunt of the freezing gale-force winds. They then take a turn in the far warmer inner circle.

Within 65 to 70 days, the chick hatches and stays under the protective feathers of the father. The female returns in July and takes over the care of the chick from the male. By this time the males have not fed for up to 4 months and will have lost half their body weight. The father returns to the sea to hunt and feed. Over the next few months both parents make the long migration to the feeding grounds several times to bring food back to their young chick. Within around 150 days of hatching, the chicks are ready to leave the nest.



2.28 Emperor penguins

2.29 Food chain in the Antarctic



migrating thousands of kilometres northwards during the winter for breeding and calving. Toothed whales, such as the orca, feed on larger species, such as seals and penguins, while the elusive giant squid is the favoured food of the sperm whale.

Penguins

Penguins are perhaps the most iconic of the Antarctic animals. Penguins live both on land and at sea. These flightless birds are highly adapted to their marine existence. They are excellent swimmers and can dive to considerable depths in search of prey. Penguins evolved flippers instead of wings, which they use to propel themselves through the water. Their waterproof coats consisting of short overlapping feathers, help to insulate them against the harsh cold.

All seventeen species of penguins live in the Southern Hemisphere. Four of these are found in Antarctica and its surrounding islands. The Adélie and emperor penguins breed on the shores of the continent, while the chinstraps and the gentoos are found in the Antarctic islands.

Figure 2.29 illustrates the Antarctic food chain.

ACTIVITIES

Knowledge and understanding

1. Describe the extent (size) of Antarctica.
2. Explain why the ice sheet in western Antarctica is at greater risk of disintegration.
3. Describe how a reduction of Antarctic sea ice will affect the global climate
4. Outline the nature of Antarctica's flora.
5. Describe the importance of plankton in the Antarctic food chain.

Applying and analysing

6. Examine Figures 2.23 and 2.26. Write a report on the effect of ice on the geography of Antarctica.
7. Using a flow chart or other graphic organiser, describe the breeding cycle of the emperor penguin.
8. Less than 0.5 per cent of Antarctica is ice free and these areas are where tourists mainly visit. Using the information in this unit create a PMI chart about tourism in Antarctica.

2.7 Australia's major ecosystems

Australia has a diverse selection of highly valued aquatic and terrestrial ecosystems. The immense diversity found on and around the continent is a product of its size, latitudinal extent and long coastline, as well as a long geological history. This is reflected in the particular combinations of plants and animals found within the different ecosystems.

Diverse ecosystems

Australia is one of the earth's seven continental landmasses. Among the continents, Australia is unique in many ways and possesses a remarkable wealth of life, despite the harsh natural environment.

Aquatic ecosystems

Australia's aquatic ecosystems are found in marine and freshwater environments. These are illustrated in Tables 2.30 and 2.31.

2.30 Australia's marine aquatic ecosystems

Marine

With such a long coastline, there are many highly specialised marine ecosystems found around Australia.



a Rottnest Island, Perth, Western Australia

Coastal zone: the warm, nutrient-rich, shallow waters that extend from the high-tide mark on land, to the gently sloping, shallow edge of the continental shelf (the submerged part of the continent). This water is disturbed by wind (producing waves at its surface) and ocean currents. Copious amounts of seaweed float in the water, supporting animals such as sea snails, crabs and lobsters. Fish abound and larger animals, such as turtles and whales, move through on their migration routes.

Along the shoreline of the coast there are beaches and rock platforms under the cliffs of headlands, where tidal pools are found.



b Gippsland Lakes, Victoria

Estuaries and their associated coastal wetlands: where sea water mixes with fresh water and nutrients from rivers and surface run-off. It includes inlets, bays, river mouths and the fringes of land that are inundated by the changing tides. Many of these sheltered areas are covered with mangrove forests. In the northern Australia the tidal range is quite substantial and so the tidal reach inland is far-reaching. This is the habitat of the freshwater crocodile.



c Great Barrier Reef

Coral reefs: occur in shallow seas along much of north-eastern Australia, where the Great Barrier Reef (the largest coral reef system in the world) is found. Scattered reefs, such as Ningaloo Reef, are found along the Western Australian coast. Coral reefs are one of the most complex ecosystems on earth and support immense biodiversity.

Freshwater

Despite being such a dry continent, Australia does have distinct and valuable freshwater ecosystems.

a Finke River, Northern Territory



Watercourses: across the surface of Australia, there are a number of watercourses that mostly drain towards the sea, though inland rivers such as the Diamantina and Barcoo empty into Lake Eyre in rare outback rain events. While river flow in Australia is characteristically quite low, it is also highly variable. A riverbed can become merely a chain of waterholes in a dry spell and then transform into a torrent after heavy rain. The ecosystem supports a multitude of life forms, from microscopic organisms in the mud on the bottom of the channel to large populations of freshwater fish.

b Kakadu National Park, Northern Territory



Freshwater wetlands: associated with rivers, flood plains, lakes and groundwater discharges. Some bodies of still water are only linked to the main river by floodwaters, but they are very productive ecosystems rich in life forms. Many are like a rich soup of micro-organisms that young fish, such as the Murray cod fry, rely on to survive. The diversity of algae found in these wetlands ensures the continual productivity.

c Cradle Mountain and Dove Lake, Tasmania



Lakes: are large natural bodies of still or standing fresh water that fill depressions on the earth's surface. They are not common in Australia, but they do support characteristic life forms in different layers, depending on the depth of the water and the amount of sunlight available.

Terrestrial ecosystems

Spanning almost 33° of latitude, Australia's climate ranges from the hot, wet tropical far north, to a cool temperate (with snow) south. Australia is the driest inhabited continent in the world, with the Lake Eyre region in South Australia averaging only 100 millimetres a year. Tully, in northern Queensland, has an annual average of 4204 millimetres. The responses to so many different climate regimes across such a vast continent underpin the diversity found in Australia's terrestrial ecosystems, which are outlined in Table 2.32.

2.32 Australia's terrestrial ecosystems

a Rainforest in Queensland



Only found in isolated pockets on the well-watered eastern side of the Great Dividing Range where annual rainfall exceeds 1200 to 1500 millimetres. Tropical rainforests are found in the hot climate of northern Queensland, but as the temperatures decrease towards the south, subtropical rainforests take over. In the cooler states of Victoria and Tasmania, cool temperate rainforests are found. Rainforests are characterised by a closed canopy of tree crowns and a large diversity of species of plants, animals and insects.

b Forest in Southern Australia



Sclerophyll forests are dominated by eucalypt trees, which have hard leathery leaves that are able to survive in the poor, phosphate-deficient soils of Australia. Wet sclerophyll forests have tall eucalypt trees sheltering an understorey of moisture-loving shrubs. They generally occupy moist gullies on the shaded southern side of highland areas and wetter eastern coast. Dry sclerophyll forests have smaller trees that are well spaced, allowing the sun to reach the understorey, where hardy plants, such as banksias and grevilleas thrive. Such forests burn fiercely, but then regenerate.

c Eucalypt woodlands near Horsham, Victoria



The eucalypt woodlands have fewer and shorter trees scattered among grasses and shrubs. In the semi-arid fringes, the mallee tree survives droughts and fires because it has a large lignotuber that is protected underground. The temperate grasslands have no trees but are dominated by extensive perennial grass tussocks such as kangaroo grass, which dominate the landscape.

d The Kimberley, Western Australia



Large, generally flat areas covered by extensive grasslands (such as Mitchell grass) with a few low, scattered trees are found across northern Australia. The climate has a distinct wet and dry season, with fires common in the dry season. Marsupials dominate the animals of the savanna.

e Uluru-Kata Tjuta National Park



Two-thirds of Australia is desert or semi-desert (receiving less than 250 millimetres or between 250 and 300 millimetres of annual rainfall respectively). Some desert surfaces are covered with sand or stones. Others have tussock and hummock grasslands containing spinifex grasses, with acacias and low shrubs such as saltbush. Animals such as the bilby and reptiles such as goannas survive by burrowing underground to avoid the extreme heat.

f Snowy Mountains, Kosciuszko National Park, New South Wales



Mountains of sufficient height have unique ecosystems. The highest parts of the Snowy Mountains in southern NSW are too cold for trees to grow. The alpine area only occupies 100 square kilometres around Mt Kosciuszko. The alpine area is a mosaic of heathland, alpine grasses, herbfields and bogs, interspersed by protruding rocks. Highly specialised plant and animal communities are adapted to the extreme cold, such as the marsh marigold, which flowers under the snow, giving it enough time to spread seed in the brief summer.

ACTIVITIES

Knowledge and understanding

1 List the reasons why Australia has such diverse aquatic and terrestrial ecosystems.

Applying and analysing

2 Study Tables 2.30, 2.31 and 2.32 then do the following tasks.

a Create a four-column table, label the columns with the following headings and fill in the table:
- photograph letter (according to table)
- type of ecosystem (select from the tables)
- dominant features (include information about climate where available).

b Individually rank the photographs, from the environment that appeals to you the most to the environment that appeals to you the least.

c List the criteria you used.

d In groups of four, compare your individual rankings and criteria. Then as a group, rank the photographs. What criteria did the group use?

e Share your group's rankings with the rest of the class. How much agreement was there?

2.8 Productivity of ecosystems

All life on earth depends on the production of new organic matter within ecosystems. This production is carried out by the primary producers, which form the base of the food chain. Various ecosystems differ in their primary productivity and this is significant as it determines the food supply for humans and other animals.

Process of primary production

The earth's organisms either produce their own food or consume it after others have made it. The organisms responsible for primary production are known as primary producers or autotrophs (self-feeders). They alone are able to capture and store the energy from the sun through photosynthesis.

Producers

On land the producers are mostly green plants. In fresh water and marine ecosystems near the shoreline, algae and green plants are the major producers. However, in the open water of the oceans of the world, the dominant producers are phytoplankton. They are microscopic organisms that float or drift in the sunlit upper layer of vast stretches of sea water.

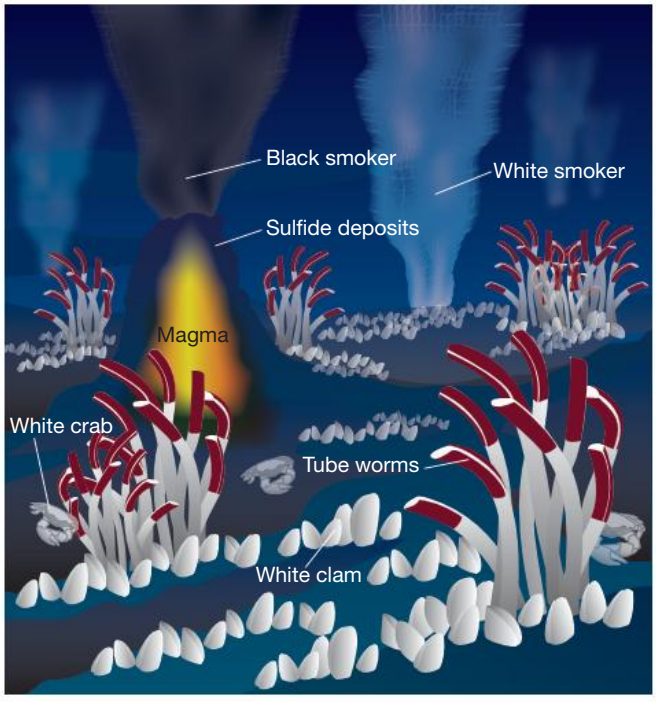
Process of photosynthesis

During photosynthesis, the producers convert the light energy of the sun into chemical energy that is stored within plant tissues. Using this sunlight, as well as carbon dioxide, water and nutrients, the producers create new organic compounds or simple sugars, such as glucose, which hold chemical energy. In the process of making their own food, plants also provide oxygen to the atmosphere.

The chemical energy within the plant supports it as it grows in size and over time this primary production results in the addition of new biomass to the ecosystem. Consumers derive their energy from these primary producers.

Chemosynthesis in the dark ocean depths

There are only a few producers, mostly highly specialised bacteria, that can convert simple compounds from their environment into food without any sunlight. They are found deep within the ocean near the deposits that form when superheated water shoots out of vents on the ocean floor near some tectonic plate boundaries. As the water mixes with the cold sea water, black particles precipitate out and accumulate as chimney-like structures known as black smokers. A variety of rare and exotic life forms, including giant clams, 2-metre tubeworms and eyeless prawns exist in the dark depths around these black smokers. These life forms are supported by bacteria that produce food through chemosynthesis from the minerals discharged by the vents. Figure 2.33 illustrates how life forms are supported by chemosynthesis.



2.33 The sun's energy penetrates only about 200 metres below the surface of the water. Exploration of the deep ocean floor as recently as 1977 resulted in the totally unexpected discovery of abundant and unusual sea life around black smokers, 2.5 kilometres below the surface.

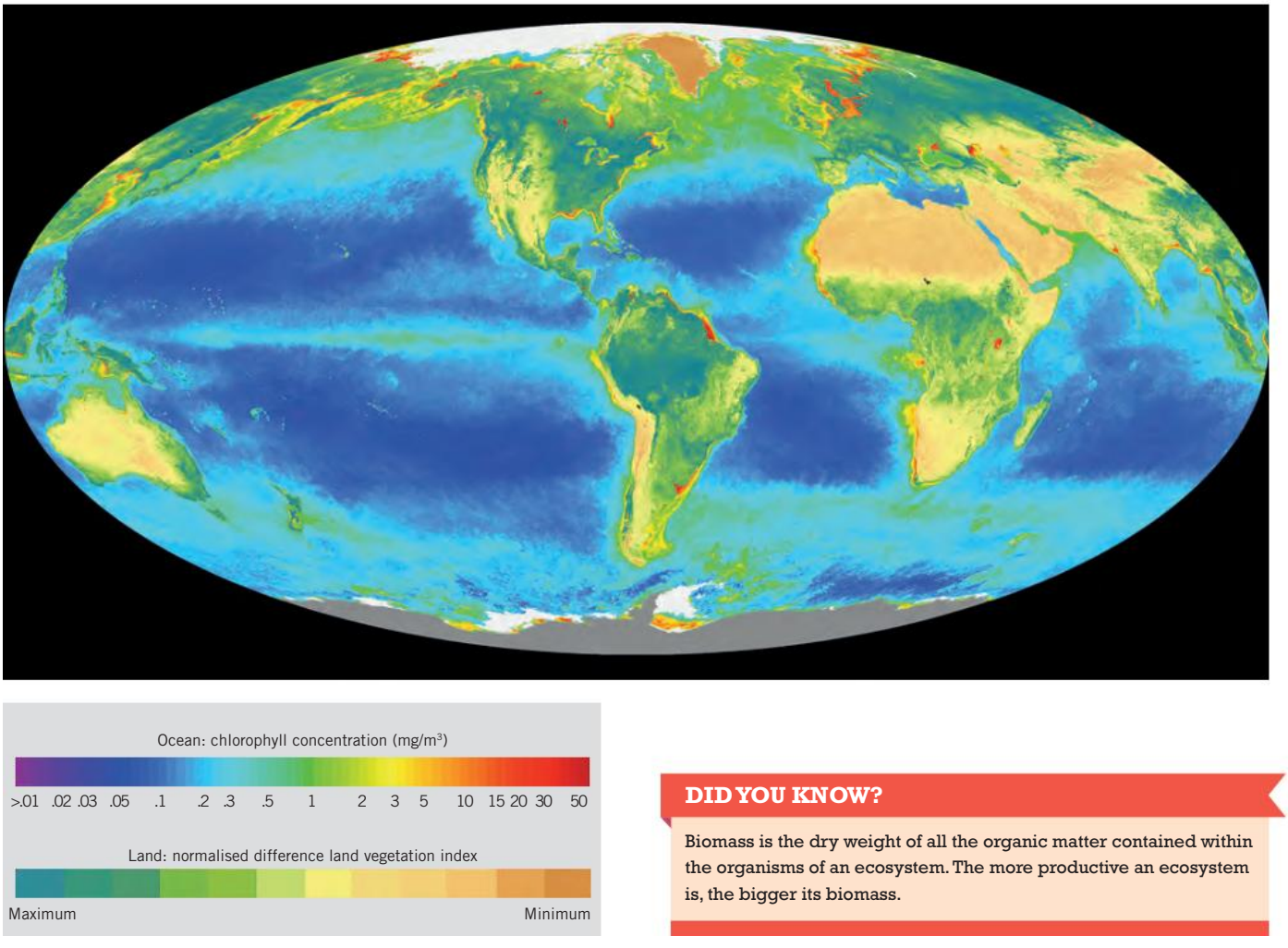
Types of primary productivity

The rate at which photosynthesis occurs determines the rate at which biomass increases within an ecosystem. It is identified as the **primary productivity** of that ecosystem. When comparing the primary productivity of different ecosystems it is important to consider the different types of primary productivity.

Gross primary productivity

Gross primary productivity (GPP) is the rate at which the primary producers in an ecosystem convert the sun's energy into chemical energy in the form of biomass found in their tissues. GPP is measured in terms of the energy produced per unit of area over a given time span, such as kilocalories per square metre per year (kcal/m^2/yr). Figure 2.34 shows satellite data of the earth's GPP in terms of ocean and land concentrations of chlorophyll. Note that ocean chlorophyll concentration is often measured in milligrams per cubic metre (mg/m^3). On land, rainforests and other highly productive areas are dark green, and the least productive (mostly deserts) are brown. Note that the colours are the opposite in the oceans, with red, orange and yellow representing the highest values and dark blue the lowest values of the chlorophyll found in phytoplankton. The highest values are in the cooler waters near the polar regions, as cold water holds more oxygen.

2.34 Image of the earth's GPP. All plant life contains the primary photosynthetic pigment chlorophyll 'a'.



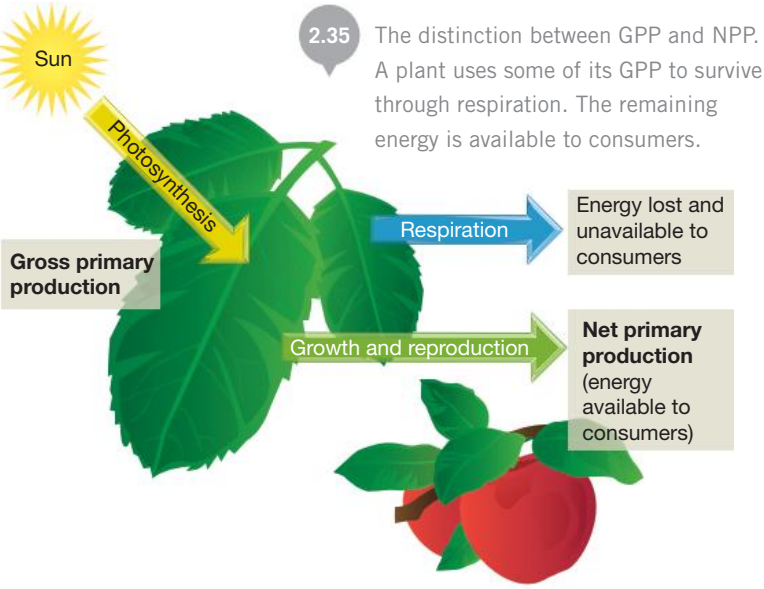
DID YOU KNOW?

Biomass is the dry weight of all the organic matter contained within the organisms of an ecosystem. The more productive an ecosystem is, the bigger its biomass.

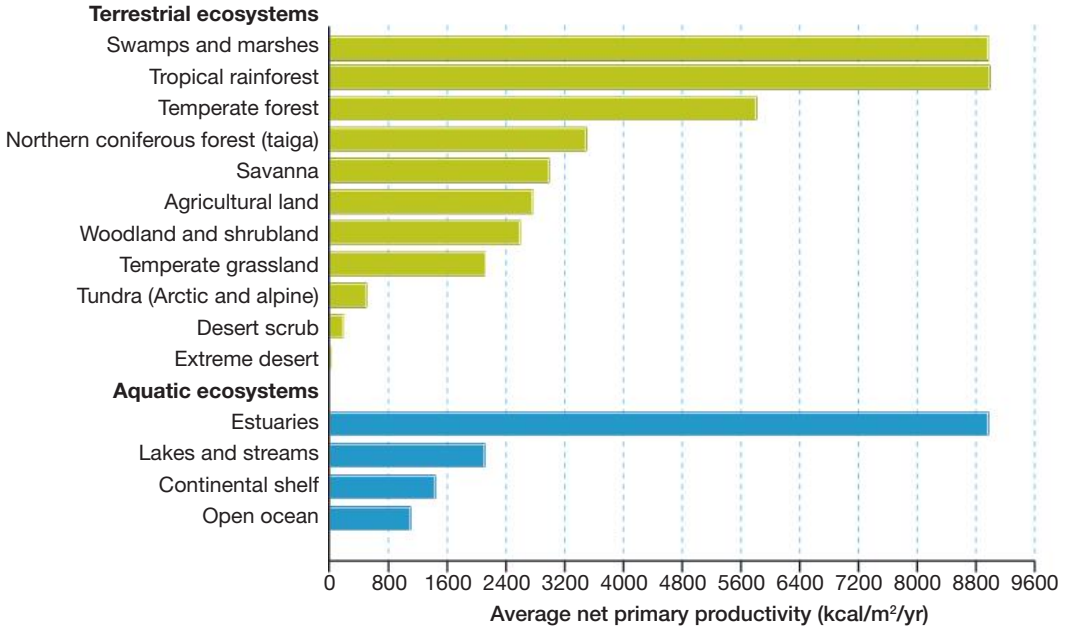
Net primary productivity

Not all of the chemical energy produced is available to others in an ecosystem. The producers must use some of it for their own respiration in order to stay alive, grow and reproduce. Net primary productivity (NPP) is the rate at which producers use photosynthesis to produce and store chemical energy minus the rate at which they use some of this for their own respiration. This is depicted in Figure 2.35.

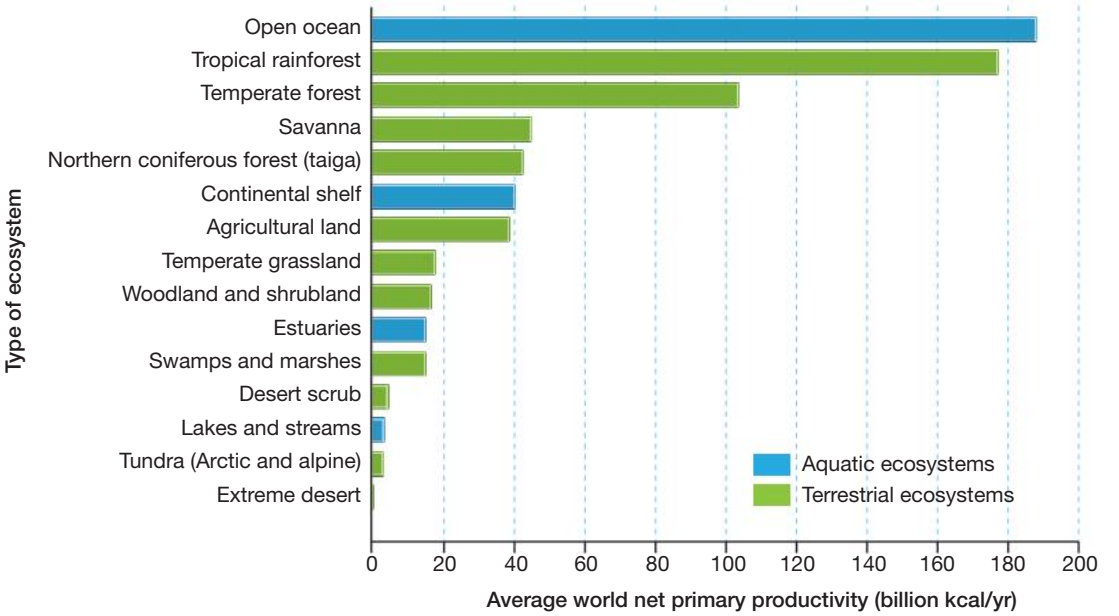
NPP is a measure of how quickly producers can make the chemical energy they store in their tissues that potentially becomes available to the consumer organisms within the ecosystem. NPP is the base of the food supply for humans and other animals.



2.35 The distinction between GPP and NPP. A plant uses some of its GPP to survive through respiration. The remaining energy is available to consumers.



2.36 The estimated annual average NPP per square metre



2.37

Primary productivity of ecosystems

The biomass within a particular ecosystem is determined by how much and how quickly its producers are able to capture and store solar energy as chemical energy. Terrestrial and aquatic ecosystems differ in their NPP, as is illustrated in Figure 2.36. The highest NPP rates are in swamps and marshes, tropical rainforests and estuaries, while the lowest rates are found in the desert, tundra and open ocean.

On land, NPP per square metre decreases between the Equator and the poles in response to the amount of solar radiation available to producers. It is highest at the Equator, as is evident in tropical rainforests, and lowest towards the poles, in tundra and arctic ecosystems.

In aquatic ecosystems, the highest NPP per square metre is found in **estuaries**, swamps and marshes, which are rich in the nutrients found in the sediments carried in by rivers. The open ocean has a very low NPP per square metre, as it is usually low in nutrients, except in locations where there is an upwelling of water from the bottom depths to the surface that brings nutrients with it. As can be seen in Figure 2.37, the open ocean produces more of the earth's biomass than any other ecosystem, simply because there is so much open ocean—71 per cent of the world's surface. Even though estuaries (see Figure 2.38) are very productive, their total area is small.

SPOTLIGHT

Humans and the NPP

Peter Vitouseck, Stuart Rojstaczer, and other ecologists estimate that humans now use, waste or destroy about 27 per cent of the earth's total potential NPP and 10–55 per cent of the planet's terrestrial ecosystems. They contend that this is the main reason why we are crowding-out or eliminating the habitats and food supplies of so many other species.

Physicist Paul MacCready estimates that humans, their livestock and pets now make up 98 per cent of the earth's total vertebrate biomass. This means that wild vertebrates make up only 2 per cent of the planet's vertebrate biomass, as humans have overtaken much of the planet. Many of the remaining tigers, elephants, birds and small mammals face extinction as the human footprint becomes heavier.

G Tyler Miller, *Living in the Environment*, fifteenth edition, Thomson Brooks/Cole, Belmont, 2007

Primary productivity for humans

Primary producers are the source of all food available for every other organism within an ecosystem. Furthermore, only the biomass represented by the NPP is available to support consumers. It is the planet's NPP that ultimately limits the number of species (including humans) that are able to survive on earth.



2.38 The estuary at Merimbula, New South Wales

ACTIVITIES

Knowledge and understanding

1. Explain why the primary producers of ecosystems are so important.
2. Distinguish between GPP and NPP.
3. Compare photosynthesis with chemosynthesis.
4. Describe the differences in the NPP per square metre of ecosystems from the Equator to the poles.

Applying and analysing

5. Model your family's weekly budget on the concepts of GPP and NPP.
6. Study Figure 2.36 and write a short response to the following statement:
   As swamps and marshes and estuaries are the most productive ecosystems, they should be protected before all other ecosystems.

Geographical skills

7. Study Figure 2.34. Compare the gross primary productivity (on land) of Australia, South America and Africa.

2.9 Biodiversity's impact on energy and matter

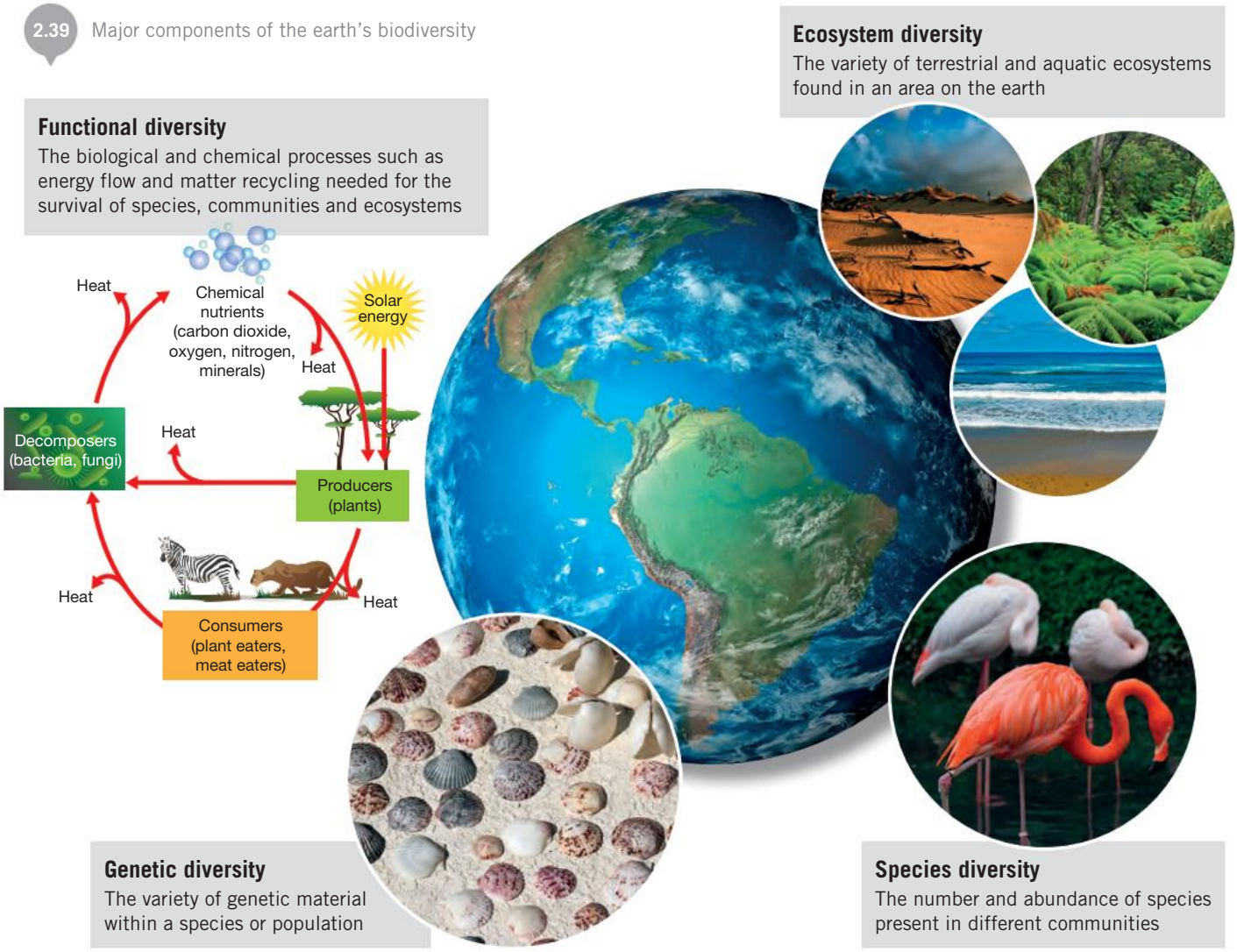
Biodiversity is found in the variety of the earth's genes, species, ecosystems and ecosystem processes. It is vital in sustaining the flow of energy and cycling of matter that supports life. Humans, like all other species, are dependent upon the maintenance of this biological wealth. Biodiversity is of great value and it must be protected to ensure our future wellbeing.

Components of biodiversity

Biological diversity, or biodiversity, is illustrated in Figure 2.39 and includes:

- ***species diversity:*** the number of species within particular communities
- ***ecosystem diversity:*** the variety of aquatic and terrestrial ecosystems
- ***functional diversity:*** chemical and biological processes such as the flow of energy and cycling of matter needed for the existence of species, communities and ecosystems
- ***genetic diversity:*** the inherited variation that occurs within species populations as a result of different genes or biochemical packages.

2.39 Major components of the earth's biodiversity



Biodiversity in ecosystems

Within an ecosystem there are many interrelationships between numerous species whereby energy flows through the food chain and matter is constantly recycled, sustaining life. Should a disturbance occur, such as a storm or a fire, an ecosystem rich in diversity is more able to recover and restore functioning and so has greater **resilience**.

Feeding pathways

Feeding pathways are the means by which energy and matter move through an ecosystem. When biodiversity is high there are many pathways, so if a few are destroyed, others can be used and the ecosystem is able to continue to function. However, in ecosystems lacking biodiversity, the impact of disturbances can be catastrophic. A reliance on limited food pathways means that, if they are lost, the flow of energy in the food chain is halted, resulting to the demise of dependent species.

Tropical rainforests are renowned for their immense biodiversity. If a particular fruit tree favoured by a fruit-eating bat dies, the usual feeding path is lost. However, in the rainforest, the bat will simply turn to another source in the abundance of fruit on offer. The Jamaican fruit-eating bat shown in Figure 2.40 thrives on the number and variety of fruit-bearing trees in the rainforest.

Functional diversity for food production

Grasslands are the biome that is most heavily relied upon for food production. Seeds from grasses such as wheat and barley provide the cereal grains that are staple foods. Throughout the temperate latitudes there has been widespread clearing of native grasses, which have been replaced with a monoculture of a cereal crop. Most significantly, the grassland biome is underlain by deep, fertile soils. With continued cultivation, the flow and cycling of energy has generally been maintained by good farming practices, and with it the productivity of the land.

Tropical rainforests have a much higher productivity than grasslands, but they are a fragile ecosystem and not suited to clearing for food production. They are also highly valued for their immense diversity, as they contain up to half the world's plant and animal species, many as yet undiscovered. Their continued productivity can be maintained only if rainforests remain intact, as the soil underneath is quite impoverished. The soil depends on all the decaying organic matter that reaches the ground from above to provide nutrients, and the rainforest ecosystem is very efficient at recycling nutrients that would be otherwise leached out by the heavy rain.



2.40 The Jamaican fruit-eating bat lives in the tropical rainforest. Its favourite fruits are mangoes and bananas.

Genetic diversity for future food production

Ecosystems provide a bank of genetic material that our future existence may well depend upon. Currently, 75 per cent of the world's food is provided by just seven staple crops, so it is important that genetic material from wild stocks of plants is kept for use if needed. Genetic diversity will be vital in developing new crops if environments change with global warming.

ACTIVITIES

Knowledge and understanding

1. Outline the components of biodiversity.
2. Explain why biodiversity is important in ecosystem functioning.
3. Discuss why resilience is important.

Applying and analysing

4. Compare the suitability of grasslands and rainforests for food crops.
5. Explain why genetic diversity is important for future food production.

2.10 Biomes and food security

The vegetation of biomes is vital for the survival of other species on earth, as plants are the basis of all food chains. They capture the sun's energy and through photosynthesis convert it into compounds that keep organisms alive and serve as food for others. Biomes sustain life, and humans, like other species, depend upon them for food.

Food for humans

Humans eat to live. Daily nourishment from food provides our bodies with fuel and the nutrients essential for vital body functions that maintain good health. A well-balanced diet contains vegetables, fruit, meat, fish and dairy products as well as grains such as rice, wheat, rice, nut and seeds. Such a diet is much more diverse than that of any other animal.

Humans are omnivores, as they eat both plant and animal products. This has enabled them to live in many very different environments, many of which are very harsh.

Some humans are able to survive the extreme aridity of deserts in the icy lands of the Arctic. They could not do this if they were unable to obtain sufficient food. The availability of food often determines the number of people that can be supported in a region. The fertile river valleys of South-East Asia support some of the highest rural population densities in the world, as the rich alluvial soil is capable of producing up to three rice crops a year—plenty of food to support plenty of people. Table 2.41 shows some of the food crops produced in various regions around the world.

2.41 Selected food crops across the world

Region	Main crops
Chinese–Japanese region	Bamboo, *millet*, mustard, orange, peach, rice, soya bean
Indochinese region	Bamboo, coconut, grapefruit, mango, *rice*, sugar cane, *yam*
Australian region	Macadamia nut
Hindustani region	Banana, bean, chickpea, citrus, cucumber, eggplant, mango, mustard, *rice*, sugar cane
Central Asian region	Apple, apricot, bean, carrot, grape, melon, onion, pea, pear, plum, *rye*, spinach, walnut, *wheat*
Near Eastern region	Almond, *barley*, fig, grape, lentil, melon, pea, pistachio, *rye*, *wheat*
Mediterranean region	Beetroot, cabbage, fava bean, grape, lettuce, *oats*, olive, radish, *wheat*
African region	Coffee, *millet*, oil, palm, okra, *sorghum*, *teff*, *wheat*, *yam*
European–Siberian region	Apple, cherry, chicory, hops, lettuce, pear
South American region	Cacao, *cassava*, groundnut, lima, bean, papaya, pineapple, *potato*, squash
Central American and Mexican region	French bean, *maize*, pepper, chilli, *potato*, squash
North American region	Blueberry, sunflower

Note: Staple crops are shown in italics.

Source: FAO Corporate Document Repository, *Dimensions of Need—An Atlas of Food and Agriculture*

SPOTLIGHT

History of food production

For most of human history, people collected food from the wild by gathering fruits, nuts and seeds, or by hunting wild animals for their meat. These **nomadic** hunters and gatherers wandered across the land, taking advantage of food where they found it and moving elsewhere when it ran out.

About 8000 years ago, people began to grow food by planting the seeds of plants that they ate most often. Farming had begun and with it the skills of tilling the land and nurturing crops until they could be harvested. The earliest evidence of cultivation has been found in the Middle East, where wheat and barley were sown in fields. People also began to domesticate wild animals by collecting them in herds and then breeding them.

Once a reliable food supply was secured, people were able to live in settlements (such as towns and cities) and populations thrived.

Staple foods

A staple food is one that is eaten regularly by a community or society and in such quantities so as to make it the main part of their diet. It is often eaten at every meal or each day. Staple foods vary from place to place, but usually they are easily grown in that region and so are readily available and usually quite cheap. Staple foods are shown in italics in Table 2.41. Staples are well adapted to the biophysical environment of their source regions; for example, they are tolerant to drought or nutrient-poor soils. Farmers rely on staple crops, as they are more resilient and therefore lower the risk of crop failure and a resulting food shortage.

Grains

Most staple foods are cereal grains, such as wheat, barley, maize, rice, rye, oats and triticale. They are all grasses and their seeds are harvested to provide grain foods that can be stored for a long period of time without spoiling. Such crops are **annuals** and their seeds must be replanted each year. Cereals are the main food for most people in the world. Rice, maize and wheat are the staples of over 4 billion people and rice feeds almost half of humanity.

Rice is usually eaten once it has been cooked as a whole grain. Most other cereals are refined where they are milled or ground into a finer substance. Flour from wheat and maize are used to make bread and pasta. Maize, barley, oats and millet are often boiled for porridge or baked as flat cakes. Other staple foods include starchy root vegetables such as cassava, potatoes, yams and taro. Over a billion people in developing countries depend on roots and tubers as their staple food. They are especially important in Sub-Saharan Africa. Although they may provide carbohydrates, they are poor in protein and nutrients.

As people drift to cities, they tend to replace roots and tubers with cereals, as these are easier to obtain. With increasing affluence, the more varied a diet becomes, the more meat and dairy products are consumed. However, one billion of the poorest people in developing countries still rely on roots and tubers.

2.42 What people eat

Cassava



The main staple foods in the average African diet are (in terms of energy intake) cereals (46%), roots and tuber (20%) and animal products (7%).

Bread and grains



In Western Europe, the main staples in the average diet are (in terms of energy intake) animal products (33%), cereals (26%) and roots and tubers (4%).

Traditional food crops gaining popularity

Cassava is a woody shrub that is grown in tropical and sub-tropical areas for its large, starchy, tuberous root. It can be eaten only after it is carefully prepared, as it contains cyanide. It is poisonous unless it is cooked or grated and left in the open. Cassava is grown globally, as it is a very hardy plant that survives well in poor soils and can withstand drought. It has become one of the most important staples in developing countries.

Quinoa is becoming increasingly popular, notably in wealthy countries, because of its high nutrient content. It is rich in essential amino acids such as lysine, as well as iron and calcium. Quinoa is grown for its edible seeds and with improved processing it is now also made into bread.

Biomes and food production

The productivity of biomes in terms of the amount of food that can be gained from them varies greatly.

Deserts

Their extreme aridity really limits landuse. Nomadic pastoralists such as the Tuareg and the Bedouin of the Sahara survive in this inhospitable environment (where the vegetation is sparse) by moving around to find new sources of pasture for their stock.

Tundra

The extreme cold and permafrost (permanently frozen layer of the soil) result in a very harsh environment that supports only nomadic reindeer herders such as the Nenets, shown in Figure 2.43, who live in northern Russia.

2.43 The Nenets of Siberia have migrated across their lands for thousands of years.





2.44 Temperate grasslands, Australia. Temperate grasslands are very productive ecosystems because their soils are so fertile.

Tropical savanna

The dry season restricts the amount of vegetation that can grow, so the land is really only suitable for grazing, and very large areas are needed to support stock. Cattle properties in the tropical north of Australia are thousands of square kilometres in size.

Tropical rainforests

Early hunter-gatherer societies managed to survive in tropical rainforests by hunting animals and birds, catching fish and collecting fruits, nuts and berries. Other groups, such as the Amerindians of the Amazon, engaged in **shifting cultivation**, clearing small patches of forest for gardens that yielded food for four to five years before abandoning them once the fertility of the soil was lost. The impoverished soils are the biggest limitation for food production in rainforests, as soils rely on decaying material from the forest above to maintain nutrient levels. Heavy rainfall leaches nutrients from the soil and also causes erosion if the vegetation if removed.

Temperate grasslands

As they are underlain by some of the richest soils in the world, grasslands in the temperate zone, have been heavily utilised for food production. They have been ploughed up and planted with cereal crops such as wheat in the Canadian Prairies and Australia, as well as pastures for beef cattle, such as those in Figure 2.44.

ACTIVITIES

2.4

Knowledge and understanding

1 Explain why the vegetation in biomes is so important to life on earth.
2 Outline the history of food production.
3 Describe a staple food.
4 Describe how the diet of people changes as they shift from rural to urban areas.
5 Explain why cassava has to be carefully prepared before eating.

Applying and analysing

6 Working in groups of five, prepare a newspaper headline that captures the issue of feeding the growing urban population of the world. Add a few sentences to convey the thoughts behind the headline (hint: consider how the types of food eaten change).

Investigating

7 Study Table 2.41 then do the following tasks.
   a On an outline map of the world, add text boxes locating the different food crops in the regions shown.
   b Select three crops from regions that you are unfamiliar with and prepare an illustrated report on how each food crop is grown and prepared for consumption.

2.11 Human alterations to biomes

While humans are only one of millions of species living on earth, they have, more than any other, altered the world's biomes. Like all species, they have sought to meet their immediate needs of food, water and shelter—but humans have gone further. From the beginning of civilisation the scale of their alterations to biomes has increased. Recent technological advances have accelerated the process.

Humans and their place in the natural world

For thousands of years many indigenous people lived in harmony with nature. While they used their environment to support their way of life, and altered it to some extent, most acted as stewards of their environment.

As human society became more sophisticated, the relationship with nature changed. In the scramble to develop, nature became a casualty.

Humans have several traits that set them apart from other species.

- They desire to control or master nature, and to perceive their success in doing so as progress, which they consider good no matter what the cost to other species. The extent of this control can be seen in Table 2.45.
- They believe that that the satisfaction of human needs is paramount. Any disturbance or even destruction of the natural world is usually discounted, ignored or deemed necessary.
- They possess intelligence and by developing new technologies they have managed to achieve greater control over their environment. They have power far beyond their numbers in comparison to other species.

Why humans alter biomes

Civilisations emerged when adequate food was produced to support them. Food production has continued to be of fundamental importance and as the world's population has grown, more and more land has been needed for this purpose. As the world has industrialised and modernised, even greater demands have been placed on the natural environment to provide the fibres, fuels and all the raw materials needed. Many of the world's biomes have been affected by human activities in the scramble or competition for resources.

How humans alter biomes

The imprint of humans has spread across the earth's surface as natural habitats have been lost to agriculture, mines, dams, transport routes, canals, cleared tracts for power transmission lines and settlements. Such features of the built environment stand out as evidence of the impact of humans. Humans alter their environment to make it more suitable to their purposes. This is done in a number of ways.

Vegetation clearance

Land clearing, primarily for agriculture, is probably the most widespread cause of damage to biomes. The biome most affected has been the temperate grasslands, which have been either removed or modified on every inhabited continent of the world. The absence of trees, flat terrain and the deep rich soil made them attractive for farmland as well as urban settlements.

In 2013, the International Union for Conservation of Nature (IUCN) reported that the temperate grasslands are one of the world's great biomes—but they have mostly disappeared. Indigenous temperate grasslands are now, according to the IUCN, the most altered ecosystem on the planet. The temperate grasslands biome occupies 9 million square kilometres or 8 per cent of the earth's terrestrial surface. Of this 8 per cent, only 5 per cent is currently protected within the global system of protected areas. Indigenous temperate grasslands are now the earth's most endangered ecosystem.

Globally, about 80 per cent of the original forest cover has also been cleared, fragmented, degraded or turned into plantations for commercial crops. About half of this area has been completely cleared and the loss of habitat of a biome rich in biodiversity has resulted in the demise of many species. Early casualties were the rainforests that covered the Ivory Coast of West Africa. The same trend of deforestation continues in South America and South-East Asia.

2.45 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 or 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 deconstruction (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 lengths 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 and S Codrington, *Understanding our Earth*, Pitman, Carlton

Table 2.46 illustrates the extent of human influence on the main biomes of the world.

2.46 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 over large areas • 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 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 dry season.	Major effect of people: • herding and ranching: fires have been used to clear trees and encourage grasses • areas of overgrazing: high stock numbers cause erosion • grasslands ploughed for crops: danger of erosion
Temperature 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 temperatures and low rainfall.	People have had 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 ecosystems. Also, pollution from water areas is starting to affect marine life.
Cities and industrial areas	2	Natural vegetation cleared and people build 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 and S Codrington, *Understanding our Earth*, Pitman, Carlton



2.47 Mountainous areas are farmed using terraces. They are common in China, the Philippines and Bali.

Sourcing water supplies

Water is a vital resource for humans. Irrigated agriculture has been the backbone of increased food production and water is necessary to run stock. It is also needed in large quantities to serve the daily needs of the concentrations of people living in urban centres. Many industries need water for cooling, washing and the chemical processes involved in manufacturing. Humans have found a number of ways to tap into the water cycle to secure an adequate supply of water for their needs, such as:

- constructing large engineering projects such as dams to store water. Currently, there are around 40 000 large dams that obstruct the world's rivers. They can have a major environmental impact upstream (such as loss of habitat in drowned river valleys) and downstream (such as blocking fish migrations, changing temperature and reducing the level of dissolved oxygen in water released from the dams)
- using canals and pipelines to transport water
- sinking wells and bores to extract groundwater, which can lead to its depletion and a lowering of the water table
- using large bodies of water to dilute pollutants, such as dumping sewage into oceans.

Terracing

Terracing is an ancient farming technique that has existed in China, and elsewhere, for as long as two thousand years. It involves reducing the steepness of a slope by building structures such as earthen ridges or stone walls that divide the slope into small flat or gently sloping sections. It has enabled rice to be grown on hillsides, where water flows downhill continuously through successive levels, flooding the paddy fields so the rice can be planted. As the plants mature, the fields are allowed to dry out. By harvest time the hillsides resemble a stairway of golden grain, as seen in Figure 2.47.

ACTIVITIES

Knowledge and understanding

1. Explain why humans have had more of an impact on biomes than any other species.
2. Identify the features of that stand out as evidence of the impact of humans on biomes.
3. Describe how the forest biome has been affected by humans.
4. Outline the reasons why water supplies are very important to humans.
5. Explain how terracing enables the cultivation of steep slopes.

Applying and analysing

6. Study Figure 2.45. Rank each control from having the most negative impact to the least. Justify your ranking.
7. Study Figure 2.46. Create a pie graph that shows how the different ecosystems make up the world's land.

2.12 Global pattern of agriculture

Agriculture sustains people. It remains a way of life for many and a daily struggle for some. Even those living in urban–industrial societies, far removed from the agricultural environment, depend on the food surplus it generates. Today, agriculture remains one of the most important economic activities in the world, as it has done through most of recorded history.

Development of agriculture

Humans are believed to have been on earth for somewhere between 90 000 and 195 000 years. For most of that time they survived by hunting and gathering. Eventually, however, they learnt how to grow and breed plants and animals that could nourish them. People were then able to settle in the one place, secure in the knowledge that they would have enough to eat. By the seventeenth century, **commercial agriculture** emerged in Europe, and profit became the motive for production of food and fibre crops. This spread to the colonies as plantations became established.

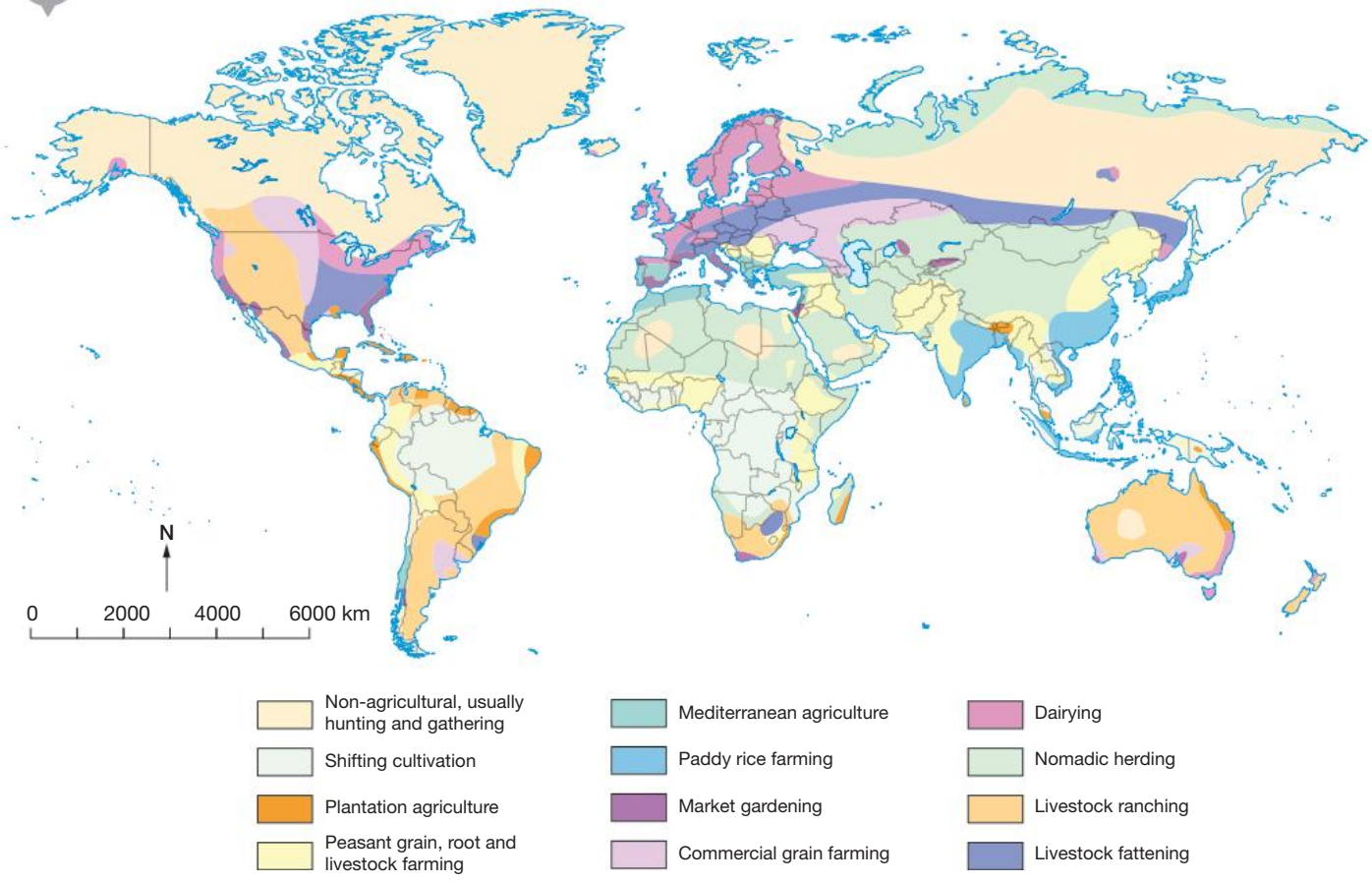
As population levels rose, more food was needed and, increasingly, the earth's surface became transformed by agriculture. Over time, distinct global patterns of agriculture have emerged, which can be seen in Figure 2.48. These reflect regional variations in the bio-physical environment and human interactions with it.

Types of agriculture

Crops

Table 2.49 outlines how agriculture (crops) is practised across the world.

2.48 Agricultural regions of the world



2.49 Types of agriculture (crops)

Type of agriculture	Where it is practised	How it is practised
Crops		
Shifting cultivation	Tropical lowlands and hills in the Americas, Africa and South-East Asia	Essentially a land rotation system. Small patches of rainforest are cleared and when the vegetation has dried, it is burnt (hence known as 'slash-and-burn' agriculture). Farmers use digging sticks to plant a variety of crops (taller plants protecting lower, more fragile ones from the tropical downpours). No fertiliser applied and little tending plants until harvest. Same clearing only used for 4 to 5 years until soils lose fertility. Plot is abandoned for 10 to 20 years.
Plantation agriculture	Tropical and subtropical regions of the Americas and South-East Asia. Today the greatest concentration is in the American tropics.	A huge landholding devoted to specialised, large-scale production. Used to rely on large amounts of labour (most workers living on the plantation), but now many are mechanised. Started in colonial times as Europeans sought spices, tobacco, cotton and rubber. Today coffee, tea, sugar cane and bananas are the main crops.
Peasant grain, root and livestock farming	Colder, drier Asiatic farming regions, river valleys of the Middle East, parts of Europe and Africa, mountain highlands of Latin America and New Guinea.	Based on grains such as wheat, barley, maize and millet. Some cash crops such as flax, hemp, coffee and tobacco are grown. Livestock such as cattle, sheep and pigs raised for milk, meat and wool. Llamas and alpacas raised in South America.
Mediterranean agriculture	Regions bordering the Mediterranean Sea and in Chile.	Based on grains such as wheat, barley, maize and millet. A few areas still practise the traditional system of wheat and barley production, with sheep and goat herding on rocky slopes. Drought-resistant vine and tree crops grown: grapes, olives and figs. Irrigation has led to expansion of citrus fruits.
Paddy rice farming	Humid tropical and subtropical parts of Asia, monsoon coasts of India, hills of south-eastern China, warmer parts of Japan.	Tiny, mud-dyked, flooded rice fields, many perched on terraced hillsides. Draft animals such as water buffalo used to plough the fields. Mechanised in Japan. Small sprouts carefully transplanted by hand from seedbeds to paddy fields. Large amounts of organic fertiliser used (more recently chemical). Double and triple cropping on same parcels of land (2 to 3 crops a year).
Market gardening	Located on fertile land in developed countries, usually close to large cities.	Specialises in intensively cultivated non-tropical fruits, vegetables and vines such as grapes (no livestock). All produce sold.
Commercial grain farming	Wheat belts stretch through Australia, America's Great Plains region, the steppes of the Ukraine and the pampas of Argentina.	Market-oriented type of agriculture. Farmers grow wheat or less frequently, rice or corn. Large properties in excess of 400 hectares Agribusiness involvement—huge corporations. Highly mechanised. Uses agrichemicals such as fertilisers, pesticides and herbicides, as well as hybrid seeds.



2.50 Shifting cultivation, Suriname. The area of rainforest cleared for cultivation can be seen.

2.51 Types of agriculture (animals)

Type of agriculture	Where it is practised	How it is practised
Animals		
Dairying	Large dairy belts in the United States of America from New England to the upper Midwest, Western and northern Europe, south-eastern Australia and northern New Zealand.	Generally found close to markets—large cities. Farmers use pastures and fodder crops (such as hay). New Zealand produces butter and cheese, as it is a long way from markets. Large feedlot systems on the fringes of large cities common in the USA.
Nomadic herding	The deserts, steppes and savannas of Africa, Arabia and the interior of Eurasia.	Graze cattle, sheep, goats and camels. Continually move stock in search of feed. Some migrate to mountains in summer. Only survives in remote areas and may soon completely vanish.
Livestock ranching	Interior of North America, Brazil and northern Australia.	Ranchers run stock on huge properties on vast grasslands Cattle sold for meat or exported live.
Livestock fattening	Corn belt of the mid-western United States of America, Europe, Australia, Brazil and South Africa.	Farmers grow fodder crops and raise/fatten cattle and pigs for sale. Maize and soybeans used as feed in the USA; oats and potatoes in Europe. Feedlots have become common in the USA and Australia.

Animals

Table 2.51 outlines how agriculture (animals) is practised across the world.

Traditional agriculture

Despite the global dominance of commercial agriculture today, some forms of **traditional agriculture** continue. In many developing countries, traditional agriculture is practised by 2.7 billion people on roughly three-quarters of the world's cultivated land. There are two main types of traditional agriculture:

- traditional subsistence agriculture—usually found in difficult environments such as tropical rainforests (see Figure 2.50), where it is practised by shifting cultivators, or in the tundra and the desert fringes, where the nomadic herders roam. People live off the land relying on their own labour to produce enough food for their families. The area covered by this form of landuse is becoming smaller with deforestation in the tropics, and many nomadic herders are abandoning their traditional life.
- traditional intensive agriculture—in the more fertile areas of South-East Asia, paddy rice farming has been practised for thousands of years. This labour-intensive form of agriculture produces high-yield crops and in good seasons there may be enough produce to sell.

Industrial agriculture

Since the 1960s, there has been a staggering increase in agricultural production as a result of technological advances. This has occurred in what is known as industrial agriculture, or the large-scale production of single crops (monocultures) or livestock in the more favourable temperate environments of developed countries. Industrial agriculture is now responsible for the production of 80 per cent of the world's food. Investments in machinery, fossil fuels, agrichemicals and irrigation water have raised yields and made profits.

ACTIVITIES

Knowledge and understanding

1 Define the term 'agriculture'.
2 Describe the development of agriculture.
3 Compare traditional subsistence agriculture and traditional intensive agriculture.
4 Explain how industrial agriculture dominates food production today, given that it occupies only a small percentage of cultivated land.

Geographical skills

5 Study Figure 2.48 then answer the following questions.
   a Identify the main agricultural regions of Australia and New Zealand.
   b What two types of agriculture dominate South-East Asia?
   c What continent has the greatest variety of agriculture in a small area?

2.13 Case study: Global grain production

Grain production is crucial to feeding the world's growing population. The size of the global stockpile of grain is considered a measure of global food security. After increasing yields and more than half a century of abundance the stockpile has recently shrunk, sparking fears of a global food crisis.

The main grain crops

Nothing is as efficient at producing food as sunshine-fuelled green plants and grass. While humans can eat plants, they cannot digest grasses. However, they do eat the seeds of grasses grown as cereal crops.

Most of what the world consumes is processed grain, with corn, wheat and rice making up most of the world's grain harvest (see Figure 2.52). While rice and most of the wheat produced are consumed directly as food, corn is largely fed to livestock.

Corn has been the world's leading grain since 1998 in response to the climbing demand for corn by more intensive forms of landuse such as cattle feedlots, dairies and poultry farms producing grain-fed beef, milk and eggs. Over half of our animal products come from grain-fed animals. Corn and other crops are also increasingly being used to produce biofuels rather than food, as the world seeks a greener and more secure transport fuel.

DID YOU KNOW?

Australia may be a relatively small producer of grains, but because it feeds only a small population, it accounts for a significant portion of the global trade in grain.

2.52 Corn (a), wheat (b) and rice (c) make up most of the world's grain harvest.

a



b



c

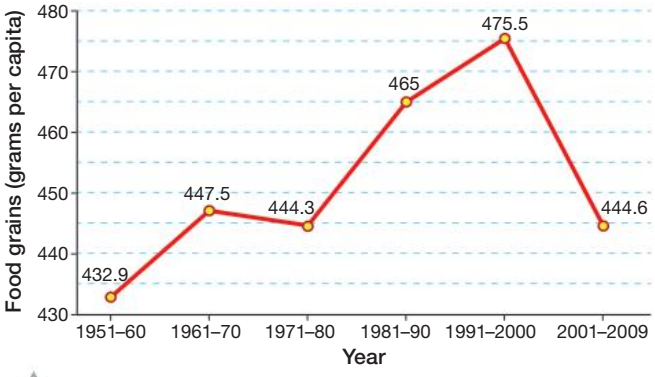


SPOTLIGHT

Feeding the world with grains

Humanity has done very well to increase grain production to match population growth. Until the middle of last century, most of the growth came from opening up more land. Since the 1960s, however, the area of arable land has remained relatively steady, while grain yields (the amount produced per unit area) have increased substantially. Indeed, the rate of increase in yields had more than matched the rate of increase in population.

Source: Fischer, *Issues*, number 89, December 2009



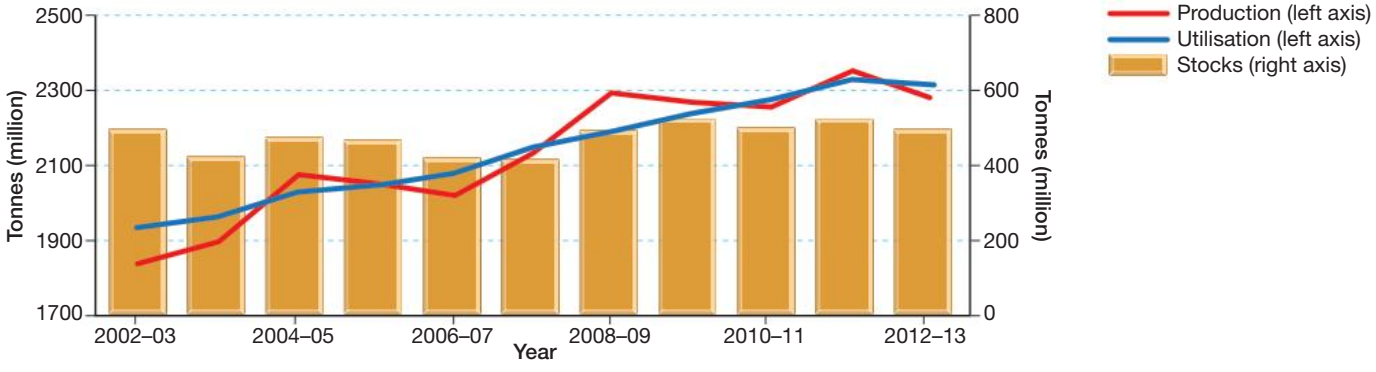
2.53 The per capita availability of food grains has declined in the last decade.

Concerns about production

While grain yields have been increasing, the rate of increase has slowed. As global population has continued to rise, the availability of food grains per capita has declined in the last decade, as illustrated in Figure 2.53. It seems that the benefits of using agrochemicals, machinery and irrigation, and breeding new varieties of crops have already been realised. This means that producers are close to getting as much grain from a hectare as can be obtained, so the chances of substantially increasing yields is limited. Yet, by 2030, the world's population is expected to be 8.3 billion, which will require 30 per cent more grain being grown.

Since 2001, there have been periods when the world has consumed more food than has been produced (as shown in Figure 2.54), halving the global stockpile of grain from a comfortable surplus of over a hundred days' supply to below fifty days. This triggered shortages and higher prices in wealthier nations, which they could still afford to pay, but the poorer nations suffered with rationing, food riots and famine. There were protests in the streets of Mexico in 2007 after savage increases in the price of maize flour in the 'tortilla crisis'.

2.54 Cereal production, utilisation and stocks from 2002–03 to 2012–13.



ACTIVITIES

Knowledge and understanding

1 Outline the importance of the size of the global stockpile of grain.
2 Describe how grain production was increased last century.
3 Explain why grain yields per capita have declined in the last decade.

Geographical skills

4 Study Figure 2.53 then do the following tasks.
  a Describe the general pattern of the per capita availability of grains in the last half of the twentieth century.
  b In what decade did it peak?
  c Calculate the drop from that peak to the period 2001–09.
  d Compare the period 2001–09 and 1951–60. What are the implications for global food security?
5 Study Figure 2.54 then do the following tasks.
  a Compare the patterns of production and utilisation to the stockpile of grains over the period shown.
  b Explain why the utilisation of grain has increased steadily while production levels have fluctuated.

2.14 Case study: Cotton

Cotton is the most commonly used fibre in the world. Almost 25 million tonnes of cotton was produced in 2012–13. Cotton fibres can be woven or knitted into a wide range of textiles, making it a highly versatile fibre. Cottonseed is also used for making cooking oil and is often used as a cattle feed.

Cotton varieties

There are more than fifty species of cotton, which is a close relative of the hibiscus. Most species are found naturally in tropical and subtropical regions. Australia has seventeen species of native cotton. Commercial cotton species are now grown in seventy-five countries, covering about 30 million hectares of the world's agricultural lands. The major cotton-producing nations are listed in Table 2.55.

2.55 World's top 10 cotton producers, 2011

Country	Production (millions of bales)
China	33.0
India	27.0
United States of America	18.0
Pakistan	10.3
Brazil	9.3
Uzbekistan	4.6
Australia	4.2
Turkey	2.8
Turkmenistan	1.6
Greece	1.4

4.59 bales of cotton = 1 tonne

Total world production = 115 million bales

Source: Cotton Australia

Cotton plants prefer hot summers with low humidity and plenty of sunshine. Cotton is grown from seeds planted in the spring. By the following autumn the plant will have grown to around one metre in height, and will flower briefly. Once pollinated, the flower is replaced by a fruit known as a 'cotton boll', shown in Figure 2.56. Cotton lint, which is found inside the boll, becomes cotton fibre after processing (known as ginning).



2.56 Cotton fibre is produced from the cotton boll, a type of flower.

DID YOU KNOW?

Cotton can absorb up to twenty-seven times its weight in water.

SPOTLIGHT

Cubbie Station

Cubbie Station, located in south-west Queensland, is Australia's largest cotton farm. It covers an area of more than 96 000 hectares and produces about 10 per cent of the country's total cotton crop. In 2012, Cubbie Station made headlines around the country after it was announced that it would be sold to a group of companies led by a huge Chinese textile firm.

Cubbie Station holds water licences, allowing it to store more water than in Sydney Harbour. In a typical year the station uses more than 200 000 million litres a year to irrigate its crops, making it the largest irrigation property in the Southern Hemisphere. Those opposed to the sale of Cubby to the Chinese firm argued that such a large property and water rights should not be allowed to be owned by foreign interests.



2.57 Cubbie Station

Cotton and the environment

Pest control

As cotton is a natural fibre, it is often marketed as a 'green product', but cotton production does have a number of major impacts on the environment. Cotton is vulnerable to pest attack, with around 100 insect species considered a major threat to cotton crops. These are commonly controlled through spraying insecticides. Such spraying can lead to toxic chemicals making their way into waterways and being carried by winds to adjoining bushland.

Australia is a world leader in reducing reliance on insecticide sprays to control pests. Integrated pest management systems are now used by many farmers. These involve the use of less harmful chemicals and encouragement of 'good' insects, which attack the pest species and keep their numbers down.

Water use

Cotton crops are major consumers of water and are often grown in irrigation areas. In most major cotton-producing countries, the plants are grown in very large irrigated fields. The fields are fed with water through a complex system of irrigation channels. Some estimates place the amount of water used to irrigate a single hectare of cotton in Australia at 6.7 million litres of water. In Australia, about 320 000 hectares of cotton are planted annually, making the industry a major consumer of water. Cotton growers contend that their crops use less water per hectare than rice, soy beans and a number of other crops. Here in Australia the cotton industry has devoted considerable research into strategies for reducing water use, including computerised control systems and high-tech sprinklers.

Genetic engineering

An increasing proportion of the world's cotton crop is genetically modified (GM). In China, the world's largest producer and consumer of cotton, about 70 per cent of the cotton crop is now GM cotton. Genes within the cotton have been altered to increase the plants' resistance to some pests and therefore reduces the need for spraying. Australia has been a world leader in developing GM cotton and now almost the entire Australian crop is genetically modified. Cotton Australia, the body that represents Australian cotton growers, argues that GM cotton has reduced insecticide usage by 80 per cent and is far better for the environment.

ACTIVITIES

2.5

Knowledge and understanding

1 State the size of the world's cotton production in 2012–13.
2 Describe what integrated pest management involves.
3 Explain why cotton growers are using genetically modified cotton.
4 Describe the controversy surrounding the sale of Cubbie Station.

Geographical skills

5 Study Table 2.55 then do the following tasks.
   a Calculate the percentage of the world cotton produced by Australia in 2011.
   b Write a paragraph outlining global cotton production in 2011.

2.15 Case study: Global fisheries

The world's fisheries are vital to global food security. Unfortunately, they have been used excessively, resulting in a decline and even a collapse of many fish stocks. This over-exploitation has become an international concern, as it not only threatens food security and the wellbeing of people, but it also places aquatic ecosystems at risk.

The increasing importance of fish

Fish has always been an important part of the human diet, as it is a protein-rich food. A diet based on fish is considered to be a healthy one. Increasingly, consumers in wealthy countries are recognising this and are eating more fish. However, the biggest increase in demand for fish has come from newly affluent consumers in the rapidly growing economies of Asia. China's average consumption of fish has risen from below 3 kilograms per capita in 1970 to more than 30 kilograms today.

The escalating pursuit of fish

Fish is one of the most traded food commodities worldwide. Over the last five decades, the global food fish supply has exceeded the rate of population growth. This has been achieved by the use of increasingly sophisticated technologies, such as:

- factory freezer vessels that process and store the catch
- synthetic fibres and mechanical net haulers
- satellite systems that help find the fish by monitoring sea temperatures and plankton concentrations, which is where the fish are likely to be feeding.

Large industrial fishing fleets initially focused on the Northern Hemisphere's coastal fisheries, but as stocks became depleted they moved their operations southwards.

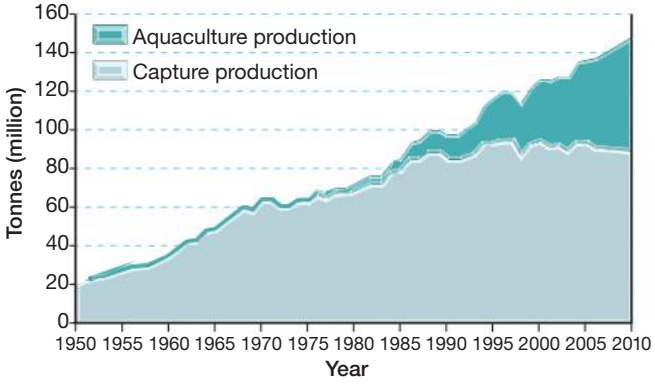
DID YOU KNOW?

A modern factory ship processes and freezes over 1000 tonnes of fish daily. There are more than 38 400 such ships taking fish from the world's oceans, many staying out at sea for up to several months.

Changing structure of global fisheries

Historically, most fish has been sourced from the ocean, but this has all changed in recent decades, with aquaculture and inland fishing providing a larger share of production, as is shown in Figure 2.58.

2.58 World capture fisheries and capture production, 1950–2010



Wild-capture fisheries

Exploitation of the world's marine fisheries increased between the 1950s and the 1990s, when production started to decline as many marine fisheries became depleted. Huge reductions in the populations of the larger predatory fish such as tuna, cod (shown in Figure 2.59) and marlin led to the targeting of smaller and younger fish. The Food and Agriculture Organization (FAO), the United Nations body that gathers fisheries statistics, reported that over-exploited stocks increased from 10 per cent in 1974 to 29 per cent in 2012.

Global wild catch production has remained fairly stable in recent decades, signalling that the oceans may have reached their maximum production.



2.59 Cod are caught in a net in the Gulf of Maine.

Aquaculture

Since 1980, world food fish production of aquaculture has expanded by almost twelve times. There are now 600 aquatic species raised in captivity in about 190 countries. Fish farms are highly productive, generating ten times more animal protein per hectare than from normal livestock.

According to the FAO, 'aquaculture is set to remain one of the fastest-growing animal food producing sectors and, in the next decade, total food production from both wild-capture and aquaculture will exceed that of beef, pork and poultry'.

Rebuilding fisheries

Global fisheries have suffered through a long history of over-exploitation. The importance of restoring the functioning of marine ecosystems has been recognised and attempts to rebuild some fisheries are underway. Lower exploitation rates are needed to reverse the demise of many vulnerable species.

Good progress has been made towards achieving sustainable harvests of fish stocks in the United States of America, Canada and Australia. Management strategies such as creating marine reserves where fishing is completely excluded, setting catch restrictions so that the fish stock can recover and modifying fishing gear have been successfully implemented. Even so, Figure 2.60 warns that the world must move quickly to secure a sustainable future for global fisheries.



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2.60 A cartoon alerting people to the threat of overfishing

ACTIVITIES

2.6 2.7

Knowledge and understanding

1 Explain how new technologies have increased the size of the fish catch.
2 Distinguish between wild-capture fisheries and aquaculture.
3 Outline some measures undertaken to rebuild fisheries.

Applying and analysing

4 Study Figure 2.60. Write a paragraph outlining the point the cartoonist is making.

Geographical skills

5 Study Figure 2.58.
   a Since 1950, what has been the increase (in million tonnes) of:
      i capture production?
      ii aquaculture production?
   b Suggest reasons for the difference.

Investigating

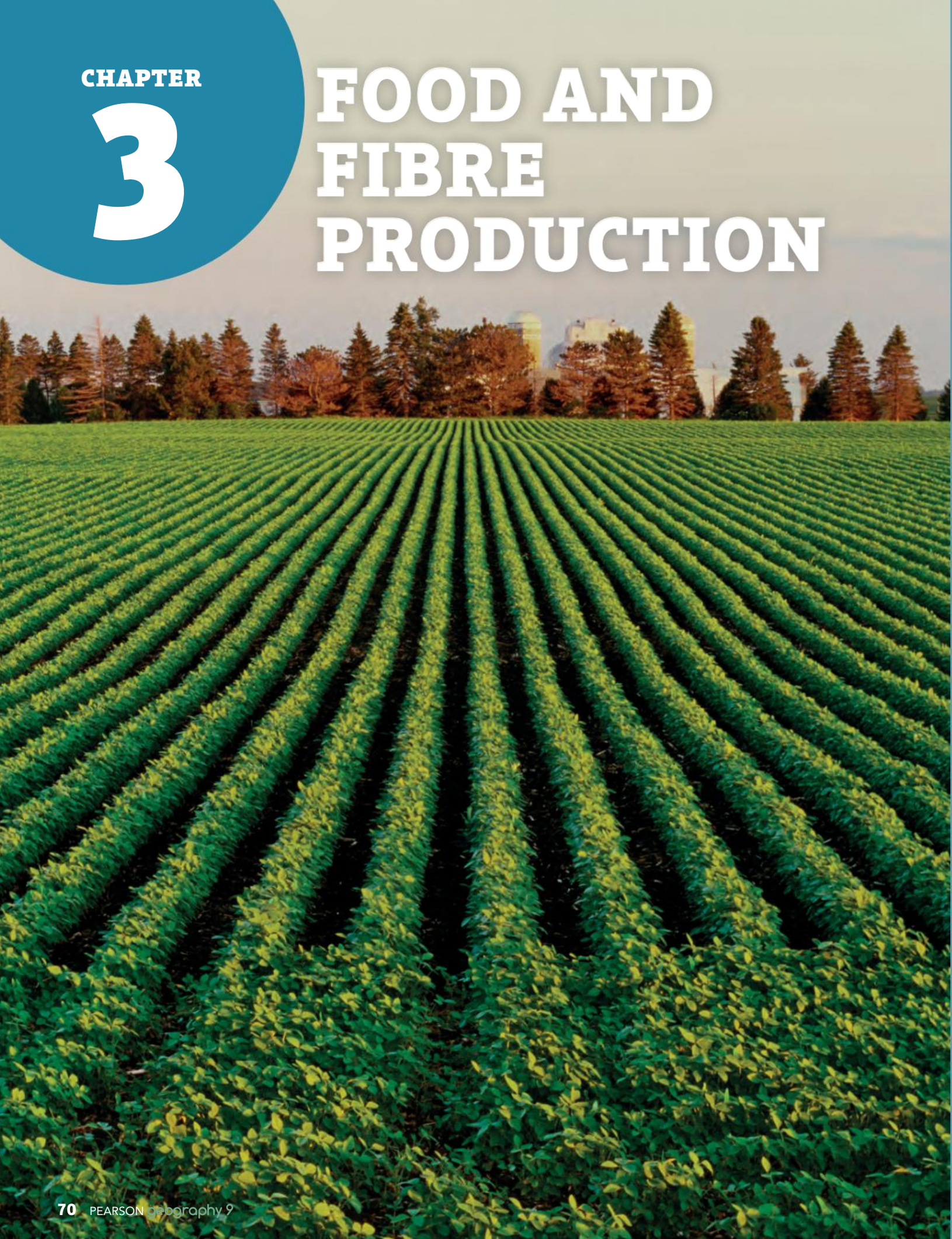
6 Select a fishery that has been over-exploited, such as southern fin tuna, Atlantic bluefin tuna, Patagonian toothfish, trevally, cod or marlin and complete the following tasks.
   a Create a map where the fish are found and breed.
   b Describe the life cycle of the fish.
   c Explain why the fisheries has been over-exploited.

   Make a recommendation for future management of the fishery.

CHAPTER

3

FOOD AND FIBRE PRODUCTION



Food security, population growth, environmental sustainability and economic wellbeing are all issues critical to our future. However, such issues cannot be viewed in isolation, and they cannot be considered without recognising the role of food and fibre production. We need to know where the food and fibre that sustain our lives come from and resources are needed to produce the products we consume and use.

Food and fibre production is big business. The food industry is especially complex. It includes the diverse range of businesses that participate in the supply chain that provides much of the food energy consumed by the world's population. These businesses involve farmers and ranchers; processors; those involved in research and development; food processors; the transport and logistics industry; farm machinery suppliers; and the food distributors, marketers, wholesalers and retailers. Only subsistence farmers—those who survive on what they grow—fall outside the scope of the modern food industry.

Fibre production is also complex. It includes commonly used products such as cotton, hemp, jute, flax and sisal. Plant fibres are used in the manufacture of textiles and paper.

In this chapter we study the human alteration of biomes to produce food, industrial materials and fibres, and the environmental effects of these alterations.

KEY IDEAS

- To develop an appreciation of the complexity of global food and fibre production
- To understand how food and fibre production is changing and the factors driving such changes
- To appreciate the complex nature of food supply chains and role of consumer choice in shaping the production process
- To recognise that food production often involves choices based on ethical considerations
- To know how to interpret flowline maps

GLOSSARY

agribusiness	businesses collectively associated with the production, processing and distribution of agricultural products
aquaculture	the farming of aquatic organisms such as fish, crustaceans, molluscs and aquatic plants under controlled conditions (also known as aquafarming)
commercial agriculture	the use of energy, water and chemicals to produce food and other agricultural products for sale
desertification	the expansion of deserts due to overgrazing, soil erosion, climate change or prolonged drought
environmental vegetarianism	the practice of abstaining from the consumption of meat—red meat, poultry, seafood and the flesh of any other animal—in the belief that intensive agriculture is environmentally unsustainable
wild-caught seafood	seafood harvested from the open oceans

3.0 Soybean plants, Iowa, United States of America

3.1 Global food and fibre production

In the past, the types of crops and pastures grown were largely dependent on the biophysical environment and the choices made by the farmers were limited. Today, however, the genetic engineering of plant species and the use of irrigation have allowed agriculture and fibre production to expand into areas once considered to be marginal.

Importance of agriculture

Agriculture sustains people. It is a way of life for many and a daily struggle for some. Even people living in urban–industrial societies, far removed from the agricultural scene, depend on the food and the fibres generated by agriculture. Today, agriculture is one of the most important economic activities in the world, as it has been through most of recorded history.

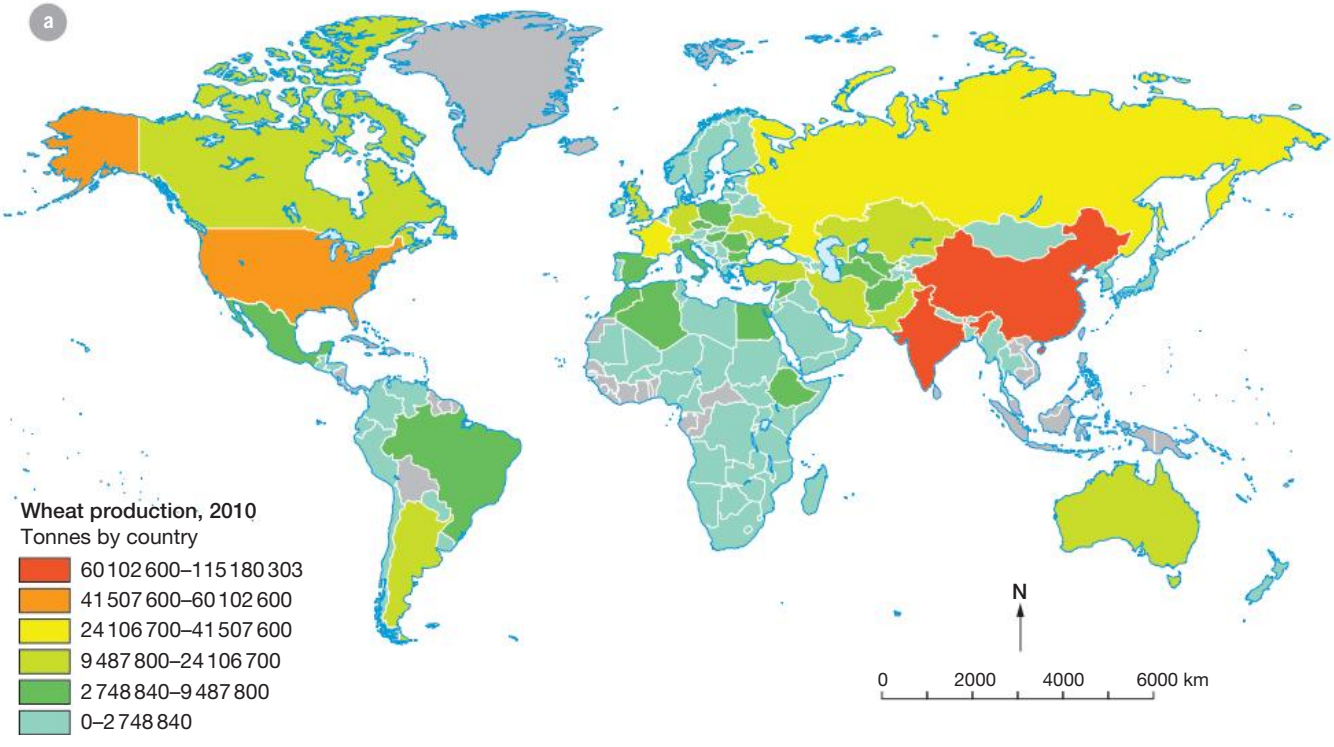
Food and fibre crops

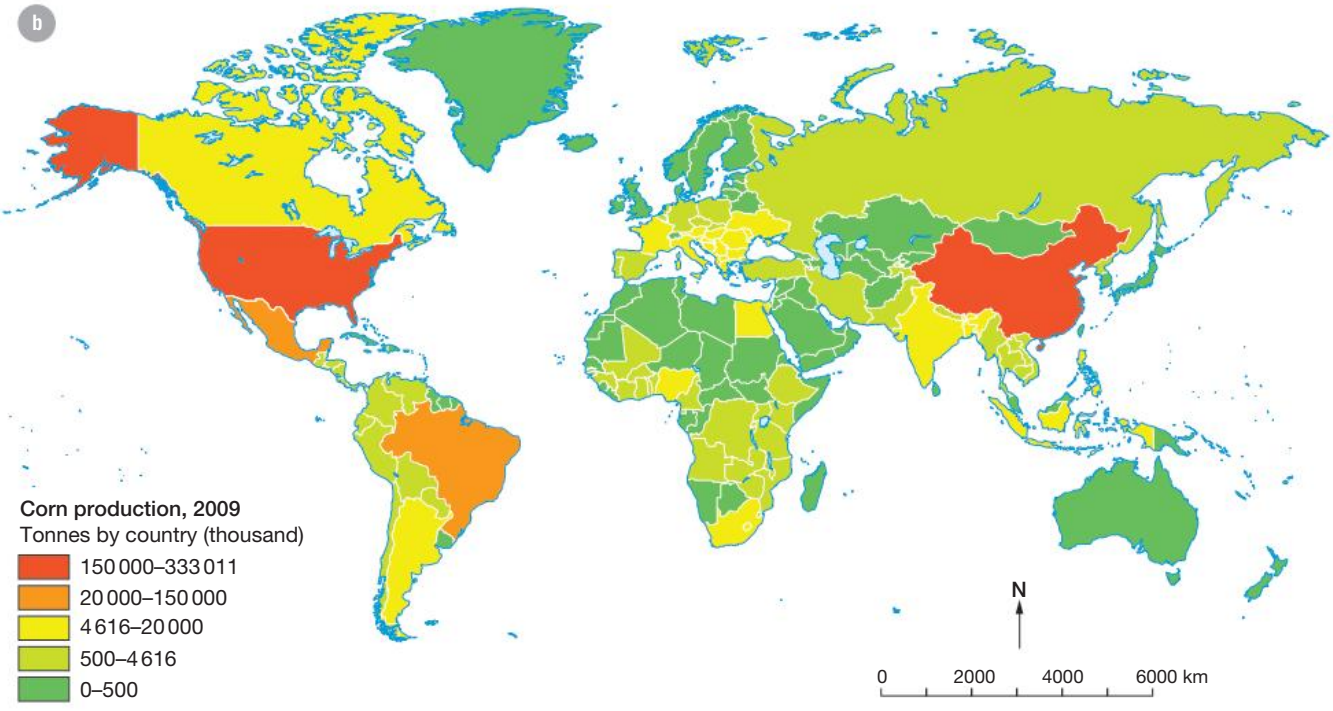
It is thought that there are 50 000 plant species on earth that people can eat. Since agriculture began, about 10 000 of these species have been used as a direct source of food or as feed for livestock that provide meat and milk. It is estimated that 90 per cent of the global energy intake is provided by just four plant species and eight terrestrial animal species. Of this 90 per cent, 60 per cent comes from just three grain crops—wheat, rice and corn. Figure 3.1a–c shows the spatial distribution of wheat, rice and corn production around the world.

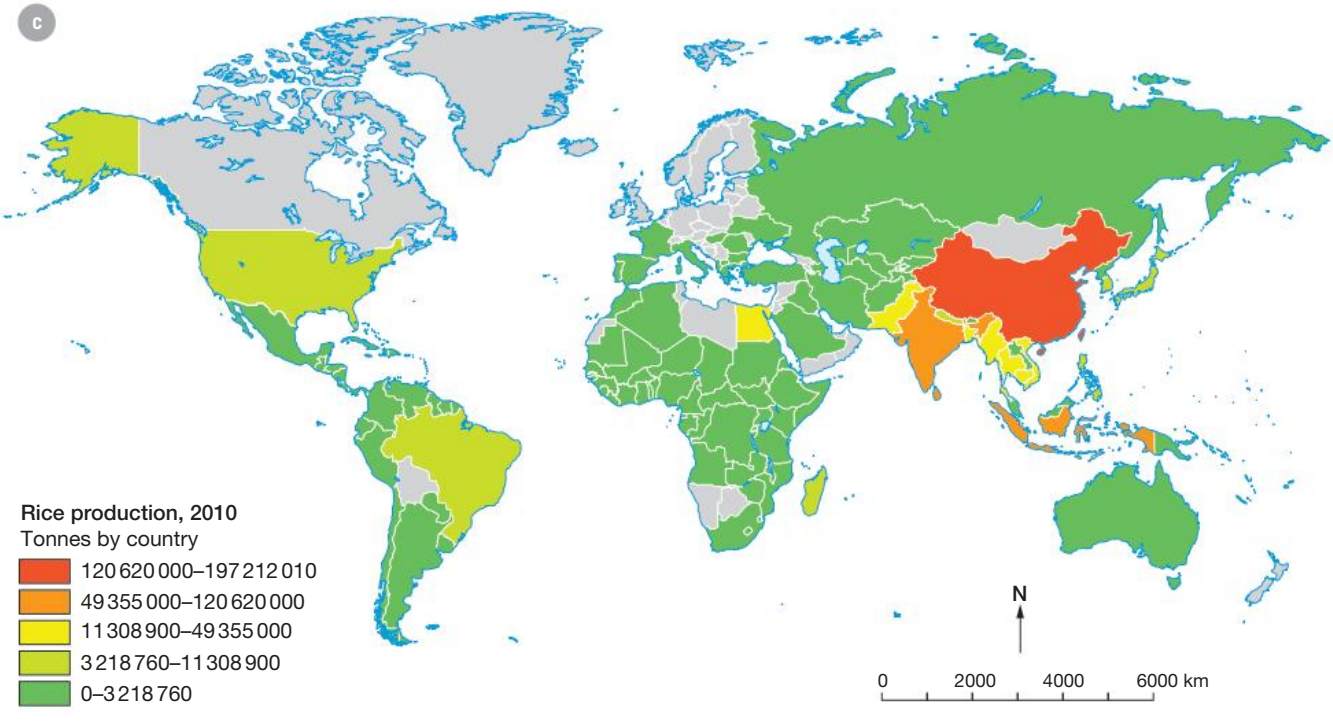
Plants yielding fibres are second to food plants in terms their worth to humans and the development of civilisation. They have been used in weaving and filling and made into textiles (cloth) and paper.

3.1 Global production of the main grain crops

a







Types of plants

It is impossible to estimate the number of species of fibre plants, but over a thousand species have yielded fibres in America alone, and over 800 in the Philippines. Plant fibres of commercial importance are relatively few, however, most being native species used in traditional agriculture.

3.2 Climate regimes associated with the world's major food and fibre crops

Grain or fibre	Suitable climate
Wheat	Wheat can be grown in a wide range of climates, but is best suited to the dry, mild climates of the temperate zone, as it is susceptible to diseases such as rust that thrive in very hot, humid climates. It generally requires between 110 and 130 days from planting to harvesting. It grows best in climates with temperatures between 21°C and 24°C, with annual precipitation totals between 310 and 380 millimetres. Wheat also needs plenty of sunshine for the heads of grain to fill.
Corn	Maize can also be grown in a range of climatic conditions, so long as the night time temperatures do not fall below 15.6°C, as it stops growing then. It cannot survive frost at any stage of its growth. So corn is a crop that loves warm weather, where the mean summer temperature is above 23°C. It thrives in bright sunshine. It also needs at least 600 millimetres of precipitation annually, as inadequate soil moisture results in poor yields because of shrivelled grains.
Rice	Rice is best suited to regions that experience high temperatures and prolonged sunshine. The optimum average temperature during its life cycle is between 20°C and 38°C. While rice may be tolerant of a range of temperatures, it is very demanding of water (with both the amount and timing). It cannot be grown successfully if the annual total precipitation is below 1000 millimetres and during the growing season 125 millimetres is needed each month. Once ripening of the rice is underway, dry weather should prevail until harvesting.
Oilseeds	Palm oil is grown in hot, wet tropical climates, where temperatures remain around 26°C all year and between 1700 millimetres and 3000 millimetres of precipitation falls annually.
	Soybeans grow best in climates with hot summers where mean temperatures range between 20°C and 30°C, and only need 500 millimetres to 600 millimetres of annual precipitation.
	Olive oil is suited to the Mediterranean climate of long, hot, dry summers, where monthly average temperatures are above 26°C. The winters are mild and annual average precipitation is between 250 millimetres and 430 millimetres.
Cotton	Cotton is a warm-climate crop, requiring temperatures between 11°C and 25°C and 6 months free of frost. Throughout the plant's growing period it needs between 600 millimetres and 120 millimetres of precipitation, followed by dry weather and abundant sunshine while the crop matures.
Wool	Fine wool sheep are raised in arid and semi-arid climates where the annual rainfall totals are less than millimetres, whereas long-wool breeds are suited to the cool, wet climates, where up to 1600 millimetres of precipitation is received annually.
Silk	The mulberry trees that support sericulture (silk farming) can be grown in a range of climates from cool temperate to subtropical where there is ample rainfall.

Global pattern of agriculture

The suitability of a region for agriculture has always been heavily dependent on the biophysical environment, as natural elements affect plant and animal growth. Crops have certain requirements, such as temperature, availability of soil moisture, soil fertility and the length of the growing season that must be met for them to grow and flourish. Some plants are intolerant of frosts or high winds, which cause damage that reduces yields and so restricts their distribution. Table 3.2 outlines the climate regimes that are associated with the world's major food and fibre crops.

Agriculture is a deliberate attempt by humans to modify natural processes for their own advantage. While agriculture relies on the natural environment, human elements determine how these natural elements are organised. The level of civilisation; cultural, social and political organisation; management skills; and available technology all affect how the land is used. Distinct global patterns of agriculture have emerged which reflect regional variations in both the biophysical environment and human interactions with it.

Since the 1960s, there has been a large increase in agricultural production as a result of technological advances. This has occurred in what is known as industrial agriculture or the large-scale production of single crops (monocultures) or livestock in the more favourable temperate environments of developed countries. Industrial agriculture now produces 80 per cent of the world's food. Investments in machinery, fossil fuels, agrochemicals and irrigation water have raised yields and generated profits.

Global food production

Globally, more land is taken up for the growth of wheat than for any other grain. On average, wheat yields only 3 tonnes per hectare, whereas corn yields are generally much higher and are close to 5 tonnes per hectare. In the United States of America, corn yields in the most productive areas can exceed 10 tonnes per hectare when conditions are favourable.



3.3 Bales of wool, ready for export. The wool trade continues to be important to the Australian economy.

Nearly half the world's grain is produced in just three countries: China, the United States of America and India. China produced an estimated 479 million tonnes of grain in 2012—its largest harvest ever—compared with the United States of America's 354 million tonnes. India harvested 230 million tonnes. The countries in the European Union produced 274 million tonnes.

Global fibre production

Cotton is produced in many parts of the world, the largest growers being China, India and the United States of America. Australia is the leading global producer of wool (see Figure 3.3), although China has more sheep.

The history of production and trade

By the seventeenth century **commercial agriculture** emerged in Europe and profit became the motive for production of food and fibre crops. Commercial agricultural practices spread to the colonies as plantations became established. During the colonial era an extractive relationship developed between wealthy nations and the rest of the world that would last for centuries, whereby the less developed nations became the suppliers of food and the raw materials that fuelled the growing wealth and power of Western capitalism. In Australia, after European settlement was firmly established, commercial agriculture began. The two main commodities were wheat and wool. These products were sent mainly back to the United Kingdom and helped make Australia a wealthy country.

During the twentieth century, production levels soared as agriculture became industrialised, supported by technological innovations and agrochemicals that lifted crop yields. World trade in food and fibre products increased as multinational corporations became heavily involved in both the production and distribution of goods.

ACTIVITIES

Knowledge and understanding

1 Identify the factors that determine how the land in a particular region is used for agriculture.
2 Describe the different forms of agriculture practised today.
3 Explain why global trade has shifted.

Applying and analysing

4 Prepare an annotated visual display of the climate regimes associated with the world's major food and fibre crops.

Geographical skills

5 Study Figure 3.1 a–c then do the following tasks.
  a Which grain has the highest production levels?
  b Which were the top six wheat-producing countries in 2010?
  c How much rice was produced in Indonesia in 2010?
6 Create a large wall map of the world. Identify the main types of agriculture practised in each of the inhabited continents by using symbols or images. Using text boxes, account for their location.

3.2 Changing food and fibre production

In 2007, global reserves of food dipped and the price of food soared. The run of cheap and plentiful supplies of food was over. The pattern of global food and fibre production has continued to shift, as trading patterns have changed and concerns over environmental quality have increased.

Changing food production

Until 2007, the world enjoyed a surplus in food production, and food was generally freely available at relatively cheap prices for those who could afford it. The wealthy developed countries continued to dominate global trade flows. Since 2007, however, there have been quite dramatic shifts in both the production and distribution of food.

The shock of a food shortage

During the world food crisis of 2007–08, world grain reserves dipped to their lowest level ever, at only 54 days supply, and, as a result, prices soared. Maize doubled in price, wheat prices rose by 50 per cent and rice increased by 70 per cent. While this had an impact on food supplies across the world, the poorest people were the worst affected, especially those living in Sub-Saharan Africa, as they could not afford to pay the higher prices.

Emerging economies

Both the origin (production) and destination (consumption) of grains and oilseeds are shifting. This is in response to the accelerating demand for crops and oilseeds of some one billion new middle-class consumers in countries such as China, India, South Korea, Poland and Mexico (see Figure 3.4).

The higher demand for grain that has resulted from increasing meat consumption and the use of biofuels is occurring at a time when productivity (or yield) is not rising as quickly. These competing demands for crops put pressure on prices, especially for corn, which is used for both.

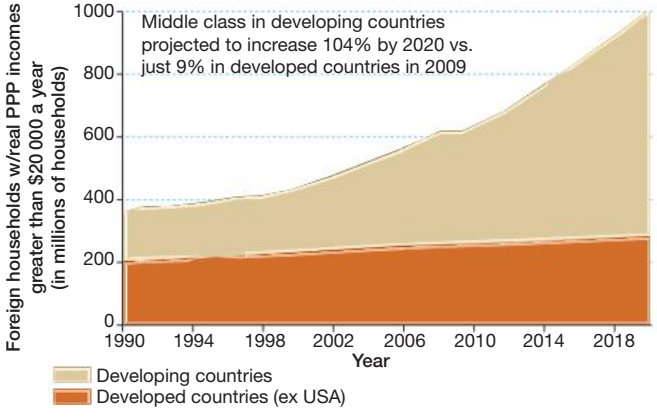
Car ownership and meat consumption

Car ownership and meat consumption are the symbols of affluence in the emerging economies. The soaring demand for these two commodities has led to rising demand for biofuels and feed crops for livestock, causing their prices to increase. As a result more farmers are replacing food crops with biofuel and feed crops.

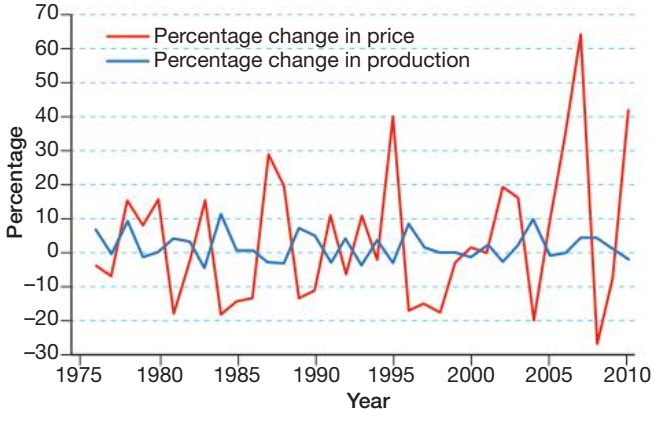
Continued volatility in prices

The upward pressure on food prices is largely a result of accelerating demand for grains and oilseeds, and in particular corn. The growing regions have not been able to keep up supplies and stocks have dwindled, resulting in extraordinary pressure on prices. Figure 3.5 illustrates the volatility of the global price of crops in comparison with their relatively stable levels of production.

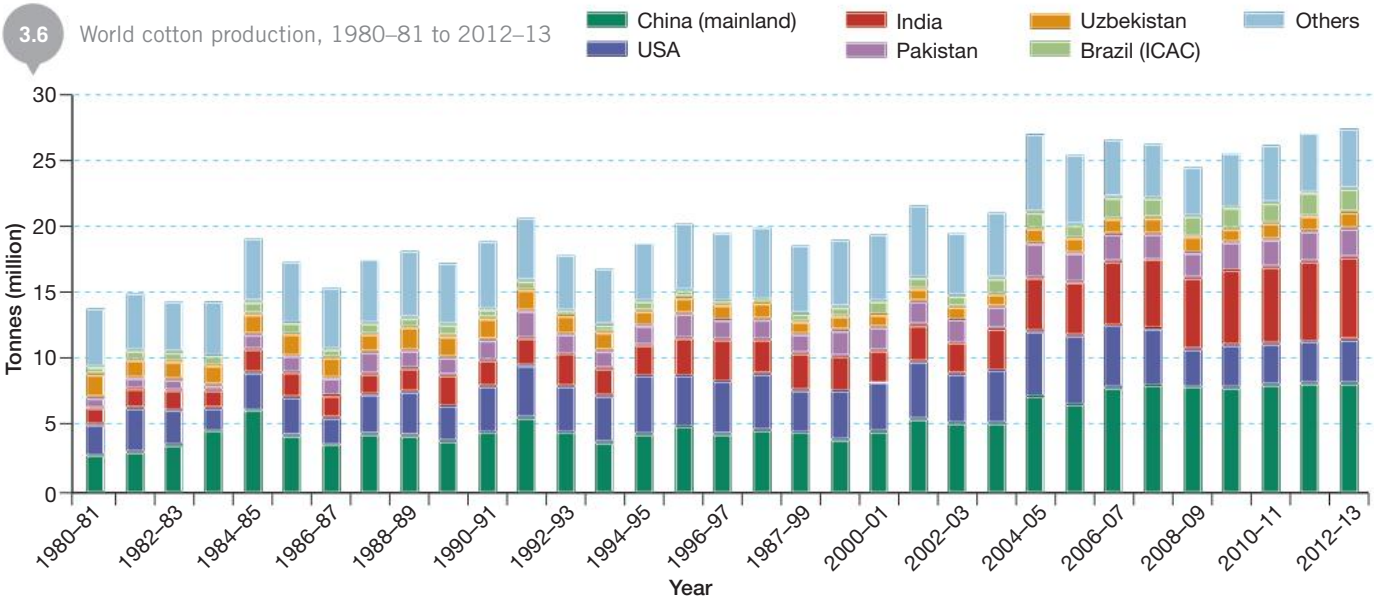
3.4 Middle-class households, 1990–2020



3.5 Prices for food crops are becoming increasingly volatile.



3.6 World cotton production, 1980–81 to 2012–13



Source: UNCTAD Secretariat

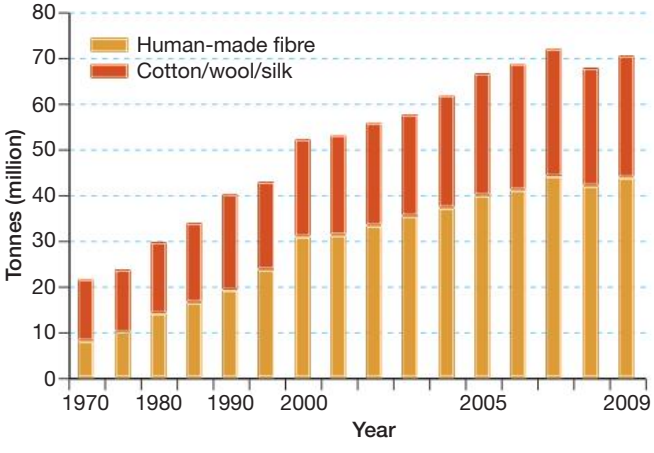
Trade in oilseeds overtakes grains

Such is the demand for oilseeds to feed livestock and for use in the production of processed food that the volume of oilseeds traded overtook grains for the first time in 2010–11. The total value of grain and oilseed trade flows have trebled in the last six years, from $70 billion to $210 billion as a result of the higher prices.

Changing fibre production

Since the 1960s, natural fibres have come under increasing competition from cheaper synthetic substitutes such as nylon and polyester. Cotton remains the most important natural fibre and its production continues to grow, as shown in Figure 3.6. As the global demand for wool has declined, so too has its production. Heavier fibres such as jute, once used to make the bags to transport agricultural products, are no longer needed as large supertankers and container ships are now used. Figure 3.7 shows how the increase in the use of synthetics in the clothing industry has resulted in the natural fibre industry losing much of its market share.

3.7 World fibres supply, 1970–2009



Synthetic fibres are popular because they are cheaper. Demand for natural fibres is increasingly correlated with income. People on higher incomes seek out the highest quality fibres such as silk and cashmere. Various trade associations promote and brand their fibres such as '100% Pure Sea Island Cotton' or 'Pure Wool'.

ACTIVITIES

3.1

Knowledge and understanding

1 Describe what happened to the price of maize, wheat and rice during the food crisis of 2007–08.

2 Outline why the prices for food crops have become so volatile.

Geographical skills

3 Study Figure 3.4 then answer the following questions.
   - a What was the number of households with incomes greater than $20 000 a year in developed and developing countries in 1990 and 2020?
   - b Compare the growth between developed and developing countries. Can you suggests reasons for the difference?

4 Study Figure 3.6 then answer the following questions.
   - a Which country has consistently been the largest producer of cotton?
   - b Which country has increased its market share the most?

3.3 The agricultural trade

Agricultural trade was motivated by the desire to acquire more food and fibre-based products for people to use. What started out as a search for new resources as civilisations developed and expanded during colonial times has gathered pace with the globalisation of recent decades.

When agriculture trade began

With the spread of civilisation and the growth of populations, emerging societies began to look beyond their immediate regions for resources. International trade developed between societies, cultures and nations. As the world industrialised, the range and volume of products expanded, particularly during the colonial era, when the European nations secured materials for themselves.

Increasing trade flows

Populations throughout the world are increasingly relying on agricultural and fibre-based products not grown within their own country. Trade has resulted because of the differences between countries that determine their ability to provide for themselves. These differences include:

- the quality of the biophysical environment: some have long growing seasons, ample fresh water and deep fertile soils, while others have to contend with arid and inhospitable terrains
- the level of economic development within a nation: this determines the quality of the workforce (in terms of health, education and skills); the infrastructure available (such as dams for irrigation and transport to move produce); and the level of research and development to provide new technologies.

As the world has become more economically integrated through globalisation, goods have flowed more freely and in greater volumes between countries. These flows are a simple transfer of products from countries with a surplus of produce to those with a deficit.

Agriculture becomes internationalised

The process of globalisation has been accompanied by unprecedented growth in trade. As multinational corporations came to control an increasing proportion of the production and distribution of agricultural and fibre-based products, both the volume and range of goods flowing around the world increased.

Large **agribusinesses** have extended their operations into many countries, taking advantage of cheap labour costs and a range of environments for different crops. They have diversified their product base by planting different types of crops, bought out competitors in numerous countries and placed the produce on the global market. The size of flows and the number of countries involved have both risen.

Technological advancements

Computers and communication technologies have enabled multinational corporations to coordinate their operations overseas. Advances in transport technologies have resulted in more goods being traded than ever before.

As 90 per cent of global trade is by sea, advances in shipping and cargo handling, such as the development of container ships and specialised bulk carriers like the one shown in Figure 3.8, have been central to the expansion of international trade. Refrigeration and new packaging systems, such as vacuum sealing, extend the freshness of produce and enable products to be moved great distances.

Matching consumer expectations

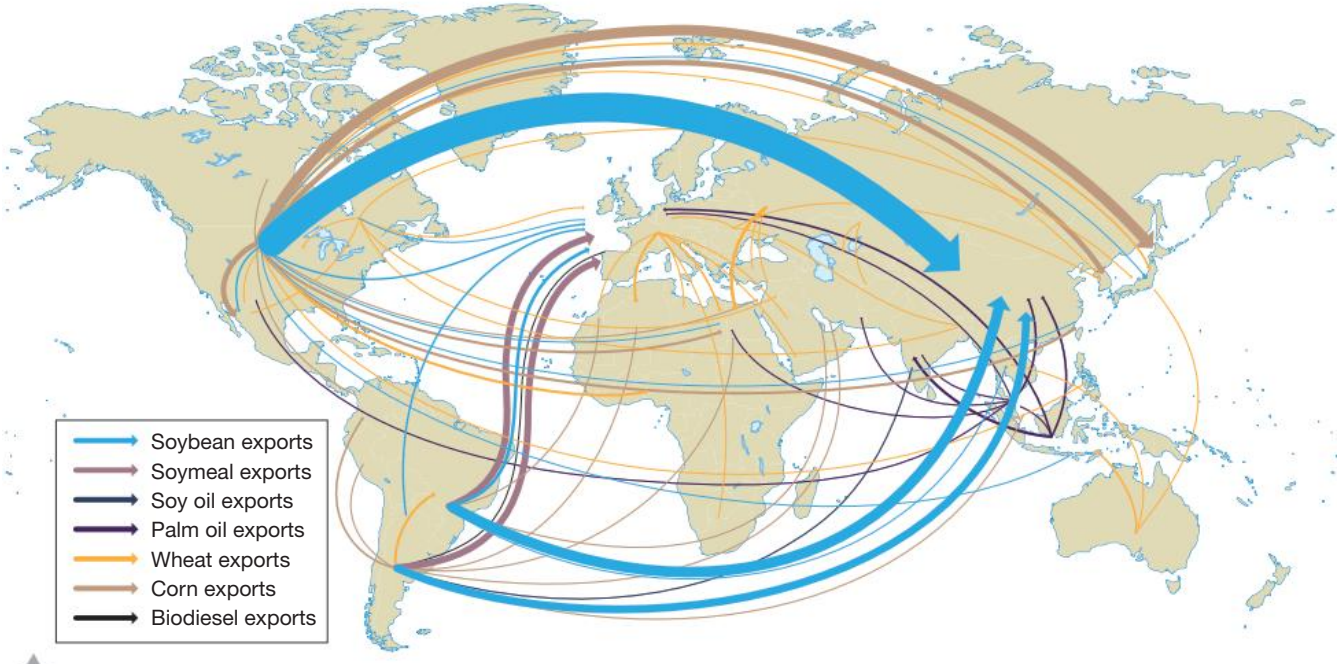
Rising standards of living, particularly in the emerging economies of the world, have increased the flows of meat, dairy products, feed crops for livestock and processed food. Consumers now seek affordable and fresh produce all year round. To meet their needs, multinational corporations keep agricultural products in cold storage and move them to countries where they are out of season.

Produce all year round

Green asparagus is a summer crop in Australia, yet it can be imported in supermarkets in the middle of winter, as it is now imported from Mexico. Like many Central and South American countries, Mexico supplies fresh fruit and vegetables to the United States of America, but it now also sends its produce as far afield as Japan.



3.8 A specialised bulk carrier loading a cargo of grain



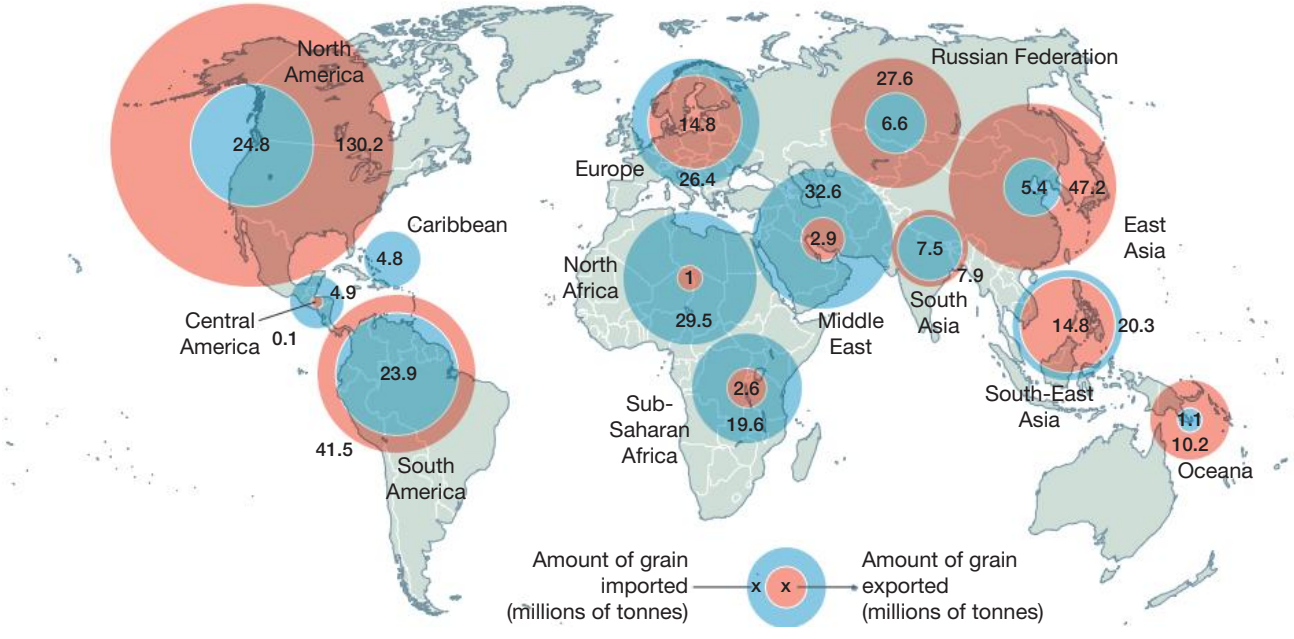
3.9 Global flows of grains and oilseeds

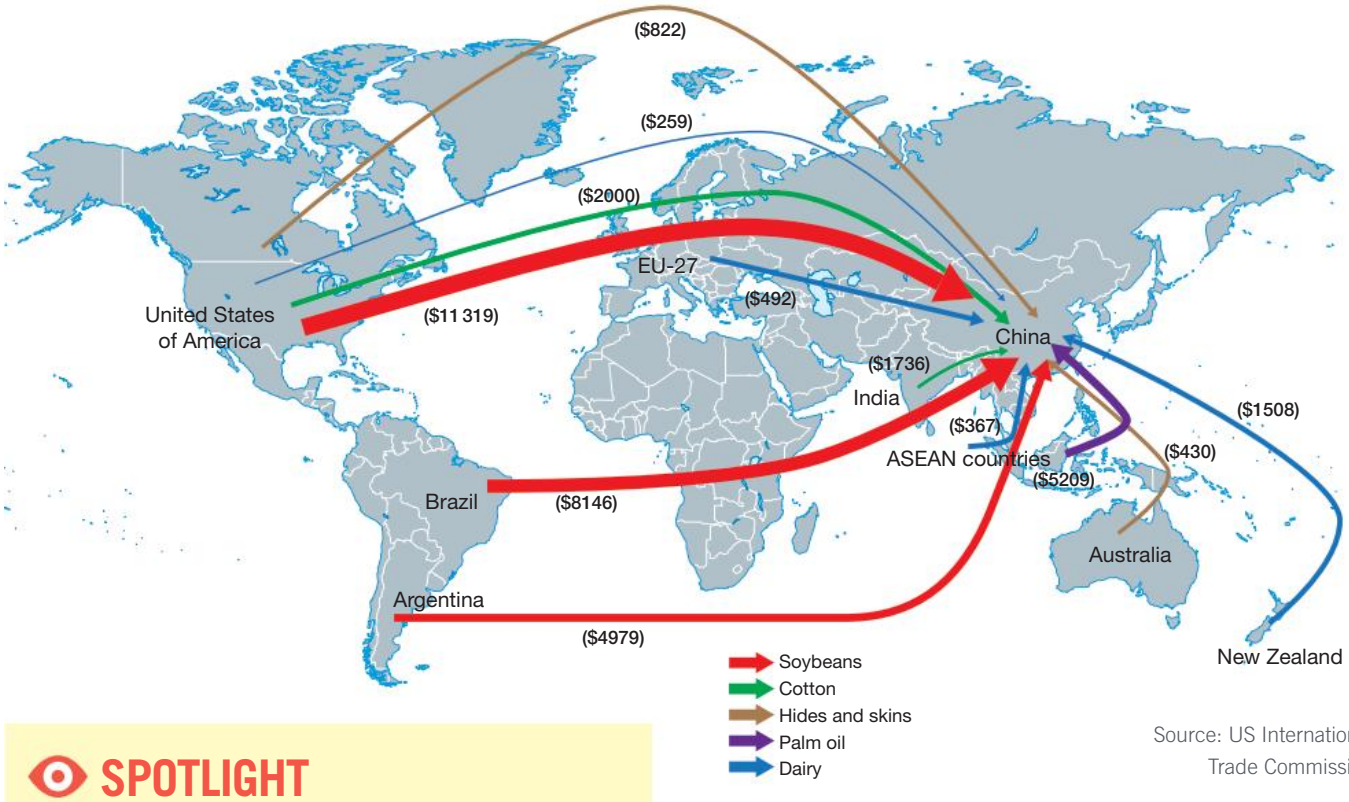
The pattern of flows

Historically, trade flows focused on the high-income countries of Europe, and they still are the recipients of a substantial proportion of trade flows, as is shown in Figure 3.9. However, there has been rapid economic development in Asia since 2000, and a massive expansion of exports to China. An enormous transformation is underway in the world economy and it will continue over the next 20 years.

The United States of America helps feed the world, supplying about half of global grain exports, as shown in Figure 3.10. It is also a major exporter of cotton, the world's most commonly used natural fibre. Prior to 2000, Europe was its largest market, but exports to Europe have declined and agricultural trade flows have switched to middle-income countries such as China and Mexico, which now account for the largest share of US agricultural exports. China has become a major importer of agricultural products, as is illustrated in Figure 3.11. China is the world's largest producer, consumer and importer of cotton.

3.10 Global imports and exports of grain





Source: US International Trade Commission

3.11 Countries from which China imports agricultural and fibre products (US$ million), 2010

SPOTLIGHT

The USA and China: the world's largest producer and consumer of soybeans

Soybeans are China's largest agricultural import. In 2011, by volume, the USA exported 60 per cent of its soybeans to China. Imports of soybean and soybean oil from Brazil and Argentina also account for the majority of agricultural trade between China and the two South American countries. In China, soybeans are typically processed into soybean meal for animal feed and cooking oil for human consumption.



3.12 Soybean products

ACTIVITIES

Knowledge and understanding

1 Explain why countries trade.
2 Outline how agriculture became internationalised and identify the technological advancements that accompanied this.
3 Describe the changing pattern of global trade flows and the role played by the United States of America and China.

Geographical skills

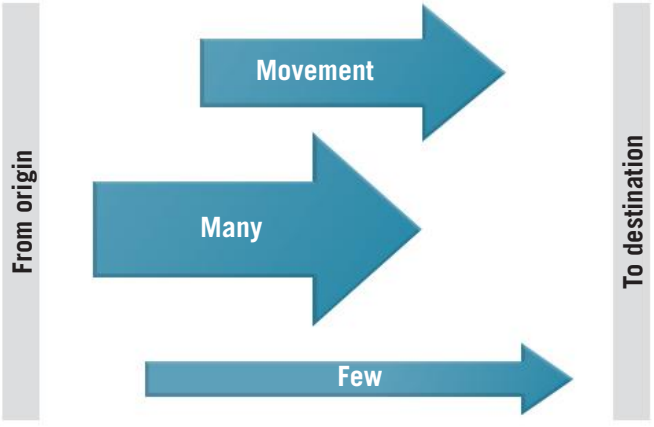
4 Study Figure 3.10 then answer the following questions.
   a What region is the largest importer of grains?
   b What continent is the smallest exporter of grains?
5 Study Figure 3.11 then do the following tasks.
   a List the agricultural and fibre-based products that the United States of America exports to China.
   b Where does China get its cotton imports from?

3.4 Geoskills: Flow diagrams

By its nature, geography is a visual subject. Keen observers note the spectacular interactions of the natural and human elements of landscape. Graphics tools such as flowline maps and flow diagrams help us to understand the workings of both the natural and the human world. Such graphics capture and highlight the important patterns and links that exist. They are a visual representation of what is happening.

Flowline maps

Flowline maps show movement between places, tracking the passage of goods, information and people. Lines or arrows link the place of origin with the destination, and the quantity that is moved is indicated by their width or thickness, as is illustrated in Figure 3.13.



3.13 Flowline map lines or arrows

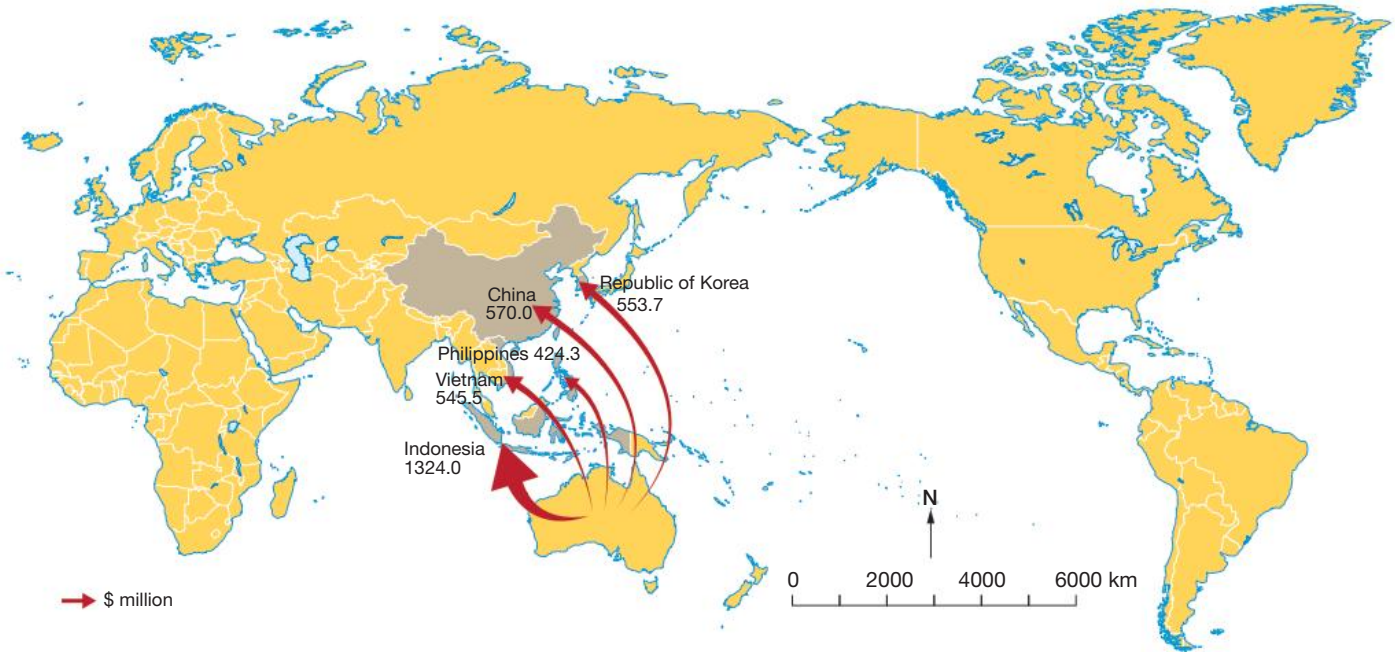
Flowline maps are drawn using statistics of actual movements that have occurred, for the purpose of demonstrating the main patterns. Trade statistics, showing the export of Australia's wheat in 2010–11, are represented in Figure 3.14. It is clear that the majority of it goes to feed people in South-East Asia.

Constructing a flowline map

To construct a flowline map, follow these steps.

1. Select your statistics and arrange them from the smallest units to the largest units.
2. Find a suitable base map.
3. Decide on the various thicknesses of the lines to match the different categories of the sizes of flows that will be shown.
4. Draw in the lines of varying thickness and add an arrowhead to show the direction of the flow.
5. Add a key and give the map a title.

3.14 A flowline map showing the main destinations of Australia's wheat exports



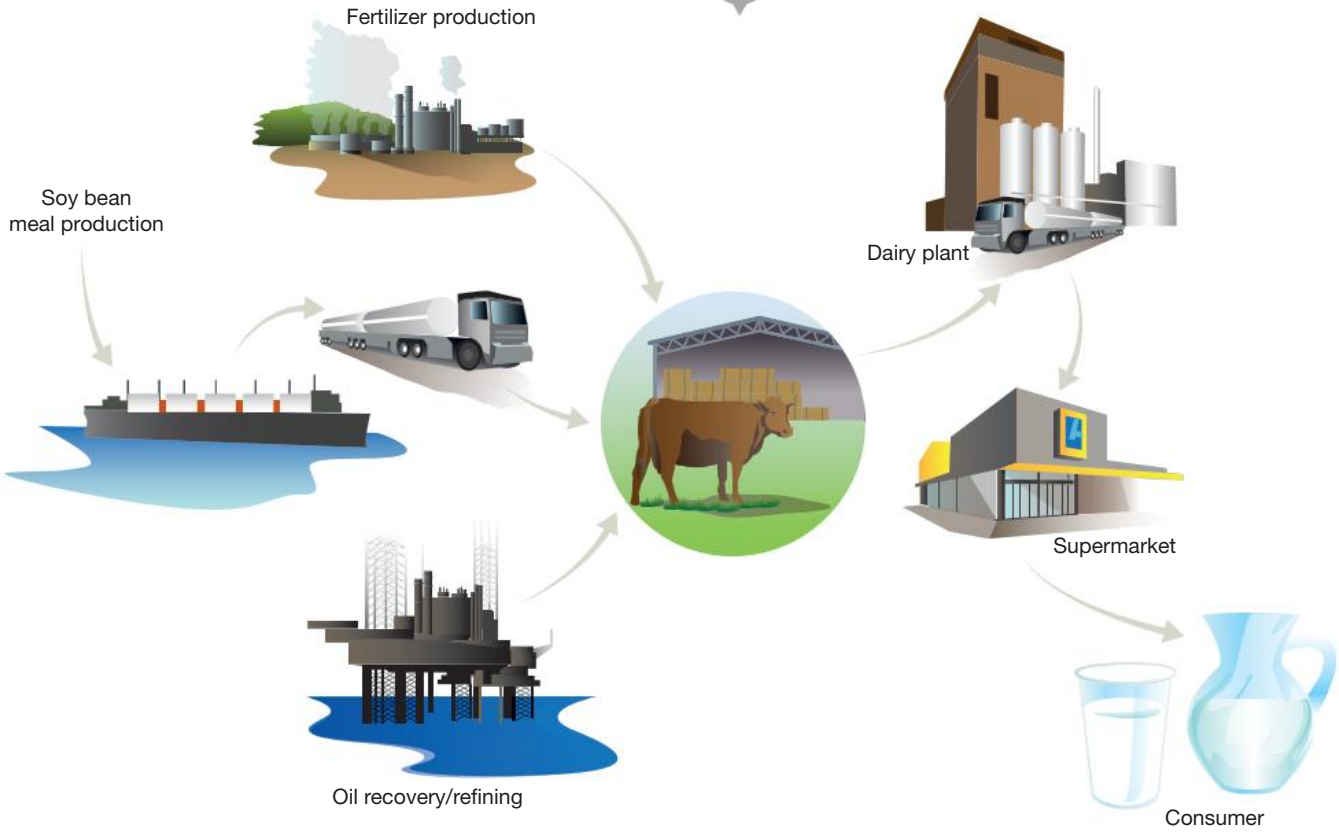
Flow diagrams

Flow diagrams are used widely in geography to illustrate how the world functions and in particular the interactions that occur within and between the physical and human environments. While flowline maps show a record of actual movement that has occurred, flow diagrams tend to be more generalised. They represent common flows that can occur in many places and they emphasise the processes and links involved. Annotations are often added to the picture to provide build a clearer understanding.

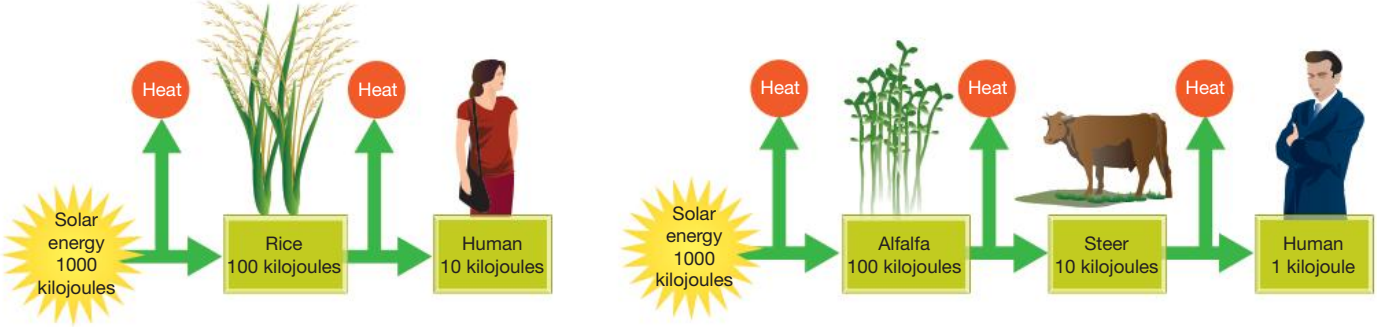
Simple

Some flow diagrams are quite simple, showing the clear stages of a process, such as the production of milk depicted in Figure 3.15. Others attempt to simplify the complexity of the real world by highlighting a simple progression, such as in Figure 3.16.

3.15 A flow diagram showing the production of milk



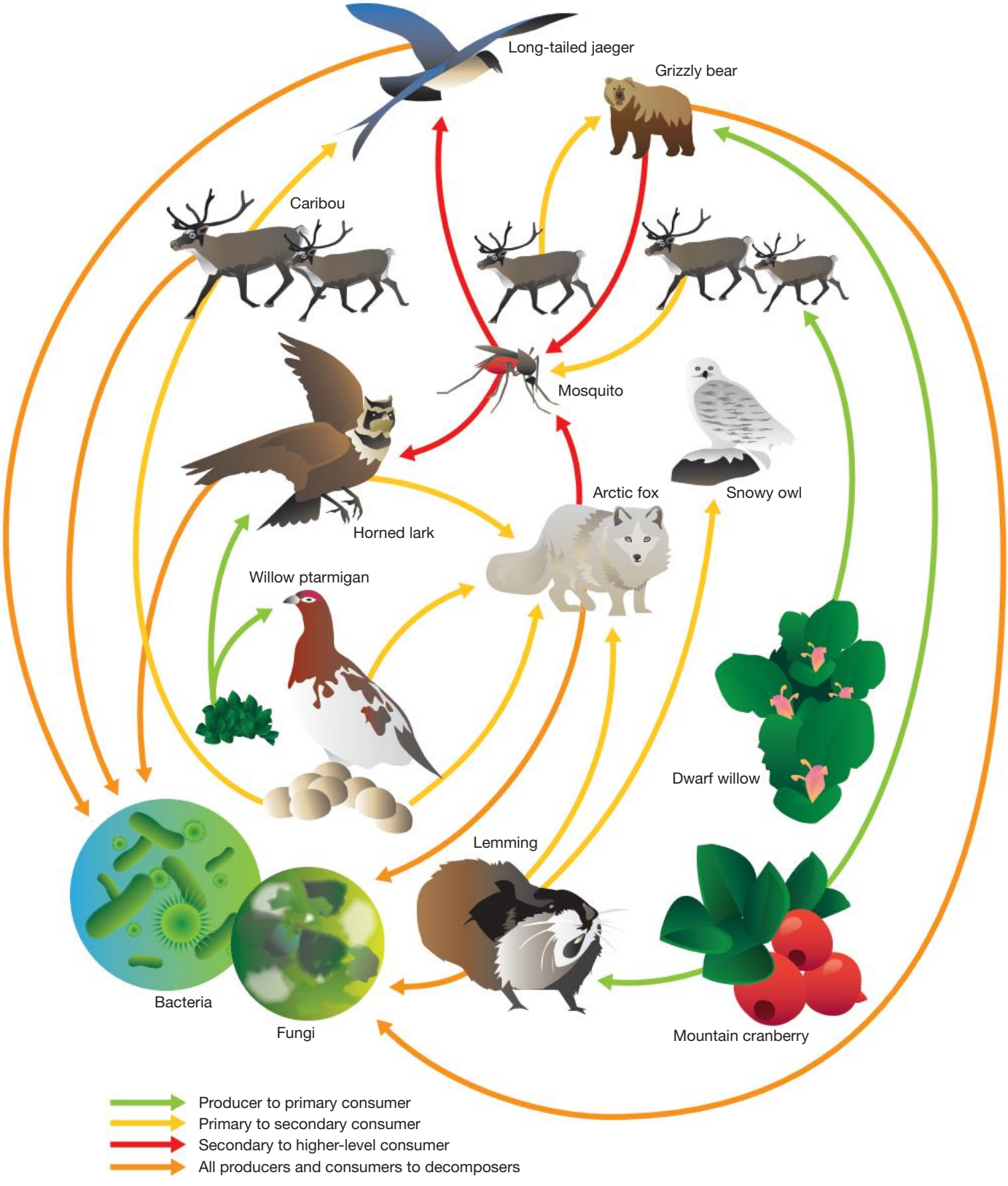
3.16 A flow diagram showing how the energy gained from food decreases when meat is eaten

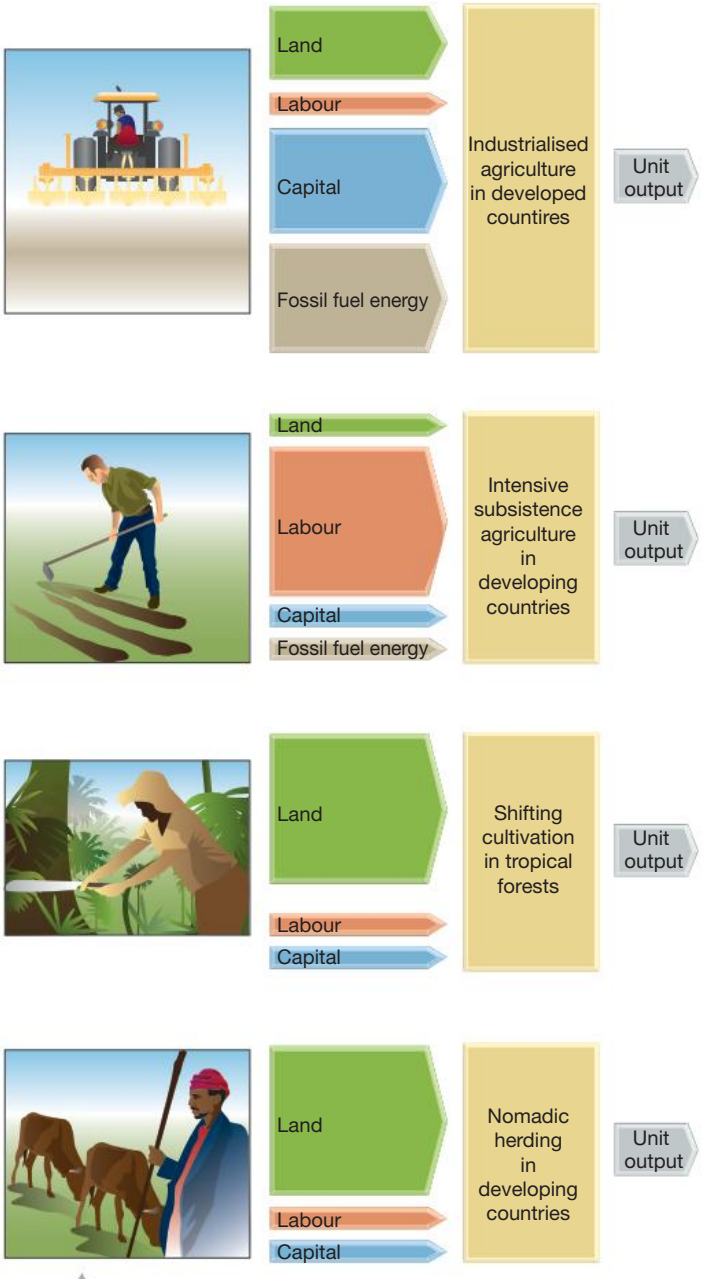


Complex

When geographers want to reveal just how complex nature is, a flow diagram, such as the one in Figure 3.16, does this well. They are also useful in analysing human activities, as illustrated in Figure 3.17.

3.17 A flow diagram showing some components and interactions within the tundra biome





3.18 A flow diagram showing the relative inputs of land, labour, capital and fossil fuel energy into major types of agricultural systems

DID YOU KNOW?

Since 1950, approximately 88 per cent of the increase in global food production has come from increased yields per hectare of land under cultivation.

ACTIVITIES

Knowledge and understanding

1 Give an example of when you would use a flowline map or flowline diagram.

Geographical skills

2 Refer to Figure 3.14 then answer the following questions.
- a What was the value of exports to Vietnam?
- c What was the value of exports to Indonesia?
- c Suggest reasons why these countries import most of Australia's wheat.

3 Using the statistics below, construct a flowline map to show the destinations of Australia's beef exports in 2010–11.

Beef (fresh, chilled or frozen)	A$ (million)
Japan	1688.8
Republic of Korea	713.9
United States of America	708.9
Russian Federation	291.5
Indonesia	177.7

Source: Department of Foreign Affairs and Trade, 2011

4 Using the following statistics, construct a flowline map to show the destinations of Australia's merchandise trade of primary products in 2012.

Primary products	A$ (million)
China	$60201
Japan	$32900
Republic of Korea	$16413
India	$8245
Taiwan	$6008

Source: Department of Foreign Affairs and Trade, 2013

5 Conduct a survey of the suburbs/towns/areas that students in your year at school come from. Construct a flowline map to illustrate your results.

6 Study Figure 3.15. Construct a flow diagram to show the production of bread.

7 Study Figure 3.16. Explain why most of the people in the world survive on a grain diet.

8 Study Figure 3.18. Compare the relative inputs of land, labour, capital and fossil fuels to the major types of agricultural systems.

3.5 Case study: Where does my denim come from?

When you think of denim the first thing to come to mind is jeans—garments made famous in the 1960s by rock and roll legends. Denim, however, was first woven in the seventeenth century and has been used for many purposes including furniture upholstery, awnings on buildings and, of course, clothing. It was even used for sails on tall ships.

Made from cotton

Denim is made from cotton and is typically made by weaving two different-coloured yarns, one white and the other blue. Traditionally, the blue yarn was produced by dying cotton with indigo, which was the most commonly occurring natural dye as well as the one of the most durable. Together, the two yarns produce the famous blue colour of denim. Today, denim is almost exclusively used by the clothing industry. It is estimated that around 400 million jeans are sold each year in the United States of America.

Global trade

The global trade in denim is estimated at more than $54 billion, with about 4 billion metres of the fabric produced each year. Although the denim industry has its roots firmly in the United States of America, where famous jean brands, such as Levi Strauss, began in the 1870s, today China, India (see Figure 3.19), Bangladesh, Turkey and Pakistan are the main producers. China dominates, with around 300 of the world's 500 denim mills.

DID YOU KNOW?

Germans are said to wear jeans more often than anyone else on earth—an average of 4.5 days a week!



3.19 Denim fabric mill in India, which is now a major player in the industry



3.20 It can take up to 10 000 litres of water to grow the cotton used in a single pair of jeans.

China produces around 1.5 billion metres of denim each year. In 2013, Indian production reached 1 billion metres and is now gradually taking more of the global share away from China. Turkey and Pakistan each produce about 500 million metres each. One of the key reasons for the rise in the number of Indian denim factories is that they are now able to produce the fabric for a cheaper price due to lower wages. For example, the average wages of a denim factory worker in Guangzhou rose from about US$380 per month in 2008 to about US$610 a month in 2012. As labour is a key cost in the production of denim, Indian production is booming.

It is estimated that demand for denim will continue to grow at a rapid rate. Some industry experts have predicted global production will rise to 8 billion metres by 2021. Much of this growth is expected to take place in India, Bangladesh and Pakistan.

Environmental cost of a new pair of jeans

Many environmentalists claim that denim is one of the least environmentally sound fabrics. This is in part due to the fact that it comes from cotton. Most cotton is grown using irrigation and uses vast quantities of water (see Figure 3.20) as well as requiring significant use of pesticides. The cotton used in a single pair of jeans can use between to 5000 and 10 000 litres of water to grow.

That famous blue colour no longer comes from the natural indigo dye. Instead, it almost exclusively comes from a synthetic dye that produces a range of hazardous chemicals as a by-product of production. Many jeans manufacturers are gaining awareness of the costs to the environment caused by denim production. Naturally dyed jeans are beginning to be sold online and big producers are turning to more organically grown cotton.

One of the best ways to reduce the environmental impact of your jeans is to reuse them. Recycled jeans have become a big hit, with vintage jeans sites online, and some companies use old jeans to make pencil cases, footwear and other items.

ACTIVITIES

3.2

Knowledge and understanding

1 Outline the products used in the manufacture of blue denim.
2 Describe the size of the global denim industry.
3 Where is most denim produced?
4 Explain why India is becoming a more dominant producer of denim.

Applying and analysing

5 Estimate the amount of water required for all the pairs of jeans you own.
6 Class discussion: Why do you think the production of jeans is considered to damage the environment?

Investigating

7 Using the internet, conduct research into more environmentally friendly jeans. Produce a short presentation or a written report on the strategies used to make the jeans more green.

3.6 Interdependence in food production

Globalisation is building interdependence in food production throughout the world. There are also other forces at work that increase interdependence. As some nations confront food shortages, others will need to work towards securing adequate supplies for affected populations or global security may be put at risk.

Providing enough food

Only 25 per cent of the world's agricultural production is traded internationally, compared with over 50 per cent of manufactured goods. Rice, in particular, is held onto and consumed by the people of the country in which it is produced—only 7 per cent is traded internationally, as shown in Table 3.21. However, when domestic supplies are inadequate, countries rely on others that produce a surplus to meet their needs.

All nations would like to be self-sufficient in food production. Those that struggle the most to do so are the poorer developing nations with the highest rates of population growth and an unfavourable biophysical environment. Sub-Saharan Africa is in this situation, where the overpopulation of marginal land has resulted in **desertification**. In the scramble to survive, the environment has become a casualty, reducing food security in the region. Self-sufficiency in cereal crops will continue to be low in North Africa, the region most dependent on food imports.

3.21 World grain and oilseed use and trade, 2011–12

Crop	Use (million tonnes)	Trade (million tonnes)	Percentage traded
Rice	458	33	7
Wheat	677	137	20
Coarse grain	1149	119	10
Oilseeds	389	113	29
Oilmeals	260	80	31
Vegetable oils	150	62	41
Total	3083	544	18

Source: USDA WASDE, November 2011

3.22 People line up to receive food in north-western Kenya, 2009.



Even efficient and surplus food producers such as Australia and the United States of America can have crop failures that expose parts of their population to temporary food shortages. Natural disasters such as droughts and floods, extreme weather events such as hailstorms and heatwaves, and diseases, can wipe out crops.

The operation of an open and efficient international market in food can enable countries to share the risks and mitigate the adverse effects of crop failures and food shortages by moving food to affected regions. Money is needed to buy the food and in many instances those poorer nations struggling with extreme famines must rely on the goodwill of other nations who provide aid, as shown in Figure 3.22. When crises such as the 2011 famine in the Horn of Africa arise, Australia provides emergency relief by funding food purchases through international relief organisations. It also invests in research and development and helps run projects in developing countries.

Consumer expectations

Many countries will continue to depend on food imports to consistently meet the needs and increasing expectations of their people. People are becoming more and more accustomed to eating food imported from other countries. With its harsh, cold winters, the United States of America has long relied on countries in Central and South America to ensure a year-round supply of fresh fruit and vegetables. The level of interdependence between countries has increased as multinational corporations have extended the global reach of their marketing of food products.

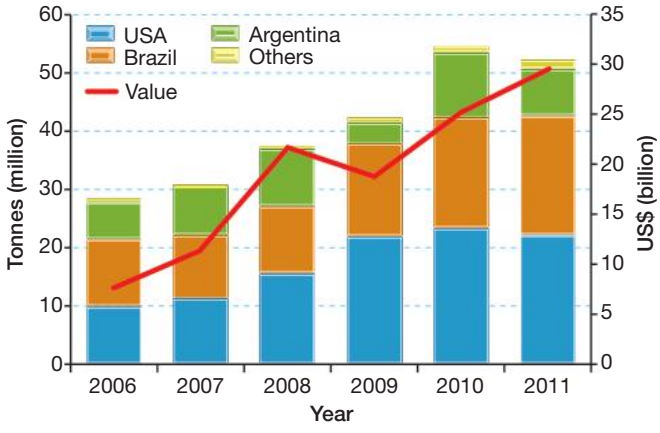
Trade relations

The surge of international trade that has accompanied globalisation is evidence of growing global interdependence in food production. The changes that have occurred in China's relationship with other countries clearly show this at work. When China embarked on the modernisation of its economy in the late 1970s there was a sharp acceleration in commodity flows in and out of the country. China now has many trading partners and has become a major player in the global economy. It actively pursues tighter trade and investment relations with countries such as Brazil and Argentina, which supply China with key food crops such as soybeans, shown in Figure 3.23.

DID YOU KNOW?

Australian farmers produce almost 93 per cent of Australia's domestic food supplies and the average Australian farmer grows enough food to feed 600 people: 150 at home and 450 abroad. Key commodities are wheat, sugar, beef, dairy and sheep.

3.23 China imports the bulk of its soybeans from North and South America.



ACTIVITIES

Knowledge and understanding

1 Compare the proportions of agricultural and manufactured goods that are traded. Give reasons for the difference.
2 Explain why Sub-Saharan Africa is heavily dependent on food imports.
3 Account for food shortages that might occur in Australia.
4 Explain how international trade can enable countries to share the risk of crop failures.
5 Describe how China has become more dependent on other countries for food products.

Geographical skills

6 Study Figure 3.21 then answer the following questions.
  a Which was the largest crop consumed in 2011–12?
  b Which crop had the highest percentage exported?
  c Calculate the percentage of all the crops that were used rather than traded.
7 Study Figure 3.23 then answer the following questions.
  a From which country did the most soybean imports come into China in 2011?
  b What was the value of soybeans imported into China from Brazil and Argentina in 2010?

Investigating

8 Investigate the assistance Australia has provided to countries suffering from food shortages. Consider some projects undertaken and how research by Australian scientists is assisting farmers overseas. Present your findings in a slide or multimedia presentation.

3.7 Food supply chains

As surplus food became available, food supply chains developed to bring the food from where it was grown to those who consumed it. From the simple pathways along which the food moved within communities, very complex global food supply chains have developed that now span the globe.

Simple food supply chains

Figure 3.24 illustrates a simple food supply chain in an African community. This supply chain is not unlike the first systems developed to produce and distribute food in early civilisations. This simple food supply chain of getting the food to the people is found in many developing countries today. It often involves the cooperation of members of the community as the food goes through a number of steps from the field to being ready and available to eat.

The number of steps involved in such a simple food supply chain depends on the specific situation for each community and the type of food involved. The food that is shared or bought at local markets is usually fresh or has had only minimal processing to make it suitable for human consumption. Cassava, for example, must be properly prepared, or it may contain residual cyanide.

Often a lack of adequate transport and technologies such as refrigeration to store the food limits the food supply chain, as many fresh food products spoil and rot quickly, especially in hot climates. They must, therefore, be consumed quickly and cannot be moved very far.



1 Getting ready to grow food
Tools, soil, seeds, knowledge



2 Growing the food
Workers, climate, water



3 Moving food from the field
Roads, carts, truck, baskets

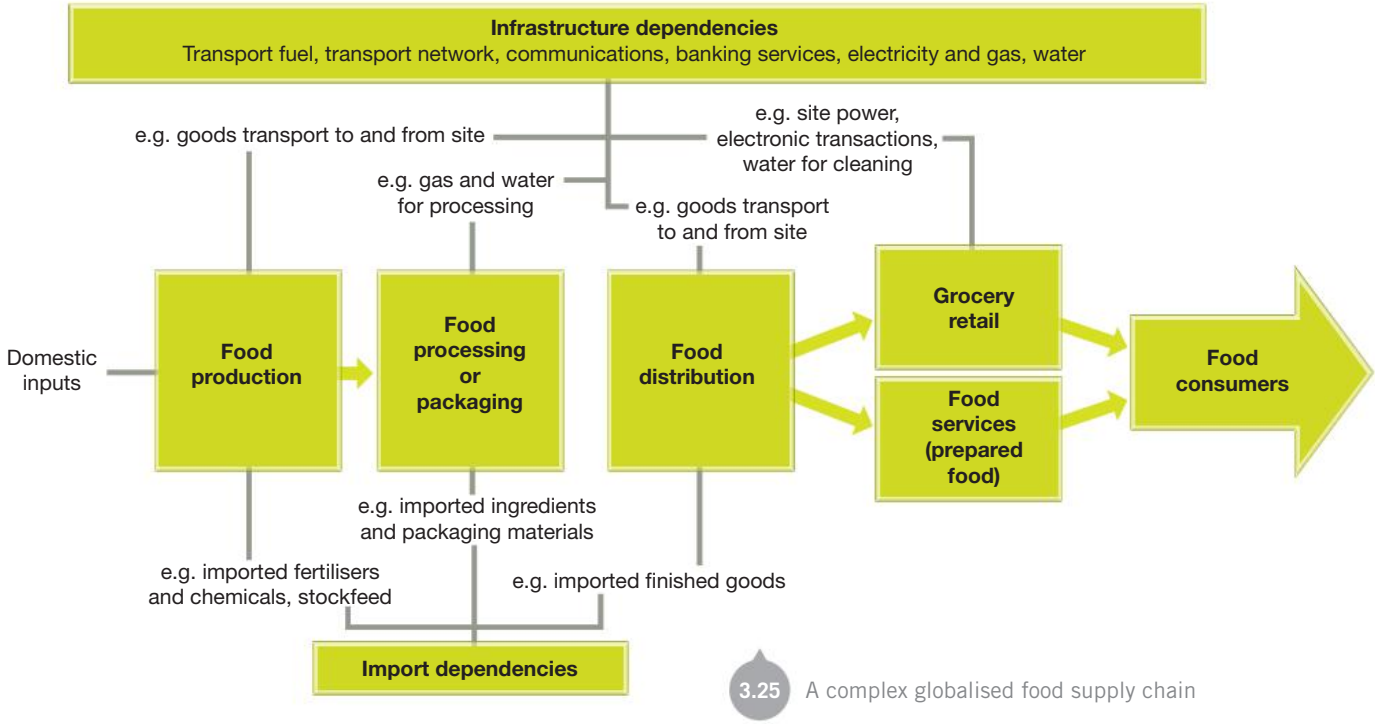


4 Processing, selling or storing the food
Marketplace, storage, jars, factories, shops



5 Preparing and eating the food
Cooking place, knowledge of nutrition and hygiene, sharing food with others

3.24 A simple food supply chain in an African community



3.25 A complex globalised food supply chain

Complex globalised food supply chains

In an increasingly globalised world dominated by the operations of multinational corporations, food supply chains have become very complex. They now incorporate multiple geographic locations and different types of industries and production areas. Modern food supply chains now have many thousands of participants, ranging in size and market power from international companies to local suppliers to consumers.

The supply chain has lengthened, especially in the case of fresh produce, as new packaging and storage technologies have enabled it to be sent to markets thousands of kilometres from the farm where it was grown. Supermarket shelves are packed with an immense variety of goods from all over the world now.

Steps in the complex food supply chains

As illustrated in Figure 3.25, a modern food industry supply chain involves four main steps.

1. Primary production: the raw product or commodity is grown on the farm.
2. Processing or packaging: the raw product is turned into a more appealing or more useful commodity for the consumer. Most agricultural commodities are processed in some form.
3. Distribution: the networks that link all the stages that eventually take the product to the consumer
4. Retailing: food is sold in grocery shops, supermarkets or the food service industry (cafes and restaurants).

Integrating food supply chains

Large multinational corporations must link their global operations across their entire systems. All the key elements of their business (production, manufacturing, distribution and retailing) must be functionally integrated into long-term supply relationships. This is achieved though advanced communications and information networking technologies that closely monitor and manage the chain. These technologies identify inefficiencies and manage operations to guarantee supplies.

ACTIVITIES

3.4

Knowledge and understanding

1. Describe a simple food supply chain operating in a small community in a developing country.
2. Explain why people in such communities rely on local produce for food supplies.
3. Identify the main steps in a complex food supply chain.

Applying and analysing

4. Create a PMI chart in regard to the following statement:
   If food supply chains were limited to operating only within their own country, consumers would be much better off.
5. Prepare an annotated visual display of a simple community food supply chain and a complex globalised food supply chain.

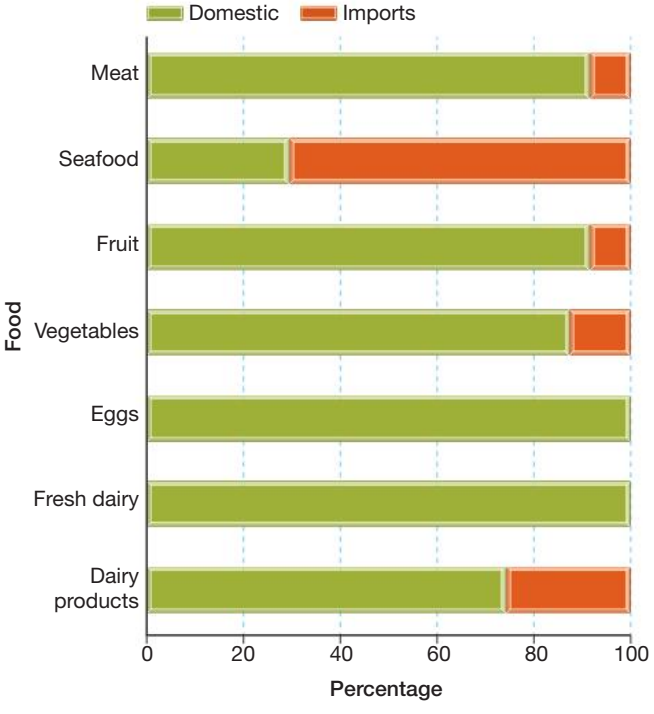
3.8 Australia and global food

Food production in Australia makes an important contribution to international food supplies. Our open and export-oriented economy ensures that our food producers are competitive in the global market. Our agricultural land currently feeds 60 million people globally. It is in our interests to improve global food security, as it is fundamental to political and social stability, especially in our region.

Australia's food supply

Australia is in the fortunate position of having an abundant and diverse food supply and the capacity to maintain this for decades. As an affluent country, we can also afford to import additional food as desired, as is shown in Figure 3.26.

3.26 The various sources of food as a proportion of the total food volumes consumed in Australia



Australia has a long history of producing food on a commercial scale and does so on the driest inhabited continent on earth, where fertile soils are limited and the weather is variable. Despite these limitations, Australia is an efficient and surplus food producer. Over 90 per cent of all the fresh produce (milk, meat, eggs, fruit and vegetables) eaten by Australians is produced within the country.

Producing food in Australia

The total gross value of farm and fisheries production (excluding non-food production such as timber, wool, cotton, fibres and pearls) in 2010–11 was $40.7 billion. The major components were meat ($13.6 billion), grains and oilseeds ($12.2 billion), fruit and vegetables ($7.4 billion), milk ($3.9 billion), seafood ($2 billion) and other food ($1.6 billion). Figure 3.27 shows the economic value of food in Australia.

Importing food

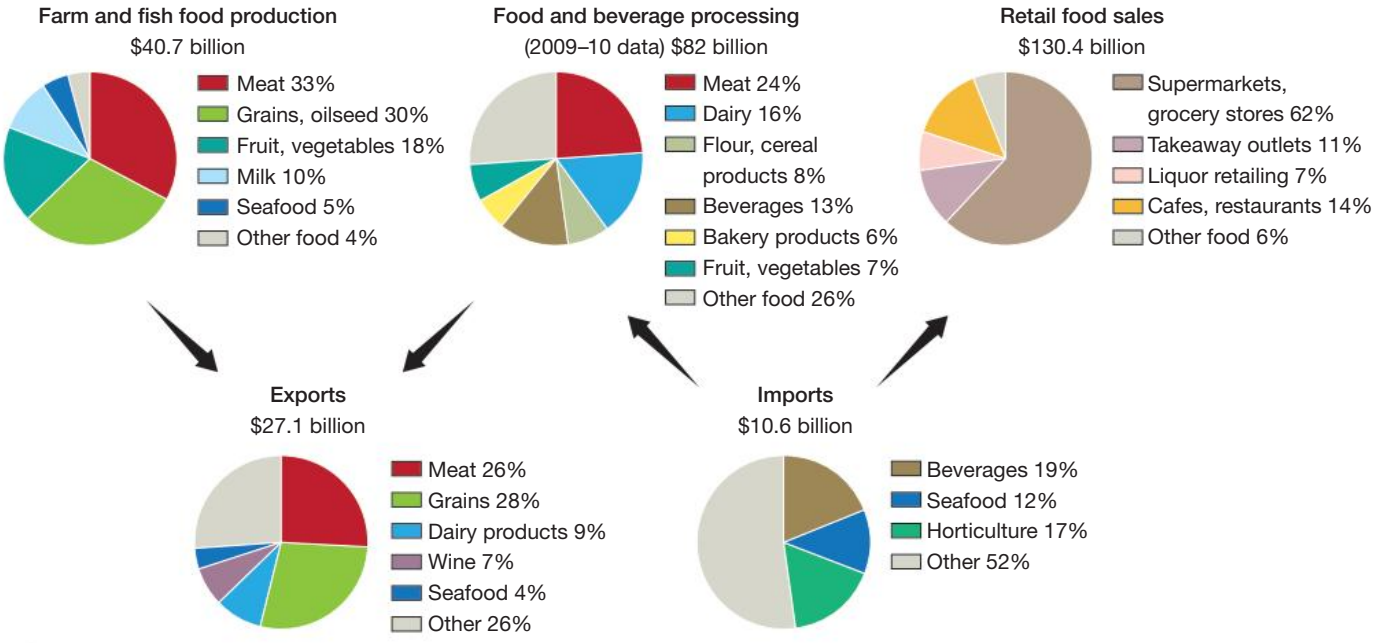
While Australia has ample food supplies, it is not entirely self-sufficient. No country is able to achieve full food security at all times. There are risks associated with food production and there are times when a natural disaster or a crop failure necessitates food to be imported. Imports are also necessary to provide consumers with produce that is out of season and to keep up the inputs of food processers.

Food consumption patterns in Australia have also changed, reflecting the growing cultural diversity of the population. Supermarket shelves and specialty stores carry a variety of international fresh and processed food products. The surge of interest in food following the growing popularity of reality cooking shows has also contributed to more diverse tastes that often extend to ingredients that are sourced overseas.

SPOTLIGHT

The changing cherry scene in supermarkets

Cherries are picked in Australia over a period of 100 days in spring and early summer, which used to be the only time Australians could enjoy fresh cherries. The official start of the stone fruit season is traditionally marked with an auction of the first box of cherries at the Sydney markets, which in 2013 raised $50 000 for charity. Nowadays, cherries can also be bought in the fruit section of a supermarket all year round, as they are shipped in from the United States of America in a near-frozen state.



3.27 Value chain for food in Australia, 2010–11

Australia's trade advantages

Australia is well placed to be a major player in the global trade in food, especially as we possess a number of significant advantages over our competitors.

Climatic diversity

As Australia extends so far from the tropical north to the cooler, temperate latitudes of the south, there are a great variety of climates across the continent. This enables a diverse range of produce to be grown, from bananas in northern Queensland to apples in Tasmania.

Locational advantages

As most of the lucrative international markets for food are in the Northern Hemisphere, Australia is in the fortunate position of having a counter-seasonal advantage, in that our seasons are the opposite of theirs. This enables Australia to provide produce that is out of season in the Northern Hemisphere countries.

Australia is also in a favourable geographic location to take advantage of the likely surge in demand for food in the fastest-growing economies of the world. The rise of an Asian middle-class has been accompanied by a change in food consumption patterns towards high-value products such as meats, seafood, vegetable oils and dairy products. Food and beverages, especially wine, have become symbols of wealth and status.

SPOTLIGHT

Seizing new market opportunities

A growing world population—and changing consumption patterns in Asia—will provide new opportunities for Australia's export food industry. The value of the world's food demand is expected to rise by 77 per cent by 2050 (in real terms). Most of this growth will occur in Asia, where demand is expected to double. This gives our food sector strong prospects over the long term, given our proximity to Asia and strengths in key growth commodities such as beef, wheat, dairy products, sheep meat and sugar. Growth opportunities will not be limited to food commodities; strong growth in the demand for processed food is also expected.

The Chinese Government is encouraging people to drink wine instead of spirits, as wine is considered a better health option and does not rely on processing precious grains and cereals that are needed to feed the growing population. Consequently, China offers enormous potential for Australian wine producers.

Australia's role in global food security

Australia may contribute less than 3 per cent of global food trade, but we are one of the net food-exporting countries in the world and have the capability to substantially increase food production in the future. The key to ensuring global food may well be innovation and this is where Australia is at the forefront, as we now rank among the best in the world for research and development. Australia has also built strong partnerships with developing countries within our region in delivering technological advancements and supporting their implementation.

3.28 Main exports of the Ord River region and their destinations

Chickpeas, borlotti beans, cannellini beans and dark red kidney beans
Australia, New Zealand, Italy, Spain







Chia
Australia, North America, Middle East, Europe

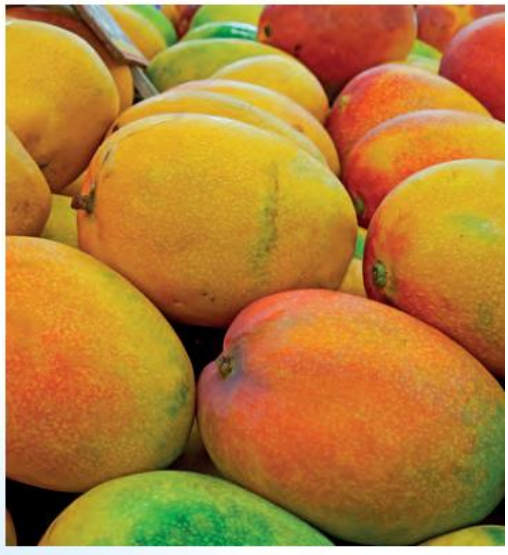


Sandalwood oil
Australia, Asia





Mangoes
Australia, Middle East, Europe, New Zealand

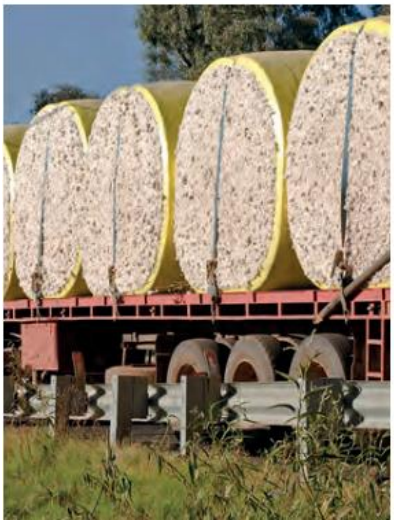


Pumpkins and melons
Perth, Adelaide, Melbourne, Sydney, Darwin, Brisbane

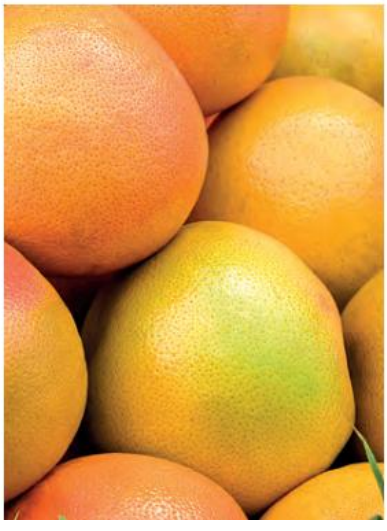




Cotton
Queensland, China, India



Red grapefruit
Australia, Europe, Japan and China



Hybrid seeds
Forage sorghum—Australia, Kimberley region, Middle East, Asia, New Zealand

Grain sorghum—Australia

Maize—Kimberley region, Northern Territory, Asia, New Zealand

Millet—Australia

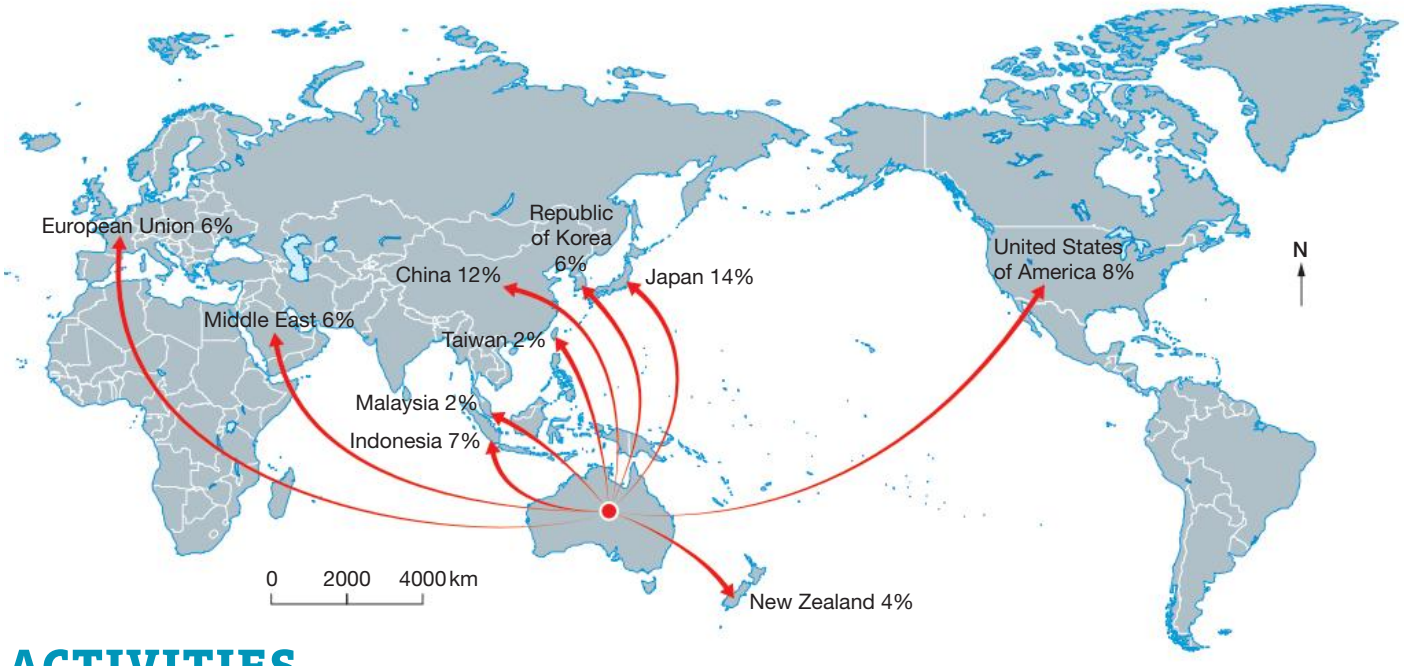


Exporting food

As Australia produces much more than it consumes, a significant proportion of the food it produces is exported. These exports contribute to the global food supply and can help countries with food security problems. In recent years, between 28 and 42 per cent of wheat shipments have been sent to countries in which more than 10 per cent of the population is undernourished. The Ord River Valley in northern Western Australia, shown in Figure 3.28, produces a wide variety of produce that is predominantly exported to South-East Asia, due to its close proximity.

Most Australian producers seek markets that will return the highest value for their produce. Traditionally, these markets have been within the wealthy developed economies. Increasingly, however, there are substantial opportunities emerging in the rapidly developing economies of Asia. Figure 3.29 shows Australia's key agricultural export destinations.

3.29 Australia's key agricultural export destinations



ACTIVITIES

Knowledge and understanding

1 Explain why Australia is in a fortunate position when it comes to securing a food supply for the nation.
2 Describe Australia's food trade advantages.
3 Australia produces a food surplus, but it must also rely on imports. Explain.
4 Outline Australia's role in global food security.

Geographical skills

5 Study Figure 3.26 then answer the following questions.
   a Which products are entirely sourced from domestic production?
   b Which imported products does Australia most heavily rely on?
   c What percentage of meat is sourced from domestic producers?
   d What percentage of dairy products is imported?
6 Study Figure 3.27 then do the following tasks.
   a Calculate the $ value of meat production in Australia.
   b At what stage of the food supply chain is the most value added?
   c Calculate the $ value of seafood imports and exports in Australia.
7 Study Figure 3.29 then answer the following questions.
   a What percentage of Australia's food exports goes to the United States of America?
   b What percentage of Australia's exports goes to Asia?

Investigating

8 Conduct a survey of your local supermarket and prepare a report outlining the countries from which the following foods are sourced:
   a seafood (fish and prawns)
   b fresh fruit
   c frozen vegetables.
9 Prepare menus for the following themes and indicate where the food for the ingredients would be sourced:
   a a reflection of the local region or state
   b an adventure in multicultural cuisine.

3.9 Case study: Australia—importing seafood

Australia has the third-largest fishing zone in the world. However, Australia ranks fifty-second in the world in terms of the amount of seafood produced. As a consequence, more than 70 per cent of the seafood consumed in Australia is now imported, equating to around 200 000 tonnes per year.

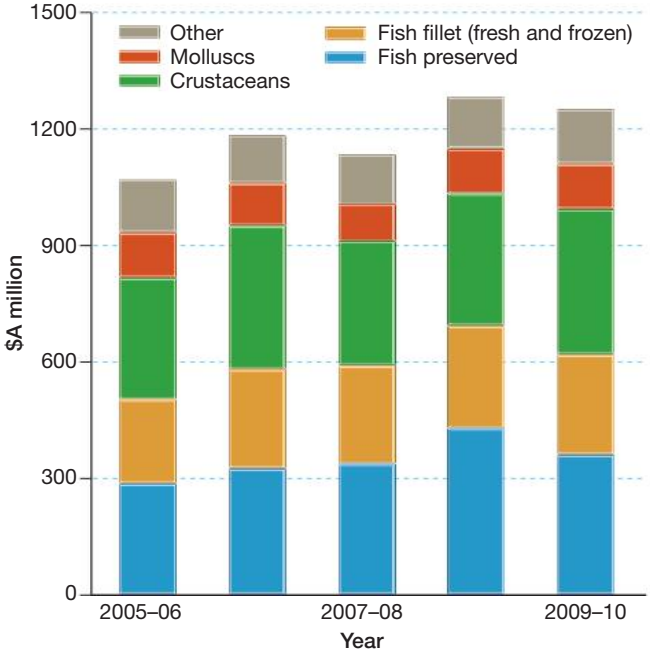
Seafood: A global industry

The global seafood industry has an estimated value of almost US$220 billion per annum. It produces more than 154 million tonnes of seafood each year. About 90 million tonnes are **wild-caught seafood** from the world's oceans, rivers and lakes; the remaining 64 million tonnes are sourced from **aquaculture**, an industry that continues to grow each year.

Seafood consumption in Australia

Figure 3.30 shows the major types of seafood imported into Australia. Processed fish, such as canned tuna, salmon and sardines, are important, along with filleted fish, usually imported frozen, and crustaceans, mostly prawns. Almost all the seafood imported into Australia is sold in the retail sector, mostly through major supermarket chains.

3.30 Main types of seafood imported into Australia



The most important source of Australia's imported seafood is Thailand, which accounts for around 30 per cent of imports (see Figure 3.31). This includes much of the canned tuna eaten in Australia, the most common seafood consumed. China, Vietnam and New Zealand are other important source countries of our seafood.

There are a number of reasons why Australia is so reliant on imported seafood. Demand for seafood has increased and domestic fisheries are now being fished at what is considered sustainable levels, so there is environmental pressure not to increase local production. The industry has also complained that high costs and regulations have restricted local growth.

Importing seafood

Australia has one of the most sustainable fishing industries in the world. Huge marine reserves now surround the continent, protecting enormous areas of our marine environment. However, as we import so much seafood there is an argument that we are simply buying in seafood from other parts of the world to compensate for making our fisheries more sustainable. In this sense we are protecting our own marine environment at the expense of marine environments elsewhere.

Many environmental groups have serious concerns about the sustainability of fishing practices in many parts of the world, including South-East Asia, where much of Australia's imported seafood comes from. Aquaculture is also said to have a massive impact on the environment, especially the water quality of river systems.

Promoting sustainability

The Seafood Importers Association of Australia (SIAA) represents the majority of companies importing seafood into Australia. It argues that the main species imported into Australia are harvested sustainably. Companies, such as Heinz and John West, which produce much of the canned tuna eaten in Australia, say that they work closely with



3.31 Workers in Samut Sakorn, Thailand, on the food-processing lines at Thai Union Frozen Products, one of the world's largest processors of canned seafood.

environmental organisations and government agencies to ensure that their tuna from Thailand is caught in sustainable ways. They also argue that importing seafood has significant social benefits for developing countries, providing employment opportunities for many communities.

The World Wide Fund for Nature (WWF) has begun to work with major seafood businesses and retailers to help them source and sell more sustainable seafood in Australia. A key part of this is sourcing seafood that has been certified by the Marine Stewardship Council and the Aquaculture Stewardship Council. These organisations audit seafood producers to make sure that their products are sustainable. They certify those that meet their standards (see Figure 3.32).



3.32 The Marine Stewardship Council certifies seafood products, such as these frozen fish fillets, as sustainable.

ACTIVITIES

Knowledge and understanding

1 Describe the size and value of the global seafood industry.
2 Describe the reasons why Australia needs to import so much seafood.
3 Outline the debate over the environmental impacts of importing seafood.
4 Explain the value of the Marine Stewardship Council certification.

Applying and analysing

5 Take on the role of an education officer for the WWF. Prepare the script for a radio advertisement encouraging people to purchase sustainable seafood.

Geographical skills

6 Study Figure 3.30 and do the following tasks.
   a Estimate the value of imported preserved fish in 2009–10.
   b Calculate the difference in fish fillet imports from 2005–06 to 2009–10.
   c Calculate the difference in seafood imports from 2005–06 to 2009–10.

3.10 Case study: From farm to supermarket

The path taken by fresh food from the farm to the supermarket has changed. In the past decade the giant supermarkets that dominate food retailing in Australia have reshaped the food supply chain. Most of their produce is now supplied directly, secured in long-term agreements with increasingly larger growers.

The fresh produce market

A decade ago, a large number of small growers used to truck their fresh produce to the wholesale fruit and vegetable markets in the large capital cities. The supermarket buyers would join the early morning bustle at the markets to purchase the supplies for their outlets. Since then, however, the big supermarket chains have moved to buy produce directly from the growers who operate under long-term contracts.

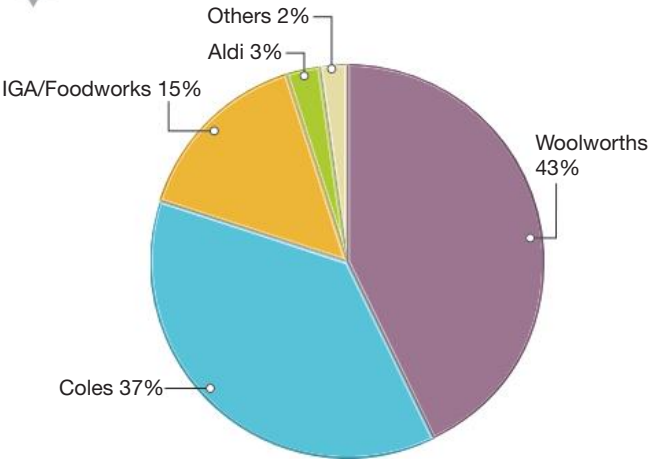
In Australia, just two supermarket chains (Woolworths and Coles) dominate the sector, as shown in Figure 3.33. Even by world standards this is a relatively high level of concentration. There is greater competition in the sector in the United Kingdom, as shown in Figure 3.34.

Supplier concerns

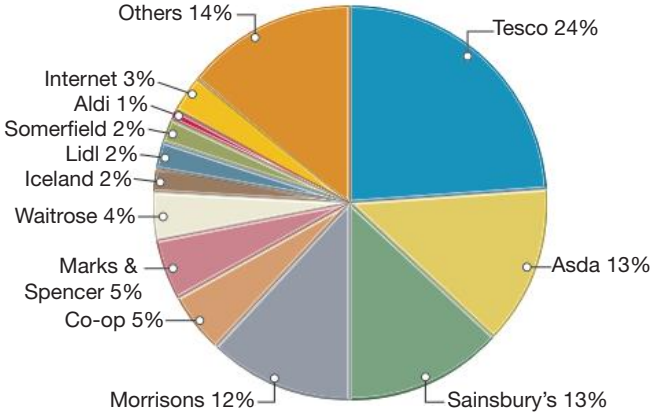
Food retailing in Australia is generally described as a high-volume, low-margin business. Even though the supermarket makes only a small amount of profit per item, it is the extraordinary number of items sold that generates their revenue. So even small reductions in costs can have a huge impact on the profit made.

Supermarkets have been criticised for trying to increase their profits by failing to pay suppliers the agreed prices and imposing penalties. Faced with rising costs, the smaller suppliers are placed in a very difficult situation.

3.33 Australian grocery market share



3.34 UK grocery market share



DOES THE FOOD BUSINESS STACK UP?

Australia's two biggest supermarkets are reshaping the nation's agriculture, diet and understanding of what fresh food is.

About 90 per cent of their fresh produce now comes direct from a diminishing number of growers who operate under long-term agreements. In these sophisticated relationships, supermarkets now influence not just what is grown, but sometimes even the choice of seed. The reality is that in most high-volume categories … seven or eight producers supply 80 per cent of Australia's supply. They are very big companies.

The story behind the brightly lit rows of fruit and vegetables at a local Coles or Woolworths is about the corporatisation of food in Australia. It is also a story about the concentration of the food supply chain—an unprecedented power shift from small growers supplying local markets to big farmers and agents.

As companies have scaled up to meet the supermarkets' demands, massive agricultural businesses have sprouted in the regional landscape. In South Australia, the Mitolo Group is the biggest producer of potatoes for fresh consumption in Australia. It produces for Coles and has a $100 million turnover and 350 employees.

Tomatoes grown in glasshouses are also becoming big businesses. The Victorian-based Costa Group has become the biggest supplier of glasshouse-grown truss tomatoes after investing millions in two 10-hectare glasshouses in northern New South Wales. The facility produces 11 million kilograms of tomatoes each year.

These sorts of investments point to a trend: while the number of farm businesses decline, those remaining get bigger. There were almost 200 000 farm businesses in 1969 and only 134 000 in 2010, but the average farm grew in size from about 2500 hectares in 1969 to 3400 hectares in 2004–05.

Supplying the supermarkets with fresh food is a huge commercial undertaking. The Fresh Produce Group turns over $200 million a year supplying citrus, grapes, tropical fruits, potatoes, onions and pumpkins to the supermarkets. These days, a potato or a carrot is virtually owned by Coles and Woolworths before it is dug out of the ground. Even before that. The supermarket has mapped the continent, identifying the best growing areas for particular crops.

Source: Melissa Fyfe and Royce Millar, *Sydney Morning Herald*, 4 June 2012

ACTIVITIES

Knowledge and understanding

1. Describe how fresh fruit and vegetables were marketed a decade ago.
2. Identify the main suppliers of such produce now.
3. Explain why agriculture has changed in response to these new trends.
4. Outline some of the concerns that have been expressed by suppliers.

Applying and analysing

5. Working in pairs, consider the following question and then share your thoughts with the rest of the class: Why does southern Australia provide fresh produce in the summer while northern Australia provides it in the winter?
6. Create a PMI on the following topic: Restrictions should be placed on the dominance of large supermarket chains in Australia.

Investigating

7. Investigate the source regions of three vegetables and three fruits sold in Australian supermarkets. Create a wall display map of Australia, showing the location and suitability of the growing regions and the characteristics of the crop. Include a climate graph for each region.

3.11 The power of consumer choice

Like all businesses, the food industry is driven by consumer demand. On a global scale the agriculture industry is enormous. The value of the fast food industry alone is estimated to be well over US$1.5 trillion. In order to maintain such huge markets the food industry must respond to changes in consumer choice.

Impacts of globalisation

The growing desire of consumers to be able to access a greater variety of food more consistently has driven the globalisation of the food industry. For example, grapes are not harvested in Australia during winter and early spring. In the past, this meant that Australian consumers were unable to buy grapes in supermarkets. Now, however, grapes are imported from the United States of America during the period when locally grown grapes are not available. Consequently, the seasonal nature of much of our fresh food is no longer an issue.

Changes in consumer preferences

Changes in consumer preference are another important driver of change in the food industry. A growing appreciation of healthier food options in recent decades has led to significant changes in the way foods are processed. Many foods, such as sauces, biscuits and soft drinks, are available in low-fat, low-sugar and/or low-salt varieties. Healthier options have also led to a growth of whole new industries. For example, in 1983 Australia consumed about 5700 tonnes of olive oil, virtually all of it imported. By 2011, this amount had increased to 45 000 tonnes. This 790 per cent increase is due to a change in consumer taste, in that olive oil is considered the healthiest option in the range of fats and oils. This makes Australia the largest consumer of olive oil of any country outside the Mediterranean, the traditional home of the oil. More than 35 000 hectares of olive groves are now grown in Australia, producing about one-third of the oil consumed here.

DID YOU KNOW?

The global soup market is said to be worth more than $13 billion and noodles come in at more than $28 billion!



3.35 Consumer demand for healthier food options has led to food producers and retailers providing greater choice.

The organic food industry

Another important change is the growing preference of organic foods. As a result, the organic food industry is one of the fastest-growing agricultural sectors globally. Organic foods such as the vegetables shown in Figure 3.36 are produced using methods that do not involve the use of chemicals, such as synthetic fertilisers, herbicides and pesticides. Food additives and preservatives are also not used in the processing of organic foods.

On a global scale, the organic food market is worth more than $68 billion annually. In Australia it is valued at about $1.3 billion. Research conducted in 2012 by Biological Farmers of Australia (a body that represents organic farmers) and Swinburne University, Melbourne, found that 5 per cent of Australian consumers bought only organic food, while two-thirds of all Australian households had bought organic products in the previous 12 months.



3.36 The organic food sector is one of the fastest growing sectors.

Approximately 75 per cent of organic food purchased in Australia is from supermarkets—evidence of the power of consumers to drive change within the food industry.

Organic produce is usually more costly to produce and has a shorter shelf life. Consequently, it tends to be more expensive for consumers. Consumers are therefore wary of claims that produce is organic. This concern has led to the development and implementation of a certification system for organic food to ensure that it is truly organic.

SPOTLIGHT

China's changing tastes

As the people of China become more affluent, so does their preference for a broader range of food options and the material trappings of a Western lifestyle. Western-style foods and beverages are perceived as more luxurious and desirable. China is, for example, now the fastest-growing wine market in the world.

Although wine production in China dates from the late 1800s it was not until the turn of the twenty-first century that it became popular in China. China now has 940 wineries producing about 1 billion litres of wine. By comparison, Australia has more than 2200 wineries producing nearly 1.5 billion litres of wine. As demand for wine in China continues to grow, imports continue to rise. Australia exports about 50 million litres of wine a year to China, much of it bottled wine valued at more than $20 a bottle.

ACTIVITIES

Knowledge and understanding

1 Explain how consumer choice has led to the creation of a global food industry.
2 Describe the role of consumer choice in the growth of the Australian olive oil industry.
3 Define the term 'organic food'.
4 Describe the nature of the organic food market in Australia.

Applying and analysing

5 'When it comes to the food industry it is the consumer that has the ultimate power.' Do you think this is an accurate statement? Justify your answer.

Investigating

6 Conduct primary research on organic foods in Australian supermarkets.
   a Visit your local supermarket and compile a list of products that are available in both organic and conventional varieties.
   b Classify the products into fresh food (for example fruit and vegetables), canned foods, packaged foods and drinks.
   c Compare the prices of the products and their countries of origin.
   d Present your research in the form of a written report.

3.12 Case study: Alternative food supplies

During the twentieth century food production became increasingly industrialised. Previously, people had generally sourced their food locally and often grew much of their own. Production tended to be on a small scale. However, as communities became increasingly urbanised, local production was no longer feasible.

Changes in food production

When communities became increasingly urbanised, technological advances in refrigeration, snap freezing and the development of food preservatives meant that food could be moved over long distances and food could be traded on a global scale.

The production of food is now dominated by large multinational corporations that rely on complex supply chains to source raw materials and to produce and market food products around the world.

Such changes have meant that consumers are now far removed from the producers of their food. The oranges that go into your breakfast juice may be grown in Brazil and the juice processed in Florida before being sent across the Pacific Ocean in shipping containers. The concept of seasonality in food is also something of the past. When a crop such as strawberries is out of season in one area, suppliers are now able to import the product from elsewhere.

In recent years, there has been an increasingly popular movement against large-scale industrialised food production, and a small but growing number of people are beginning to look at alternative ways to source their food supplies.

Farmers markets

Farmers markets have become increasingly popular in developed countries. Farmers markets bring producers and consumers together directly, allowing consumers to get their fresh food directly from the farmers that produce it. There are now around 150 farmers markets operating throughout Australia. In many developing countries, many farmers continue to sell their surplus produce in local markets as they have done for centuries.

Research completed in 2011 by the Australian Farmers' Markets Association found that a desire to know where their food was coming from was the main reason most consumers shopped at farmers markets. This is known as 'food provenance' and is becoming more important as people have greater concerns about food safety. For example, many consumers express concern about lax environmental regulations in some developing countries.

Broader environmental concerns are another reason for the popularity of farmers markets. The environmental impact of processing, preserving, storing and transporting food over long distances can be considerable. Purchasing food at the farmers market, where the producers tend to be local, helps to reduce such impacts. There is also a social and community element to many markets.

DID YOU KNOW?

Despite being Australia's biggest urban area, there is still more than $500 million worth of agricultural produce grown in Sydney.

SPOTLIGHT

Farm gate trails

Farm gate trails have taken the concept of food provenance to another level. The trails combine food supplies with a tourism experience. The concept is that local agricultural producers join together to establish a trail that brings people to their farms to buy produce directly from them. In many cases the consumers can even pick their own.

Farm gate trails use the same concept that the wine industry has used for many years in popular wine districts, such as the Barossa Valley in South Australia. The trails are well signposted and participating farms display the trail symbol. Maps are provided for consumers via websites and local information centres. One of the largest and most established trails is found in the Hawkesbury region in Sydney's north-west. The trail, called Hawkesbury Harvest, was established in 2000 and now has dozens of participating farms. A similar trail is also now operating in the Yarra Valley close to Melbourne.



3.37 A roadside vegetable and fruit stall, an alternative source of fresh food

Benefits for farmers

For farmers, the markets are an opportunity to earn higher returns on their produce by cutting out the retailers, who often force down the prices they pay to farmers in order to maximise their own profits. At the markets, farmers are able to set their own prices. When they sell to large wholesalers and retailers, the price they receive is set by the buyer (see Figure 3.38). Farmers markets allow the producer to be a 'price maker' not a 'price taker', which is seen as fairer for the farmers.

There have been reports that some market stallholders may not be food producers but instead purchase their produce at supermarkets and then resell it at farmers markets for inflated prices. In response, some markets are now beginning to certify the stallholders and their produce.

The locavore movement

In March 2007, *Time Magazine* put 'local food' on its front cover and since then, a huge interest has developed in local food, with even some major retailers, especially in the United States of America and Europe, pledging to sell more locally produced food. Supporters of the local food movement have become known as locavores. They attempt to eat only food that is grown within 100 miles (160 kilometres) radius of where they live. Locavores argue that by eating locally sourced food they are reducing the carbon footprint of their food. This footprint, which has become known as the 'foobon footprint', is measured in the distance taken to move food from where it is grown to where it is sold, and is usually measured in 'food miles'. The environmental impacts of storing and transporting food can be enormous, especially when foods are transported from overseas. For example, some recent research found that the food in a shopping trolley of an average Melbourne family had travelled more than 70 000 kilometres in total to reach the supermarket.

Famers markets are one way that locavores source their food. However, there are a growing number of food retailers, and indeed restaurants, that sell locally produced food. The environmental and social organisation Do Something has launched a website called Foodwise. The site provides information on local food as well as on reducing your family's foobon footprint by reducing food waste.

There are others who argue that the local food movement may result in increased environmental impacts. A key argument is that local food production is generally small-scale, which is less efficient. As a consequence, the amount of land required to produce the same amount of food is far greater than in more industrialised farming. Furthermore, it is argued that contemporary industrialised farming allows for specialisation. For example, one region may specialise in citrus production, another in stone fruits and another in cereal grains. This allows for further efficiency and helps to reduce costs, which is ultimately good for consumers.

DID YOU KNOW?

Australian families typically throw away about 20 per cent of the food they purchase.



3.38 Melbourne's wholesale fruit and vegetable market. Produce comes from around Victoria and Australia, and from international suppliers.



3.39 Community gardens provide opportunities for people living in built-up city areas to grow their own food.

Community gardens

Even today, much of the world's population rely on growing their own food in order to survive. However, as communities become increasingly urbanised, it is not always possible. Even small vegetable gardens are not an option for people living in apartments, as increasing numbers of Australians do.

Community gardens, like the garden shown in Figure 3.39, are becoming increasingly popular in Australia and other developed nations. In Australia, many of the gardens are established on land owned by local councils. The gardens are often built on land that is vacant and serving no real purpose. For example, Rushall Garden in North Fitzroy, an inner Melbourne suburb, was established on unused land owned by the railway authority. Community gardens have also been established on many public housing estates, especially in Victoria. In some gardens there are individual plots which each person cultivates, but in others everyone shares in the work of growing crops and also in the harvest.

Such gardens have the benefit of allowing people to grow at least some of their own food. They also have important social benefits and assist in promoting healthier lifestyles by promoting exercise. Many schools have now established their own gardens as part of the school kitchen garden program. Such gardens help to educate students about healthy eating habits.

ACTIVITIES

3.3

Knowledge and understanding

1 Explain why seasonality is no longer an issue for consumers.
2 Describe the concept of farmers markets.
3 Define the term 'food provenance'.
4 Explain the link between food provenance and the growth in farmers markets.
5 Describe the concept of a farm gate trail.
6 Define the term 'locavore'.
7 Describe the concept of food miles.
8 Explain the benefits of community gardens.

Applying and analysing

9 Adopt the perspective of a farmer who produces fresh vegetables. Draft a submission to the local council, requesting the council to help establish a farmers market in your area. You will need to outline the benefits to farmers and the community of your plan.
10 Develop a plan for a school-based community garden in your school.
   a Where would you site the garden?
   b What would you plant?
   c What rules would you put in place?
   Explain your reasons.
11 Write a short report outlining the environmental arguments for and against the locavore movement.

3.13 Ethics of food production

Ethics is concerned with humans acting in ways that are considered by society to be the right ways. Notions of ethical behaviour are shaped by cultural considerations and often change over time. A good example of a change in regard to the ethics of food production is the treatment of animals.

Vegetarianism and veganism

In recent years, concerns over the environmental impacts of modern food production have also increased. There has also been a growing interest in reducing the environmental footprint of our food by reducing meat consumption—an approach known as **environmental vegetarianism**. Environmental vegetarians such as the members of the US-based organisation People for the Ethical Treatment of Animals claim that 80 per cent of the agricultural land in the United States of America is devoted to growing or feeding animals for the meat industry. They argue that this is a waste of resources; if people consumed less meat there would be more food to share and less land required for agriculture.

For most people, meat and other animal-based products are an important part of their diet. Most of us would rather not think about the processes involved in taking a living animal from the farm to a neatly packaged product for sale in the supermarket. However, most people want to ensure that those processes are as humane as possible.

Some people argue that to consume any form of meat is unethical and adopt a vegetarian diet. Vegans take this a step further and do not consume any animal-based foods, even dairy products.

3.40 More than 50 per cent of the eggs produced in Australia are laid in cages in battery hen farms.



Egg production

The Australian egg industry produces around 4.3 billion eggs (valued at around $1.5 billion) each year on 330 farms spread across the country. Egg production is one of the main ethical food production debates in Australia. There are three main ways that eggs are farmed in Australia.

- Cage eggs: The eggs are produced in large barns where hens are housed in cages. Food and water is provided to the animals along troughs running the length of the cages, as shown in Figure 3.40.
- Free-range eggs: This method does not have a single definition but generally is accepted to mean that hens are allowed to roam freely outdoors in a pen. This type of production is shown in Figure 3.41.
- Barn-laid eggs: The hens are housed in large barns but are not held in cages.

Egg production in Australia

The market has been dominated by cage egg production—a method favoured by many farmers because it is the most cost-effective and allows for intensive production. Cage egg production has attracted considerable controversy in more recent years. Many people see this production method as cruel to the birds.

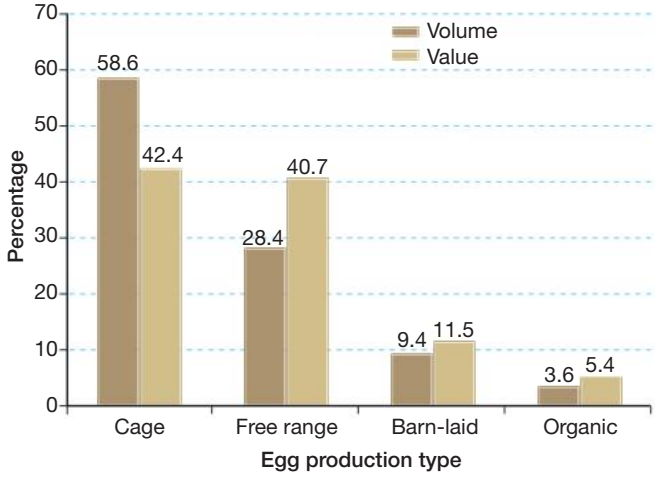
Animal rights organisations, including the RSPCA, have been lobbying to have the egg industry shift to barn-laid and free-range egg production. Consumers play a very important part in this movement. In mid-2012, the Tasmanian Government announced that it would be gradually phasing out cage egg production on Tasmanian farms.

Eggs are now labelled to provide information to consumers about the production method used. Free-range eggs now account for nearly one-third of all eggs produced in Australia. These types of eggs are usually more expensive because the costs of production are greater. Despite this, it is the fastest-growing sector of the industry and contributes more than 40 per cent of the value of the industry, as is shown in Figure 3.42. One of the large supermarket chains took the decision in 2013 not to use cage eggs for its store-label eggs. The growth of the free-range sector shows the power of consumers to change the way that food is produced to make it more ethical.

3.41 Eggs from free-range farms now account for about 30 per cent of eggs in Australia.



3.42 Types of egg production in Australia



Source: Australian Egg Corporation

ACTIVITIES

Knowledge and understanding

1 Define the term 'ethics'.
2 Outline the ethical arguments put forward by some vegan groups.
3 Compare cage to free-range egg production.
4 Explain why cage egg production is popular with egg producers.
5 Explain how consumers have affected the nature of egg production in Australia.

Geographical skills

6 Study Figure 3.42 then do the following tasks.
  a Create two pie graphs: one for the volume of egg production and one for the value of egg production.
  b Suggest reasons why there is a difference between the percentage of eggs produced in each category and the percentage of their value.

Investigating

7 Using the internet, conduct research into cage egg production. Summarise the debate over cage egg production. Consider the economic and ethical issues surrounding the debate in a written report.

3.14 Case study: Live meat exports

Australia is a major producer and exporter of meat. Some of this is exported live. In recent years, people concerned about animal welfare have campaigned to have this trade banned. They claim that livestock animals are transported in conditions that are unsatisfactory and are slaughtered in ways that cause the animals great suffering.

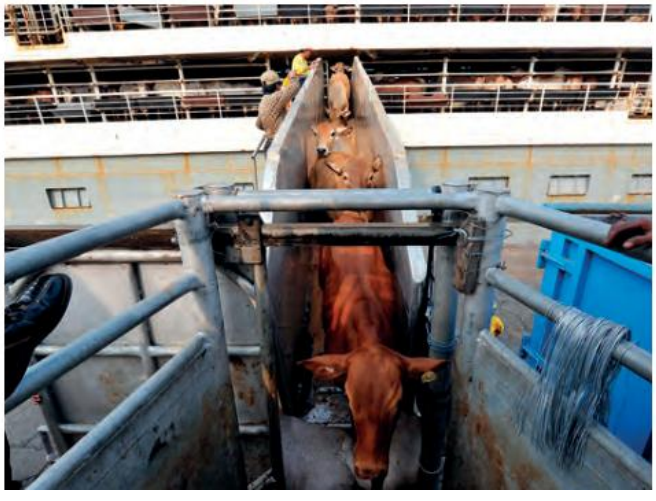
Australia's live meat exports

The live meat trade involves the export of animals from Australia to other countries, where they are slaughtered in local abattoirs. The animals are transported on huge ships, where they are held in stalls for the duration of the journey. Veterinarians and stock workers accompany the animals on the journey. The main reasons for live meat exports are cultural and religious. The Islamic and Jewish religions require the meat to be killed according to strict guidelines. Although many Australian abattoirs are able to process meat within these guidelines, there is reluctance in some countries to accept this meat. They prefer the meat to be slaughtered locally.

Live meat exports are big business. The Australian live meat export industry is valued at about $730 million a year. It is particularly important to graziers in northern Australia, where the cattle industry has developed around live exports. There are four major export markets:

- beef cattle, exported to Indonesia (see Figure 3.43), Malaysia, Israel, Philippines and Japan
- dairy cattle, exported to China, Mexico, Kuwait and the United Arab Emirates
- sheep, exported to countries throughout the Middle East, Singapore, Brunei and Malaysia
- goats, exported to Malaysia, Singapore, Mauritius and Brunei.

3.43 Indonesian workers in Jakarta unload imported cattle from Australia.



Campaigns against live meat exports

In recent years, live exports have attracted considerable criticisms because many people are concerned about the treatment of the animals. There are concerns regarding the transportation of the animals in large ships. In some cases, animals may spend several weeks at sea between Australia and their destination countries, especially live sheep exports to the Middle East. The environmental impact of moving live animals is far greater than meat that is already processed. The fuel for the ships and trucks, feed and disposal of manure while the ships are at sea all have impacts.

Another concern is the standards in abattoirs in other countries. Figure 3.44 illustrates a protest against live meat exports. In 2011, secret footage filmed in an Indonesian abattoir showed animals exported from Australia being very cruelly treated. In Australia, there are strict standards about the way animals are slaughtered. The animals are stunned first and when unconscious they are killed. The footage from Indonesia and other similar evidence from elsewhere showed such practices were not being followed. This prompted outrage in Australia. Eventually, the Australian Government banned the export of cattle to Indonesia for several months while stricter guidelines were put in place. These new guidelines require animals from Australia to be tracked from arrival in overseas countries to ensure that they are slaughtered in abattoirs that use the same, more humane, techniques used in Australian abattoirs.



3.44 In recent years there has been growing concern about the treatment of animals exported from Australia.

Despite the new guidelines, many animal rights groups, including the World Society for the Protection of Animals (WSPA), argue that animals are still being treated cruelly and that the whole live export industry should cease.

SPOTLIGHT

Australian sheep culled in Pakistan

In late 2012, the live meat export industry was rocked by images of more than 20 000 Australian sheep being killed and dumped in a huge pit beside a dock in Pakistan. Some animal welfare groups reported that some of the sheep were still alive when buried. The sheep had been originally destined for the United Arab Emirates but quarantine authorities there refused to accept the animals, stating they were diseased.

The exporter found an alternative buyer in Pakistan but when the ship arrived after being at sea for several weeks it was not allowed to offload the sheep. In the end the sheep were culled by workers slitting their throats. Many farmers believe the sheep were healthy but local meat producers in both Pakistan and the United Arab Emirates lobbied their governments to keep the Australian animals from being sold in local markets.

ACTIVITIES

3.5

Knowledge and understanding

1 Explain why live meat is preferred in some countries.
2 Describe the size and nature of the Australian live meat export industry.
3 State the criticisms of the live meat export industry.
4 Outline the impact of the footage secretly filmed in an Indonesian abattoir.

Applying and analysing

5 Create a PMI chart about live meat exports.

Investigating

6 Using the internet, conduct research into the live meat export industry in Australia. Visit the website of meat-exporting companies, such as LiveCorp, and organisations opposed to the industry, such as the World Society for the Protection of Animals.
   a Outline the views expressed by both sides of the debate.
   b Write an exposition in support or opposition to live meat exports. Be sure to justify your argument.

CHAPTER

4

FACTORS AFFECTING CROP YIELDS



In agriculture, the term 'crop yield' refers to the quantity of a crop produced per unit of cultivated land. Given that the land available for agriculture is not likely to increase significantly in the future, yields per unit of land will need to increase if we are to feed a rapidly growing world population.

To feed the projected world population of 9.1 billion people in 2050, agricultural productivity will have to rise by at least 60 per cent, and may need to more than double. The yields of four key staple crops — maize, rice, wheat and soybeans—are increasing by only 0.9 per cent to 1.6 per cent a year—a rate that would lead to an overall increase of about 38 per cent to 67 per cent by 2050, which may not be enough to meet people's needs. This does not take into account other factors, such as climate change, which could lead to sharply lower yields and massive food shortages in many areas as soon as the 2030s.

The slow increase in crop yields around the world is in stark contrast to the Green Revolution of the 1960s and 1970s that led to huge increases in crop yields in Asia, with the widespread use of new artificial fertilisers, pesticides and growing techniques.

In this chapter, we examine the environmental, economic and technological factors that influence crop yields in Australia and across the world.

KEY IDEAS

- To develop an understanding of the factors affecting crop yields
- To understand the process of soil formation and significance of soils
- To appreciate the innovations taking place in agriculture and the nature of food production in Australia
- To know how to investigate soils

GLOSSARY

agrochemicals	a generic term for the various chemical products used in agriculture
clay	a fine-grained soil material that is plastic when moist
crop yield	a measurement of the amount of a crop harvested per unit of land area
Green Revolution	an increase in food production, especially in developing countries, resulting from the introduction of high-yield crop varieties and application of modern agricultural techniques
horizon	a layer of soil material parallel to the soil surface, whose physical characteristics differ from the layers above and beneath. Each soil type has at least one, but usually three or four horizons
humus	organic material consisting of partially or wholly decayed vegetable or animal matter that provides nutrients for plants and increases the ability of soil to retain water
latosol	a reddish soil typically found in the tropics; it is deeply weathered and relatively infertile
leaching	the removal of nutrients from the topsoil by the downward movement of water
pore spaces	the spaces between individual soil particles
regolith	the loose (unconsolidated) rock material found above a layer of bedrock
renewable resource	a resource that can maintain and/or replace itself if managed carefully
salinity	the build-up of salt in soils or waterways
silt	sedimentary material made up of very fine soil particles of intermediate size, between sand and clay
soil erosion	the wearing down, transportation and deposition of soil material; the agents of erosion are water, wind and ice
symbiotic	a type of close, long-term relationship between two or more different organisms of different species
weathering	the physical or chemical breakdown of rocks into smaller pieces

4.0 Roots beneath monocotyledon plants

4.1 Crop yields

Crop production provides food for humans, fodder for livestock and fibres used for making cloth and paper. It involves exploiting plants to produce high yields from the land on which they are grown. While nature does set limits on what can be accomplished, humans have altered the environment within which selected plants are grown. This has affected crop yields and also has implications for the future.

Measuring crop yield

Crop yield is a measurement of the amount of a crop that is harvested per unit area of land and is usually expressed in tonnes per hectare. It reflects the amount of seed or grain generated by the plant. Increasing the yield of a cereal grain requires the production of more grains or larger grains on the head of the plant. Figure 4.1 shows heads of wheat that are densely packed with grains.



4.1 The heads of wheat are densely packed with grains. Increasing the size or number of the grains increases yields.

Determining crop yields

All crops require basic resources from the biophysical environment in order to grow. These are:

- solar radiation—the sun's energy provides light to plants and determines temperature regimes that are favourable for their growth
- carbon dioxide from the atmosphere
- soil water, which is contained in the **pore spaces** between soil particles
- mineral nutrients, which are dissolved in soil water
- oxygen above and below the ground
- nitrogen within the soil, which is contained in soil air.

Crop productivity depends on adequate quantities of these resources being available. They enable plants to grow and yield a successful harvest. In their endeavours to produce good, high-yielding crops, humans have manipulated this environment. They can, for example:

- determine the amount of soil water available to plants through irrigation
- improve the quality of the soil through the addition of fertilisers, increasing the availability of nutrients. Growing legumes also increases the level of nitrogen in soils, as legumes have nitrogen fixation nodules attached to their roots
- improve the supply of oxygen to plant roots by aerating soils. When soil is cultivated it turns over and large dirt clods break down into a fine soil that is an ideal environment for seed germination.

New technologies

The adoption of new farm technologies has raised crop yields in a number of ways:

- Mechanisation has improved the speed and efficiency of cultivating large areas of land and harvesting the crop quickly.
- Plant breeding has provided new high-yielding varieties of plants that grow vigorously, are more resistant to diseases or able to do well in a wider range of conditions.
- **Agrochemicals** have been developed to protect plants and improve growth rates. These include herbicides, pesticides, insecticides, fungicides, fertilisers and growth hormones.
- Irrigation has become highly sophisticated. Piezometers use soil probes to measure soil moisture and, when needed, irrigation water is applied to meet plant needs.

Maintaining high yields

The success of an agricultural enterprise in raising crop yields depends on how the crop is managed and how well the environment is protected. Some interventions in agriculture have come at a cost and if the resource base of the agricultural system is damaged through land degradation, then the practices are unsustainable and crop yields eventually fall.



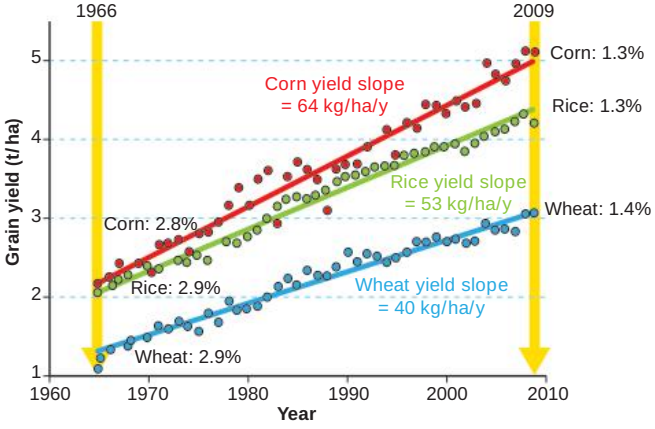
4.2 Improved irrigation and more intelligent use of fertilisers could increase agricultural production by as much as 70 per cent.

High crop yields

In the past, technology was very important in generating the growth in food output (see Figure 4.2). Despite this success, the world remains vulnerable to food shortages. As most suitable land is already under cultivation, the real challenge in the coming decades is to expand food production without significantly increasing the amount of land used.

There are concerns that crop yields are rising more slowly than they did some decades ago, as is shown in Figure 4.3. There is an urgent need for new crop varieties that offer higher yields but use less water, fertiliser and other inputs. It is important that crops are grown in an ecologically sustainable manner to protect the resource base that supports them.

4.3 Grain crop yields, 1966 to 2009. The relative rate of grain crop yield has fallen from 2.9 per cent of average yields in 1966 to 1.3 per cent in 2009, which is not fast enough to meet expected food demand without a large expansion of crop production area.



ACTIVITIES

Knowledge and understanding

1 Describe how crop yield is measured.
2 Outline the basic resources that crops need to grow.
3 Explain how new technologies have raised crop yields.

Applying and analysing

4 Create a mind map explaining how new technologies increased crop yields.
5 Demonstrate why the world is vulnerable to food shortages.

Geographical skills

6 Study Figure 4.3 then answer the following questions.
   a Which crop has had the greatest increase in yield?
   b What was the yield for corn, rice and wheat in 1980?

Investigating

7 Select a food crop to investigate and prepare an annotated visual display of its specific resource requirements.

4.2 Environmental factors

Most of the crops we rely on have quite specific environmental requirements for growth and performance. Increasingly though, other influences, which of course include humans, are affecting the actual yields realised. This is especially important when global food security may be put at risk.

Constraints within the biophysical environment

Crops rely on the air above and the soil below to grow and prosper.

Aerial environment

Crops extend their stalks and leaves up into atmosphere, taking in carbon dioxide and oxygen, and trapping solar energy. Temperature and precipitation are both very important and determine the types of crops that can be grown within a region. Most crops have a certain temperature and precipitation regime within which they grow well.

Soil environment

The roots of plants anchor them into the ground and also provide the means by which they absorb water, mineral nutrients and oxygen. The type and condition of soils can place significant restrictions on the productivity of crops. The nutrient level, water-holding capability and structure of soils are natural variables that either support or hinder growth. Fertile soils provide crops with all they need, but infertile soils impose limitations on growth and development.

Topography

The shape of the land surface can also restrict landuse, and is often related to soil type. Slope generally determines if the land can be cultivated safely. The most arable land suitable for unrestricted agricultural use is usually found on flat valley bottoms or plains where soils are deep and fertile. Typically, such areas are used to produce high-yielding crops such as those seen in Figure 4.4. Steep slopes and ridge tops are unsuitable for cultivation as they have thin, stony soils and are an erosion hazard if the land is disturbed. Terracing is one method people have developed to turn steep sloping land into crop-supporting land.

Inputs from the human environment

Historically, the major increases in crop yields have taken place as humans have intervened to overcome the physical limitations on crop production.

Technology has been particularly important in generating the growth in the output of food and it has brought about an intensification of agriculture. Conventional crop-breeding techniques have led to genetic engineering. New strains of high-yielding crops have been developed. Large inputs of agrochemicals and irrigation have been used to maintain these yields.

Economic and cultural constraints

While the feasibility of growing a crop in a particular area is determined by the suitability of the biophysical environment, the actual choice of a crop type is based on economic and cultural factors.



4.4 The fertile Canterbury Plains of New Zealand



4.5 Cultivation of marginal land in Sub-Saharan Africa. Crop yields are very low in a difficult biophysical environment and the land can become unproductive if it is overexploited.

The choice between crops being grown for commercial purposes depends on the perceived profit to be made. This is dependent on price stability, which will determine the return on production; the cost of inputs such as agrochemicals, machinery, storage and transport; and distance to the market.

In some developing nations, culture exerts a strong influence over agriculture. Rules of inheritance and gender inequality are the core determinants of access to the land for farming, and women are generally disadvantaged.

Pressures from humans

The push for higher yields in resource-intensive agriculture has resulted in environmental degradation in some areas. Erosion, the contamination of soil and water by agrochemicals, and the depletion of surface and groundwater supplies have resulted from unsustainable land practices and must be addressed. Population pressure and overexploitation of the land in poor nations also limits improvements in agricultural production. In their desperation to feed their families, people overuse marginal land—and the damage can be irreversible (see Figure 4.5).

DID YOU KNOW?

The environment is the total surroundings. It includes the living and non-living features of the natural world as well as all those features that are created or altered by humans.

ACTIVITIES

Knowledge and understanding

1 Outline the constraints that the biophysical environment places on crop production.
2 Assess the importance of technology in raising crop yields.
3 Identify the pressures people put on the land that then affect crop productivity.

Applying and analysing

4 Study Figure 4.5. Brainstorm and list the circumstances under which people might be forced to exploit the land even when they know that what they do is unsustainable.

Geographical skills

5 Study Figure 4.4 and draw an annotated photo sketch. Highlight the relationship between topography and landuse in the region.

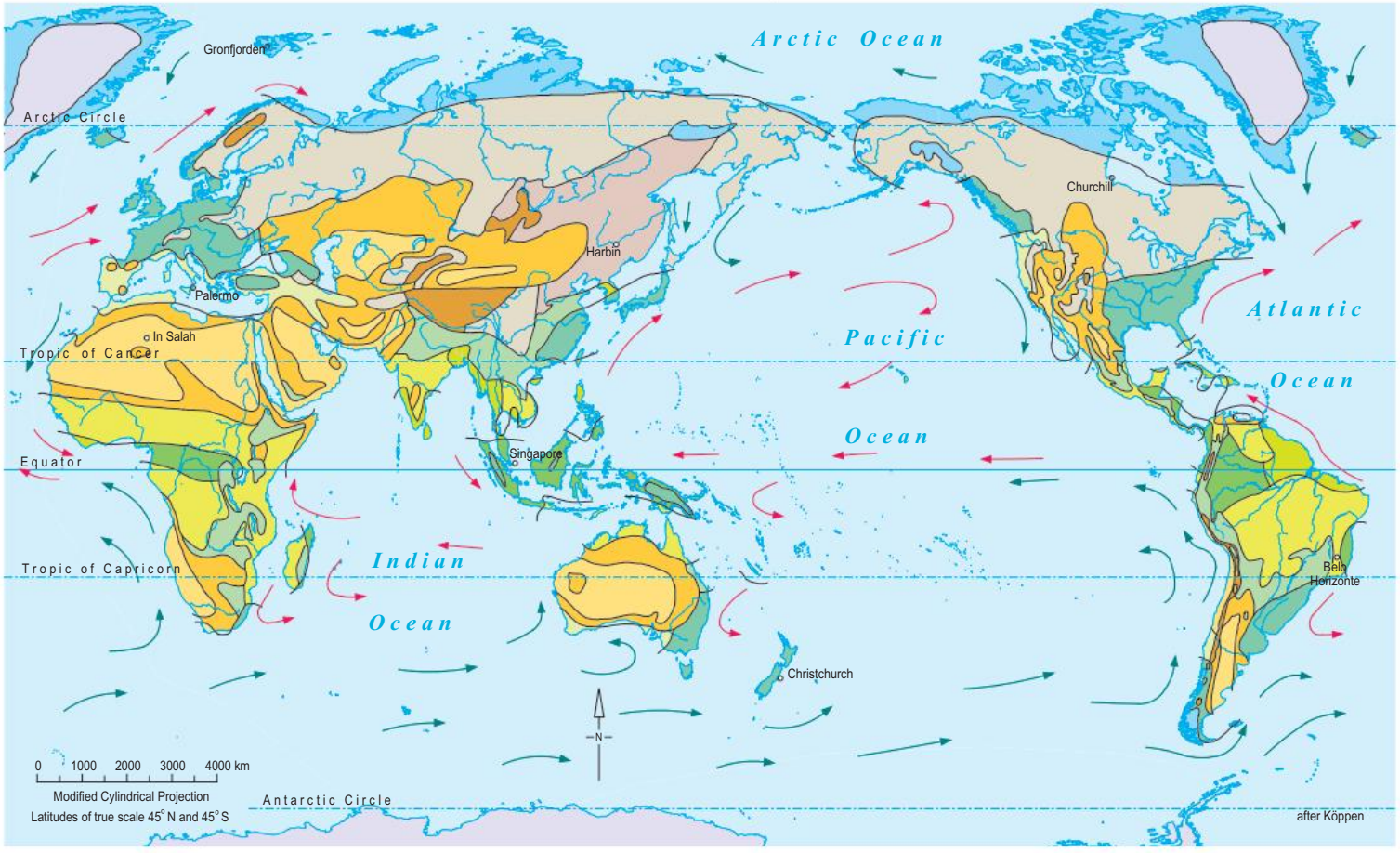
4.3 Climate

Climate is the most important factor in determining the viability of cropping and grazing. Most crops are suited to certain regimes of temperature and rainfall in which their seeds germinate and subsequent growth produces the desired grains and fibres. The actual yield of a crop at harvest reflects the seasonal conditions that have been experienced while the crop has been growing.

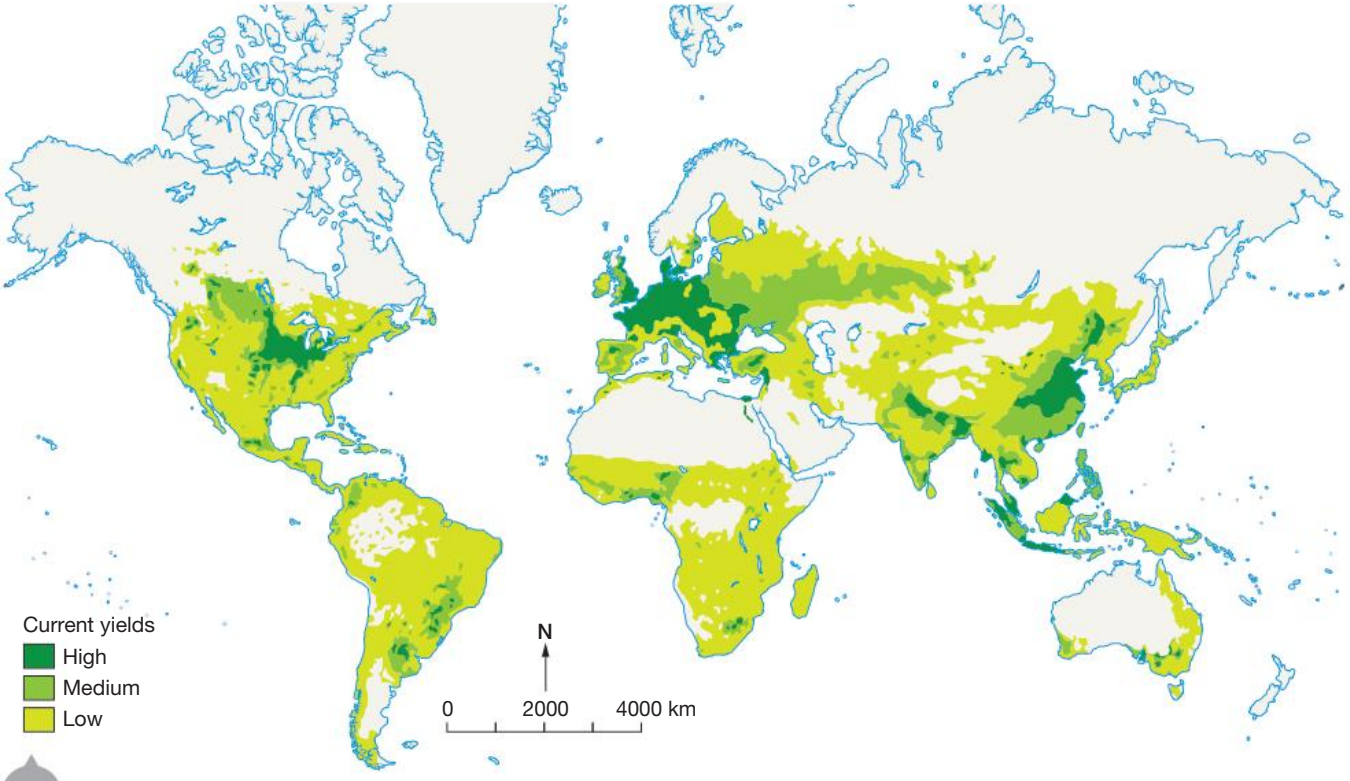
Climate and crop choice

The climate experienced in any area determines the types of crops that can be grown there. Crops vary in their yields and these differences closely reflect the growing conditions found within the various climate belts across the world (see Figures 4.6 and 4.7). The key climate variables are the temperature and precipitation ranges to which some crop types have quite specific tolerances.

4.6 World climates



- Hot and rainy all year
- Hot and rainy most of the year
- Hot all year, rainy most months but with a definite dry season
- Hot and mostly dry all year; unreliable rainfall
- Hot and dry all year; unreliable rainfall
- Warm to mild months, wet all year
- Warm to mild months, dry in winter
- Hot dry summer, mild wet winter
- Warm to mild summer, cool to cold winter; wet all year
- Warm to mild summer, cool to cold and dry winter
- Cold most months with a short summer
- Cold all year
- Climate strongly affected by altitude
- Cold ocean current
- Warm ocean current



4.7 Global crop yields

Temperature

The limits for crops being introduced to any region are set by a number of factors.

- ***Daily maximum and minimum temperatures:*** Wheat tolerates temperatures as low as 3°C and up to 32°C. Corn, however, is a warm-climate crop and its ideal temperature for germination is 21°C. It is frost sensitive, but can withstand temperatures up to 40°C. Rice also requires high temperatures from 21°C to 37°C throughout the lifespan of the crop.
- ***Soil temperature:*** This is crucial for many of the processes that enable seeds to germinate and crops to grow and mature. Adequate heat is necessary to support the billions of micro-organisms active in the soil. If the soil water freezes it then becomes unavailable to plants, as it cannot move into the roots.
- ***The length of the growing season:*** This is set by the number of frost-free days from the last frost of spring to the first frost of autumn. This is usually the amount of time required for a crop to complete its life cycle and produce an economic yield. Cotton, for example, needs 200 days to be ready for harvest, so it cannot survive in a cold climate.

SPOTLIGHT

Harvested when frozen

Icewine is an intensely sweet and very expensive dessert wine that is produced from grapes grown in the cool climate of southern Canada. The grapes stay on the vine and become dehydrated, which intensifies their flavour. The moment they freeze they are harvested by hand, usually when the temperature reaches –13°C.



4.8 Grapes must be just frozen through before they are picked to make icewine.

4.9 Excessively high and low temperatures hinder crop yields.

Excessively high temperatures	Excessively low temperatures
Increases the rate of evaporation of soil moisture.	Results in poor growth and low yields because photosynthesis is slowed down.
Increases the rate of transpiration from the leaf pores of plants.	Causes the plant to go into dormancy; that is, it stops growing because plant processes shut down.
Causes the plants, leaves and stems to droop or wilt and halts the growth of new shoots.	Reduces the germination of seeds.
Can cause the pollen to become unviable and so flowers do not grow, which means that there will be no seed or grain to harvest.	Kills the flowers, which also stops seed and grain being produced. If frosts hit plants that have just flowered they can wipe out the entire crop for a season.
Can kill the plant as it frizzles up.	Causes death of many plants if temperatures drop below zero. When the water freezes it expands, which can kill the plant tissue by tearing its cell membranes. Plants often turn black after they have been hit by a frost overnight.

Temperature extremes

Temperatures are especially important for crop production and any extremes that are experienced can have an undesirable effect on crop yields, as is shown in Table 4.9. Crops are influenced by temperature in the following ways.

- Their growth depends on the combined processes of photosynthesis and respiration, which increase with temperature. For example, the rate at which photosynthesis occurs in corn increases until the temperature reaches 30°C and then it levels off, even if the temperature increases further.
- Optimum temperatures mark the upper and lower limits at which a crop performs best. This is where they accumulate the maximum amount of dry matter in the form of cereal grains or fibres.
- Adequate night-time temperatures must be maintained to enable the growth of new shoots on the plants.
- Temperature affects the amount of water a crop needs to stay alive and function properly. On hot days, crops need more water to sustain plant processes.

Precipitation

Without water, crops cannot grow. Given that they are 85 per cent water, it is easy to understand the importance of rainfall to crop growth. The individual water requirements of the main food and fibre crops are shown in Table 4.10.

The lack of water is a major constraint on productivity in much of the world's arable lands. If rainfall is inadequate, water must be supplied to the crops from other sources, such as irrigation water. Too much water is also not good for many crops, especially when the soil becomes saturated. When this happens, all the pore spaces in the soil fill with water and there is no air available. Rice is the only crop that demands such conditions; it is grown in flooded paddy fields.

Seasonal variations

While climate largely determines crop choice, more than 50 per cent of the variation in crop yields is determined by seasonal variations in the climate. Both the extremes of drought (when precipitation is insufficient to meet crop needs) and floods (when excessive precipitation drowns crops) can be disastrous. Australia often experiences the variability of seasonal rainfall.

There are increasing concerns that climate change could bring more frequent and extreme weather events that will affect crop production in the future.

DID YOU KNOW?

Rice is the main crop in the tropics because it requires both consistently high temperatures and substantial rainfall. It is particularly high yielding as three crops can be grown in a year.

4.10 Crop water needs and sensitivity to drought

Crop	Crop water need (mm/total growing period)	Sensitivity to drought
Alfalfa	800–1600	low–medium
Banana	1200–2200	high
Barley/oats/wheat	450–650	low–medium
Bean	300–500	medium–high
Cabbage	350–500	medium–high
Citrus	900–1200	low–medium
Cotton	700–1300	low
Maize	500–800	medium–high
Melon	400–600	medium–high
Onion	350–550	medium–high
Peanut	500–700	low–medium
Pea	350–500	medium–high
Pepper	600–900	medium–high
Potato	500–700	high
Rice (paddy)	450–700	high
Sorghum/millet	450–650	low
Soybean	450–700	low–medium
Sugar beet	550–750	low–medium
Sugar cane	1500–2500	high
Sunflower	600–1000	low–medium
Tomato	400–800	medium–high

Source: FAO

ACTIVITIES

Knowledge and understanding

1 Describe how temperature limits what crops can be grown in a region.
2 Assess the impact of temperature extremes on crop productivity.
3 Explain why water is crucial to crop growing.
4 Identify what determines the actual crop yield realised in any particular season.

Geographical skills

5 Study Table 4.10.
   a Identify the three crops that need the most water and are the most sensitive to drought.
   b Identify the three crops that need the least water and are the most tolerant of drought.
6 Study Figures 4.6 and 4.7, and Table 4.10, then do the following tasks.
   a Describe and account for the crop yields across the Australian and African continents.
   b Explain why many farmers in Africa choose to grow sorghum and millet.
   c Explain why the banana and sugar cane farms in Australia are located on the east coast of Queensland and northern New South Wales.

Investigating

7 Research the crops that are most commonly grown in either the USA or China. Prepare a multimedia presentation identifying:
   - the choice of crops
   - where they are grown
   - the suitability of the climate to these crops
   - the productivity of these crops
   - any limitation on farming imposed by climate in parts of the country.

4.4 Soil formation

Soil is an important natural resource. It provides the foundation for life on land. Because natural processes are constantly forming soil, it has long been considered a renewable resource. However, in many parts of the world, where the landscape has been altered, soil is being lost faster that it forms. Therefore, the long-held the assumption that soil is a renewable resource is being challenged.

Soil

Soil is the thin outermost layer of the earth's crust. Soil formation is a very lengthy process. It may take thousands of years for the bedrock, from which the inorganic component of the soil is created, to be broken down by the processes of **weathering**. As water gradually seeps down through cracks in the rock strata, physical and chemical changes occur. Over time, the solid rock mass is transformed into a layer of loose, broken material that undergoes further changes as it combines with air, living organisms and decaying organic matter.

In well-developed soils, the action of water and organisms has, over time, changed the original rock material to the extent that different layers, or **horizons**, develop. Eventually topsoil forms. This is the outer layer of nutrient-rich soil, within which plants (including the crops humans depend on) take root.

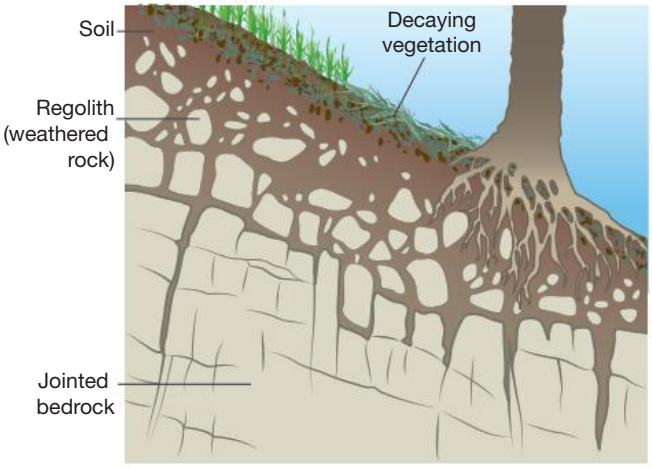
Most soils have evolved over extremely long periods of time. It may have taken tens to hundreds of thousands of years for a layer of soil to develop in some landscapes. It can take up to 400 years for 1 centimetre of soil to form and between 3000 and 12 000 years to produce soil of a sufficient depth for farming.

The rate of soil formation under most Australian conditions is close to zero because of the aridity of the continent.

Soil formation

Soil formation starts with the weathering of rocks and minerals, and continues in combination with organic matter. Soil is a product of many interrelated soil-forming factors acting together.

Initially, underlying bedrock is weathered into a layer of loose material known as the **regolith**, shown in Figure 4.11. When this is mixed with air, water, living organisms and decayed organic matter, a topsoil develops.



4.11 Physical and chemical weathering processes break down massive rock into smaller particles that form the inorganic component of the soils.

Soil formation is the combined effect of a number of factors.

- ***Parent material:*** The underlying bedrock is the main source of mineral matter in the soil, and makes a major contribution to the nature of the soil, especially its fertility and the size of soil particles. Sandstone contributes large quartz grains, and the sandy soil that results is not very fertile and water quickly drains through it.
  Some soils form on material that is transported into an area by wind and rain. Alluvium, which is the material deposited by rivers, produces soils of finer particles, such as silt and loam. They are typically very fertile.

DID YOU KNOW?

Weathering is the physical disintegration (breaking up) and the chemical decomposition (decay) of rock material at the site at which it is found.

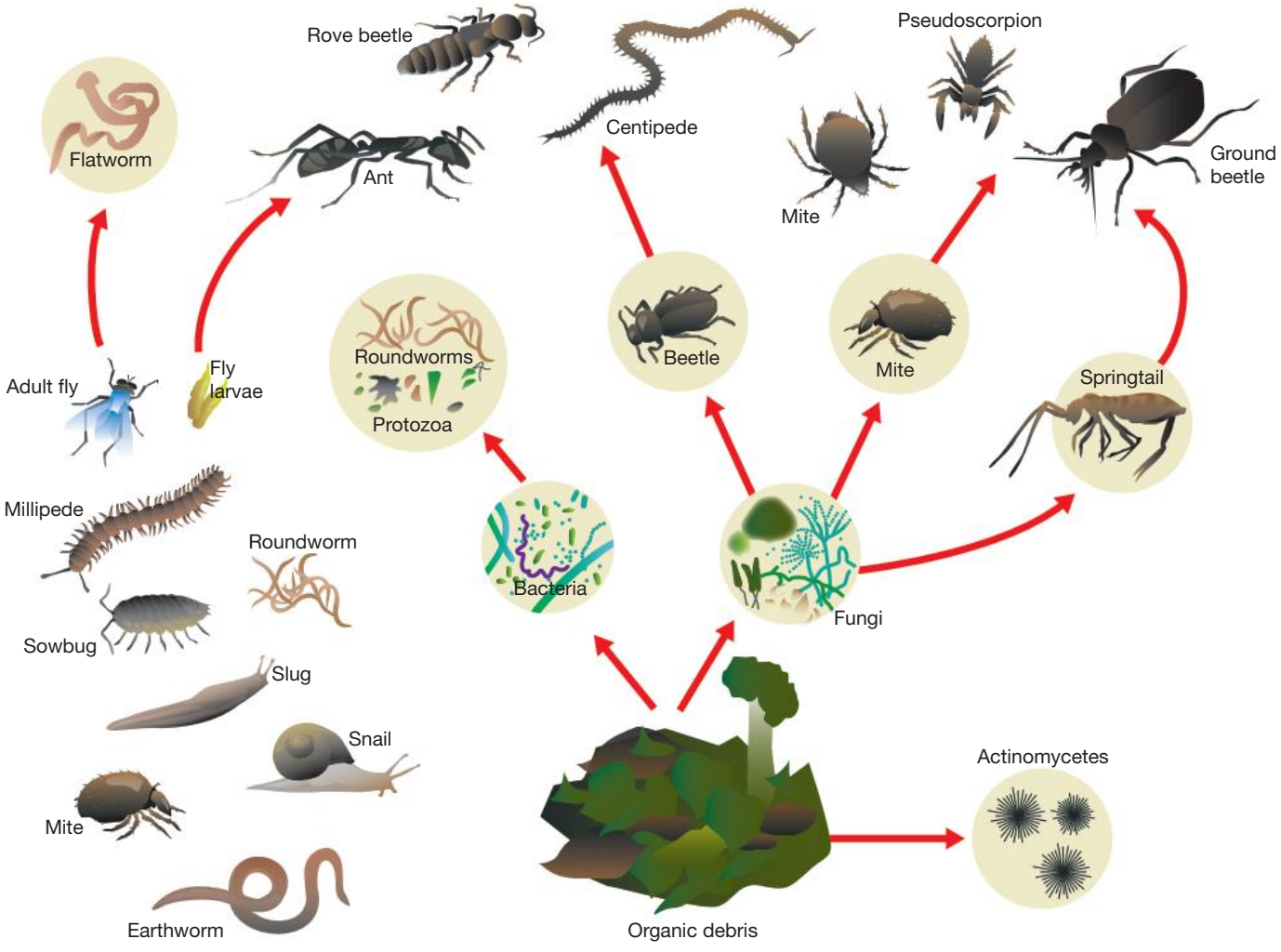
- ***Climate:*** Climate is the most important factor in determining soil type. Both temperature and rainfall influence the rate of weathering of underlying rock, as well as other soil-forming processes, and therefore the character of the soil. Soil tends to be deeper in warm, humid regions, as there is more weathering and the micro-organisms, bacteria and fungi are more active. Soil in dry or arid climates tends to be shallower, less well developed and not as fertile.
- ***Topography:*** The shape of the land, especially the steepness of the slope, has a big influence on soil development. On steep slopes, especially on the tops and sides of mountains, the soil may be carried away by erosion almost as quickly as it forms. What is left is thin and stony. On gentler slopes or flat country, the soil tends to be deeper and much more developed.
- ***Living organisms:*** Soil contains many living organisms, from large animals that burrow into the ground to tiny micro-organisms, as shown in Figure 4.12. There are approximately 6.5 tonnes of living organisms in an average hectare of soil. Most important are the small insects, bacteria and fungi. Worms are very important because, as they move, they make tiny tunnels that aerate the soil.

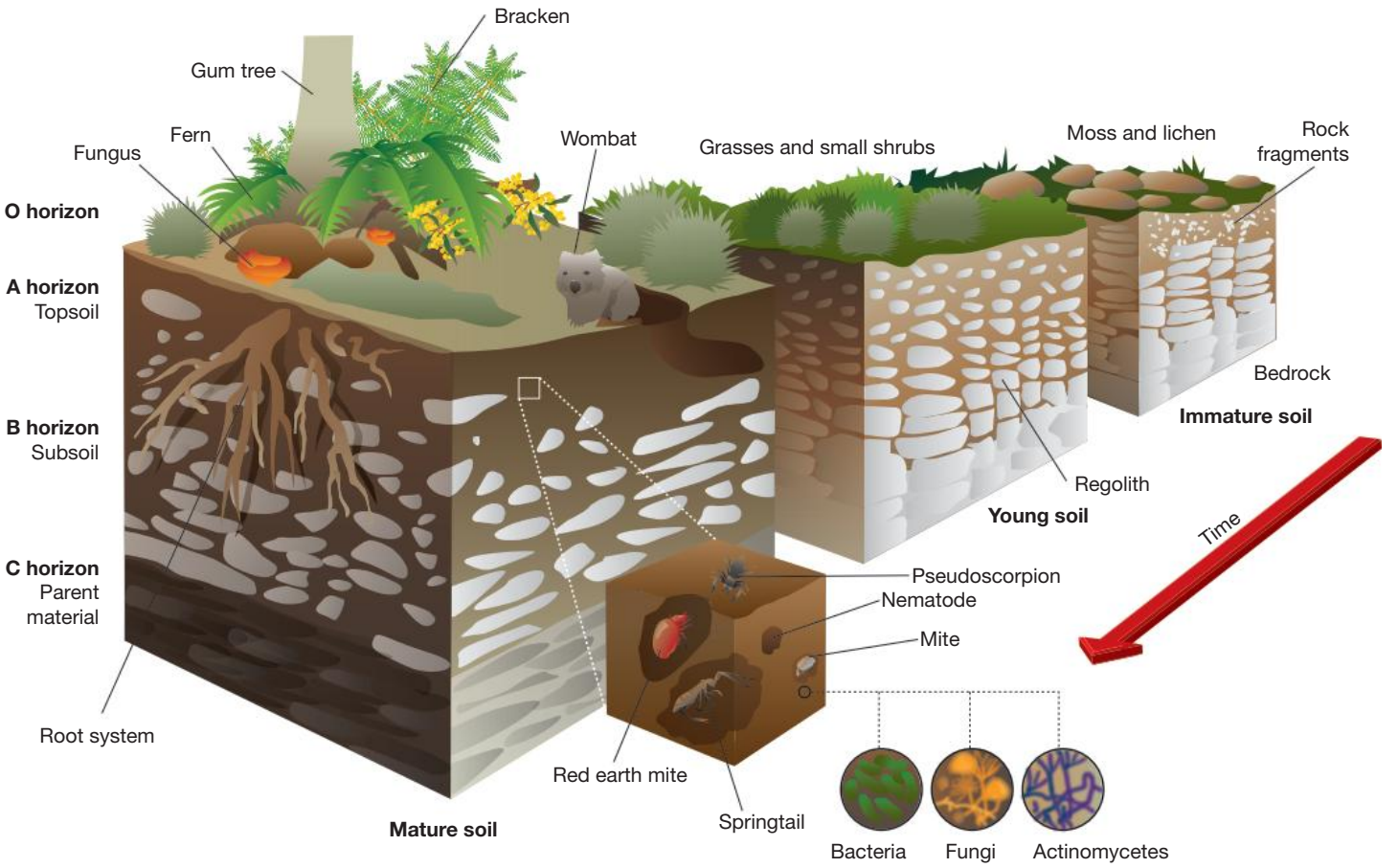
The transfer of nutrients from the organic matter to the soil depends on the bacteria, fungi and decomposer micro-organisms. There are millions in every handful of soil. They break down waste material, changing it into simpler nutrients that dissolve in the water in the soil. Their activity is determined by the climate; it is fast in hot climates and slow in the cold. Plant roots are able to take nutrients in and use them to grow.

DID YOU KNOW?

There may be may be one million earthworms and 25 million insects in just one hectare of pasture, and as many as one million bacteria can inhabit one cubic centimetre of soil.

4.12 A multitude of organisms is found in soil.





4.13 Over time, soil deepens and supports more organisms.

- ***Time:*** Soil forms slowly. At the beginning of the process the soil consists mainly of rock fragments near the land surface. It may take hundreds of years for just a centimetre of soil to develop. A mature soil that has developed over a long period of time is deep, with several layers above the underlying bedrock, and is packed with organic life, as shown in Figure 4.13.

Rapid soil loss

Once soil is formed, it does not stay in the one place indefinitely. It can be picked up and blown along by the wind, or washed away by water in a process known as **soil erosion**.

While erosion is natural, it is generally not excessive, with plant roots holding most of the soil in place. However, when humans alter landscapes and remove this protective plant cover, the rate at which soil erodes accelerates. Clearing the land for activities such as agriculture, logging and construction can result in severe soil loss.

Nature is very unforgiving and 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 and 500 AD, but at the expense of their soils. Productive farmland was degraded and then abandoned.

Renewable or non-renewable

Soil is a very important natural resource. It has long been thought of as a renewable resource as natural processes continually replace it. However, soil is eroding more rapidly than it forms on one-third of all cropland. The amount of soil that is blowing or washing into rivers, lakes and oceans each year equals a loaded ore train long enough to encircle the globe 150 times.

Soil is renewed only very slowly because it takes so long for underlying bedrock to be broken down sufficiently for soil to develop. So, in a time frame relevant to humans, soil must now be considered a non-renewable resource. Maintaining and improving the condition of soil resources, especially by avoiding soil loss or degradation, is crucial for our future wellbeing.

SPOTLIGHT

The miracle of Mycorrhizal fungi

Mycorrhizal fungi form a mat around plant roots. They do not harm the plant, but rather help it by acting like a sponge mopping up nutrient-rich soil water. In exchange, the plant gives the fungi food in the form of sugars, which they need as they cannot photosynthesise under the ground, where there is no sunlight. This is known as a **symbiotic**, or mutually beneficial, relationship, whereby the plant and the fungi work together to help each other survive.



4.14 Mycorrhizal fungi allow the plant to extend the reach of its roots.

ACTIVITIES

4.1

Knowledge and understanding

1. Explain why soil is such an important resource.
2. Outline how soil is formed.
3. Define the term 'regolith'.
4. List the main factors involved in soil formation.
5. Explain how the climate of an area influences soil type.
6. Describe how mycorrhizal fungi and plants benefit each other.

Applying and analysing

7. Study Figure 4.13. In groups, consider the relationships that exist between different organisms found in the soil.
8. A farm has poor and degraded soils. Devise a plan to improve the quality of the soil.
9. Outline the ways in which soil is lost.
10. Explain how humans can accelerate the rate of erosion.
11. Do you think soil should still be considered a renewable resource? Explain.

Investigating

12. Select one of the following ancient civilisations and investigate how they suffered due to exhausted soil resources: Mayans, Easter Islanders, Angkor civilisation.
    - **a** Include a map of the civilisation.
    - **b** Describe their main crop/s.
    - **c** Examine how the crop/s affected the soil and environment.
    - **d** Discuss what happened to the civilisation.

4.5 Elements of soil

Soil is a mix of fine rock particles, decaying organic matter, air and water. It is teeming with hidden life. Within the soil are millions of living organisms, most of which are microscopic. Soil is, therefore, composed of both living and non-living elements that are loosely packed together. Most land plants grow within this combination of materials, drawing on nutrients and water contained within the soil.

Soil components

There are four components of soil: inorganic minerals, organic matter, air and water, as shown in Figure 4.15. This combination enables soil to support life, making it very different from the rock from which it was originally formed. The ideal soil for plant growth is thought to hold 45 per cent minerals, 25 per cent water, 25 per cent air and 5 per cent organic matter. In reality, however, the percentages of the four components vary greatly, as shown in Figure 4.16.

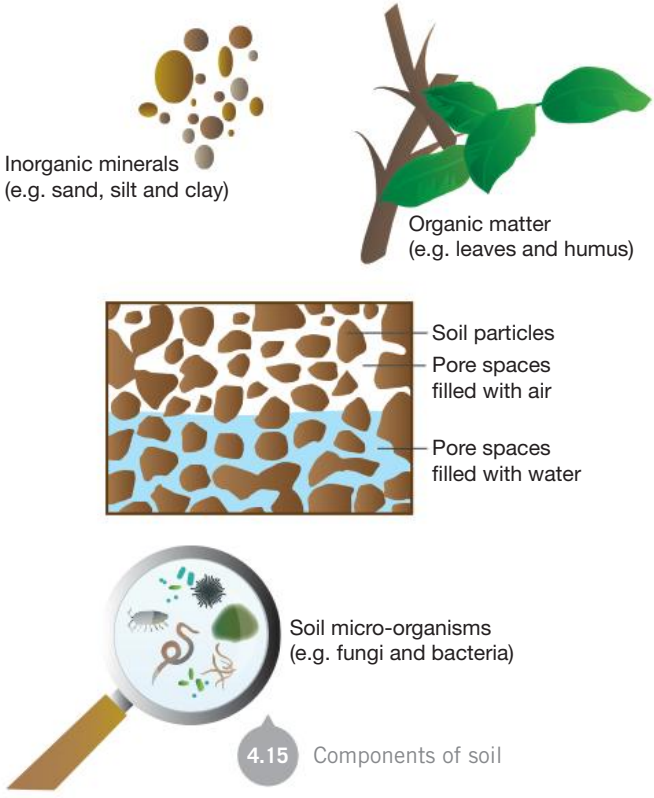
Inorganic minerals

The most obvious component of soil is the large fragments of rocks or gravel at or near the surface of stony soil. Of more significance are the smaller particles that make up most soils. These are classified according to size from course-grained elements such as sand, to **silt** and the finest particles, **clay**. Rock particles alone do not make a soil, but they do influence the water-holding capacity and fertility (richness) of the soil.

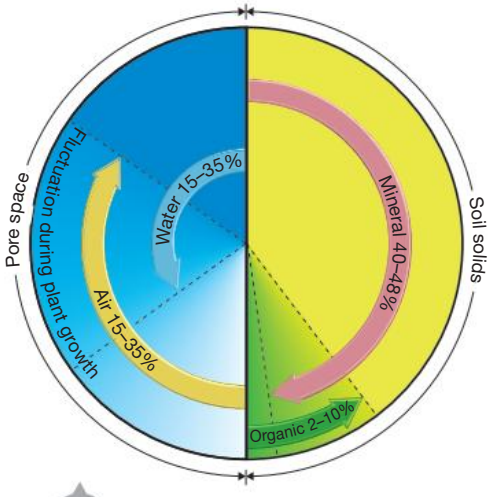
Organic matter

Organic matter includes the carbon-containing material in living organisms such as plants and animals, their remains, and any nutrients that have come from their decay. Though this makes up only a small fraction of the total materials in soil, it is extremely important. No soil existed until life appeared on land. Vegetation is the main contributor of organic matter to the soil. Grasslands provide the largest amount of organic material, even more than forests.

Soil also holds micro-organisms, bacteria and fungi that are vital for the conversion of inorganic and organic material into nutrients.



4.15 Components of soil



4.16 Percentages of oil components under normal conditions



	The surface litter layer: This is the material that sits on top of the ground. It is a collection of freshly fallen or partially decomposed leaves, bark, twigs and decaying animal wastes. This litter eventually takes on a dark brown or black colour.
A horizon	The A-horizon or topsoil: This layer is normally rich in organic matter mixed with inorganic mineral particles. It is also quite a loose layer, with pore spaces between the soil particles. The abundance of partially decomposed organic matter (called **humus**) gives the topsoil its dark colour. Humus mixes with the mineral matter of the soil and becomes inseparable from it. The lower part of the A horizon is also the zone from which soluble minerals and clay particles are washed downwards. Minerals such as iron are dissolved in water and removed in a process known as **leaching**. Clay particles are also picked up and carried downwards by water.
B horizon	The B-horizon or subsoil: This is the layer where the minerals and clay that have moved down from the topsoil are redeposited. Over time they accumulate, giving this layer a brighter colour, such as red when iron builds up.
C horizon	The C-horizon: Broken pieces of weathered rock sit on the parent rock below.

4.17 Layers within a soil profile

Air and water in pore spaces

About half of the total mass of soil is made of interconnecting holes between the solid soil particles. These gaps or pore spaces are filled with air or water. While soil minerals and organic matter are the sources of nutrients, it is through soil water that plants are able to take up these nutrients through their root systems. Soil air is just as important, as the micro-organisms need it to break down rotting organic material.

The amount of air and water filling the soil varies greatly as conditions change, fluctuating with extended dry periods or heavy rain.

Layers within the soil

The presence of layers indicates a true soil. The layers can differ markedly from the original parent material. Most soils that have developed over a long period of time have three main horizons: A, B and C. They each have their own distinctive colour and characteristics, as described in Figure 4.17.

ACTIVITIES

Knowledge and understanding

1. Identify the four components of soil.
2. Explain how soil is different from the underlying rock.
3. Outline the importance of soil pores.
4. Define humus.

Applying and analysing

5. Copy Figure 4.16 and label it 'Soil composition under normal conditions'. Redraw the diagram to illustrate how the proportions would change when the soil:
   - **a** becomes very wet after heavy rain
   - **b** dries out during an extended dry period.
6. Construct a general soil profile. Shade each layer in the appropriate colour and account for its appearance. Add flow lines to show the movement of water and annotate how this contributes to the characteristic colours.

4.6 Types of soils

There are thousands of different soil types found throughout the world. The type of soil in an area is usually related to its climate and the associated vegetation, as well as the underlying bedrock. All soils vary in the way they have formed and this is reflected in their colour, content, pore space, acidity (pH) and depth. These differences can be used to classify soils.

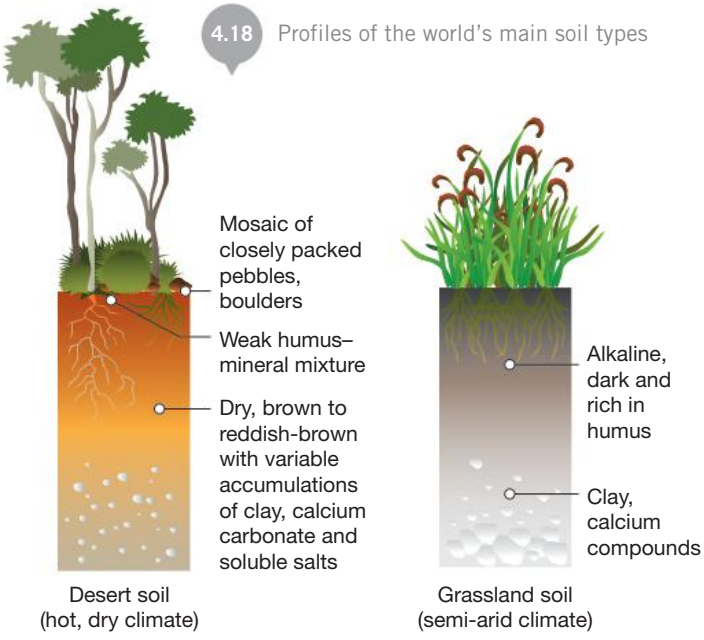
World pattern of soils

The world pattern of soils is closely linked to the distribution of the world's major biomes or vegetation regions. The five main soil types are typically found in five different biomes, each with a distinct profile, as shown in Figure 4.18. The characteristics of the main soil types are outlined in Table 4.19.

Deciduous forest soil

The alfisol soils that form under the deciduous (leaf-shedding) forests of the Northern Hemisphere are very fertile. The temperate climate is favourable to soil formation. There is ample rainfall, but not so much that it leaches the nutrients from the topsoil. The milder temperatures enable leaf litter to accumulate and humus to develop in the A-horizon. The clay-enriched subsoil and abundance of nutrients make the alfisols very fertile.

4.18 Profiles of the world's main soil types



4.19 Characteristics of the main soil types

	Chromosols	Latosols	Alfisols	Podsols	Mollisols	Aridisols
Vegetation	Grassland	Tropical rainforest	Deciduous forest	Coniferous forest	Grassland	Desert
Weathering of parent rock		Extremely fast	Moderate	Extremely slow	Moderate	Extremely slow
Soil depth	Up to 1.5 metres	Up to 30 metres	Up to 15 metres	Under 1 metre	Up to 25 metres	Under 1 metre
Leaf litter	Thin	Thin as quickly decomposed	Thick, especially in autumn	Thick layer of pine needles	Thick	Absent
Movement of water		Rapid leaching	Limited leaching	Strong leaching	Limited leaching	Upward due to evaporation
Recycling of nutrients	Moderate	Very rapid	Moderate	Very slow	Rapid	Very limited
Earthworms/organisms		Many	Many	Very few	Many	Hardly any
Fertility	Moderate	Infertile	Very fertile	Very infertile	Very fertile	Very infertile

Tropical rainforest soil

The soils that support the rainforests of the world's hot, wet tropical areas are known as **latosols**. They are infertile soils with a thin A-horizon that has little organic matter. Humus does not accumulate because bacteria rapidly break it down in the hot conditions. The torrential rain also leaches out nutrients and minerals that dissolve in the water moving through the soil. This water reaches deep into the bedrock that is also weathered to great depths.

Rainforest soil has a distinctly reddish colour because of the iron and aluminium compounds that accumulate with clay in the B-horizon. If erosion exposes this horizon, it bakes in the hot sun. In this state, the soil is useless for cultivation.

Grassland soil

The mollisol, or cracking clay, soils under grasslands are among the most fertile in the world. They are characterised by a thick, dark surface horizon. Their fertility comes from the long-term addition of organic matter from the grasses that make the soil rich in humus. The extensive mat of roots of the grasses also holds the soil together, which is very important, as these soils are rich in clay, which cracks open in extended dry periods. Trees are unable grow in cracking clay soils as their roots become exposed when these deep cracks extend over a metre into the ground.

Desert soil

Aridisols are found in the hot, arid deserts of the world. The climate is too dry and the vegetation too sparse for any significant soil development. Any moisture in the soil is likely to be drawn upwards and evaporated, leaving the surface crusty with salt. Soils are usually thin and lack organic matter. Such land is unsuitable for agriculture.

Coniferous forest soil

The cool, moist climates of Canada and Russia, where the great coniferous forests extend, have also produced infertile, acidic podsol soils. In these conditions, pine needles from the conifer trees accumulate on the ground, making the leaf litter and humus very acidic. Below this, the A-horizon is very pale in colour—it has been strongly leached as the clay and many important minerals have been washed downwards, where they accumulate in the B-horizon. Podsols cannot produce crops unless lime and fertiliser are added to correct the acidity.

ACTIVITIES

4.2

Knowledge and understanding

1. Identify what the world pattern of soils is linked with.
2. Explain why soils in tropical rainforest are deep yet infertile.
3. Describe podsol soils.
4. Explain why grassland soils crack open in droughts.
5. Justify why desert soils are considered unproductive.

Applying and analysing

6. Construct a KWL chart to summarise what you know, what you would like to know and what you have learnt about the different soils of the world.
7. In groups, review the two main sources of nutrients for soils. Given that rainforest soils are infertile, consider how the luxurious plants of a tropical rainforest are able to grow there. What implication does this have for managing rainforest environments with so many of them threatened by deforestation?

4.7 In the field: Investigating soils

Much can be learnt about soils by studying them in the field. In order to understand a soil, and how soils differ from each other, geographers observe and measure soil properties. Colour, texture and structure can be evaluated by looking at the soil or feeling it. To determine the chemistry of a soil, special equipment is needed to test the pH (acidity) and salinity (salt content) levels of soil samples.

How to investigate soils

Examining a soil profile

The following steps explain how to examine a soil profile.

Step 1

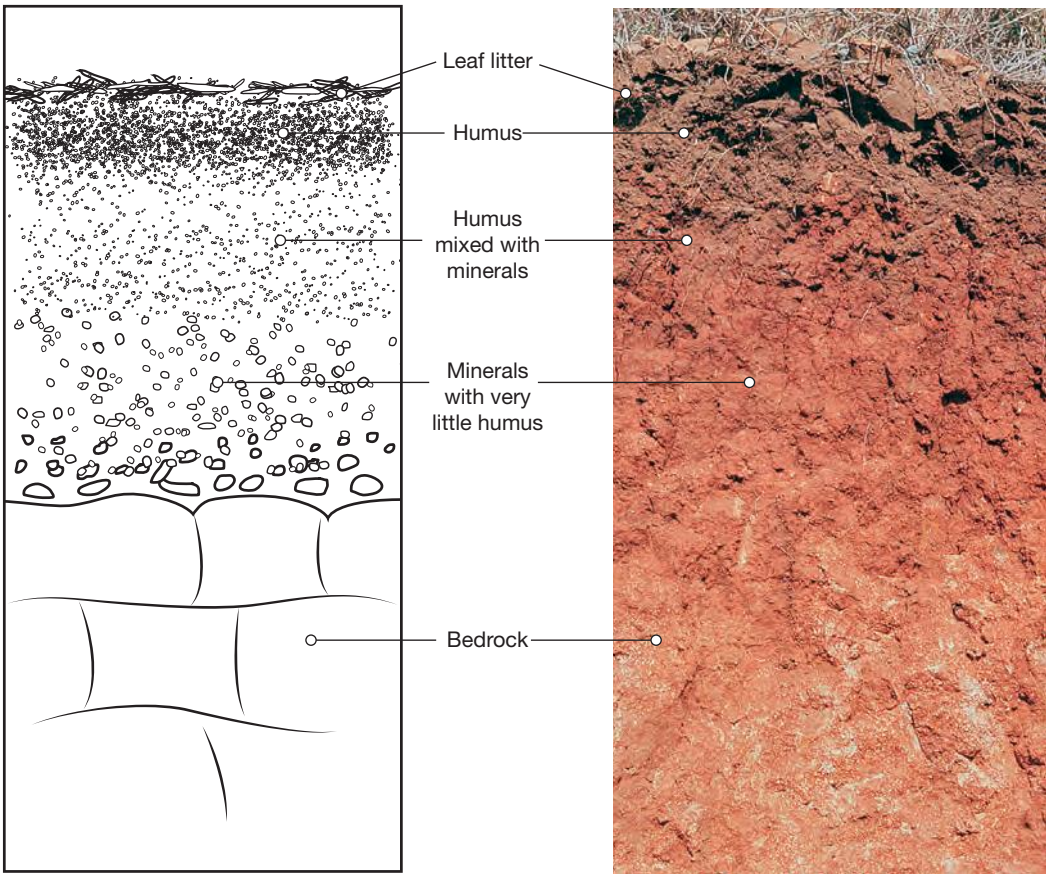
Examine the soil profile. The investigation of a soil is best done where the whole profile can be examined. This allows us to determine the properties of each of the various layers of the soil. This soil profile may be exposed at a road or railway cutting or in a safely constructed soil pit. The latter is better, as it is less likely to be affected by the processes of weathering.

Step 2

Draw up a table or a detailed, annotated field sketch. Identify each horizon and label it on the sketch. Indicate the depth of each horizon and describe the lower boundary (is it sharp, indistinct or irregular?). Figure 4.20 shows an example of a chromosol soil profile and field sketch.

Step 3

Describe the various characteristics of each horizon. (Note: Many of these tests require a sample of the soil to be collected. Account for the differences between the various horizons. Look for evidence of leaching of minerals and clay particles being carried downwards in the profile.



4.20

Soil colour

Colour is usually the first thing that is noticed about a soil. It tells us a lot about the soil because it reflects the amount of humus as well as the different minerals that are found in the soil. Soil scientists officially recognise 170 different soil colours. Table 4.21 lists the characteristics of soil colour.

4.21 The characteristics of soil colour

Soil colour	Characteristics
Dark brown or black	Contains a lot of humus (organic content), very fertile, nitrogen-rich, good for growing crops and pastures.
Light brown or grey	Contains little humus, low in organic matter, less fertile.
Red and yellow	Contains iron and aluminium, lacks nitrogen, less fertile.

Step 1

Observe and describe the colour of the soil. If the soil is not exposed to the surface, a small patch of ground may need to be carefully cleared by pulling aside the plants or, if necessary, removing a few to reveal the soil at their roots.

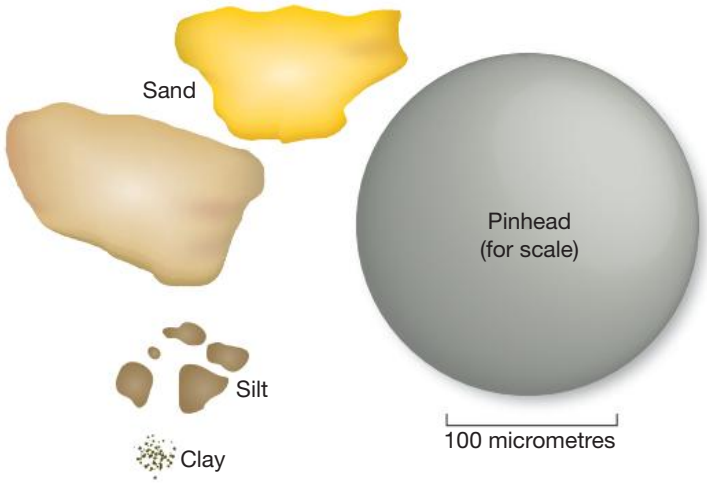
Step 2

Look at the full soil profile. Examine and record the different colours of the soil horizons.

Soil texture

Soil texture refers to how coarse or fine the mineral matter of a soil is. It is determined by the particle sizes of the mineral matter: sand is the largest, between 0.05 and 2 millimetres; silt is between 0.002 and 0.05 millimetres and the smallest particles are clay, which are less than 0.002 millimetres. This is shown in Figure 4.22. The proportions of sand, silt and clay in a soil establish its texture. Soil texture is important, as it determines the amount and movement of soil air and water, as well as the water-holding capacity of a soil.

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



Investigating soil texture

You can determine soil texture by noting how the soil feels. If it is gritty and easily slips through the fingers it is sandy, whereas silt holds together more and feels smoother. Clay becomes sticky when wet and can be moulded into shapes, like plasticine.

Step 1

Take a small handful of soil and pick out any stones or leaves. Gradually add very small amounts of water while you work the soil into a small ball. If the soil is very sandy it will be impossible to form a ball. If it forms into a ball easily then it has clay in it. Stop adding water when the ball starts to stick to your hand.

Step 2

Squeeze the ball between your fingers. If it is gritty and scratchy, it has sand in it, and if it feels sticky then clay is present. A smooth, silky touch indicates fine silt particles.

To determine how much clay is in the soil, roll the ball into a ribbon. The longer the ribbon you are able to roll, the more clay is present.

Step 3

Repeat this test on soil samples collected from each soil horizon.

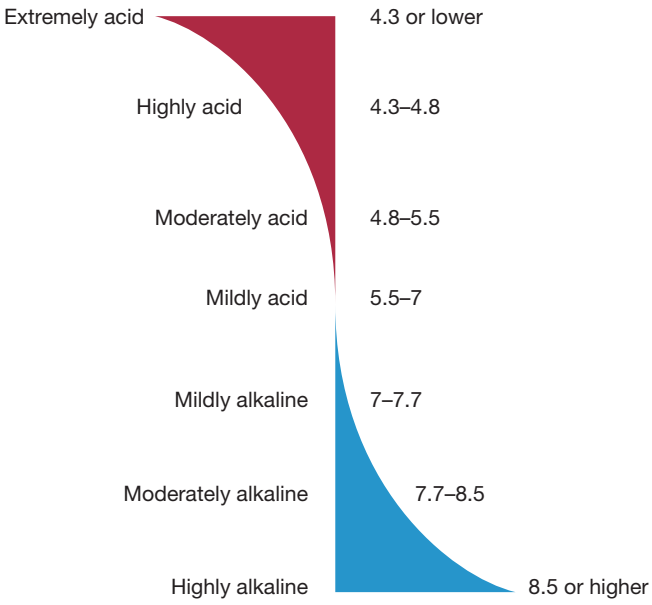
Soil structure

Soil structure refers to the way in which soil particles hold together. They can be observed as the aggregates (crumbs or lumps) that soil breaks into. The arrangement of the aggregates gives the soil its structure. A soil with good structure has enough pore spaces between the aggregates to hold air and allow water to enter and drain easily, while still holding enough moisture to support plant growth (see Figure 4.23).

Soil that slips through the fingers has a very weak structure. Good soil structure gives water, air and plant roots easy entry into the soil. Those with a good crumb structure are the best for farming, as they hold together well, but with enough space in the soil to hold water, air and humus.



4.23 Soil structure is very important for plant growth.



4.24 Soil pH range

Investigating soil structure

It is easiest to work with the topsoil, as the lower soil horizons are often quite solid and hard.

Step 1

Dig a small hole about 30 centimetres deep.

Step 2

With a shovel, cut a thin slice from the side of the hole. Carefully lift it out and lay it on plastic.

Examine the size of the soil aggregates. If the aggregates are large, hard clods, they are usually difficult to break. A crumbly soil is softer and easily broken, which makes it easier for plant shots and roots to develop. A fine silt soil in which the particles are all the same size is usually less crumbly and quite dense (see Figure 4.23).

Soil pH

The pH of a soil is a measure of the number of potential hydrogen ions available—hence the abbreviation, pH. The more hydrogen ions there are in the soil, the more acidic the soil is. The pH is measured on a scale of 0 to 14, as shown in Figure 4.24. If the pH of a soil is less than 7.0, the soil is said to be acidic, and if the pH is more than 7.0, the soil is said to be alkaline. The pH level controls many of the chemical processes that take place within soils and so is an indication of the availability of plant nutrients. Most plants grow best when the pH level is between 5.8 and 9.0. Within this range all nutrients are readily available. A pH level of about 6.3 to 6.8 is also the range preferred by most bacteria, such as mycorrhizal fungi.

Investigating soil pH

There are two different methods for measuring pH: litmus paper procedure and electronic pH procedure. For the litmus paper procedure, follow these steps.

Step 1

Mix a small sample of soil with distilled water.

Step 2

Insert a strip of litmus paper. If the soil is acidic, the paper will turn red. If the soil is alkaline, the paper will turn blue. Record your results.

For the electronic pH procedure, follow these steps.

Step 1

Insert the rod of the electronic pH recording meter into moistened soil.

Step 2

Record the reading on the meter.

Soil salt concentrations

Plants need mineral salts to photosynthesise. Plants absorb mineral salts in a soluble form through their roots. If salt concentrations in the soil build up and become too high, plant growth may be affected, as high levels of salts are toxic to most plants. Salinity has become a widespread problem in Australia.

Investigating salt concentrations

When mineral salts dissolve in water they separate into particles called ions, which have positive or negative

charges. This means that salts have the ability to carry an electrical current. As the salt concentration increases, so does the electrical conductivity. Salt concentrations in soils can therefore be measured by determining the electrical conductivity of a solution.

There are three methods that can be used to extract the salts from soil:

- 1:5 extraction method: place 20 grams of air-dried soil in a screw-top jar with 100 millilitres of distilled water. Shake well for 30 seconds every 5 minutes for a period of 1 hour.
- 1:2 extraction method: this is similar to the 1:5 extraction method except that you use 50 grams of air-dried soil and 100 millilitres of distilled water.
- saturation extraction method: place 250 grams of air-dried soil in a screw-top jar. While stirring, add distilled water to the sample until it has the consistency of a thick paste. Allow the sample to stand for 1 hour. Then, using a vacuum pump, extract the soil water.

Step 1

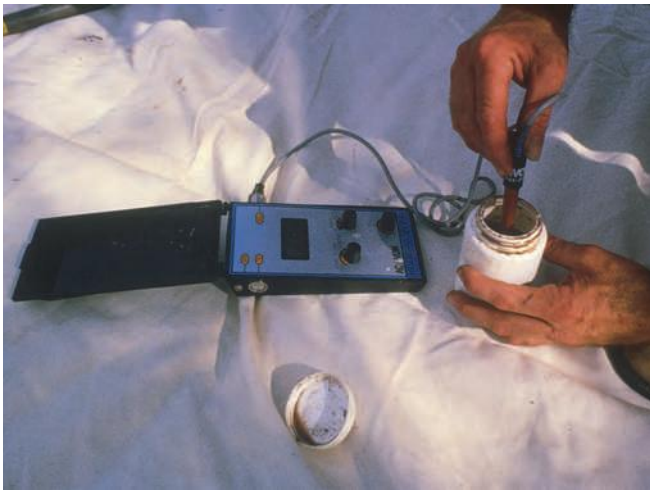
Determine which extraction method you will use. Collect the desired weight of soil from your site and follow your chosen method to extract the salts.

Step 2

Place a conductivity meter in the extracted solution to determine its electrical conductivity (see Figure 4.25). Record your results and then interpret them using Table 4.26.

4.26 Soil salinity

Conductivity reading (millisiemens/centimetre)	Soil quality
Below 0.10	Soil low in nutrients—fertiliser needed.
0.10–0.29	Acceptable range for plant growth.
0.30–0.79	Generally safe, but the higher values in this range may affect some salt-sensitive species, especially if drainage is poor; seed germination may be affected.
0.80–0.99	Increasing salinity problems—the nature of the impact varies according to the plant species.
1.00–1.49	Plant growth likely to be affected—leaf discolouration should be evident.
Over 1.49	Too high—only salt-tolerant plants are unaffected.



4.25 Testing electrical conductivity of a diluted soil sample as a measure of soil salinity

ACTIVITIES

Aim

To investigate the properties of a soil at a selected site.

Instructions

1 Choose a suitable site (see Step 1).
2 Create a field sketch of the soil profile. Annotate the field sketch to indicate the:
   a colour of each layer
   b texture of each layer
   c structure of each layer.

   Option 1: Investigate the pH level of your soil profile. Interpret your results using the information about pH. Add this information to your field sketch.
   Option 2: Investigate the salinity of your soil profile and describe the soil quality.

Evaluation

3 Is the soil at your selected site good for growing plants? Explain.
4 How could you improve the quality of the soil?
5 What part of the field trip worked well? What didn't?
6 Would you use any different methods to investigate the soil? Explain.

Conclusion

7 Outline a program to improve or protect the soil at your chosen site.

4.8 Significance of soils

Soil is the foundation for life on land. It provides the nutrients needed for plant growth and also sustains the animals that feed on these plants. Historically, the fertility of soils has strongly influenced the distribution and activities of people. It has determined agricultural patterns, settlement locations and the numbers of people living in an area.

Not just dirt

Unless you are a farmer, you probably think of soil as just dirt—something you do not want on your hands, clothes or carpet. While you are very aware of your need for air and water, you may be unaware that your life, and the lives of other living organisms, depend on soil, especially the upper layer known as topsoil.

The nutrients in the food you eat come from soil. Soil also provides you with wood, paper, cotton, and the many other vital materials people use on a daily basis. It also helps purify the water you drink.

As long as soil is held in place by vegetation, it stores water and releases it in a nourishing trickle instead of a devastating flood. The decomposer organisms of soils recycle the key chemicals humans and most other forms of life need. Bacteria in the soil decompose degradable forms of rubbish you throw away. The buildings, roads, infrastructure and waste treatment plants we use are all built on and supported by soil. Soil is truly the basis of life and civilisation, as is shown in Table 4.27.

4.27 Importance of soil to different people

	Importance of soil to wellbeing/livelihood
Gardener	A home gardener wants to use the dirt in the yard to grow flowers, herbs, vegetables, ornamental shrubs and trees to beautify the living environment and supplement food supplies.
Farmer	A farmer is interested in the complex factors that contribute to a soil's productivity to maximise production and income from crops and livestock. Knowing the capabilities and limitations of different soils is fundamental to successful farming.
Builder	A builder uses the soil as a foundation for construction. It should provide a stable base that is free from waterlogging. Soil is also an important source of clay that is the basic material for brick making.
Engineer	An engineer is concerned with the properties of soil that will contribute to a stable, long-lasting structure that will not crack or collapse. Soil is also used as a construction material for dams and road bases.
Hydrologist	A hydrologist is involved in determining how quickly and to what extent soils will absorb rainfall after a storm event and how this water moves across a landscape.
Urban planner	Urban planners are responsible for appropriate development within an urban area that entails knowledge of soil capabilities and any problems with drainage.
Conservationist	Conservationists are bound to protect soils, as they are a fragile resource that is subject to degradation when used beyond capacity. Soil is vital for the maintenance of biodiversity above and below the ground. With much of this activity hidden from view, conservationists work to increase awareness of the importance of soil and its myriad micro-organisms in sustaining landscapes.



4.28 Fertile, dark-brown topsoil is highly productive.

Soils influencing agriculture

Soil is fundamental to agriculture. Food and fibre crops, as well as pasture for the grazing of animals, depend on the nutrients and water available in soil. The suitability of soil depends on a number of characteristics, such as fertility, texture, water-holding capacity and aeration (air content).

Colour

The colour of the topsoil is an indicator of how good the soil is for agriculture. If the topsoil is dark brown, then it is rich in organic matter and nutrients (see Figure 4.28). Most of the world's crops are grown on land that has been cleared of grasslands and deciduous forests as these are the soils that are fertile because of their high humus content and good texture. Soils that are a pale colour or grey, yellow or red in colour are generally low in organic matter and not as fertile.

Texture

The texture of the soil also determines its suitability for agriculture.

- Sandy soils contain large, angular sand grains that are loose and so water passes through them very easily. While the soils are light, well drained and aerated, which makes them easy to cultivate, they are not very fertile. They have little organic matter and the water quickly leaches out any minerals, so they require a lot of fertiliser to remain productive. Sandy soils tend to be used for growing vegetables and fruit. The roots of crops such as carrots find the soil easy to penetrate.
- Clay soils are the opposite to sandy soils, as nutrients cling to the tiny clay particles. Such soils are very fertile and usually high in organic matter, making them especially productive. However, if the clay content is too high, they are considered heavy soils that are hard to cultivate, especially after rain. Heavy clay soil areas are often left under permanent grass as pasture for stock.
- The best soil for agriculture is a loam, which has enough clay to retain moisture and nutrients, sufficient sand to be well drained and aerated, and enough silt to hold the clay and sand together. These fertile soils are highly favoured for food and fibre crops.

ACTIVITIES

Knowledge and understanding

1. Describe how soils have influenced the activities of people throughout history.
2. Identify the characteristics of soil that determines its suitability for agriculture.
3. Given that sandy soils are not very fertile, explain why they are good for growing vegetables.
4. State the landuse that clay soils are most suitable for.
5. Explain why loam soils are favoured for cropping.

Applying and analysing

6. Use the 'think, pair, share' strategy to complete the following statements.
   a. 'I used to think soil was just dirt …'
   b. 'Now I think soil is …'
7. Study Table 4.27 and the section 'Not just dirt' Make a list of all the ways your family depends on soil.

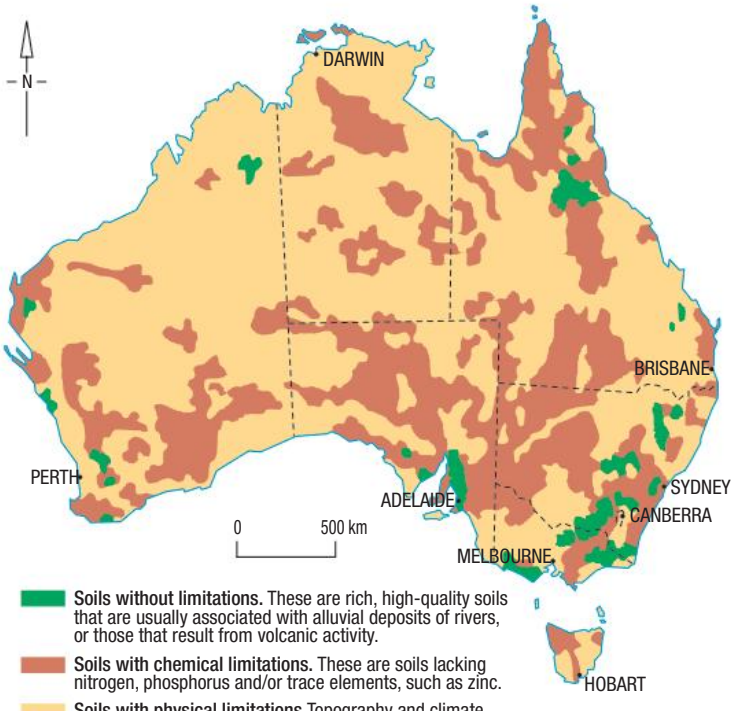
4.9 Australia's soils

Australia is often described as an ancient land because it has been stable over a very long period of geological time. This means that the surface of the continent has been exposed to the processes of weathering and erosion for millions of years. As a result, the continent has one of the world's flattest and most ancient landscapes, with soils that are among the world's oldest and least fertile.

Australia's ancient soils

Australia's soils, shown in Figure 4.29, are ancient because deep chemical weathering and the leaching of the continent's ancient rocks have resulted in the loss of many minerals. When the rocks break down into sediment, the soils that result tend to lack the nutrients needed to support agriculture.

Volcanic activity, which produces new volcanic rock, from which rich volcanic soils are formed, has been largely absent from the continent. The volcanic activity that did occur millions of years ago was mainly concentrated along the eastern edge of the continent. Here it poured out basalt, which formed the basis of the rich basaltic soils found in areas along the length of the Great Dividing Range. The absence of large-scale tectonic mountain building meant that there was little erosion rapid enough to expose and transform bedrock into sediment.



4.29 Australian soils. Only 6 per cent of Australia's soils are suitable for agricultural industries.

Unlike Europe and North America, which have quite fertile soils, Australia was not covered by an ice sheet during the Pleistocene Ice Age (that is, 1.8 million to 4000 years ago). Moving ice sheets grind up unweathered rock, transforming it into fertile soil. Ice sheets last covered Australia more than 300 million years ago.

Impacts of European settlement

The European settlers found the soils of Australia difficult to manage. Their knowledge of agriculture had been gained in temperate lands with deep, productive soils and predictable weather patterns. Their farming practices, which had proved highly effective in Europe, were applied in Australia. The result was the widespread degradation of the land, as shown in Figure 4.30.

Many Australians are just beginning to realise that the degradation of their life-supporting resources of soil and water has reached a crisis point. Government authorities and community-based groups, such as Landcare and Greening Australia, are tackling the problem of land degradation through the promotion of sustainable landuse practices.

Agricultural potential of Australian soils

The potential of the land to support agriculture depends on the soil type and associated properties, especially its fertility and water-holding capacity. Areas of land with poor soils in the agricultural zone of Australian are generally left uncleared. Agriculture in Australia is supported by a great range of soils.



4.30 The heavily eroded landscape west of Charters Towers, Queensland

The arid and semi-arid expanses of the continent have ancient, very weathered and infertile soils lacking not only nutrients but also organic material and soil moisture. At best this land in northern Australia and the drier western margins of Queensland and New South Wales can only support extensive cattle grazing, as the land cannot carry much stock.

Other soils are younger, deeper and more fertile, especially the alluvial soils found in river valleys, particularly along the east coast. They are used for more intensive forms of agriculture, such as growing vegetables and fodder crops for haymaking, and dairying. The rich red volcanic soils are also very productive. In Queensland they support the growth of peanut crops, as well as sugar cane and tropical fruits.

The red-brown soils (which have a sandy loam topsoil over a clay subsoil) and black cracking clay soils support the wheat-growing regions of Australia, where summer crops such as sorghum, sunflowers and soybeans are also grown. Such soils are also irrigated to grow cotton and rice. The valuable grazing lands of the tablelands that produce fine wool are mainly on red soils that are predominantly sandy and porous.

ACTIVITIES

Knowledge and understanding

1 Explain why Australia's soils are described as being ancient.
2 List the factors that contributed to the antiquity of Australia's soils.
3 Explain the impact European arrival had on Australian soils.
4 Outline what is now being done to address the impact that Europeans had on the land.
5 Identify the properties of soil that are needed to support agriculture.
6 Describe the range of soils that support agriculture in Australia.

Geographical skills

7 Study Figure 4.29. Describe the distribution of Australia's high-quality soils (soils without limitations).

Investigating

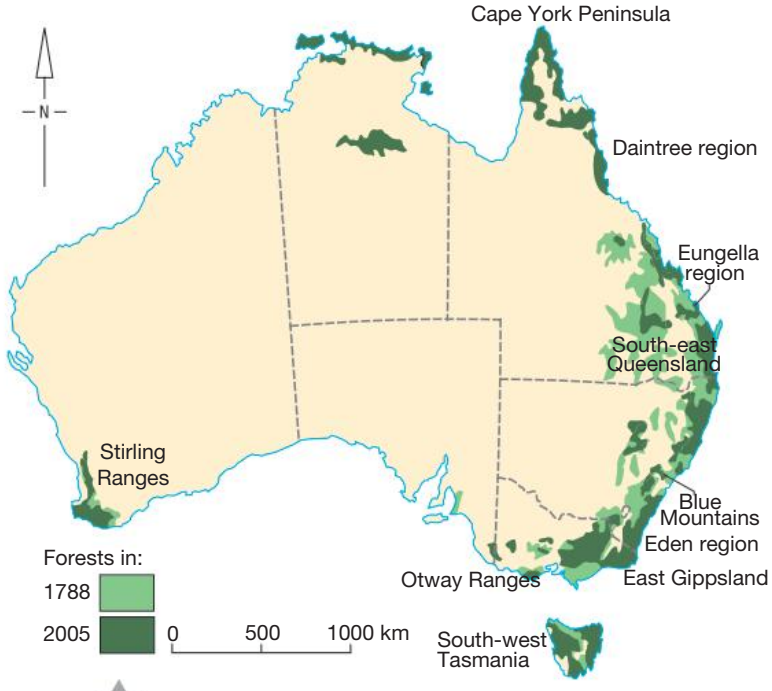
8 Select one of the following organisations involved in improving soils: Landcare or Greening Australia.
   a Investigate the organisation and include the following information in your oral report:
      • when the organisation was established and the main aim of the organisation
      • where in Australia the organisation works
      • with whom the organisation works.
   b Select one program and describe the work of the organisation.
   c Evaluate the work of the organisation.

4.10 Soil erosion

Two centuries of European settlement have taken a heavy toll on Australia's soils. From the very earliest days of European settlement, people have been clearing the land. Clearing the land exposes the soil to the processes of weathering and erosion. Over time, too much of Australia's soil has been either washed or blown away. Careful land management is needed to minimise soil erosion.

Land clearing

When the British first arrived in Australia in 1788, forests covered about 10 per cent of the Australian continent. Woodlands occupied a further 23 per cent. Within 225 years of European settlement, the area covered by eucalypt forests has been halved and the area of rainforest has been reduced by 75 per cent. More than 35 per cent of woodlands have been cleared or severely modified, as shown in Figure 4.31. The forests that remain are disappearing at a rate of 1 per cent each year. In some places, particularly south-east Queensland, the rate of land clearing exceeds that being experienced in the Amazon Basin in South America. Once the native vegetation cover is removed the soil is exposed to the processes of erosion.



4.31 Australia forest cover, 1788 and 2010

Water erosion

Figure 4.32 shows that the most widespread type of land degradation affecting Australia's soils is water erosion. This process involves the removal of soil particles by heavy rainfall or running water. The loss of soil is greatest in places where the vegetation cover is thinnest. Plant roots bind the soil, while leaves protect it from the impact of heavy rain. A layer of humus (leaf matter) helps to absorb rainfall and reduce the run-off that can carry away soil in small rivulets. Any sort of slope makes water erosion more severe, because water flowing downhill has enough force to dislodge more soil particles.

Sheet erosion

Figure 4.33a shows the process of sheet erosion. Sheet erosion occurs if the water moves evenly, stripping soil across a broad front. An example of sheet erosion can be seen in Figure 4.34.

Rill and gully erosion

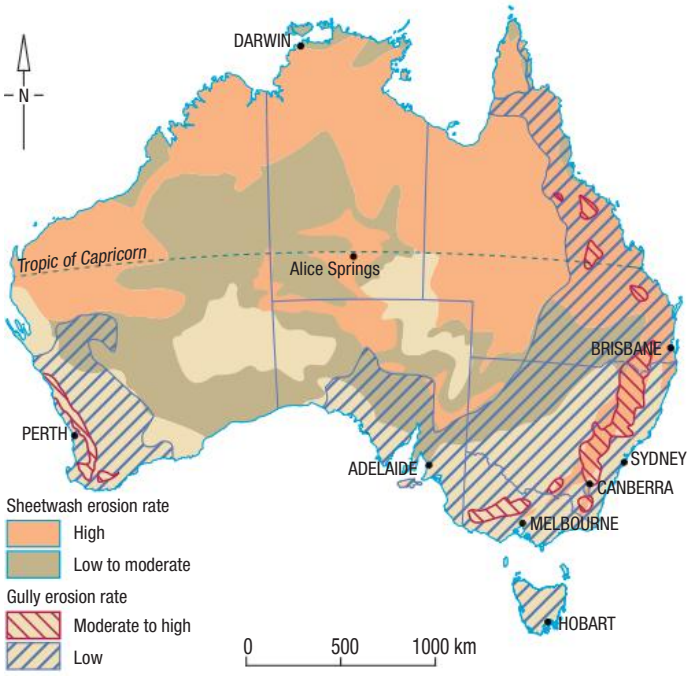
Figure 4.33b shows how rill and gully erosion occur.

- If water flows into channels or rivulets, the soil will be washed away along these lines, forming furrows or rills. This is called rill erosion.
- Sometimes, even larger channels (called gullies) develop. This is called gully erosion.

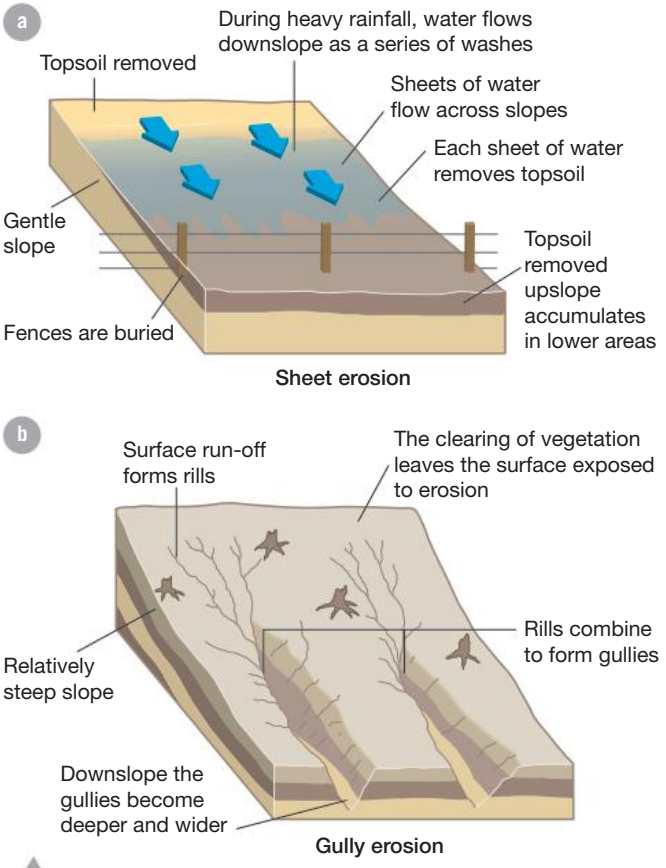
The eroded material will eventually be deposited elsewhere, usually at the bottom of a valley. Some is washed into river systems, where it clogs channels and increases the turbidity (muddiness) of the water. Silt may also build up in dams, shortening their useful life. Eventually, most of the eroded material enters the sea.

DID YOU KNOW?

Between 2000 and 2004, 1.5 million hectares of forest (which includes native and non-native vegetation) were cleared across the continent. After forest regrowth, the total loss was 287 000 hectares.



4.32 Areas of Australia affected by water erosion



4.33 Sheet (a) and gully (b) erosion



4.34 Sheet erosion in a corn field



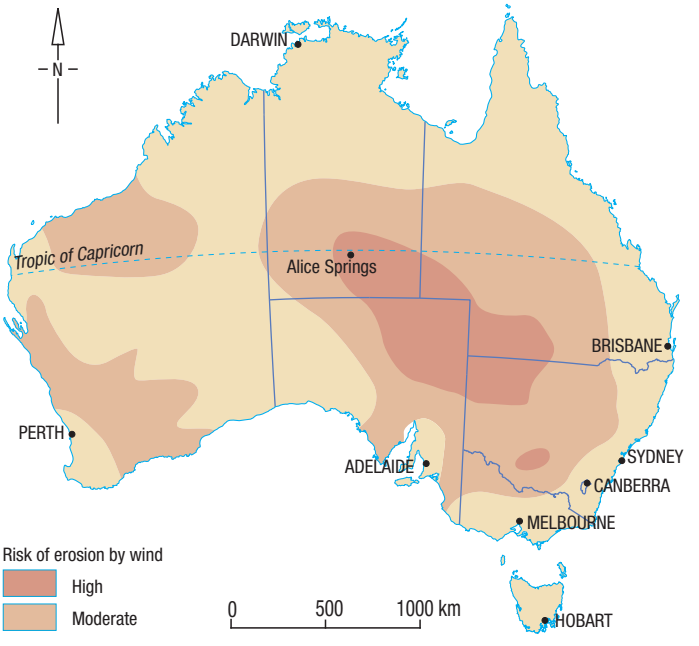
4.35 Approaching dust storm over the road from Melbourne to Geelong, Victoria

Wind erosion

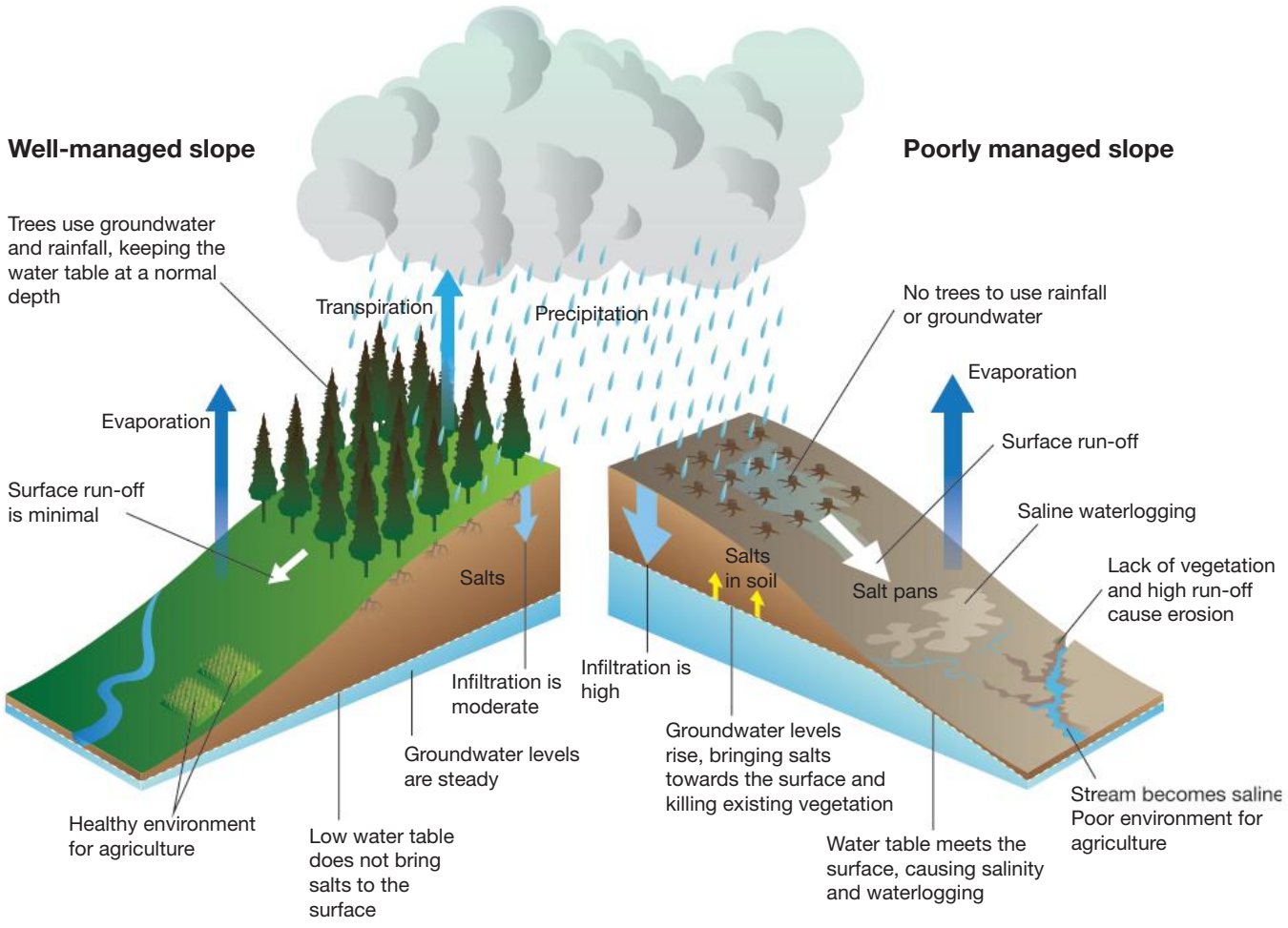
Wind erosion occurs when soil particles are detached from the soil surface and blown away by the wind (see Figure 4.35). The areas of Australia that are most affected by wind erosion are those where soils are sandy and rainfall is low. Figure 4.36 shows the areas of Australia that are affected by wind erosion.

DID YOU KNOW?

Every year, tens of thousands of hectares of Australian bushland are bulldozed, chained or poisoned to prepare land for forestry and agriculture.



4.36 Areas of Australia affected by wind erosion



4.37 Managing a slope to minimise salinity

Reducing soil erosion

Strategies for reducing soil erosion include:

- minimising the length of time that soil is left bare, particularly in areas where strong winds and drought occur
- maintaining plant cover by reducing the amount of stock (animals)
- eliminating pests, such as rabbits, which can strip an area of its vegetation
- building raised areas of soil, called contour banks, across slopes to reduce the movement of water down slopes
- ploughing across, not down, slopes, or avoiding the cultivation of sloping land
- planting trees to form windbreaks.

Land clearing can also result in salinity. Figure 4.37 compares a well-managed slope, on which there is a forest, and a poorly managed slope, from which forest cover has been removed.

ACTIVITIES

4.3

Knowledge and understanding

1. Explain what water erosion is. Where is the problem most severe?
2. Distinguish between sheet, rill and gully erosion.
3. Describe what happens to the eroded material.
4. Explain the causes of wind erosion. Where is the problem most severe?

Applying and analysing

5. Study Figure 4.37. Prepare a brochure for farmers explaining how erosion of a slope can be minimised.

Investigating

6. Investigate land clearing in Australia. Access the websites of the Australian Conservation Foundation and the Wilderness Society. Use the information available on these websites to develop a multimedia presentation highlighting the extent and impacts of land clearing in Australia. Outline the campaigns mounted by these organisations and evaluate their effectiveness. What successes have these organisations had? How do they seek to influence the decision-making processes of governments?

4.11 Innovations in agriculture

Since the very beginnings of agriculture, humans have worked hard to improve the amount of food that could be obtained from the land. Productivity has been improved through the generation and adoption of new methods and technologies. However, the world is now at a critical point in its history. It will need to produce more food for more people than ever before.

Overcoming the limitations on crop yields

The majority of the world's food comes from agriculture—the deliberate cultivation of plant and animal species. Agriculture exploits the processes of growth and reproduction that occur within nature. The amount of food (the yield) that can be obtained from the land depends on the efficiency of these processes. Overcoming any limitations on these processes increases yields.

In Ancient Egypt, irrigation was used to water the crops in a dry land; by 2500 BC an ox-drawn plough was being used to break up the ground for seeds to be planted. When the horse collar was invented in 1000 AD, horsepower came to dominate agriculture in the Western world. The invention of the tractor and the introduction of machinery designed to till the land and harvest the crops greatly improved agricultural output.

Rapid improvements in productivity

The development of new technologies and the growing knowledge base and skills of farmers has resulted in spectacular improvements in productivity over the last fifty years. This progress have been underpinned by three factors: new breeding technologies, the expansion of land under irrigation and the widespread use of agrochemicals.

New breeding technologies

Scientific research into new varieties of crops and breeds of animals uses genetics to shape strains that are more suitable for human needs. New hybrid crops have much higher yields, ripen more quickly during shorter summers and are disease resistant. For example, investments in cocoa research in Nigeria led to the introduction of a hybrid seed and effective control of the pests capsid (an insect) and black pod (a fungus), producing annual returns of more than 40 per cent. Breeding programs using artificial insemination have boosted livestock productivity, with more meat or milk and more offspring.

Expansion of land under irrigation

About 20 per cent of arable land is now irrigated, overcoming the limitation of water shortages. Such land is very productive, providing 40 per cent of global food. It has been especially important in China and India, where the high yields have helped feed their growing populations. In India, the area of crop production under irrigation grew from less than 20 per cent to over 40 per cent between 1961 and 2004. Over that same period, their cereal production rose from 87 to 230 million tonnes.

Widespread use of agrochemicals

The cultivation of modern varieties of crops has necessitated the intensive use of chemical fertilisers to retain nutrient levels in the soil and chemicals to control weeds and pests that damage the crop or compete with it for water and nutrients.

New research

Biotechnology and precision agriculture are emerging technologies that are becoming increasingly important.

Plant biotechnology

In addition to traditional research from agricultural scientists, plant biotechnology research has improved productivity and enabled advances in overcoming environmental limitations such as drought and salinity. Biotechnology includes genetic engineering and the transfer of genes from unrelated plants and micro-organisms to develop crops with desirable traits. While improvements in production have been realised, there is some consumer concern about the effects of genetically modified food.

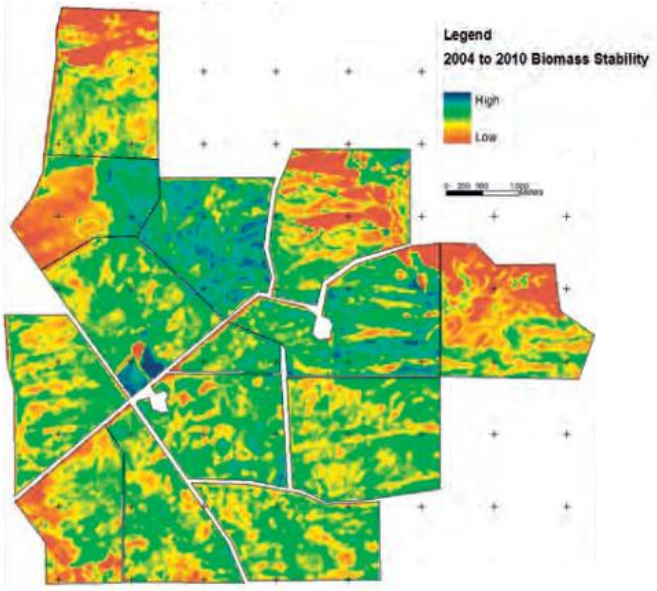
Precision agriculture

Agricultural land is variable and consequently productivity is variable. Farmers have always been aware of this, but without any means of recording or tracking variations, they have been limited in overcoming the issue. The development of precision agriculture, involving

new technologies such as soil sensors, yield monitors, global positioning systems (GPS) and geographical information systems (GIS), has given farmers the sophisticated tools they need to recognise the variations within their paddocks. They are then able to manage the land differently and more efficiently. Figure 4.38 shows an example of the new technologies used in precision agriculture.

Future challenges

Scientific advances have underpinned yield improvements in crops to date but the development and delivery of breakthrough innovations is required to ensure that enough food is produced (see Table 4.39) in the future. Future productivity gains will rely on removing inefficiencies in production and investing heavily in research. Above all, the resource base that supports crops needs to be protected for future production. Ecological sustainability must be a priority.



4.38 After a satellite image of a property is captured, sophisticated GIS tools are used to compare it with yield data and determine the response of the crop to certain treatments.

4.39 Crop technology breakthrough predictions in 2020 and effects on crop production in China

Technology	Expected effects on crop production (percentage of those expecting a breakthrough in the technology)				
	Likelihood of significant technological progress	Increases in yields and efficiency	Allows increase in sown area	Allows increase in cropping intensity	Other effects (e.g. on nutrition or pollution)
Conventional plant breeding	97	49	17	10	24
Genetic engineering	97	43	23	6	28
Precision technology	71	56	11	15	18
Information technology	76	41	8	13	38
For use in water-short areas	97	49	31	10	10
Labour-saving technologies	76	53	16	14	18
For increasing nutrition	82	30	2	2	66
For sustaining productivity	85	54	14	16	16

ACTIVITIES

Knowledge and understanding

1. Outline the early efforts undertaken to overcome the limitations to food production.
2. Explain how innovations in agriculture have lifted productivity in the last 50 years
3. Describe plant biotechnology and precision farming.
4. Identify the growing concern about future global food production and the role innovations will have in addressing this.

Applying and analysing

5. Prepare a T-chart to show the arguments for and against producing genetically modified food.

Investigating

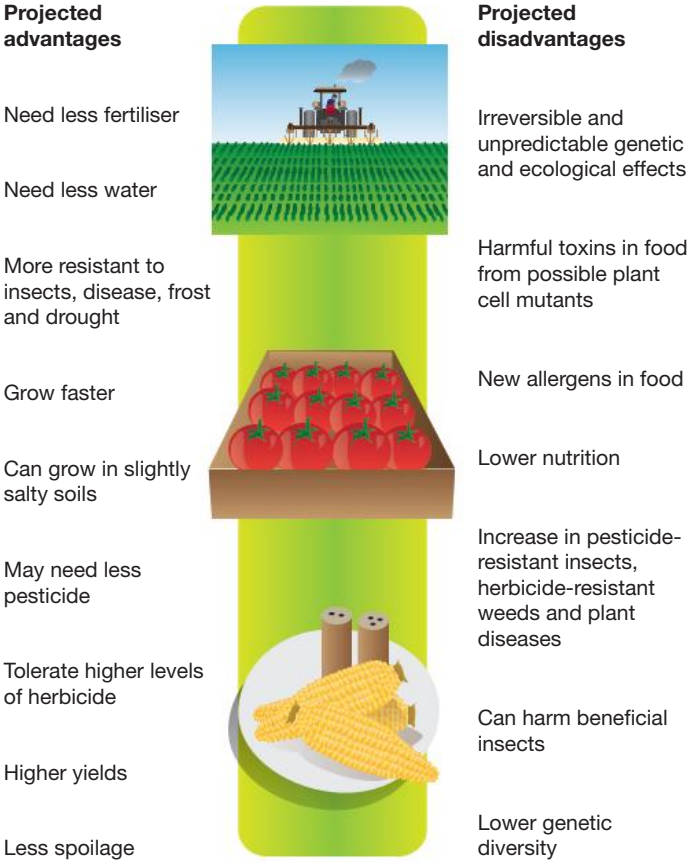
6. Use the internet to investigate the various forms of controlled environment agriculture, including greenhouses, hydroponics, aeroponics and vertical farming. Present your findings on a poster with illustrations and text boxes.
7. Investigate the research into precision agriculture that is being undertaken by the CSIRO in Australia. Present your findings in an oral report.

4.12 Case study: The Gene and Green revolutions

Since the 1950s, there has been an intensification of agriculture. Advances in farming technology have raised the productivity of land in what is often referred to as the Green Revolution. Scientists have developed genetically improved varieties of crops and animals through genetic engineering.

The Gene Revolution

Scientists are using genetic engineering to develop improved strains of crops and animals. This enables a gene with desirable characteristics to be transferred into another species. This technology is advancing rapidly and its supporters believe that genetically modified food has the potential to end global food shortages. However, critics are wary of this new technology and warn that, as yet, the long-term impacts on human health and ecosystems are unknown. The projected advantages and disadvantages of genetically modified crops and food are shown in Figure 4.40.



4.40 Projected advantages and disadvantages of genetically modified crops and food

SPOTLIGHT

Golden rice and edible cotton plants

Genetic engineers used genes from ordinary daffodils and a soil bacterium to produce golden rice. This rice contains beta-carotene, a substance the body can convert to Vitamin A, which prevents blindness and common childhood infections.

Scientists have also genetically altered normally inedible cotton plants (grown in more than 80 countries worldwide) so that their cottonseeds can be ground into flour and made into bread and other foods that could potentially meet the protein requirements of a billion people a year.

Source: G Tyler Miller and S Spoolman, *Environmental Science*, Brooks Cole, Belmont, 2008

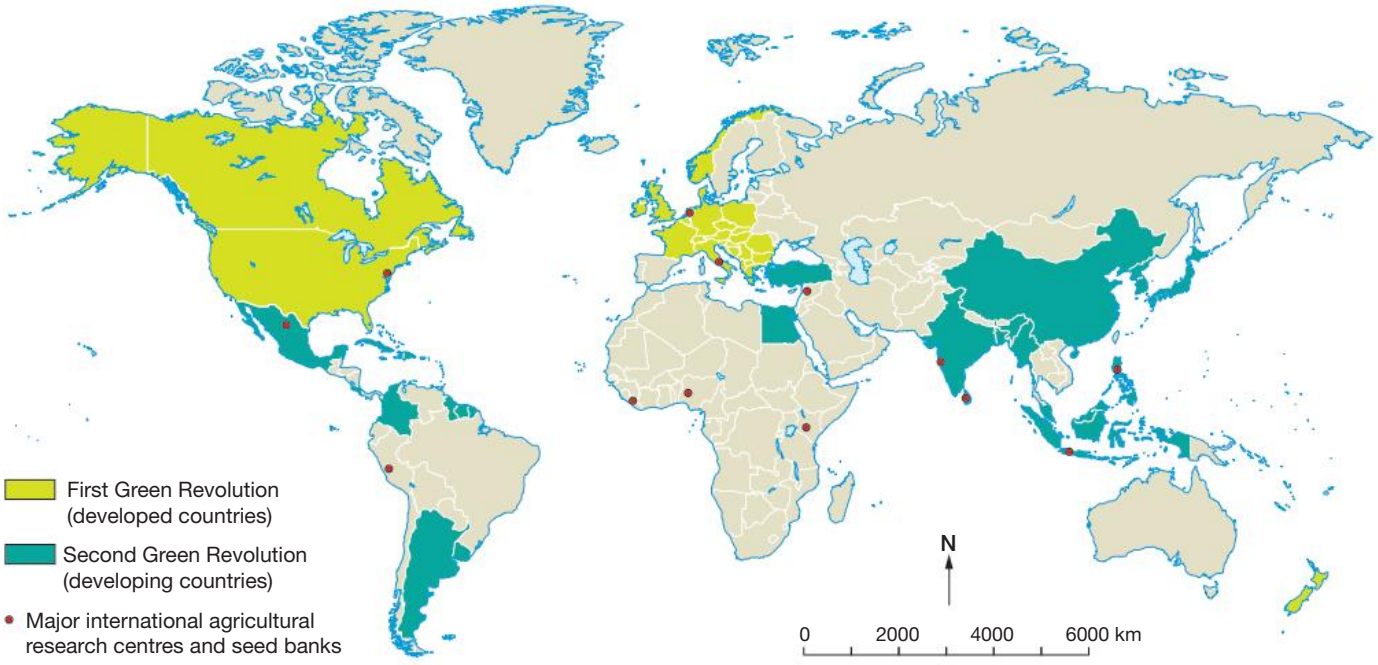
The Green Revolution

The **Green Revolution** in agricultural production began in Mexico in 1943 with US scientists trying to solve Mexico's reliance on imported wheat. Strong winds, heavy rain and associated diseases such as rust had damaged crops and lowered productivity. New varieties of wheat and maize were successfully introduced. Yields of wheat and maize tripled and doubled respectively between 1944 and 1967, with Mexico producing a surplus and subsequently able to export food crops.

The First Green Revolution

Between 1950 and 1970, crop yields in most developed countries increased dramatically. This is shown in Figure 4.41. There were a number of key advances.

- New high-yield varieties of key food crops such as wheat, corn and rice were selectively bred or genetically engineered. Monocultures dominated, with single crops covering large areas of land.



4.41 Countries whose crop yields increased during the First and Second Green Revolutions.

- Large inputs of a range of agrochemicals maintained the high yields.
  - Artificial fertiliser continually provided nutrients to plants.
  - Herbicides removed weeds that otherwise would compete with crops for both water and nutrients in the soil.
  - Pesticides combated insects, which thrive in a monoculture where there is so much for them to eat.
  - Fungicides protected crops from fungal attack when it became humid.
- Irrigation met the water demands of the crops grown or guard against drought.
- Multiple cropping was achieved by increasing the number of crops grown on a plot of land each year.

This high-input industrialised agriculture produced bumper crop yields in developed countries.

The Second Green Revolution

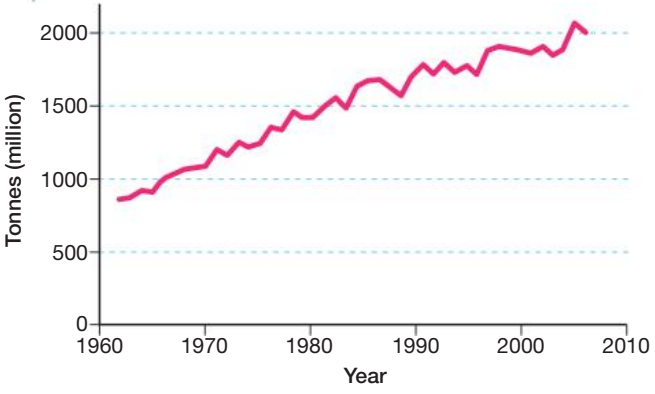
When research first began in Mexico, there was no consideration of the need to transform agriculture in other developing countries. However, when thousands of people died in India during the drought of the mid-1960s, their government started importing seed stock of the high-yielding crops from Mexico in 1967. New varieties of rice and wheat were bred for tropical and subtropical climates and the Second Green Revolution spread to India, China and countries of Central and South America.

The new varieties were dwarf plants with strong, stiff stalks that could hold up larger heads of grain and not fall over. Adding irrigation water, fertilisers and other agrochemicals boosted yields up to five times those of traditional varieties. Having such fast-growing crops meant that multiple cropping was possible, with two or even three crops being grown on the same land in one year.

Impact of the Green Revolution

Global grain production has tripled since 1950, mostly because of the Green Revolution; Figure 4.42 shows grain production since 1960. Both India and China are now mostly self-sufficient in food. The Green Revolution is credited with saving millions of people from hunger and starvation. Unfortunately, it has not spread to Africa, where population growth rates are the highest in the world and food shortages are the most acute. The limitations of poor soils and water shortages, as well as the chaos of civil unrest and war, have limited the adoption of new technologies.

4.42 Global grain production, 1960 to 2010



Changing diets

Increases in grain production are not necessarily feeding more people, either. As incomes grow, people tend to include more meat in their diet. As production intensifies, grain is fed to livestock rather than to people. Grains are also being used as biofuels for cars.

Environmental impacts

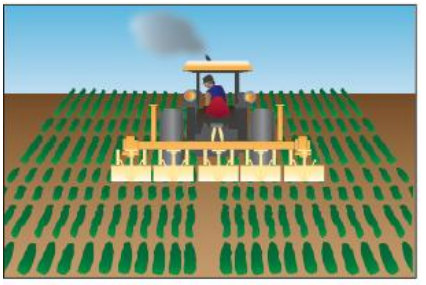
The problem with intensive farming methods is the damage that can occur to the environment. The impacts of farming are shown in Figure 4.43. Boosting and maintaining high levels of production are heavily dependent upon the use of artificial fertilisers and other agrochemicals, which can accumulate within the soil and disrupt natural processes. They can also have adverse impacts on the wellbeing of people living in the area.

Fertiliser use has tripled since the 1960s and it continues to rise. The over-application of fertilisers (mostly nitrates and phosphates), in excess of what is taken up by the crops, leads to nutrient-rich water washing into waterways with irrigation water or following rain. Here the fertilisers encourage algae growth, limiting the survival of other aquatic species.

The use of agrochemicals can have serious implications when residues enter soils or waterways. The increasing concentration of dangerous chemicals such as DDT and PCBs in the tissues of organisms at successively higher levels of the food chain can damage human health. Fish deaths have occurred in Asian waterways, denying the people an important source of protein in their diet.

The increases in agricultural output that have been achieved by the Green Revolution have relied on the use of fossil fuels in making and applying the fertiliser and agrochemicals, pumping the irrigation water and running machinery such as tractors. Industrial agriculture has become addicted to oil.

4.43 Major environmental impacts of food production



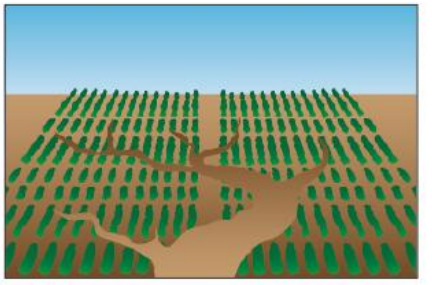
Biodiversity loss

Loss and degradation of habitat from clearing grasslands and forests, and draining wetlands

Fish deaths from pesticide run-off

Killing of wild predators to protect livestock

Loss of genetic diversity from replacing thousands of wild crop strains with a few monoculture strains



Soil

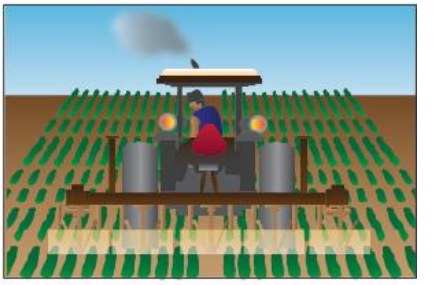
Erosion

Loss of fertility

Salinisation

Waterlogging

Desertification



Air pollution

Greenhouse gas emissions from fossil fuel use

Other air pollutants from fossil fuel use

Pollution from pesticide sprays



Water

Water waste

Aquifer depletion

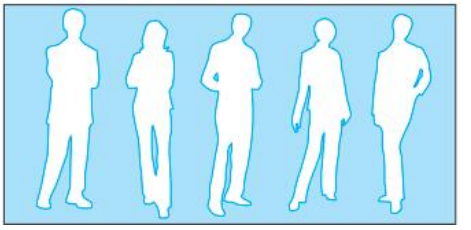
Increased run-off and flooding from land cleared to grow crops

Sediment pollution from erosion

Fish deaths from pesticide run-off

Surface and groundwater pollution from pesticides and fertillisers

Overfarming of lakes and slow-moving rivers from run-off of nitrates and phosphates from fertilisers, livestock wastes, and food-processing wastes



Human health

Nitrates in drinking water

Pesticide residues in drinking water, food and air

Contamination of drinking and swimming water with disease organisms from livestock wastes

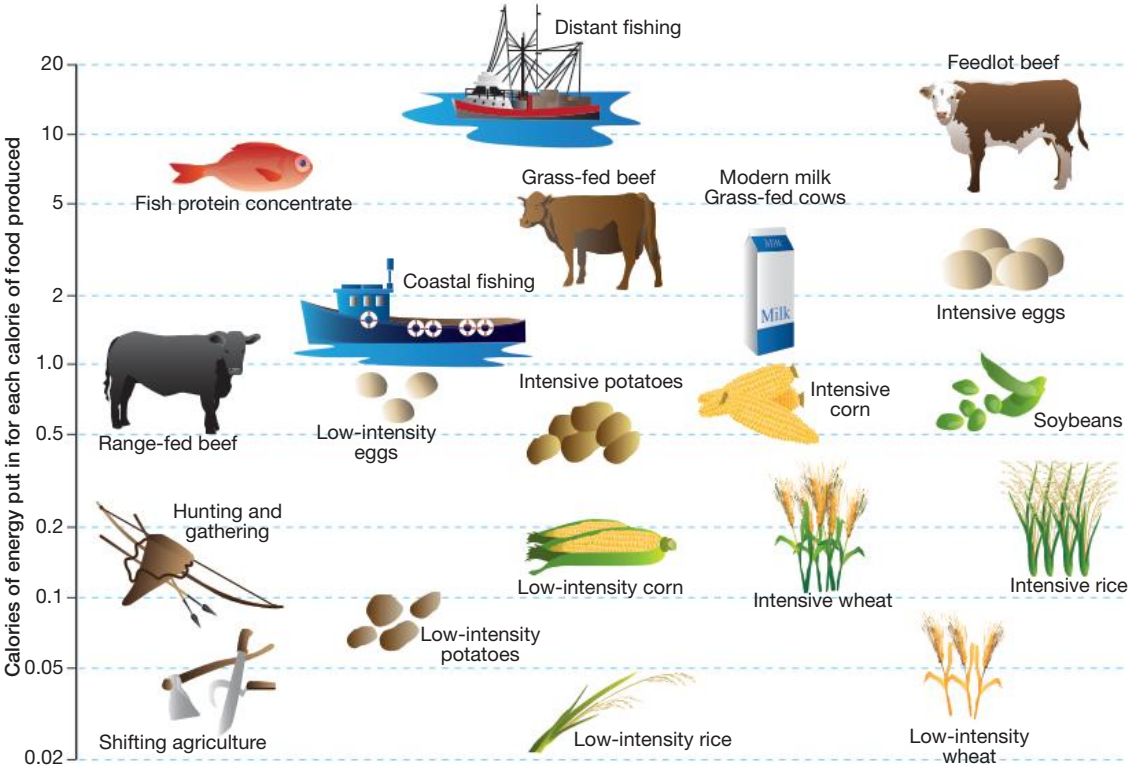
Bacterial contamination of meat

Social impacts

The Green Revolution gave many countries an improved level of food security and helped lift large numbers of people out of poverty. However, it also increased inequalities in many countries, as not all farmers could afford all the necessary inputs. In India, farmers with less than one hectare of land have become poorer, while those with larger holdings have usually become richer.

The way forward

Figure 4.44 illustrates the amount of energy required to produce a range of food products. Agricultural research will be important in further increasing production to meet the growth in demand for food in developing countries. By building on the strengths of the Green and the Gene revolutions, while seeking to avoid their weaknesses, progress may be made in achieving sustainable global food security.



4.44 The amount of energy needed in food production varies with the intensity of landuse.

ACTIVITIES

Knowledge and understanding

1 Outline the key advances of the first Green Revolution.
2 Describe the Second Green Revolution in agriculture.
3 Explain why the Green Revolution has not benefited all farmers in developing countries.
4 Describe recent advances in the Gene Revolution.

Geographical skills

5 Study Figure 4.41. With the aid of an atlas, identify the countries where the First and Second Green revolutions occurred and where the major international agricultural research centres and seed banks are located.
6 Study Figure 4.44 and describe and account for the calories of energy put into range-fed beef and feedlot beef.

Applying and analysing

7 Complete the following table with arguments for and against the following statement.

Genetically modified food is 'Frankenfood' and should be banned.
Hint: 'Frankenfood' is a reference to the monster created by the fictional character Victor Frankenstein.

For banning GM foods	Against banning GM foods

8 Write an extended response on the following topic: The intensification of agriculture has been of great benefit to the world.

Investigating

9 Investigate the scientific advances that led to the Green Revolution with reference to Norman Borlag; the International Maize and Wheat Improvement Centre in Mexico; and the International Rice Research Institute in the Philippines. Prepare a multimedia presentation.

4.13 Economic factors

As soon as agricultural surpluses were produced they became commodities to be exchanged or sold to others who needed them. Today, the trade in crops is big business and it is big business that dominates global food production and distribution. Economic factors are becoming increasingly important in agriculture.

A long history of trade in food

The earliest trade in agricultural produce was bartering, with goods being swapped for mutual benefit. Once the wheel was invented, making transport easier, and as the money economy emerged, trade became more extensive. The grain trade is almost as old as grain production, as maize, rice, wheat and barley flowed into ancient civilisations in Mexico, China and the Near East.

Expansion of trade

The age of exploration and colonialism brought a massive expansion of trade as European powers spread their interests into Africa, the Americas, Asia and even Australia. The colonies were exploited for desirable food and fibre crops to feed the people of Europe. Crops such as tea (see Figure 4.45), coffee, cocoa, spices and sugar could only be grown in the warmer tropical climates found in the colonies.

4.45 Commercial tea production has been carried out for centuries in India.



Economic costs of production

Unless there is a demand for a crop, it will not be grown. There are many economic factors that determine the success of any farming venture. These include land value, the costs of inputs such as agrochemicals, commodity prices and the charges for transporting the crop to market.

Modern commercial farms are run as business enterprises and the costs of production are balanced against the return from crop sales. Profitability relies on the efficiency of the enterprise and the yields gained. The technology available to promote 'precision agriculture' is enabling farmers to maximise their returns. For example, investing in tractors that have auto-steer technology guided by GPS has several advantages.

- The paddocks can be worked 24 hours a day, rather than having to stop when it gets dark.
- Every section of a paddock is brought into production. Not a square centimetre is missed.
- There are no overlapping runs by the tractor, which means that when fertiliser or herbicide is applied, there is no doubling up or wastage.
- The farmer can sit in air-conditioned comfort, watching a DVD, rather than enduring the open, hot, dusty cabins of old.

The growing dominance of agribusinesses

Modern food production is characterised by large-scale, industrialised food production systems that are owned by multinational corporations. The scale of operations of agribusinesses has grown and their involvement in food production and distribution has spread all around the world. In their attempts to increase crop yields, they have funded research and development and are responsible for many of the advances made in crop breeding and biotechnology. Similarly, they have invested in the heavy use of agrochemicals to obtain the desired yields of industrial agriculture.

ABCD OF FOOD—HOW THE MULTINATIONALS DOMINATE TRADE

Wherever you live, you can't avoid the four global giants

The ABCD group of ADM, Bunge, Cargill and (Louis) Dreyfus, account for between 75 per cent and 90 per cent of the global grain trade.

By mid-morning snack you will certainly have encountered their products several times already wherever you are in the world, whether it is the corn in your flakes, the wheat in your bread, the orange in your juice, the sugar in your jam, the chocolate on your biscuit, the coffee in your cup. By the end of the day, if you've eaten beef, chicken or pork, consumed anything containing salt, gums, starches, gluten, sweeteners, or fats, or bought a ready meal or a takeaway, they will have shaped your consumption even further.

This extraordinary concentration of power and money in the global food trade has been identified by Oxfam in a new report as one of the structural flaws of the system. At each stage a handful of players dominate, not just in primary agriculture but in food manufacturing and retailing. The result, according to Oxfam, is that 'they extract much of the value along the chain, while costs and risks cascade down on to the weakest participants, generally the farmers and labourers at the bottom'.

Oxfam is the latest in a long line of critics to highlight this corporate concentration as a root cause of hunger and poverty. The ABCD group have said they welcome informed debate but that, as far as they are concerned, their operations are the vital waters that keep food and its finance flowing from those who can grow it to those who need to consume it. Scale enables them to be highly efficient. The grain trade is capital intensive; they invest heavily in storage facilities and port and transport infrastructure.

US-based Cargill with the highest revenues is the largest private company in the world. As well as being a leading player in the trading, processing and transporting of the most important agricultural commodities, fertiliser and meats. It produces about half of all McDonald's chicken products across Europe. It sells fats to Unilever.

Cargill, ADM and Bunge are thought to have acquired about 80 per cent of China's soya processing capacity. More recently, Cargill has been moving up the food chain into high-value, hi-tech additives and what it calls food solutions for the manufacturing industry.

To add to the concentration, Cargill, ADM, and Bunge have strategic alliances and joint ventures with the seed and agrochemical companies that dominate the agricultural inputs part of the global food system. Four firms, Monsanto, Dupont, Syngenta and Limagrain, account for over 50 per cent of global seed sales. In agrochemicals, six firms, DuPont, Monsanto, Syngenta, Dow and the two German chemical giants Bayer and BASF, control 75 per cent of the market.

Source: Felicity Lawrence, *The Guardian*, 3 June 2011

ACTIVITIES

Knowledge and understanding

1 Outline the history of the global food trade.
2 Explain why economic factors are important to farming.

Applying and analysing

3 Read the newspaper extract above then do the following tasks.
   a Identify the four multinationals that dominate global food trade.
   b How much of the global grain trade do they account for?
   c Outline Oxfam's concerns.
   d How did the ABCD group explain the role they play in providing food for consumers?
   e Explain how strategic alliances add to the concentration of control.
4 Prepare an extended response on the following topic: Agribusinesses have too much control over global food production and distribution.

4.14 Case study: Simplot

J R Simplot Company, commonly referred to as Simplot, is a US company that produces many of the processed foods that can be found in Australian supermarkets. Iconic Australian brands such as Edgell and Birds Eye were acquired by the company when it expanded its operations to Australia. They have become part of a highly diversified global food company.

Start of an empire

The Simplot Company had its beginnings as a one-man farming operation undertaken by J R Jack Simplot in 1925 in a little farming community in Boise, Idaho (an American state famous for its potatoes).

He fed pigs, an army and a nation

When J R Simplot left school at the age of 14 he started a business by renting 16 hectares of land on which he grew potatoes and raised pigs. The J R Simplot Company soon became the largest producer of fresh potatoes in the United States of America and during World War II it provided millions of kilograms of dehydrated potatoes and onions to the US military.

Fertiliser was needed to maintain the high levels of production, but it was difficult to obtain because of wartime shortages. J R Simplot responded by building his own fertiliser manufacturing plant. This marked the kind of entrepreneurship and innovation that was to take the company in many new directions.

Invention of frozen french fries

In the late 1940s, the J R Simplot Company created and marketed the first viable commercial frozen french fries in the world. It became the exclusive supplier of fries to McDonalds and the business relationship has continued to this day.

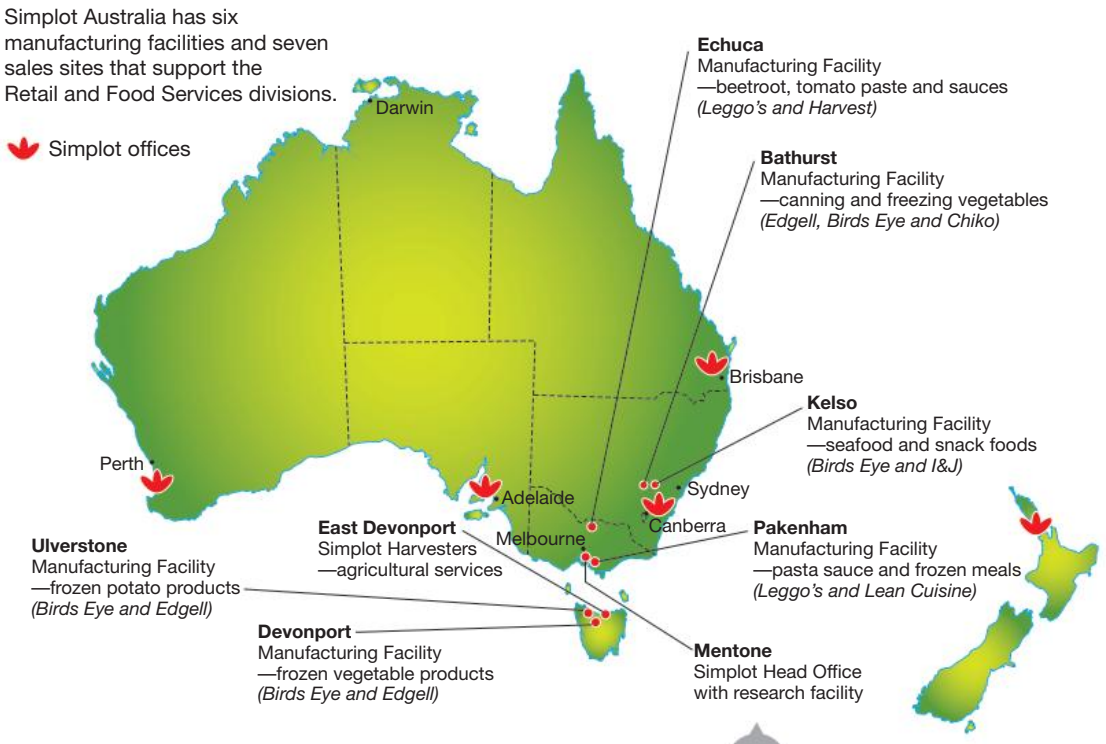
Expansion of the company

The J R Simplot Company has grown through the process of vertical integration. Vertical integration involves the expansion of a business forwards or backwards in the production process. Establishing the fertiliser factory was an example of this process.

The next step was to find a use for the potato peelings and by-products that were being generated by all the processing plants making fries. J R Simplot decided they would make excellent cattle feed. This led to the establishment of cattle feedlots, producing beef.



4.46 Products of the J R Simplot Company



A$1.6 billion turnover p.a.

2440 employees

373 farmers

1182 food products

125 000 tonnes of frozen chips produced p.a.

8000 hectares of farmland under cultivation

28 000 tonnes of seafood purchased p.a.

4.47 Operations of Simplot Australia

With steak and fries already on the dinner plate, the company then diversified its business to include all kinds of fruit and vegetables, as well as seafood (see Figure 4.46). It also expanded its operations overseas. For example, I&J is a familiar brand of frozen fish produce sold in Australia. It had its beginnings in South Africa in 1910, when George Irvin and Carl Johnson pioneered trawl fishing in the waters off Cape Town. It is now part of the J R Simplot Company. Today, fish are caught, processed and frozen at sea and exported.

The J R Simplot Company now has major operations in the United States of America, Canada, Mexico, China, Australia and New Zealand, and it exports to more than 40 countries worldwide. Its annual sales now exceed $US5 billion.

SPOTLIGHT

Simplot Australia

Simplot Australia was founded in 1995 when the J R Simplot Company acquired a number of well-known Australian brands, such as Edgell, Birds Eye, Harvest, Chiko and Leggo's. The company has since expanded, acquiring the John West brand, licensing the Lean Cuisine brand and undertaking joint partnerships with I&J and Quorn. The J R Simplot Company has retained these brand names, as they enjoy a lot of brand loyalty and their histories extend more than 100 years.

ACTIVITIES

Knowledge and understanding

1 Describe the early history of the J R Simplot Company.
2 Explain how the company used vertical integration to expand its operations.
3 Demonstrate how its operations have become multinational.

Applying and analysing

4 Study Figure 4.46 then do the following tasks.
  a Identify the oldest brand that is now part of Simplot Australia.
  b Identify the two newest brand names. Investigate what products they carry under these names and why the company has chosen to market them.
  c Assess the role of Simplot Australia in Australia's economy. Validate your assessment with the use of statistics.
  d Why are its operations concentrated in the eastern states?

Investigating

5 Visit the J R Simplot website and, with reference to Figure 4.47, provide an annotated visual display of the operations of this company, in particular the size and diversity of its operations.
6 Investigate the research undertaken by the J R Simplot Company into improving agricultural production.

4.15 Food production in Australia

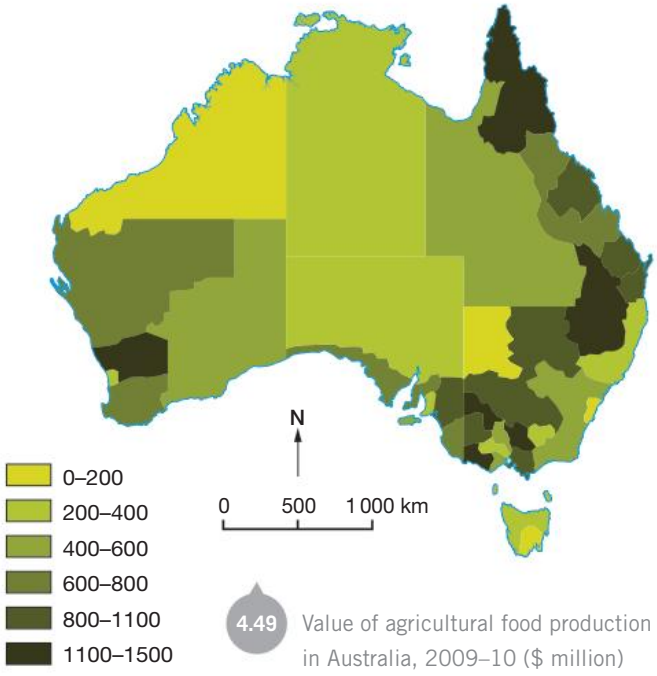
Australia's agricultural industries have undergone significant change in recent decades. Productivity has improved, more than doubling the agricultural output of the nation. However, this growth has been uneven. Some of the most notable trends that have emerged have been in the size of properties and the intensity of landuse.

Where food has been produced

Figure 4.48 shows the value of Australian farm and fisheries production since 1995. Their growth has been uneven. The value of agricultural food production in Australia is shown in Figure 4.49. The difference in value between regions is usually a reflection of the quality of the biophysical environment. Constraints such as climate, landforms and soils limit which landuses can be undertaken and also determine the yields gained. The availability of irrigation water has enabled some water-deficit regions to be brought into production.

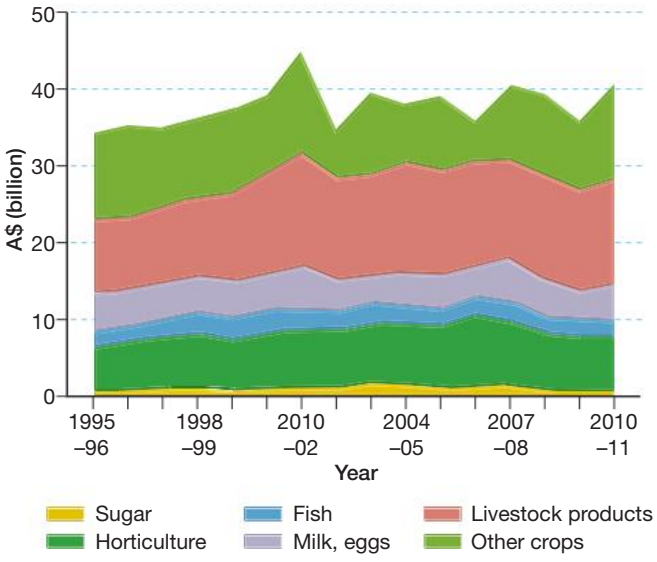
Within Australia, three broad zones of distinctive agriculture can be identified.

- The pastoral zones are in the semi-arid inland and tropical north, where beef cattle are grazed on sparse native pastures. The stocking rates are very low and the properties are huge—some over a million hectares in size.



4.49 Value of agricultural food production in Australia, 2009–10 ($ million)

4.48 Value of Australian farm and fisheries production, 1995–96 to 2010–11



- The high rainfall coastal zone is in a narrow strip of highly productive land along the east coast of the continent, as well as in Tasmania and the south-west corner of Western Australia. Dairying, fruit and vegetables growing are predominant in the south, while sugar cane, tropical fruits and vegetables are important in the north. Beef cattle are also fattened on permanent sown pastures and this land has the highest stocking rates. With such intensive landuse, the properties are small.
- The wheat belt is between the well-watered coast and the arid interior. It produces most of Australia's cereal grain, often in combination with raising livestock. Wheat is grown throughout, with barley and oats and sheep in the south. Further north, where it is warmer, sorghum and oilseeds are also grown, cattle are common and cotton is grown under irrigation.

Drivers of change in food production

In the past, changes occurred as producers grappled with and overcame the challenges associated with water availability and reliability, as well as soil fertility and pests. The adoption of new technologies and farming methods has led to an expansion of agriculture. The volume of food produced has been growing progressively over time, as more land has been brought into production. The key drivers of change in recent decades have been globalisation, changing consumer tastes, technological advances and environmental concerns.

Globalisation

Australian producers operate within a global food market, where they must compete with other countries. Agriculture has become increasingly export-oriented over the last 20 years, with two-thirds of the food produced for export. There has been a shift to a diverse range of processed products; wine and cheese have sold strongly overseas.

Globalisation has also meant that producers face more competition from imported food on the domestic market. Overseas interests can also influence production as large corporations or agribusinesses extend their interests into Australia.

The impact of globalisation can be seen in Western Australia's Ord irrigation scheme in the Kimberley region. A large Chinese conglomerate, Shanghai Zhongfu, won the sole right to develop all the available land in the second-stage expansion of the scheme in 2012. Shanghai Zhongfu is going to turn the region into a new Asian food bowl, growing sugar cane across the entire region. The cane will be processed into sugar and ethanol biofuel for export.

Consumer trends

As food production in Australia is commercially based, meeting consumer expectations of diversity, quality and value is fundamental to profitability. Consumers are increasingly conscious of their health and wellbeing and this affects their food choices.

Technological advances

Experimentation, research and innovation have been used to help overcome limitations to food production and lift productivity. New technologies provide opportunities to convert, intensify or develop new landuses. Computers have moved on from being novelties to commonplace tools on properties.

Environmental concerns

Some of Australia's agricultural lands are fragile and degraded, and careful management is necessary to ensure sustainable food production. There is also uncertainty regarding the impact of global warming, which could affect not only productivity, but also where crops can be grown in the future.

SPOTLIGHT

Ancient grain becomes a modern superfood

It's not often that you can find an obscure product, see its potential and in a few short years become the world's leader in marketing and selling it. West Australian farmer John Foss has revived an ancient, little-known plant grown in Central and South America and turned Australia into the biggest producer of its grain in the world, all within a decade.

Chia is a plant once grown by the Mayan, Aztec and Inca civilisations as early as 3500 BC. It produces seeds about 1 millimetre in diameter, which are high in dietary fibre, omega-3 fatty acids, protein and antioxidants. While its nutritive powers were no secret to the Mayans, Aztecs and Incas, it is only in recent decades that chia has become known to modern civilisation as a 'superfood'.

Source: Peter Hemphill, *Weekly Times*, 2010



4.50 A chia crop looks similar to lavender and produces an oilseed that is highly nutritional.



4.51 New housing encroaches on market gardens in Clyde, near Cranbourne, Victoria.

SPOTLIGHT

The fertile fringe

A substantial proportion of Australia's most fertile farmland now sits within Melbourne's expanded urban growth boundary. It has been argued that the sandy loam soils that produce much of Melburnians' daily greens should be set aside for growing food, not houses. Ongoing sprawl threatens 70 per cent of Victoria's fresh vegetable production, which still occurs in and around Melbourne.

Two of Melbourne's most productive horticultural areas, Werribee on the city's western fringe and the Cranbourne area to the south-east, are now facing mounting pressure from development. From these areas, trucks deliver freshly picked fruits and vegetables such as spinach, celery, leeks and herbs to the distribution centres of the two major supermarkets in the city.

Source: Royce Millar and Melissa Fyfe, *The Age*, Melbourne, 26 May 2012

Current trends in food production

Larger farms

Farms in Australia have typically been run as family businesses and passed on from one generation to the next. However, the impact of new technologies and globalisation has made large farms more economically viable than small ones. The average size of farms has increased and, as a result, the number of farming families has declined. The increase in farm size has been most evident in the grain and cotton industries.

Intensification of landuse

Farmers have used more intensive production techniques, such as the increased use of irrigation, feed and chemicals to produce more food per hectare. This has been common on cotton and poultry farms, and in nurseries and vineyards. Farmers are seeking to improve profitability, particularly as they face increasing international competition.

DID YOU KNOW?

There are approximately 134 000 farm businesses in Australia, 99 per cent of which are family owned and operated. Each Australian farmer produces enough food to feed 600 people—150 at home and 450 overseas. Australian farmers produce almost 93 per cent of Australia's daily domestic food supply.

DID YOU KNOW?

The Murray–Darling Basin produces almost 95 per cent of Australia's orange crop and 54 per cent of apples.

Organic foods

As consumers have become increasingly concerned about the environment and more interested in knowing more about how their food is produced, organic foods have become popular. The basic principle of organic farming is that no agrochemicals are used and that environmental quality is maintained. There are now a substantial number of certified organic producers in Australia across a broad range of industries such as viticulture, meat and horticulture.

Loss of agricultural land to urban areas

Most of the best agricultural land in Australia is found on the coastal fringe, which is also where most of the population growth is occurring. As large cities spill over into the rural areas, their market gardens are buried under new housing subdivisions (see Figure 4.51).

ACTIVITIES

4.4 4.5

Knowledge and understanding

1 Outline the biophysical constraints on food production.
2 Describe the main food production zones in Australia and explain why they differ in productivity.
3 Identify the current trends in food production.

Geographical skills

4 Study Figure 4.48 and answer the following questions.
   a In what year did food production peak?
   b What type of production increased the most over the period shown?
   c What was the value of fisheries production in 2010–11?

Applying and analysing

5 Conduct a class debate on the following topic: The second stage expansion of the Ord River lease should have been given to Australian interests.

Investigating

6 Study Figure 4.49. Identify the high-value production areas of Queensland. Prepare a report on their location, the biophysical environment and the nature of the food production.

CHAPTER

5

FOOD SECURITY



Our wellbeing depends on having access to affordable food. But a complex combination of increasingly unreliable harvests (a consequence of climate change), competition for agricultural lands from biofuels, higher energy prices, the surging demand for food in China and India, and distortions in world trade, are driving food prices up worldwide. Some countries, especially in Africa, are facing an increasingly dire situation, while even consumers in wealthy nations are being forced to make adjustments to their food budgets.

In the future, food shortages have the potential to destabilise governments, ignite street riots and send a new wave of hunger rippling through the world's poorest nations.

The issue of food security to likely dominate the international policy agenda for decades, especially as the world's population heads towards 9 billion.

In this chapter we study the challenges to food production, including land and water degradation, shortage of fresh water, competing landuses, and climate change, for Australia and other areas of the world.

KEY IDEAS

- To develop an awareness and appreciation of the issue of food security
- To understand the threats to food security
- To assess the potential for increasing food production through agricultural expansion and intensification

GLOSSARY

acidification	the build-up of hydrogen in soil, which reduces the soil pH
algal bloom	a high concentration of microscopic aquatic plant life
biodiversity	the variety of all life forms—plants, animals and micro-organisms, the genes they contain, the ecosystems of which they form a part and the processes that link them
biofuel	a solid, liquid or gas fuel derived from biological material
cash cropping	the growing of agricultural crops for sale and profit
degradation	the act or process of degrading soils and their productive capacity
desertification	the expansion of deserts due to overgrazing, soil erosion, climate change or prolonged drought
diversification	the re-allocation of some of a farm's productive resources, such as land, capital, farm equipment and paid labour, into new crops or livestock products
mixed farming	agricultural practices that mix arable farming with the raising of livestock or growing two or more diverse crops on the same piece of land
monoculture	the cultivation of a single crop on a farm
soil compaction	the process in which a weight applied to a soil causes air to be displaced from the pores between the soil particles

5.0 Drying the argan, Morocco

5.1 Threats to global food security

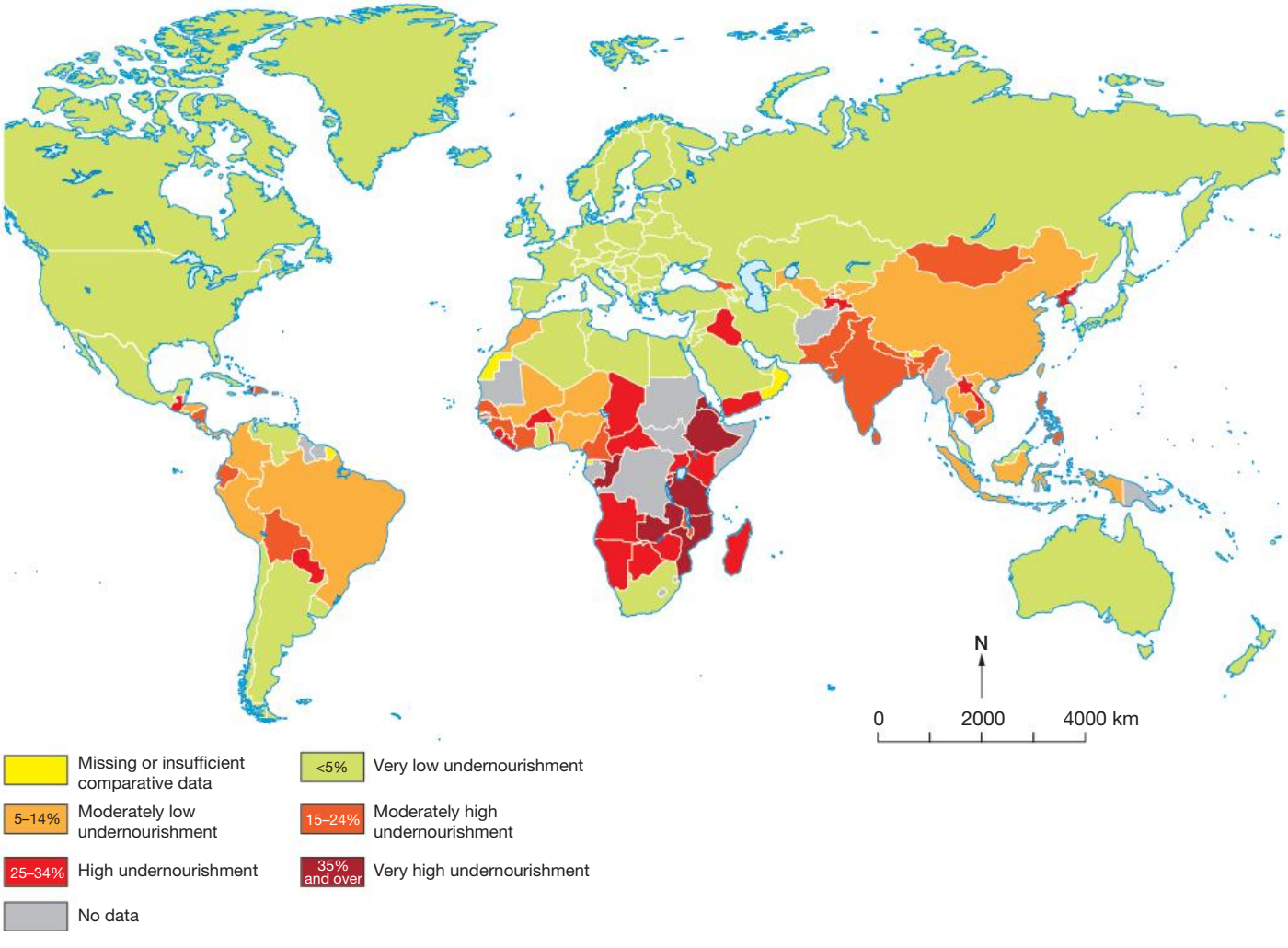
The prospect of global food shortages, famine and conflict over food is looming. Population growth, rising incomes and changing consumptions patterns are all driving up the demand for food. At the same time, food production is increasingly being constrained by the loss of arable land, shortages of fresh water, environmental degradation and climate change.

Food security

The UN's Food and Agriculture Organisation (FAO) notes that food security is achieved when all people at all times have physical and economic access to sufficient, safe, nutritious food to meet dietary needs and food preferences for a healthy and active life.

Enough food is currently produced to adequately feed all of the world's people, yet one billion are undernourished (see Figure 5.1 and Table 5.2). It is the desperately poor who are going hungry because they lack the means to acquire even the bare minimum of food. The desperately poor usually spend up to 80 per cent of their household budgets on food.

5.1 World Hunger Map 2012, showing the proportion of the global population who are undernourished



5.2 Countries containing the highest percentage of undernourished people as a percentage of their total population in 2010–12

Rank	Country	Percentage of total population of country
	Global	13
1	Burundi	73
2	Comoros	70
3	Eritrea	65
4	Zambia	47
5	Haiti	45
6	Ethiopia	40
7	Mozambique	39
7	Sudan	39
7	Tanzania	39
8	Timor Leste	38
9	Congo	37
10	Uganda	35

Food shortages

When food shortages occur, it is the poor who suffer the most. This was evident when the prices for staple grains soared in 2008 as people and governments panicked because the global stockpile had shrunk. Public unrest and riots spread across the developing world and 1.5 billion people were put at risk by the food crisis. Violent food riots broke out in some thirty countries throughout the world in 2007–08, including India, Peru, Morocco, Egypt and Bangladesh. Figure 5.3 shows a scene from food riots in Haiti.

While the situation has eased, there are grave concerns that more food shortages are inevitable. This would cause instability and major disruptions in many countries and there could well be a humanitarian catastrophe across some of the poorest regions of the world. When food shortages resulted in famines in the 1960s, the Green Revolution delivered the big surge in food production needed to lift crop yields. This has now largely fizzled out. The issue of food security has become more complex. There are now multiple threats that tend to amplify each other and compound the problem.

5.3 Food riots in Haiti, 2008



Increasing demand for food

A combination of population growth and higher consumer expectations means that the global requirement for food by 2050 will be 70 to 100 per cent greater than it is today .

Population growth

While the rate of growth of human numbers is slowing, about 100 million people are still being added to the world's population each year. This upward trend is expected to result in the global population reaching 9.1 billion in 2050. Every year there are simply more mouths to feed.

Changing consumption patterns

As people move out of poverty, they improve their diets by eating different foods, particularly those that are rich in protein, such as meat, milk and eggs. Livestock are being fed vast quantities of corn, wheat, soybeans and barley, which are no longer then available as grain foods. As these grains are converted into meat, they lose as much as 95 per cent of their kilojoule value.

Limitations on food production

Population and demand for food are together rising at about 2 per cent a year, whereas food output is now increasing at only about 1 per cent a year. There are a number of potential threats that could prevent food production from rising as much as needed to achieve global food security.

Crop yields

Although total yields for grain crops continue to increase on a global basis, there has been a disturbing slide in the yield advances being made. This has been detected in many of the major cereal crops, such as corn, wheat and rice. Where yields were once rising by 5–10 per cent each year with the sharing of the skills and technologies of the Green Revolution, they have now dwindled to only 1 per cent a year, as shown in Figure 5.4.

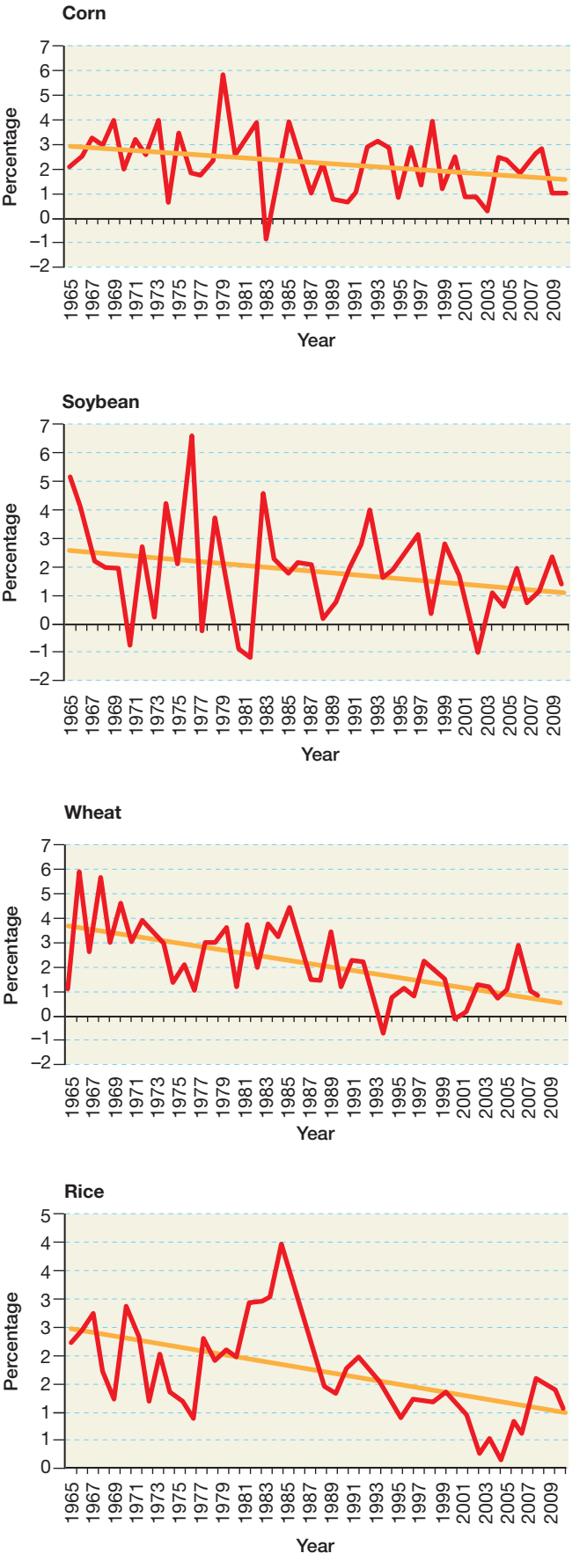
Shortages of fresh water

Water is crucial to food production and some of the most intensive food emergencies have been associated with severe water shortages. The increasing overuse of both surface and groundwater supplies, and declining water quality, are threatening the availability of fresh water. Dwindling supplies will affect agriculture and put at risk the world's food supply.

Competing uses of the land

As large amounts of cereal grains are being used to feed livestock and to produce **biofuels**, land is diverted away from food production. Similarly, arable land is being lost as cities expand outwards.

5.4 Global crop yield change, 1965 to 2009



Globalisation

Food has become a commodity and the profit motive now dominates global food production, as huge agribusinesses have taken control of all aspects of food production. The physical resource base that supports agriculture is being put at risk by this industrial agriculture. Farmers are getting lower returns for their produce, as they are locked into supplying the big corporations. International trade in food products has also soared and many poorer countries are disadvantaged by trade restrictions.

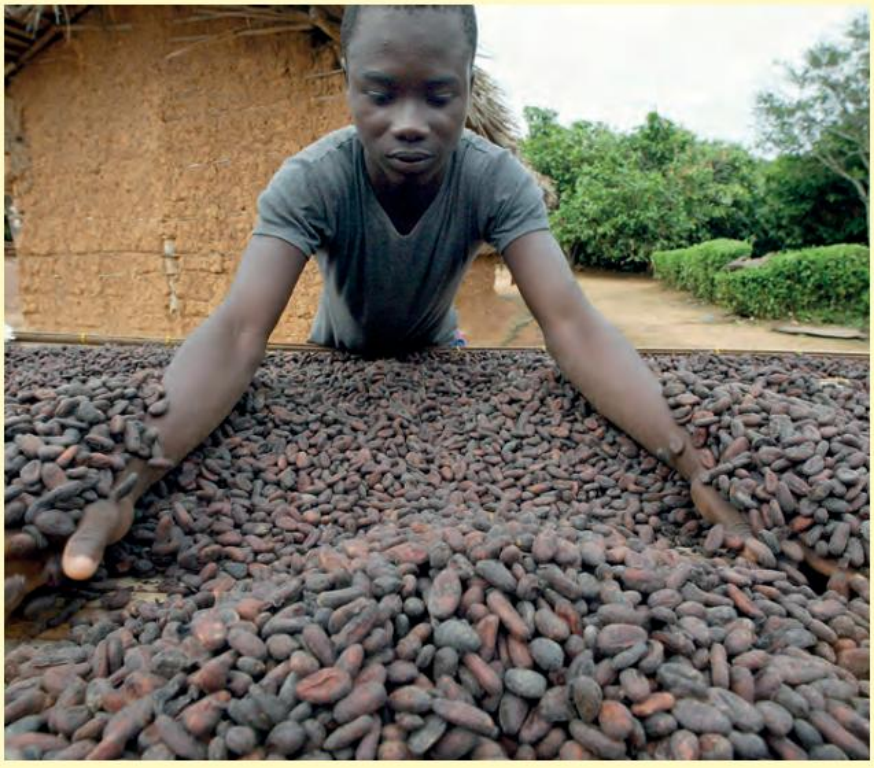
Climate change

Climate change will add to the existing and substantial pressures on global food security. Higher temperatures, shifting rainfall patterns and more frequent, extreme weather events may change the environment that crops and animals have to grow in.

SPOTLIGHT

The chocolate industry may be melting

More than half of the world's chocolate comes from cocoa produced by smallholders in Ghana and the Côte d'Ivoire. Research undertaken by the Centre for Tropical Agriculture predicted a 1°C temperature rise by 2030, increasing to 2.3°C by 2050. Such an increase could be catastrophic for this heat-sensitive crop. A rise in temperature of this extent is enough to inhibit the growth of cocoa pods. This would send yields crashing, depleting supplies of cocoa and causing prices to soar.



5.5 Cocoa production, Ghana

ACTIVITIES

5.1

Knowledge and understanding

1 Define the term 'food security'.
2 Describe what happened in 2008 when food shortages occurred.
3 Explain why the demand for food is increasing.
4 Outline the threats to food production.

Applying and analysing

5 Working in pairs, consider the following statement and then share your thoughts with the rest of the class: Poverty pushes population growth, however its elimination impairs food availability.
6 To what extent do you agree with the following statement?
'Improvements in technology will ensure global food security in the future.'
Discuss.

Geographical skills

7 Study Table 5.2 and construct a column graph showing the percentage of undernourished people for the countries represented.
8 Study Figure 5.4 then answer the following questions.
   a What two crops have had the most notable deceleration in crop yield improvements?
   b What crop has experienced the most volatile changes in crop yield improvements?

5.2 Land and water degradation

Land and water degradation result in valuable agricultural land being lost from production due to human activity. They have the potential to affect food security as the world struggles to feed its growing population. The cost of land and water degradation continues to mount, both in terms of lost production and the cost associated with trying to undo the damage caused by past land-management practices.

Land degradation

One-quarter of the earth's lands are highly degraded. Another 8 per cent are moderately degraded, 36 per cent are stable or slightly degraded and 10 per cent are ranked as 'improving'. The remaining shares of the earth's land surface are either bare (around 18 per cent) or covered by inland water bodies (around 2 per cent). The extent of land degradation is shown in Figure 5.6.

Land (or soil) **degradation** is any change in the land that reduces its existing or potential productivity. It occurs wherever the natural balance in the landscape is changed by human activity, through misuse or overuse. It is the result of using land beyond its capability.

The United Nations estimates that 1.5 billion people—one-quarter of the world's population—depend directly on land that is being degraded.

The causes of land degradation are environmental and economic.

Environmental causes, shown in Figure 5.7, include:

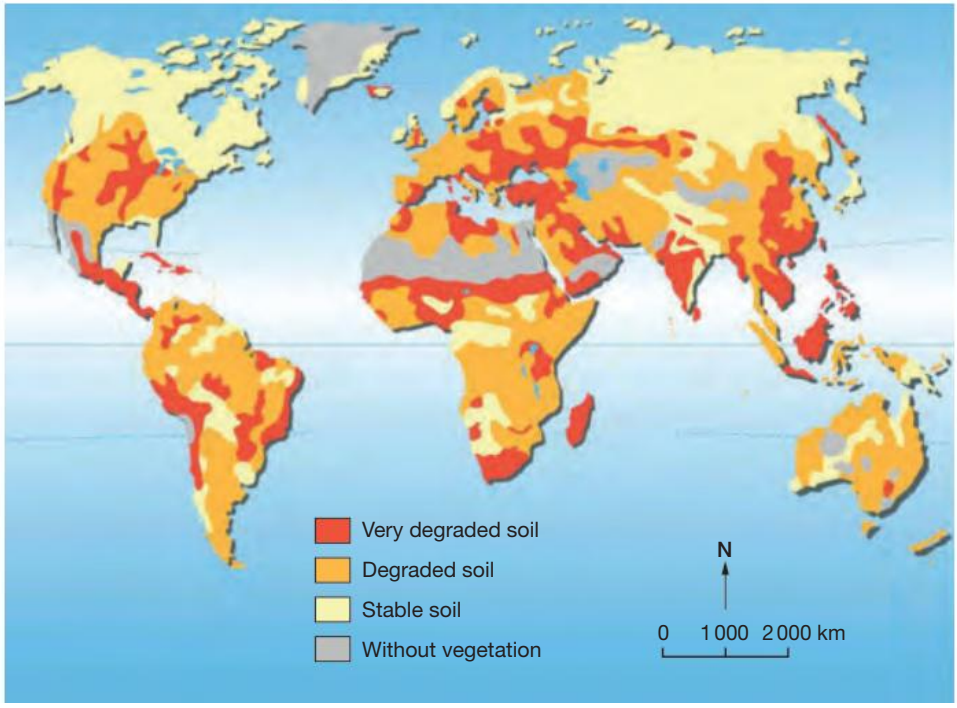
- overgrazing of livestock, especially in times of drought
- deforestation (removal of trees for industry or farming)
- land clearance (fuelwood collection)
- agricultural practices
  - reduction in soil nutrients through poor farming practices
  - excessive irrigation, resulting in salinity
  - **soil compaction** by animals and vehicles
  - exposure of soil to wind and water erosion during cultivation
- bio-industrial activities (soil contamination by toxic substances such as pesticides and heavy metals).

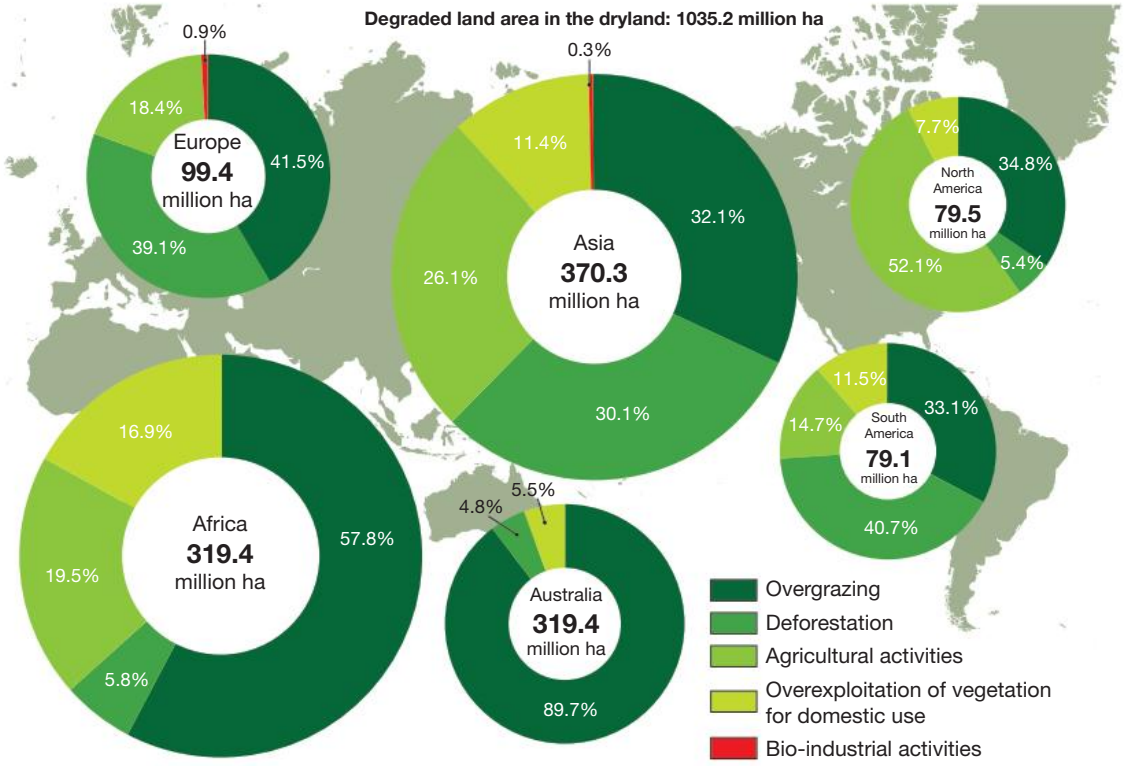
Economic causes include:

- poverty (forcing people to abandon more sustainable landuse practices, as is illustrated in Figure 5.8)
- urban sprawl.

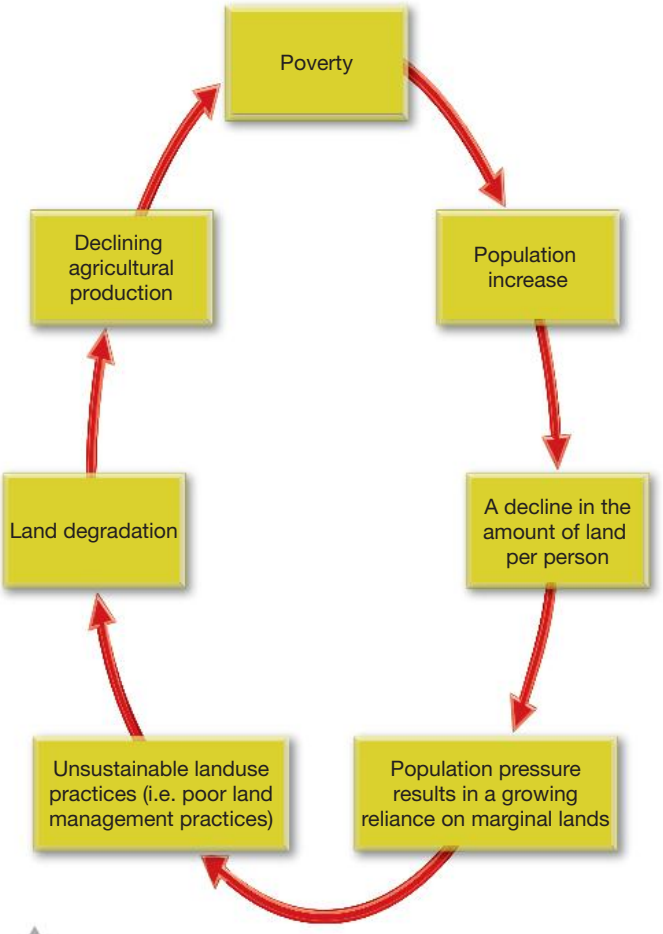
Land degradation leads to reduced productivity, forced migration (environmental refugees), food insecurity, damage to basic resources and ecosystems, and loss of **biodiversity** through changes to habitats. Figure 5.9, which shows the trends in land degradation around the world, indicates that only 18 per cent of land is improving.

5.6 Soil degradation

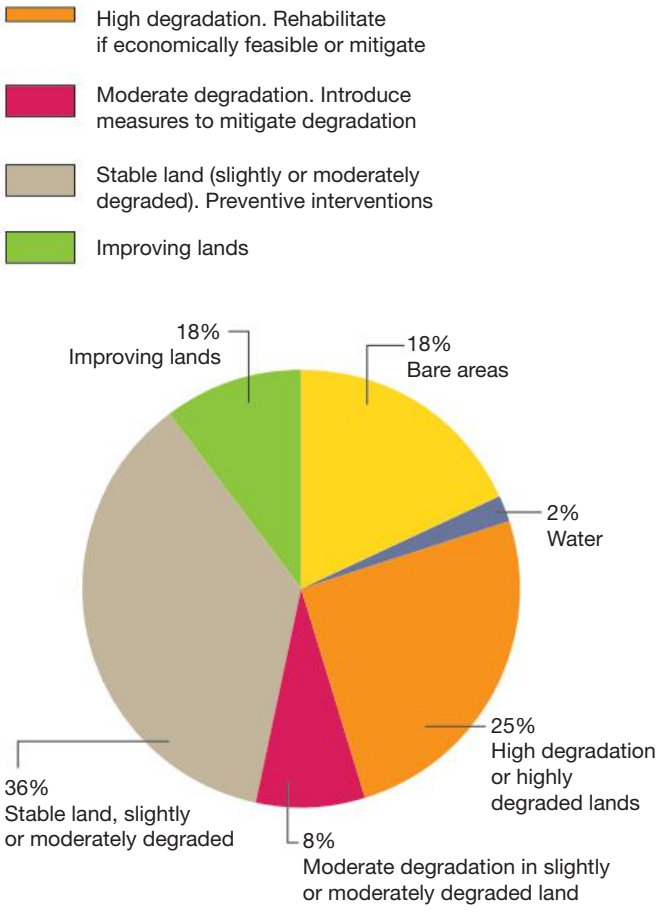




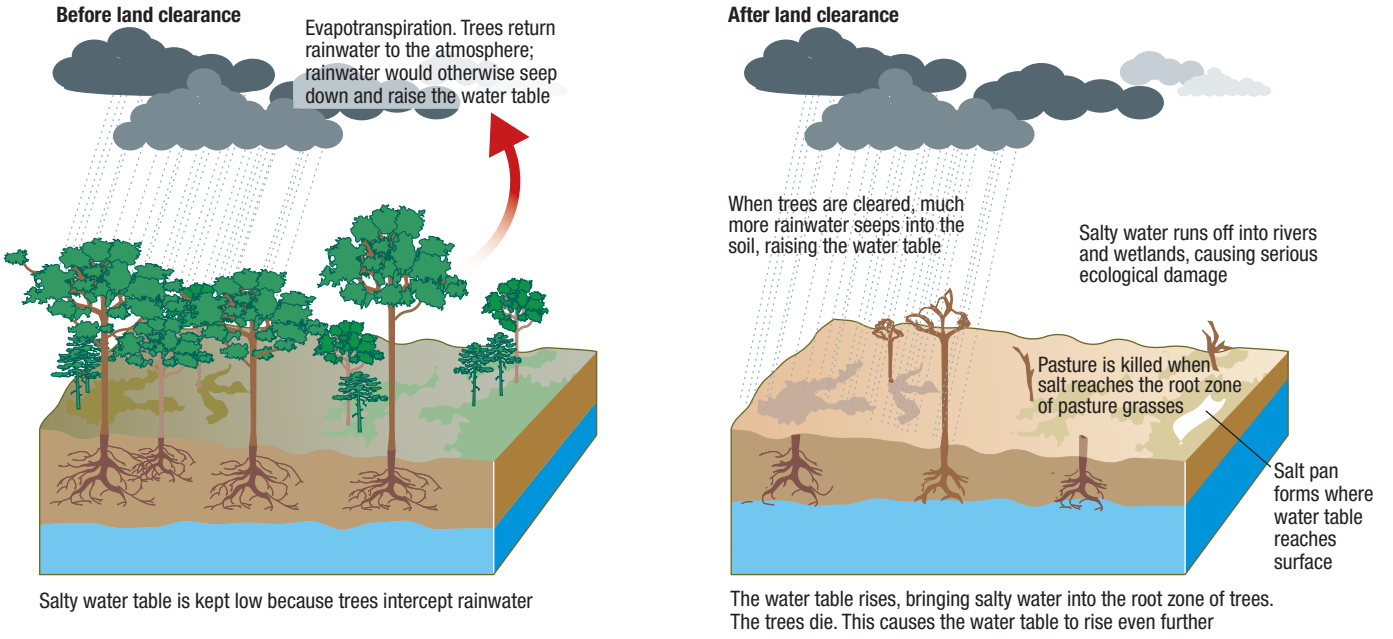
5.7 Extent and causes of land degradation by continent



5.8 Poverty and the cycle of degradation



5.9 Trends in global land degradation



5.10 Land clearance is the main cause of soil salinity.

Types of land degradation

The productive capacity of soil can be damaged, or degraded, in four main ways: through salinity, erosion, compaction or **acidification**.

Soil salinity

Increasing levels of salt in soils is common in some parts of the world, including Australia. It is caused by salty groundwater (water that is stored in rock and soil below the surface) reaching the surface of the soil. Normally, this water level is controlled by large trees, which pump water from the soil as they transpire. However, when trees are cut down, salty water may rise to the surface, as shown in Figure 5.10. The water evaporates, leaving a salty crust.

Soil erosion

Soil erosion is the removal of topsoil by water or wind. This happens wherever the soil is unprotected by plant cover. Once the original plant cover is removed, soil can be carried away easily by strong winds or heavy rain. Winds can strip the land of its topsoil and carry it hundreds of kilometres. Heavy rain and run-off can cut deep gullies in the soil.

Soil compaction

Soil can be compacted by the weight of heavy machinery or the trampling of hard-hoofed animals. Both of these can compress the air spaces in the soil so that it develops a hard layer on top. This reduces infiltration and makes it difficult to use the land for crops or pasture.

Soil acidification

Soil can be made acidic by the overuse of chemical fertilisers. Often, the use of some fertiliser is essential to ensure that the soil keeps producing crops. When used over a long period of time, however, fertilisers can also harm the soil.

Water degradation

The widespread degradation of the earth's water resources has placed a number of key food production systems around the globe at risk, posing a major challenge to the task of feeding a growing world population.

Water scarcity is growing, as are the salinisation and pollution of ground and surface water bodies. Water-related ecosystems are also being degraded. Large inland water bodies are under pressure from a combination of reduced inflows and higher nutrient loading—the excessive build-up of nutrients such as nitrogen and phosphorus. Many rivers do not reach their natural end-points and wetlands are disappearing.

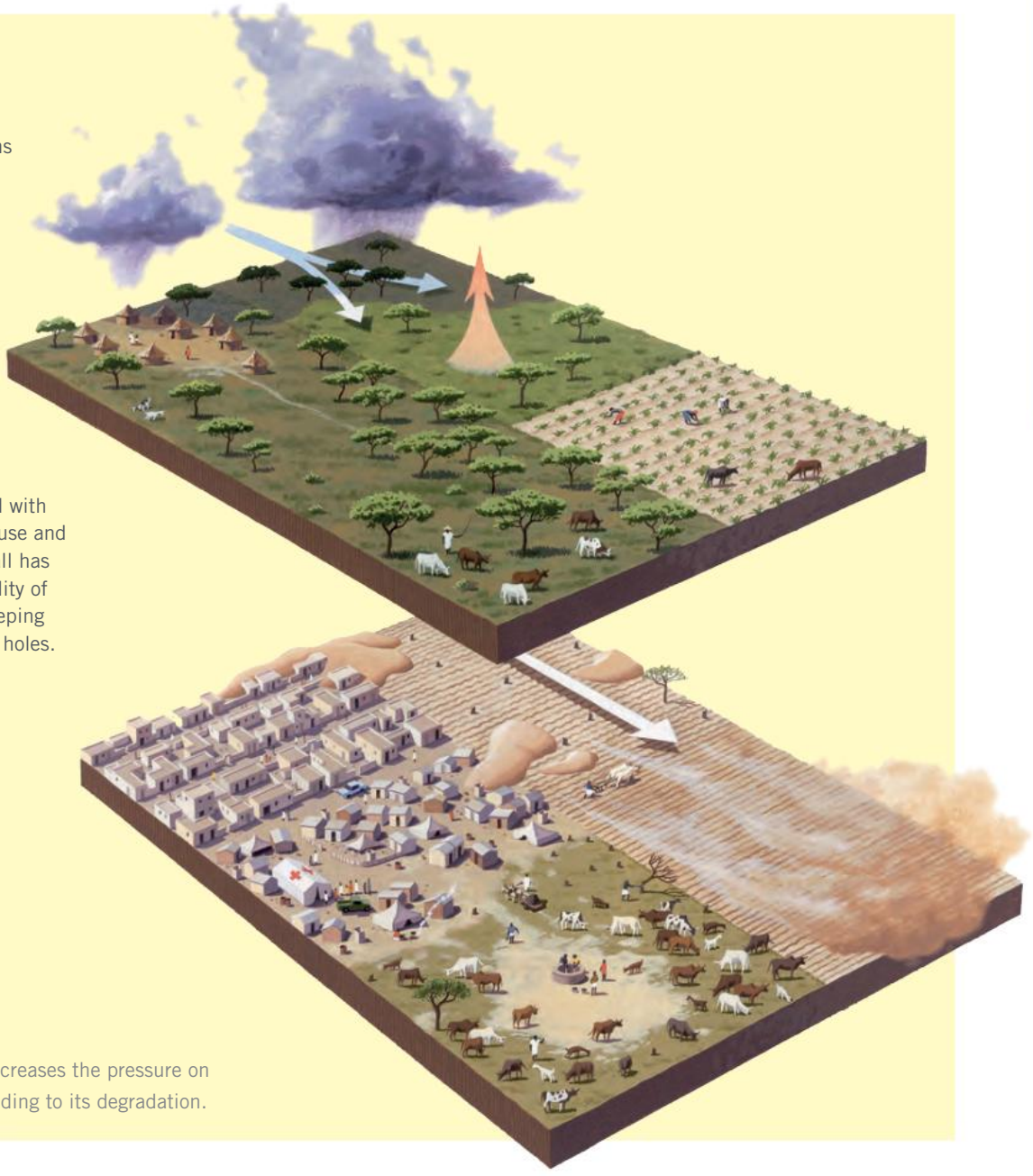
In key cereal-producing regions of the world, intensive groundwater withdrawals have resulted in a lowering of aquifers. This, in turn, has reduced the accessible groundwater stores that many rural communities rely on.

Algal blooms are a growing water-quality issue. A bloom results from a rapid increase or accumulation in the population of algae in a waterway. Some of these are toxic and can render the water unfit for use. Freshwater algal blooms are the result of an excess of nutrients, especially phosphates. The excess of nutrients may originate from fertilisers used in agriculture.

SPOTLIGHT

Desertification

One of the most serious forms of land degradation in the world is **desertification**, which means the creation of deserts. Desertification is a problem in parts of Africa, where the desert is steadily advancing over what used to be good farming land. Desertification in northern Africa has occurred at the edges of the Sahara. These marginal lands have variable rainfall and can only be used with great care. A mixture of overuse and periodic change in the rainfall has destroyed the productive ability of the land. The results are creeping desert sands and salty water holes.



5.11 Population growth increases the pressure on agricultural land, leading to its degradation.

ACTIVITIES

Knowledge and understanding

1 Define the term 'land degradation'.
2 Outline the causes of land degradation.
3 Outline the various types of soil degradation.
4 Define the term 'desertification'.
5 Identify the various ways in which water supplies are degraded.

Applying and analysing

6 Study Figure 5.10. Explain how land clearance can cause salinity related land degradation.
7 Study Figures 5.8 and 5.11. Write two to three paragraphs explaining the relationship between population increase and the process of land degradation.

Geographical skills

8 Construct a block diagram illustrating the various causes of land degradation.
9 Study Figure 5.7 then answer the following questions.
   a Which continent has the largest area of soil degradation?
   b On which continent is overgrazing the major contributor to soil degradation?
   c On which continent is deforestation the major contributor to soil degradation?
   d On which continent are agricultural activities the major contributor to soil degradation?

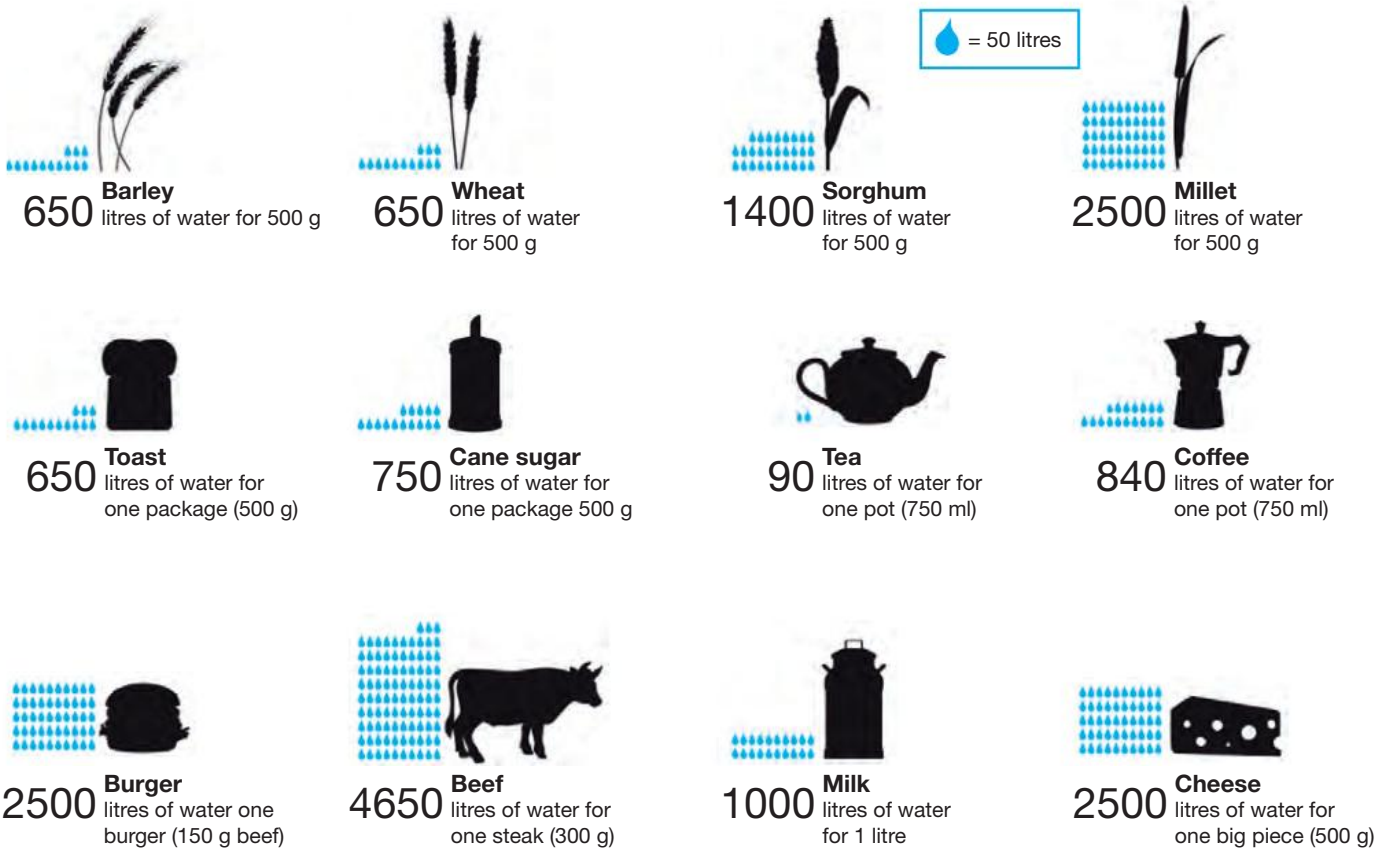
5.3 Shortages of fresh water

All food sources—from crop and livestock production to aquaculture and inland fisheries—require adequate quantities of water. Freshwater resources are central to the challenge of achieving global food security. Yet water scarcity is growing, and many of the world's key food-producing systems are being stressed by unprecedented demand for surface and groundwater supplies. Declining water quality is compounding the problem.

Water usage in food production

Producing adequate food supplies is directly related to the availability of sufficient water. Agriculture consumes 85 per cent of the world's fresh water. To produce a kilogram of rice needs 3400 litres. Figure 5.12 shows the 'water footprint' of a range of foods.

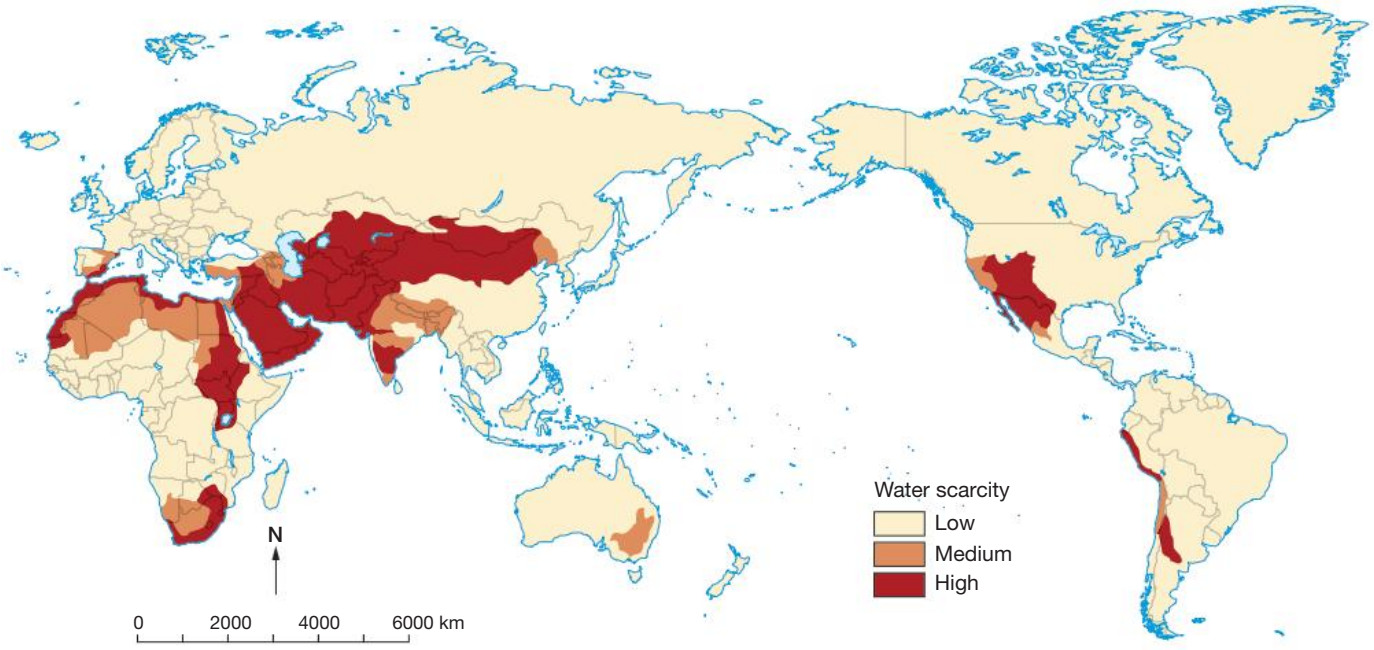
5.12 The water footprint of food produced includes the volume of water taken to produce the food from the land as well as all the water needed in the various stages of the production process, such as washing and processing.



Rain-fed agriculture

Globally, over 80 per cent of cultivated land relies on rainfall and moisture stored in the soils to support crops and pastures. If rainfall is erratic, or below average, crop yields drop. When prolonged or severe droughts occur over wide regions, crops may fail altogether, raising prices and triggering major food emergencies such as the 2008–09 crisis resulting from droughts occurring across China, the United States of America and Australia.

Those hardest hit by rainfall deficiencies are smallholders who make up the majority of the world's rural poor. They often occupy marginal land in arid and semi-arid regions such as Sub-Saharan Africa, where there is great climatic variability.



5.13 Global distribution of water scarcity by major river basin

Irrigated agriculture

An adequate and reliable supply of water can be ensured by withdrawing water from watercourses, lakes and aquifers and using it to irrigate crops. Irrigation lifts the yields of crops by 100 to 400 per cent. Although only 20 per cent of global cropland is irrigated, it is very productive and contributes 40 per cent of the total food supply.

Water scarcity

Water scarcity often has its roots in water shortages and the problems are most severe in marginal areas. Water scarcity has become an issue of global concern, as water use has been increasing at twice the rate of population growth. With excessive amounts of water being withdrawn, groundwater and river levels have dropped, placing agricultural regions at risk all around the world. Global distribution of water scarcity is shown in Figure 5.13. It is estimated that 10 per cent of all food harvested is produced by depleting groundwater supplies, which are being used at a faster rate than they can be replaced.

The North China Plain, for example, is running out of water. Water scarcity also threatens food production in Australia's Murray–Darling Basin. In North Africa, Lake Chad, once one of the largest freshwater lakes in the world, is rapidly disappearing. As 20 million people live in the region and depend on the lake for irrigation, watering livestock, fishing and drinking water, conflicts have already erupted between competing water users. In parts of India, groundwater tables are falling by more than 1 metre a year. Future agricultural production is under threat.

DID YOU KNOW?

By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world's population could be living under water-stressed conditions. The lack of water limits farmers' ability to produce enough food to eat or earn a living. South Asia, East Asia and the Middle East are already close to their resources limits, and their populations are still growing.

Water pollution

Despite food production relying heavily on water, inappropriate agricultural practices are fouling this water and making it unusable. Excess nutrients from over-fertilisation end up in water bodies, leading to toxic algal blooms. Agrochemicals such as pesticides contaminate the water and accumulate in living organisms. The more intensive the landuse becomes, the greater the risk to freshwater supplies.

ACTIVITIES

Knowledge and understanding

1 Justify the importance of fresh water for food production.
2 Describe the sources of water used in agriculture.
3 Explain why Africa is so vulnerable to water shortages.
4 Outline the impact of agricultural practices on water quality.

Geographical skills

5 Study Figure 5.12. Identify the most water-demanding foods and the most water-efficient foods.

5.4 Competing landuses

Increased competition for land and water resources is a major threat to global food security. As the world urbanises, cities spread across arable land and consume a larger share of available water supplies. There is also competition within the agricultural sector. Alternative forms of agricultural landuses—staple crops, livestock, non-food crops and biofuel production—compete for the arable land.

The impact of urban growth

The world is running out of good arable land, as some of the most productive land is lost to cities. Historically, cities occupied fertile river basins and coastal plains in better-watered areas close to food supplies. With increasing urbanisation and associated urban growth, cities have sprawled outwards, covering the rich soil with concrete and asphalt. Farmers often sell their land to developers (see Figure 5.14). By 2010, the total of the world's built-up areas was 4.75 million square kilometres, which is the equivalent to half the size of the United States of America or China. These areas occupy some of the world's best farmland.

The demand for water generated by population and economic growth is increasing much more quickly than the demand by agriculture. There is, as a result, increased competition for a resource that has a finite supply. City dwellers want water in their homes, as do industry and waste treatment facilities. These are expected to grow, crowding out the allocations to agriculture. Yet urban dwellers need food and rely on agriculture to provide it. By 2050, urban centres could swallow half or more of the world's available fresh water at a time when many rivers, lakes and aquifers will be drying up.



5.14 Rich farming country used to grow canola in the United States of America is lost to a new housing subdivision.

Competition for land and water

Staple grain crops, livestock, non-food crops (including biofuels), inland fisheries and aquaculture already compete for land and water resources. With profit being the driver of commercial agriculture, market forces are determining what the land is used for.

Cash cropping

Governments in developing countries often focus on **cash cropping** as a driver of economic growth. The prospect of generating revenue and export sales can blind them to the effect on other competing landuses, especially food production. The Pakistani Government, for example, has promoted cotton farming as the country's biggest cash crop. As a result, the production of sunflower seeds, which are used to make edible oil, has almost disappeared from the country's fertile golden triangle. Pakistan now has to import edible oil, at a cost that is second only to what they pay for imported petroleum products. The problem has been compounded by falling prices for cotton exports.

Biofuels

As the world has become concerned about diminishing oil supplies and the need for a greener and more secure transport fuel, large amounts of land have been used to grow crops for biofuels such as ethanol and biodiesel. Ethanol can be made from plants such as sugar cane and corn, whereas biodiesel is produced from oilseeds such as soybeans, canola and sunflower seeds.



5.15 The aquaculture industry uses vast quantities of water to incubate fish eggs and rear juvenile fish. Fish farms can also pollute waterways with nutrients, antibiotics and fungicides.

Aquaculture

Fish and fishery products are among the world's most traded food commodities, and aquaculture has become the fastest-growing animal-producing sector. While it is heavily dominated by the countries in the Asia–Pacific region, aquaculture is developing, expanding and intensifying in almost all regions of the world.

Fish farming (see Figure 5.15) makes heavy demands on the land. As it takes more than 5 tonnes of wild-catch marine fish stocks to feed a single tonne of farmed fish, they are fed grain. This imposes another strain on available grain stocks, which are also being fed to livestock. The availability of staple grains as human food diminishes even further.

Water wars

The fiercest competition for water is over that withdrawn from watercourses and storages to water stock and irrigate crops. Local disputes are common, and fighting can break out, as it did between farmers and herders in 2005 in the arid regions of western Sudan after the rains failed to arrive. In recent years, Africa, the Middle East and Central Asia have been the regions drawn into conflict over water. Such disputes could well lead to war this century, if tensions increase as climate change takes hold.

ACTIVITIES

Knowledge and understanding

1 Describe the impact of urban growth on the land and water resources traditionally used for agriculture.
2 Explain why governments favour cash cropping and how it can affect food production.
3 Outline the competition for land and water from biofuels and aquaculture.

Applying and analysing

4 Create a cartoon highlighting how competing landuses threaten global food security.
5 Read the following statement and complete the table.
To protect Australia and the world's food security, the selling of farmland for housing should be stopped.

Arguments for	Arguments against

Investigating

6 Select the topic of biofuels or aquaculture to investigate. Research the nature of its production and how it may continue to affect food production. Present your findings in a T-chart showing arguments for and against each.

5.5 Case study: Flower production

Flower production is a cash crop that now generates revenue of more than US$120 billion dollars a year worldwide. The industry's main producers are increasingly based in developing countries, while the main consumers are based in developed countries.

Producers

Over the past three decades the global distribution of flower production has changed significantly. The focus of production has moved from traditional growers such as the Netherlands, in Europe, to countries where the climates are more suitable and production costs lower. The use of airfreight has reinforced this trend. High-value flower crops are grown far from their point of sale.

New production centres

The new centres of production are typically found in developing countries. East African countries such as Ethiopia, Kenya and Tanzania are important suppliers to the European market. In South and Central America, countries such as Colombia (now the world's second-largest flower exporter) and Ecuador are major suppliers to North America. India, Israel, Thailand and Malaysia are also notable flower exporters in Asia. South Africa, Australia and New Zealand, because of their location within the Southern Hemisphere, supply seasonal flowers that are not otherwise available in North America and Europe.

Kenya's flower industry

Kenya's flower industry is big business. It is now one of the country's top foreign exchange earners, bringing in US$1 billion annually. Significantly, an estimated 500 000 people (including over 90 000 flower farm employees) depend on the industry for their livelihood. A quarter of the cut flowers sold in Europe are grown in Kenya.

Kenya's climate is ideal for growing flowers all year round. Being on the Equator, the country gets plenty of sunlight. In addition to the ideal climate, Kenyan flower growers employ high levels of technology. Computerised drip irrigation and greenhouses ventilation systems, net shading, cold storage facilities, fertiliser recycling systems to prevent wastage, wetlands for wastewater treatment, artificial lighting to increase day length, grading/packaging sheds, and refrigerated trucks are used to ensure the quality demanded by the mainly European market.

The centre of Kenya's flower industry is Lake Naivasha. In Figure 5.16, we see sunlight reflecting off the long rows of glass greenhouses, turning them silvery blue and white in this view from space. Fallow fields appear pink, while growing plants turn the ground bright green. Roses, lilies, and carnations are the most common flowers grown in the greenhouses and fields scattered around the lake.

The flowers provide an important source of income to Kenya, as can be seen from the level of exports in Figure 5.17, but there are a number of environmental concerns. Strong chemical pesticides are used on the flowers to produce the perfect, pest-free bloom, and this poses a health risk to workers and local wildlife, including the hippopotamus. The chemicals may also have threatened the water quality of Lake Naivasha, one of Kenya's few freshwater lakes. The Kenya Flower Council has instituted a code of conduct to establish guidelines for pesticide usage, as well as phasing out the use of one of the most toxic pesticides.

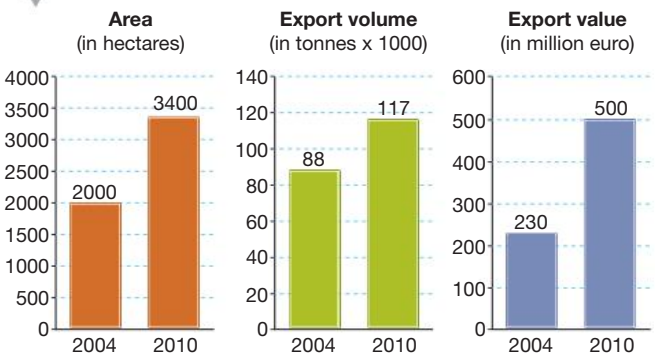
5.16 Satellite photograph of Lake Naivasha, Kenya, showing flower-growing fields and glasshouses



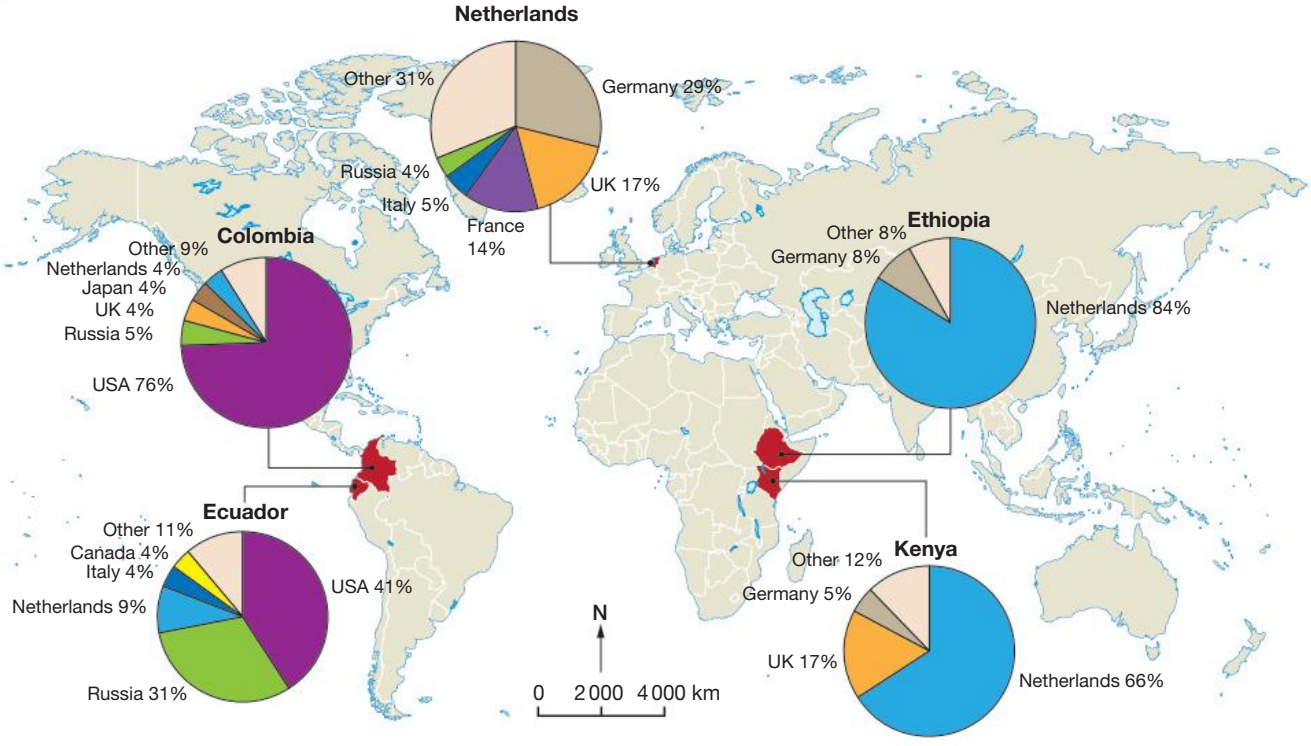
Consumers

The market for flowers fluctuates with economic conditions. Because flowers are a discretionary purchase they depend on the level of consumer confidence. When confidence is low, such as in a recession or financial crisis, sales decline. Figure 5.18 shows the major producers of cut flowers and the destination of their exports.

5.17 Kenyan flower industry, 2004 and 2010



5.18 Destination of flower exports, selected countries, 2010



ACTIVITIES

Knowledge and understanding

1. Outline the changing distribution of flower production. What factors are driving the changes?
2. State the economic importance of the flower-growing industry to Kenya.
3. Explain why countries such as Kenya have been able to compete with the traditional flower-growing countries such as the Netherlands.

Applying and analysing

4. Outline the technical innovations that have characterised the development of the Kenyan flower-growing industry.
5. Identify the environmental concerns associated with the Kenyan flower-growing industry.
6. Identify the largest markets for cut flowers. Explain why demand changes according to economic conditions.
7. As a class, debate the proposition that the land devoted to cash crops such as flowers would be better used to grow food for the world's rapidly growing population.

Geographical skills

8. Study Figure 5.17. Using data from the graphs, describe the growth in Kenya's flower-growing industry between 2004 and 2010.
9. Study Figure 5.18. Identify the main markets for flowers produced in the Netherlands, Kenya, Colombia and Ethiopia.

5.6 Case study: Palm oil

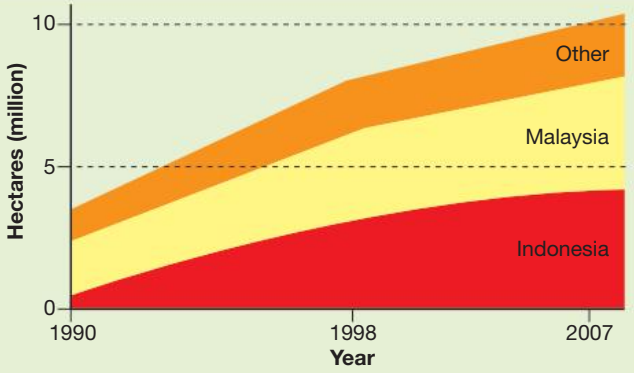
You may not have even heard of palm oil, but you have all used it. Palm oil is found in shampoo, margarine, ice cream, lipstick, detergents and many other everyday products. It is a very useful ingredient for many different kinds of liquids and creamy products that we use.

Where palm oil is grown

Most of the world's palm oil is grown on large plantations, which are examples of **monoculture** (they grow only one crop), as a cash crop. The plant can only be grown in the tropics. Malaysia and Indonesia are the two largest producers. Together they have about half of the area of palm oil plantations (see Figure 5.19).

The production of palm oil has doubled in the last decade and global production exceeds 35 million tonnes. Palm oil now makes up over 68 per cent of all the vegetable oils used. The main importers of palm oil are the European Union, India, China, Pakistan, Japan, Singapore, Egypt and Bangladesh. It is estimated that the demand for palm oil will double again by 2020. As a result, new plantations of palm oil are being developed and existing plantation are increasing in size.

5.19 Area devoted to palm oil



Global production:	35 million tonnes
Share of all vegetable oil production:	35%
Global trade volume:	27 million tonnes
Global trade-to-production ratio:	75%
Share of all vegetable oil trade:	68%
Principal exporters:	Indonesia, Malaysia
Principal importers:	European Union, India, China, Pakistan, Japan, Singapore, Egypt, Bangladesh

Source: Oil World, 2008

Environmental impacts

The rapid expansion of the palm oil industry has caused a number of environmental problems. The areas being cleared to develop palm oil plantations are tropical rainforests, as shown in Figure 5.20. These are the home of many animals and birds, as well as being important in lowering carbon dioxide levels in the atmosphere.

The rainforest is clear-felled for the establishment of plantations. This means that the soil is left bare, subject to severe erosion from the heavy tropical rains, and baked by the heat of the equatorial sun. The burning of the trees in the process of clear-felling contributes significant carbon dioxide to the atmosphere.

Impacts on biodiversity

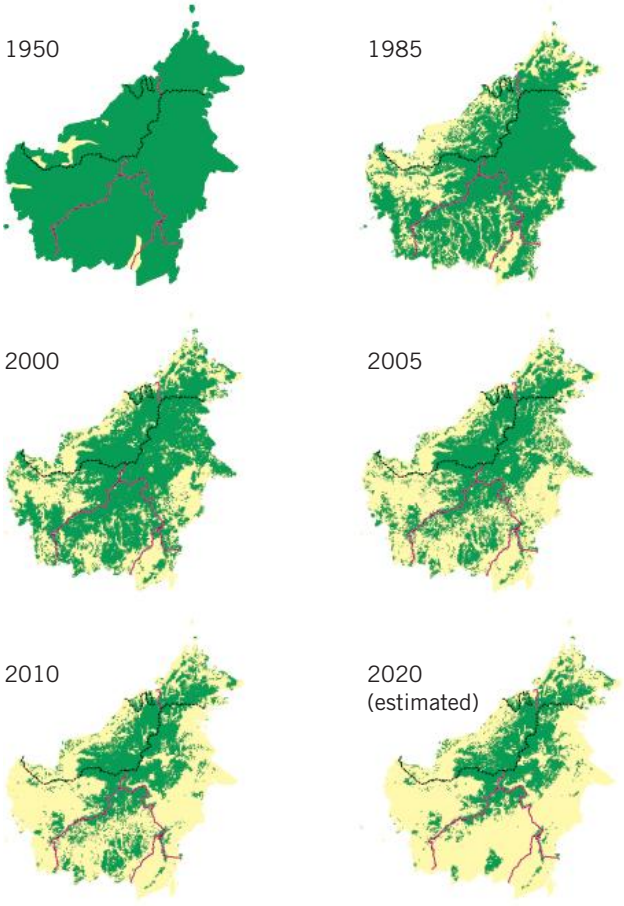
The most significant problem in the long term is the lowering of biodiversity of the rainforests. Clearance (shown in Figure 5.21) has taken large areas from the habitats of animals such as the orang-utan. Furthermore, corridors of rainforest, which connected larger areas of forest with genetically different animals, have been removed indiscriminately. This means that the genetic characteristics of animals in future generations will be more restricted, leading to less adaptability to environmental change and disease. Animal species adversely affected by oil palm plantation spread include the Asian elephant, orang-utan, Sumatran rhinoceros and tiger.

The reduced biodiversity is demonstrated by the fact that whereas eighty species of mammals live in Malaysia's rainforests, secondary (regrowth) forests have only thirty species, and oil palm plantations have twelve species. As the forests are reduced in an area, the animals that live there are forced into smaller areas with denser populations. This results in more human–animal conflict over areas which both groups see as their living areas. Some animals, such as elephants and orang-utans, can continue to live in the disturbed rainforest, but are then considered a pest by people living nearby.



5.20 Palm oil plantation, Indonesia

Another biological problem is the increase in the rat population, which occurs with the growth of plantations. Rats increase because their natural predators, such as snakes, are killed off during the clearing of forest. The use of poisons to kill them has been dangerous for other animals and birds.



5.21 Rainforest loss in Borneo (Indonesia, Malaysia and Brunei)

DID YOU KNOW?

In Indonesia, the equivalent of six football fields of primary forest disappears every minute as the palm oil industry expands.

ACTIVITIES

Knowledge and understanding

1 State what palm oil is used for and where it is grown.
2 Identify the environmental impacts of palm oil production.
3 Outline the impacts of palm oil production on biodiversity.

Applying and analysing

4 Use your knowledge of the geography of tropical rainforests and your skills of inquiry to write a short description of the environmental characteristics within a rainforest that makes it a suitable habitat for so many species. Write a contrasting piece detailing the environmental characteristics of a plantation of oil palms. Consider sunlight, rainfall, humidity, wind and sources of food in your response.
5 Because oil palms are so profitable, the industry is likely to continue to expand in the countries named in this unit. From what you have read and discussed, suggest ways in which the plantations could have less impact on the threatened animals of the rainforest.

Geographical skills

6 Study Figure 5.21. Describe the change in rainforest coverage in Borneo, 1950–2020.

5.7 Population growth

The world's population continues to rise, and this growth is one of the main drivers of increased global food demand. Despite a slowing of population growth rates in recent decades, the world is becoming increasingly food insecure. An imbalance between population growth and food production could become acute in some of the world's poorest nations.

The pattern of population growth

For most of human history, the world's population grew quite slowly. But for the last 200 years there has been an explosive increase in numbers as a result of:

- settlement expanding across the planet, opening up new land for exploitation
- the development of modern agriculture, which has enabled increased food production
- better sanitation, health care and medical advances such as immunisation, all of which have helped to control the spread of diseases and resulted in death rates dropping sharply.

While the rate of population growth has slowed down considerably, the population is still rising. The United Nations predicts that 2.3 billion people will be added to the world's population by 2050, taking the total to 9.1 billion (see Figure 5.22). Most of this growth will occur in developing countries, because poverty is a major cause of continuing population growth.

Implications for global food security

While more people means that there are more mouths to feed, where rates of population growth are greatest, the security of food supplies is at its most tenuous.

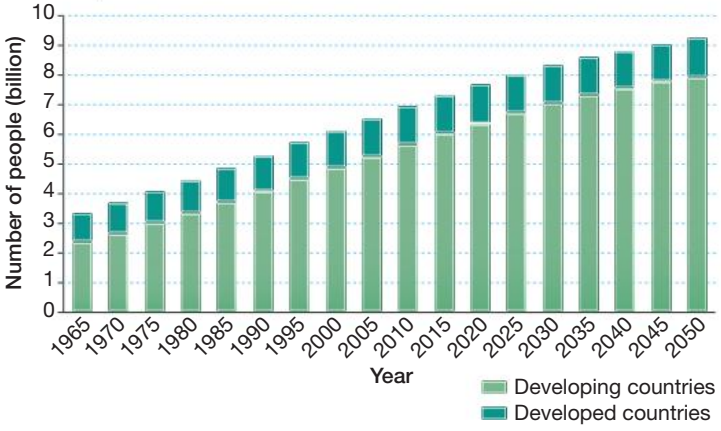
Within cities

While rural areas will still be the home of the majority of the poor and hungry for quite some time, increasing numbers of people are moving to cities. By 2050, more than 70 per cent of the world's population is expected to be urban. This growing concentration is already affecting consumption patterns: there is a growing preference for meat, dairy products, fish, fruit and vegetables and processed products, at the expense of more traditional foods such as pulses, roots and tubers. Figure 5.23 illustrates this change in food consumption.

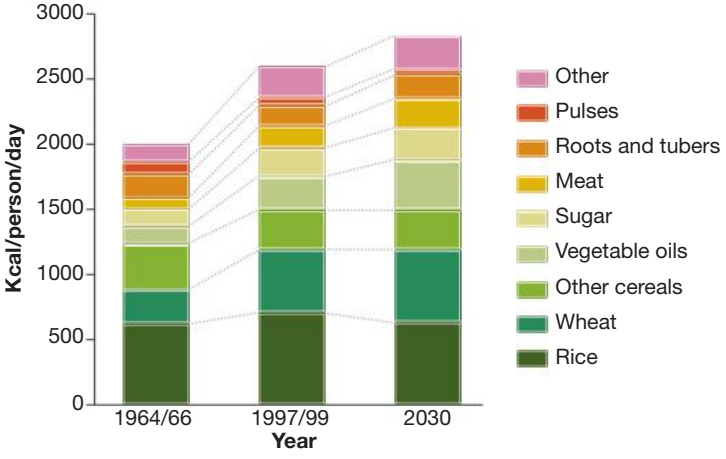
DID YOU KNOW?

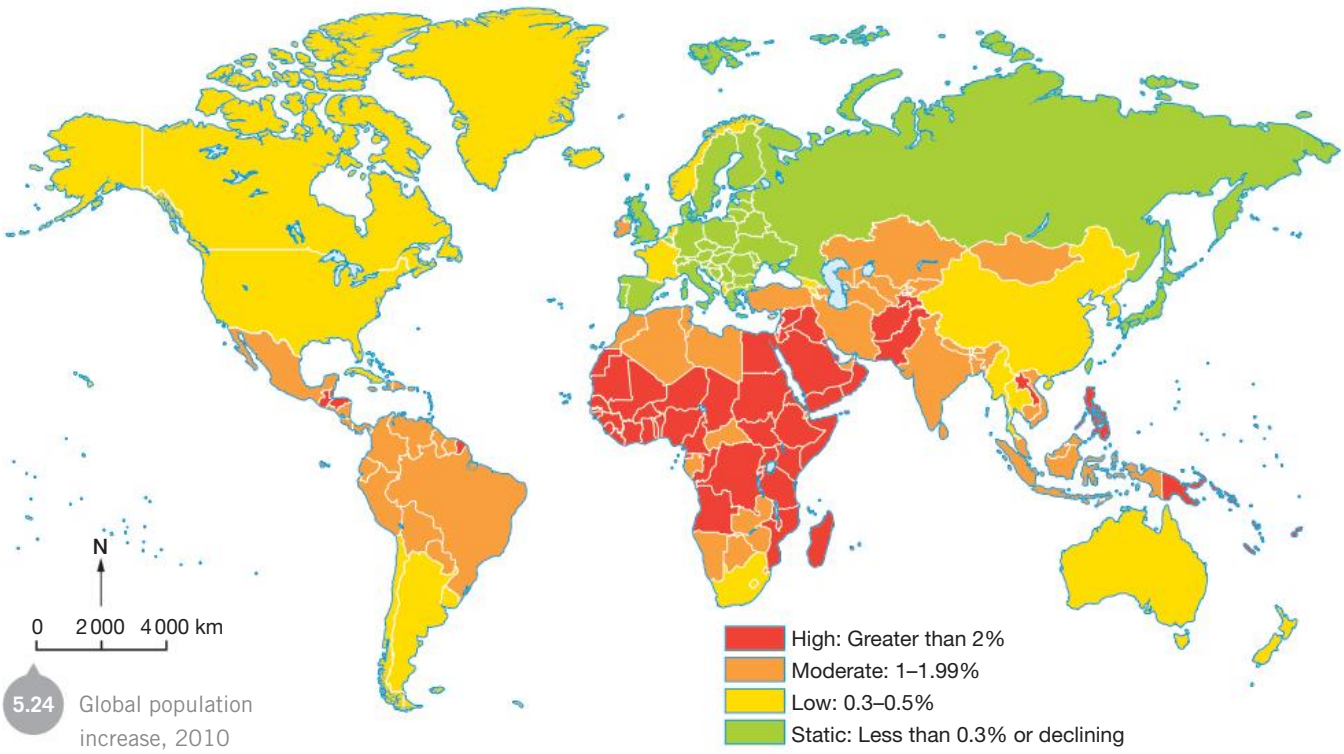
An average of two people is added to the world's population every time your heart beats.

5.22 World population, 1965–2050



5.23 Global changes in food consumption





5.24 Global population increase, 2010

Within developing countries

If current trends continue, almost all future population growth will occur in developing countries, as shown in Figure 5.24. Countries such as the Democratic Republic of Congo, Uganda and Yemen are expected to have populations in 2050 that are four to five times greater than they have now. Yet these countries already struggle with food and water shortages because of the limitations of their biophysical environments, as well as chronic poverty, a lack of education and conflict. These countries are also losing large areas of their arable fields and pastures through erosion and desertification.

ACTIVITIES

5.3

Knowledge and understanding

1 Explain why there has been such a large increase in the world's population in the last 200 years.
2 Outline the United Nations prediction for the world's population in 2050.
3 Identify those countries that are expected to more than quadruple their total population by 2050 and explain why this will pose problems for them.
4 Describe what is happening to the percentage of people living in urban centres and how this will affect food consumption patterns.

Geographical skills

5 Study Figure 5.22 then complete the following table.

	Total population	Percentage in developed countries	Percentage in developing countries
1965			
1990			
2010			
2030			
2050			

6 Study Figure 5.23 then answer the following questions.
- a How much wheat was consumed in 1997–99?
- b How much meat will be consumed in 2030?
- c The consumption of which food will have decreased the most from 1964–66 to 2030?
- d The consumption of which food will have increased the most from 1964–66 to 2030?

7 Study Figure 5.24 then answer the following questions.
- a Which continent has the greatest number of countries with the highest rates of population increase? Explain this.
- b Identify the continent that has the greatest number of countries with static rates. Explain this.
- c For each category on this map, name two countries that are the largest in terms of total area.

5.8 Climate change

Food production, probably more than any other human activity, depends on a stable climate. Sustaining or increasing crop yields to secure food supplies is challenging enough, but projected changes to the world's climate will place pressure on global food security.

Climate change and farming

Climate affects almost every aspect of food production. It determines what can be grown and where. Climate influences both the quality of the produce and, most importantly, the yield. It follows then that if the climate changes then the nature of food production will also change and, most significantly, the amount of food that is actually produced.

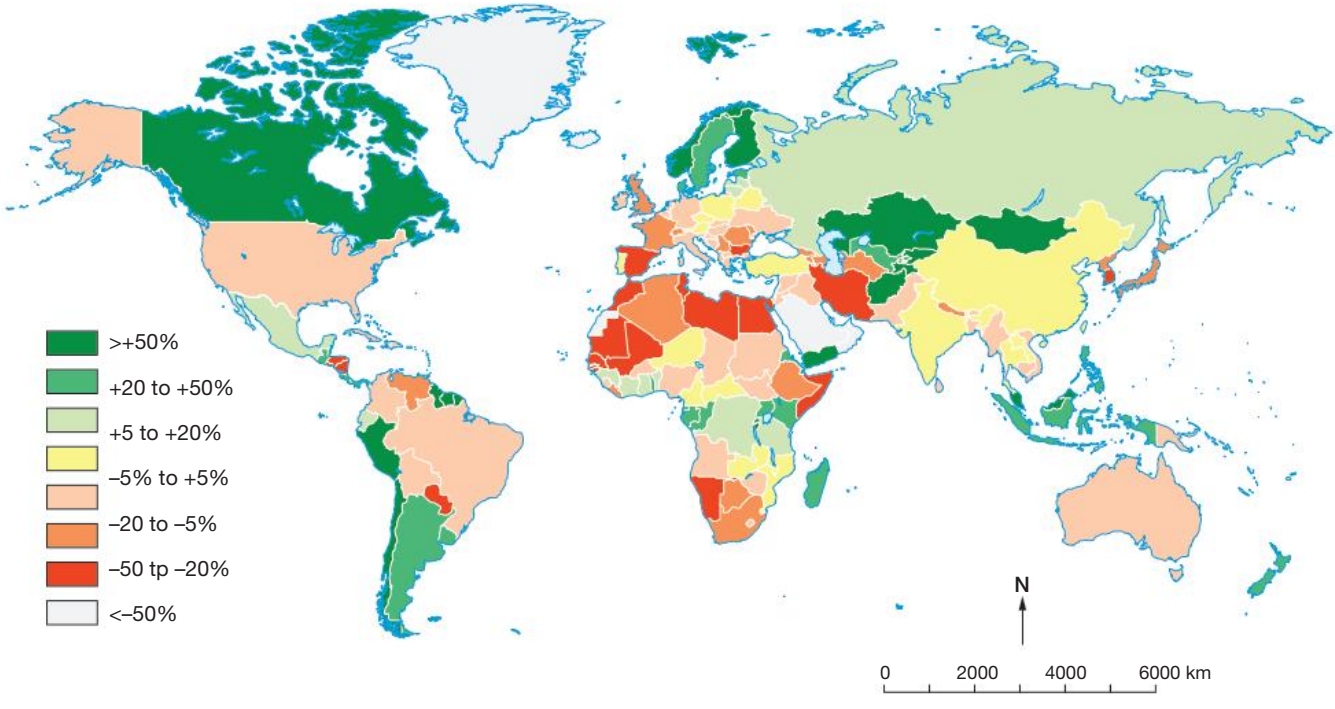
Understanding climate change

According to the 2013 Intergovernmental Panel on Climate Change (IPCC), there is a 95 per cent belief that the atmospheric concentrations of greenhouse gases such as carbon dioxide, methane and nitrous oxide, are rising as a result of human activity. These gases trap additional heat in the atmosphere, keeping it warmer than it would otherwise be. There is strong evidence that such changes in the composition of the atmosphere are affecting global climates. The global mean surface temperature is expected to rise between 1.8°C and 4.0°C by 2100.

Food production in a warmer world

Climate change may have disturbing consequences for food production due to an increased incidence of extreme weather events and greater climatic variability. Data collected by the IPCC strongly points to a worldwide decrease in productivity if global temperatures rise by more than 2.7°C—which is well within the range of current predictions. Rain-fed agriculture could be hit hardest, with yields halving as soon as 2020 because of prolonged and severe droughts (see Figure 5.25).

5.25 Projected percentage gains and losses in rain-fed cereal production potential by 2080





5.26 Drought causes a rice crop to wilt in Aceh, Indonesia, in 2012.

While there is wide consensus among scientists that climate change is already ongoing, the extent of the change in various parts of the world is less clear. The impacts of climate change on food production are distributed very unevenly geographically. An example of the impact on grain and cereal production can be seen in Figure 5.26.

Winners

Some aspects of climate change are positive. Rising carbon dioxide levels may increase the efficiency of photosynthesis in crops and lead to marginally higher yields. According to the IPCC report, crop productivity is projected to increase slightly in the middle to high latitudes with moderate warming, but then decrease if warming goes too far, which is likely to occur in the second half of this century. Most of the land found in these latitudes is in the Northern Hemisphere. Here higher temperatures would lengthen the growing season and open up more land for cereal production. Russia and Canada could expect to benefit from moderately warmer temperatures and increased precipitation.

Losers

Although the countries of the Southern Hemisphere are not the main originators of the emissions responsible for climate change, they may suffer the most from extreme weather events, such as the droughts and floods that accompany climate change. Those areas that will be hit hardest by climate change first are where the poorest people live, such as Indonesia.

The IPCC predicts that rising temperatures will decrease the yields in forty developing countries, mainly in Sub-Saharan Africa, and that a 3°C increase in warming will increase the price of food by 40 per cent. This will exacerbate food insecurity in the world's poorest regions. Scientists warn that 200–600 million of the world's most vulnerable people could face malnutrition and even starvation due to the effects of projected climate disruption.

Productivity is expected to decline in the coastal tropical and subtropical regions with flooding and damage caused by higher seasonal rainfall and severe storms. Rising sea levels would cover river deltas and disturb fish production in aquaculture ponds. Saltwater intrusions are already contaminating water supplies.

ACTIVITIES

5.2

Knowledge and understanding

1 Explain why climate is important to food production.
2 Outline the findings of the 2013 IPCC.
3 Identify the positive aspects of climate change for food production and those parts of the world that may benefit.
4 Identify those parts of the world that are most at risk from climate change and explain why a drop in food production would be difficult for people living there.

Geographical skills

5 Study Figure 5.25 then do the following tasks.
   a Identify the continent most at risk of reduced grain production due to climate change.
   b Identify five countries that are likely to have gains in rain-fed cereal production. Explain why this would be the case there.

5.9 Agricultural expansion and intensification

Globally, the amount of land available for agriculture is limited and most of the best quality farmland is already being used. So, increasing food production will require more intensive use of land already under cultivation. The only alternative is to expand into marginal areas that are vulnerable to land degradation and unlikely to be able to sustain adequate yields over the long term.

Forests for food

The world's most productive agricultural regions were once covered with temperate forests and grasslands. However, the forests that remain today are mainly in the tropical zone and they do not hold the same potential for supporting agriculture, as their soils quickly become impoverished once the rainforest itself is cleared. Claims that the clear-felling of the Amazon and the Congo rainforests is the answer to global food shortages cannot be justified.

Land suitability

It would appear that the world has plenty of spare land, but like water, it is not always where people need it. More significantly, not all land is suitable for agriculture. Table 5.27 shows the amount of suitable land by region around the world. Those parts of the world that will experience the biggest increases in food demand (as a result of rising populations) are where most of the suitable land is already under cultivation. Food demand is likely to more than double in Asia (see Table 5.28), yet there is only room for a modest 25 per cent expansion in cultivated land. Land shortages are even more acute in West and North Africa, where only 13 per cent more farmland is available, yet the region needs to provide one and a half times the food by 2050.

Latin America and Sub-Saharan Africa have more land available, but much of this land may never be farmed, and probably should not be.

- The tropical rainforests of Latin America were the primary source of new croplands during the 1980s and 1990s. High rates of deforestation were condemned globally, as tropical rainforests were valued for their immense biodiversity. Annual rates of deforestation and land clearing have since declined.
- The land in Sub-Saharan Africa is marginal and prone to degradation and desertification, as droughts strike often and overuse pushes the land beyond recoverable limits.

5.27 Usage of suitable land for agriculture, by region

Region	Cultivated area (millions of hectares)	Area suitable for agriculture (millions of hectares)	Percentage of suitable land in cultivation
Asia	439	585	75
Latin America	203	1066	19
OECD	265	497	53
Russia	387	874	44
Sub-Saharan Africa	228	1031	22
West Asia and North Africa	86	99	87
World	1600	4152	39

Source: Ghislain de Marsily, 'Water, Climate Change, Food and Population Growth,' *Revue des Sciences de l'Eau*, 21, no. 2 (2008), pp. 111–28

5.28 Food needed in 2000 and 2050, by region

Region	Cereals needed in 2000 (millions of tonnes)	Cereals needed in 2050 (millions of tonnes)	Rate of increase (%)
Asia	1800	4150	2.34
Latin America	272	520	1.92
Sub-Saharan Africa	262	1350	5.14
West Asia and North Africa	154	390	2.5

Source: Ghislain de Marsily, 'Water, Climate Change, Food and Population Growth,' *Revue des Sciences de l'Eau*, 21, no. 2 (2008), pp. 111–28



5.29 Vertical cattle farm in Fukuyama, Japan

Intensification of agriculture

Most of the future growth in food production is likely to result from the intensification of existing agriculture. The objective of the intensification is to increase the yield per hectare. This is achieved with more inputs into the land, such as irrigation water, fertilisers, herbicides and pesticides, as well as planting high-yielding seeds. Increasing high-input farming on land that is most suitable for cropping will take the pressure off agricultural expansion and encroachments into forests and marginal land.

Agriculture has changed significantly in recent decades. The first noticeable shift followed World War II, when intensive monoculture (the cultivation of a single crop) was favoured over **mixed farming** (a variety of crops and livestock) that had been the norm for centuries. As farming industrialised, most farmers took advantage of the high-yielding crops and the agrochemicals of the Green Revolution. Mechanisation improved their efficiency and irrigation lifted yields.

Factory farming methods were extended to livestock production as meat and dairy products became popular in the daily diet. Livestock production is becoming an industrial-scale process, whereby tens of thousands of cattle or pigs, or over 100 000 chickens, are held in a single facility and fed grains to fatten them. Such intensive but large-scale facilities are favoured as they are considered more efficient. Vertical farming is already used in Japan to fatten cattle, as shown in Figure 5.29.

City farming

A recent innovation in intensive agriculture is city farming. There are currently rooftop gardens producing fruit and vegetables in many large cities, such as Sydney and New York. It is anticipated that whole vertical garden skyscrapers could be used to grow food. It is estimated that a 30-storey skyscraper could feed 40 000 to 50 000 people a year. Realistically, skyscrapers would probably not be suitable for growing grains, as more extensive areas are needed for such crops.

ACTIVITIES

Knowledge and understanding

1. Identify the two ways in which land can be used to lift global food production.
2. Explain why tropical rainforests are not suitable for continual cropping.
3. Identify those regions of the world that face the greatest challenge in increasing food production because most of the land suitable for agriculture is already in use.
4. Explain how the intensification of agriculture has lifted crop yields.
5. Describe the intensification of livestock production.

Geographical skills

6. Study Table 5.27 then do the following tasks.
   - a Identify the region that has the lowest percentage of arable land still available for cultivation. Give reasons for your answer.
   - b Identify the region that has the highest percentage of arable land still available for cultivation. Give reasons for your answer
7. Study Table 5.28 then do the following tasks.
   - a Identify the region that needs the highest rate of increase to provide enough cereals in 2050. Give reasons for your answer.
   - b How many extra million tonnes of cereals will be needed in Asia in 2050 compared with 2000?

5.10 Case study: Market gardening in Oregon

Much of the best farmland in Oregon, United States of America, is lost to urban expansion each year. Thompson Farms is one of the few properties still operating within Oregon city limits. It is a thriving market garden that grows fifty varieties of fruit and vegetables. They are harvested all year round and sold directly to consumers rather than to processors or the big supermarket chains.

Market gardens

A market garden involves the commercial production of fruit, vegetables and flowers on a small area of land, sometimes as small as a few hectares. They are usually found on the fringes of large cities and provide a wide range and steady supply of in-season produce.

Market gardens in the United States

Demand for locally grown produce, bought directly from market gardens, has increased sharply in recent years. Consumer preferences have shifted towards the purchase of fresh produce because it is considered to be of higher quality. People are also becoming increasingly concerned about the chemical residues in mass-produced foods. Large 'industrial' farms tend to specialise in high-volume production of a single crop. Production methods



5.30 Market gardening is a labour-intensive form of agriculture.

are typically highly mechanised and dependent on agrochemicals to control weeds and pests. Produce is often kept in cold storage for extended periods and transported thousands of kilometres to market. Quality and taste are often casualties of such a long supply chain.

Market gardens are very different enterprises, as they are low-volume and usually very diversified operations. The quality of freshly picked fruit and vegetables is appealing to more discerning consumers, who like to know where and how their food was produced. They feel more secure in the knowledge that many market gardens have rejected the use of agrochemicals and introduced more environmentally sustainable farming practices.

Labour is usually the biggest expense on these small farms, as crops are planted, harvested, sorted, washed and packed by hand (see Figure 5.30). The produce is typically sold at farmers markets, roadside and on-farm stands, tailgates (off the back of trucks) and even at 'pick-your own' operations.

Thompson Farms

Larry Thompson is a second-generation farmer who successfully markets his produce by opening his farm gate to the local suburban community. His 40-hectare farm is only 30 kilometres from the centre of Portland, Oregon, on the Pacific north-west of the United States of America. As a result of the city's expansion, his farm now lies within the city limits. Thompson Farms has used this proximity to its advantage.

Conventional market garden

The farm was first established on the undulating country to the south-east of Portland in 1947. Raspberries, strawberries and broccoli were grown by conventional methods and sold to local processors. The canneries required the farmers to adhere to a schedule of six chemical applications of fumigants and pesticides a season. This was expensive, but the returns on their crops were low, as the purchase price was set by the canneries. The farmers tried selling to the grocery shops in Portland during the mid-1980s, but the big supermarkets moved in and the shelves were then filled with cheap imported food.

Direct marketing and diversification

For the last few decades, Thompson Farms has marketed its own produce. Initially, it offered 'pick-your-own berries', whereby locals came onto the farm and collected their own strawberries. Sales were strong, so it diversified into other fruits such as raspberries, blueberries, marionberries and cherries, as well as vegetables such as cauliflower, corn and lettuce. It employed an additional twenty-three workers and expanded their sales outlets to six farmers markets and two farm stands (see Figure 5.31).



5.31 Thompson Farms runs a stall at the local farmers market.

Thompson Farms attributes its success to its customers' appreciation that it is chemical free and has been for the last fifteen years. It has implemented a number of strategies that have brought significant environmental benefits to the farm.

- Cover crops: all the vegetables are overseeded with crops such as cereal rye and Austrian winter peas. The rye saves them from having to fumigate the soil, as it controls pests such as nematodes, and the peas are a major source of nitrogen fixator. Both crops provide a protective cover on the easily erodible soils, as well as helping with the infiltration of water.
- Natural habitats: by allowing native grasses and dandelions to grow within the berry patches, beneficial insects are attracted to pollinate the flowers and prey on pests.

ACTIVITIES

5.4

Knowledge and understanding

1 Describe a market garden.
2 Explain why the demand for locally grown produce has risen in the United States of America.
3 Compare the operations of a market garden to a large, industrial farm.
4 Describe the changing nature of food production on Thompson Farms in recent decades.

Applying and analysing

5 Prepare a poster promoting Thompson Farms.

Investigating

6 Investigate a fresh produce market that operates in Australia. Conduct a survey of the types of fresh fruits and vegetables that are sold in the market and determine where they are grown. Present your findings in a brochure and include a map.

CHAPTER

6

FEEDING BILLIONS



Increasing population and consumption are placing unprecedented demands on agriculture and the earth's natural resources. Today, approximately a billion people do not have enough to eat, while our agricultural processes and other landuses are, in some cases, degrading the land, water resources, biodiversity and climate on a global scale. To meet the world's future food security, food production must grow significantly while, at the same time, agriculture's environmental footprint must shrink.

Strategies used to address the issue include halting agricultural expansion into areas now occupied by natural ecosystems, increasing yields on underperforming lands, increasing cropping efficiency and reducing waste. If done properly, these strategies could double food production while reducing the environmental impacts of agriculture.

In this chapter we study the capacity of the world's environments to sustainably feed the projected future population to achieve food security for Australia and the world.

KEY IDEAS

- To appreciate the implications of world population growth for global food production
- To understand the barriers to expanding food production
- To identify opportunities for increasing food production
- To understand the concept of sustainable agriculture, the strategies that can be used to restore the functioning of ecosystems, and the ways in which the adverse impacts of agriculture can be addressed

GLOSSARY

agrobiodiversity	a subset of general biodiversity that includes all forms of life directly relevant to agriculture: rare seed varieties and animal breeds; it also includes other organisms such as soil fauna, weeds, pests, predators, and all of the native plants and animals (wild biodiversity) existing on and passing through the farm
agro-energy	the production of renewable energies in agriculture
ecological footprint	a measure of the load imposed by a given population on nature
environmentalism	advocacy for, or work towards, protecting the natural environment from destruction or pollution
natural systems	cropping systems based on processes found in nature
net primary production	the capacity of the earth to support life through its biophysical processes
organic food	food that is produced using methods that do not involve the use of modern synthetic inputs such as synthetic pesticides and chemical fertilisers
perennial crops	crops that live for more than two years; with such crops, the inputs necessary to produce food are reduced; by eliminating the need to replant crops annually, perennial cropping can reduce topsoil losses resulting from erosion
perennial polyculture	the planting of multiple perennial crops in the same space, in imitation of the diversity of natural ecosystems, thereby avoiding large stands of single crops, or monoculture; examples are multi-cropping and intercropping
sustainable agriculture	environmentally friendly farming methods that preserve an ecological balance by avoiding depletion of natural resources

6.0 Row crop irrigation, California, United States of America

6.1 Population growth and food production

The growth of the human population has been accompanied and supported by substantial increases in crop and animal production. The extraordinary spike in food prices in 2008, however, raised people's awareness of a number of long-term trends that had been at work for decades and which threaten global food security. Securing future global food supplies will depend on our capacity to address these issues.

Feeding a growing population

While the rate of population growth has slowed, the number of people on earth is projected to continue to increase for most of this century and this will affect food availability.

Annual increases in population

Adding even more people to the planet and satisfying all their needs may well be at the expense of valuable agricultural land and involve the use huge amounts of water and energy, both of which are needed for the production of food. By 2050, agriculture will need to produce another one billion tonnes of cereals and 200 million tonnes of livestock products each year to feed everyone.

Population growth alone will push up the price of grain. Coupled with climate change, the trends are disturbing for the countries that grow the world's three most important food crops—wheat, corn and rice.

Increasing urbanisation

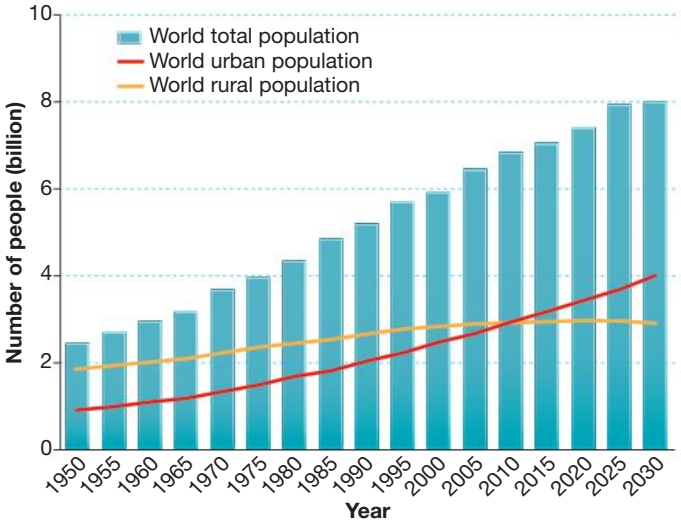
Figure 6.1 shows that the majority of the world's population now live in urban areas. In Latin America, Asia and Africa, the urban population will have doubled from between 2000 and 2025. Ninety-five per cent of future population growth will occur in the urban areas of developing countries.

So the movement of people from rural areas to towns and cities is a trend set to continue. As rural dwellers, many families grew their own food, but as urban dwellers they must rely on buying food grown elsewhere.

Trends in food production

With the number of malnourished people increasing in the world, future agricultural production is going to have to rise faster than the rate of population growth if global food security is to be assured. The potential for expanding food supplies may well be limited by some emerging trends.

6.1 The urban and rural populations of the world, 1950–2030



Source: World Vision, *Get Connected*, 2009

Environmental degradation

Land and water resources and the ways in which they are used are crucial to the challenge of achieving global food security. The resource base that supports food production has been put at risk by the rapid intensification of agriculture through mechanisation, irrigation and the application of agrochemicals. Land degradation and declining water quality and quantity have become issues of real concern, especially when agricultural productivity needs to be increased but is actually falling in many areas.

The need to address the adverse environmental impacts of agriculture and restore the functioning of the natural ecosystems that support crop and livestock production is

DID YOU KNOW?

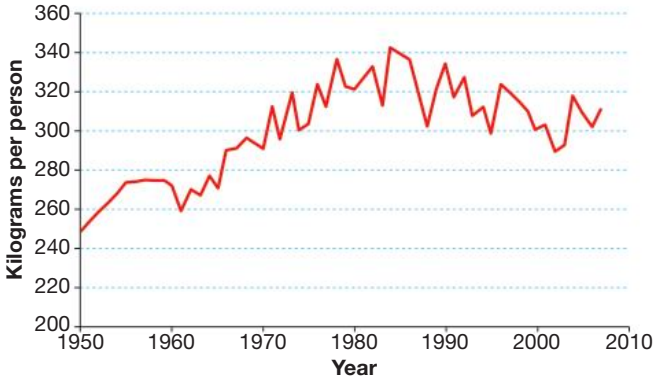
According to the FAO, the number of hungry people in the world has increased, with almost 870 million people chronically undernourished in 2010–12.

increasingly recognised. The idea that agriculture must be sustainable to meet human needs in the future is becoming widely accepted.

Trends in crop yields

The gains in global grain production per capita that resulted from higher yields from the Green Revolution started in the 1960s, plateaued during the 1980s, and have since been in decline, as can be seen in Figure 6.2. As a consequence, the global grain reserve has shrunk, and this triggered high prices and food riots in 2008. The slide in crop yield advances has continued and this does not bode well for future grain reserves.

6.2 Per capita world grain production 1950–2010



Source: F Magdof and B Tokar, 'Agriculture and food in crisis', *Monthly Review Press*, New York, 2010

Diversion of crops to other uses

Both traditional and newly emerging demands for agricultural produce are putting pressure on already scarce resources. By 2050, the global demand for food and fibre crops is anticipated to grow by 70 per cent, but increasingly crops may be used for bio-energy and other industrial purposes rather than food.

The rush to produce biofuels has been driven by the desire of governments in Europe and the United States of America to reduce their dependence on foreign oil. They have subsidised programs to grow corn to produce ethanol and soybeans for biodiesel. The competition for land and water resources that has arisen between crops for food and biofuels has resulted in scarcities and higher prices for food.

This represents a shift in landuse away from food production to **agro-energy**. It poses a risk to global food security as farmers seek higher monetary returns by using their land to grow the crops to make biofuels rather than to provide food. New arable land is also being used to provide for this rapidly expanding liquid biofuel industry. The grain that is used to produce biofuels in the United States of America in one year could feed 350 million people.

SPOTLIGHT

Inside the meat lab: the future of food

The Dutch government is funding food-innovation research into the production of artificial meat. Behind such research is a recognition that nine billion people cannot go on eating food, especially meat, produced in the traditional way. The planet just cannot take it. While consumers may be reluctant to eat artificial meat, ethical reasons could speed up its approval. Taking stem cells from a pig, rather than killing millions of pigs in abattoirs, may be more acceptable. Furthermore, it would take only 1–2 per cent of the land and water resources that pasture or grain-fed production of meat takes.



6.3 Dish of the day: breeding and mutating food species may be the only convincing plan anyone has for feeding the world.

Shortage of arable land

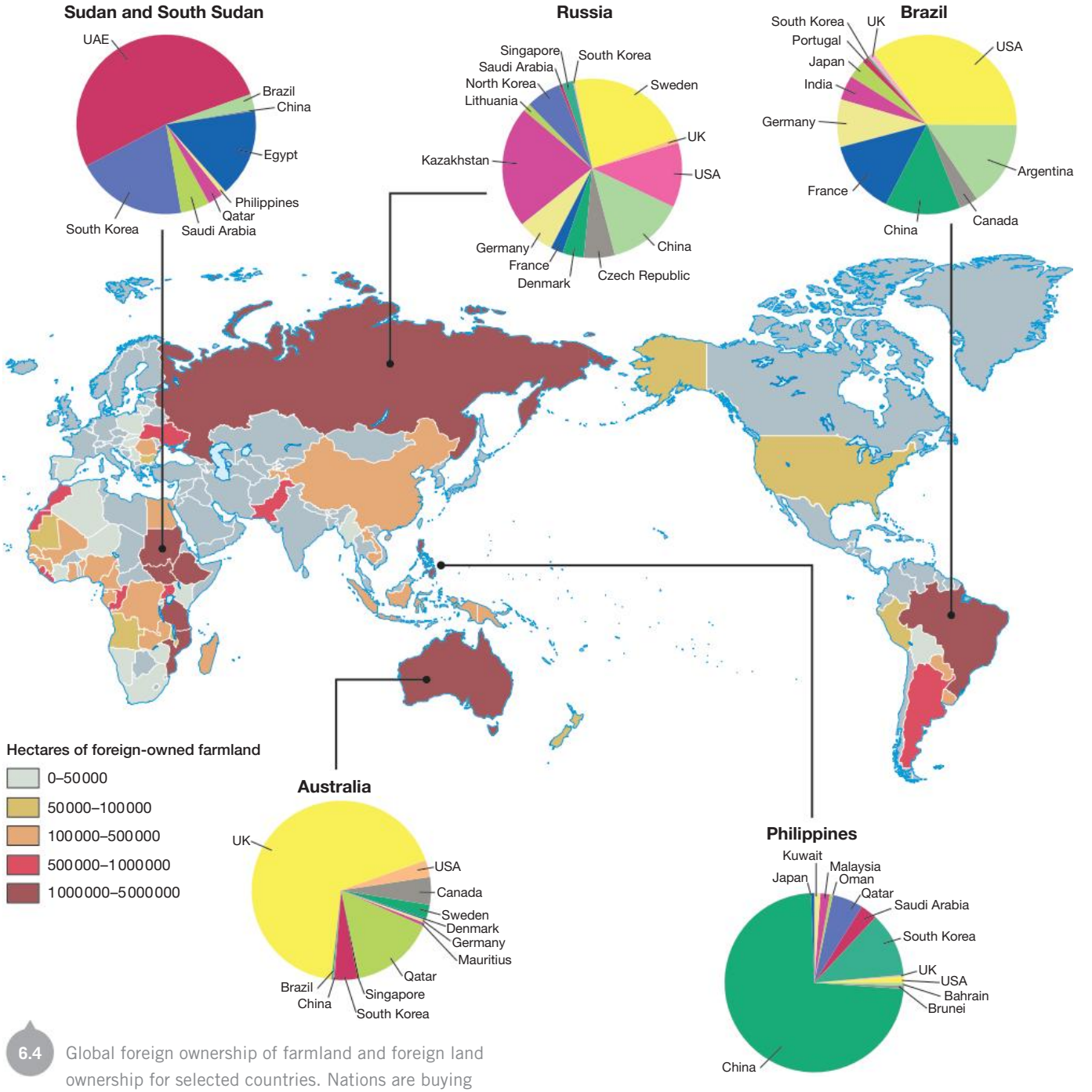
With most of the suitable agricultural land already in production there are growing concerns about having enough arable land available to secure food supplies.

The international scramble for land

A further pointer to approaching global land scarcity is the rate at which certain countries are now buying up land in others. China has proposed foreign land acquisition as a strategy, similar to its acquisition of global energy resources. China has land in Algeria and Zimbabwe. Saudi Arabia has purchased land in Ethiopia and is in negotiations with other Arab Nations to purchase over 400 000 hectares of farmland in Pakistan. The world land grab is shown in Figure 6.4.

Control of food production

Corporations, intent on maximising profits, are increasingly controlling all aspects of food production, from seeds and fertilisers to processing and distribution. The global trade in food commodities is now dominated by a few large companies. Small producers in developing countries face many trade barriers, such as tariffs imposed by the developed countries. The developing countries do not really get a fair return for their produce.



6.4 Global foreign ownership of farmland and foreign land ownership for selected countries. Nations are buying farms across the world to ensure access to biofuels and fibre production, and food security.

Source: Grain Org is original source of data. Grain Org gathers data by monitoring online sources about land deals.



6.5 As much as half of all the food produced in the world—equivalent to two billion tonnes—ends up as waste every year.

Waste of food

An unacceptable amount of food is thrown away. This often happens in households where the food simply spoils before it can be used. Australians waste more than $5 billion worth of food each year. Figure 6.5 provides a snapshot of common food wastage. The corporatisation of agriculture also generates a lot of waste, particularly with fresh produce—fruits and vegetables are rejected if they do not meet the exacting requirements of retailers, such as blemishes. Food is commonly discarded after its 'use-by date' is reached.

ACTIVITIES

6.1

Knowledge and understanding

1 Describe the pressure that population growth will put on global food security.
2 Explain how environmental degradation may affect future food supplies.
3 Describe how new demands for agricultural produce is affecting food production.

Applying and analysing

4 Create a PMI chart about the following statement: Artificial food must become acceptable if the human population is to adequately feed itself in the future.
5 Study Figure 6.4.
  a With the aid of an atlas, list the countries with the highest levels of foreign-owned farmland.
  b Compare foreign ownership in Australia, Philippines, Brazil, Russia, Sudan and South Sudan.
  c Can you suggest reasons for this pattern?

Investigating

6 Investigate the foreign acquisition of agricultural land in Australia. Present your findings in a feature newspaper article.

6.2 Potential for expanding food production

Today the world's population is well over seven billion. Estimates based on statistics from the United Nations Food and Agricultural Organization are that about 925 million people are malnourished—meaning that they do not receive enough food. The developed world, on the other hand, is facing a problem of obesity. While the population of the developing world continues to grow there is a need to expand global food production.

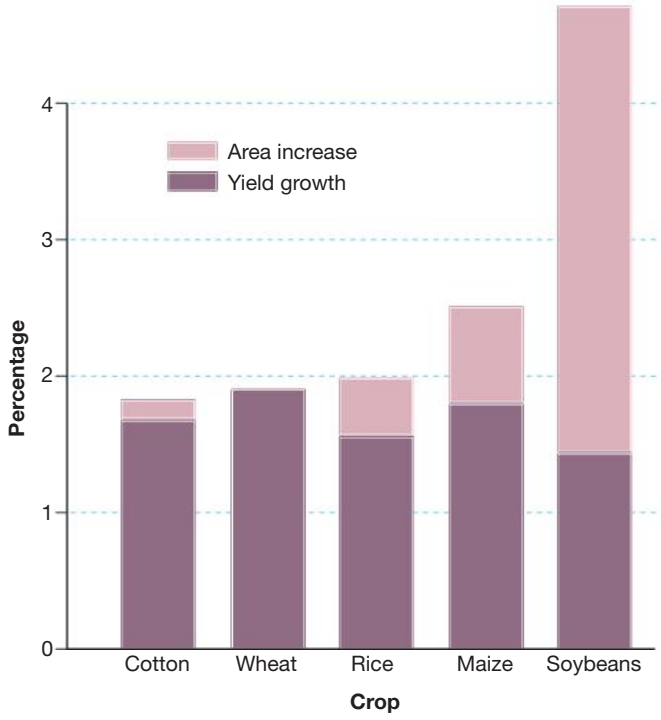
Meeting the needs of a growing population

In the period following World War II (1939–45) the world's population began to grow rapidly. There were fears that the world might run short of food but this did not happen.

In the 1940s, US scientist Norman Borlaug began research into improved agricultural techniques that would allow expanded food production. By the 1960s, Borlaug's research was being put into place around the world in what became known as the 'Green Revolution'.

Figure 6.6 shows the impact of the Green Revolution on production on the world's major crops throughout the second half of the twentieth century.

6.6 Impact of the Green Revolution on global crop production in the second half of the twentieth century



Expanding food production

The potential to expand food production in the twenty-first century is likely to come from four main factors:

- enhanced technologies—especially genetically modified (GM) crops and irrigation techniques
- improvements in the efficiency of growing meat
- decreasing food wastage
- dietary changes—especially reducing intake of animal-based food products, particularly meat and diary.

GM crops

Genetically modified food is one of the most debated issues in agriculture. Many scientists believe that it holds the answer to improving food production. Modifying the genes of plants can increase production by reducing the crop losses to pests and natural events, such as drought. However, many people fear the environmental consequences and unintended health effects of such modifications.

Meat

Meat is an increasingly important source of protein for much of the world's population. However, meat is a fairly inefficient source of food production, as it requires considerable inputs in the form of land, water and energy. Improving the efficiency of these inputs will enable an increase in meat production. For example, some agricultural scientists believe that by more intensively using aquaculture (fish farming, as shown in Figure 6.7), we can eat more fish protein, which tends to grow more efficiently than traditional meat sources such as cattle and pigs. A more radical proposal put forward by some groups is to promote a vegetarian diet, or at least one that contains less meat and other animal-based products.

Reduced waste

In 2013, a study conducting by the British Institution of Mechanical Engineers found that almost half of all the food produced in the world is wasted. Figure 6.8 provides an example of enormous food wastage. A study in New South Wales found that on average families throw away more



6.7 Intensive farming, like these fish farms, offers possibilities for increasing protein production.

than $1000 worth of food each year. Reducing the amount of wasted food is a simple but highly effective strategy for ensuring the world has enough food. Education programs designed to help consumers preserve and conserve food are being developed in many countries. There is also pressure on food producers to reconsider their labelling regimes. Many people argue that producers place unnecessarily short 'best before' dates on food in order to promote more sales by having consumers and retailers throw away the food more quickly than is required. In many countries, charitable organisations collect food from retailers to distribute to communities in need rather than allow it to be thrown away.

Changing diets

Meat and dairy production uses resources such as water and fodder. Fields are being used to grow grains to feed animals; these fields could be used to grow crops consumed by people. There are also negative environmental outcomes from animal farming, such as the methane gas produced by cattle, which accounts for about 20 per cent of the world's methane.



6.8 This tomato mountain in Tenerife was created after the price of tomatoes fell below the cost of exporting them from the islands.

ACTIVITIES

6.2

Knowledge and understanding

1. Explain why increasing food production is so important.
2. Describe the Green Revolution.
3. Describe the strategies proposed for meat production.
4. Outline the extent of food wastage.
5. Describe the strategies proposed to reduce food wastage.

Investigating

6. Copy and complete the following table.

	Advantages	Disadvantages
GM crops		
Meat—become a vegetarian		
Reduce consumption		
Reduce waste		

Geographical skills

7. Study Figure 6.6 then answer the following questions.
   - a By what percentage did rice and wheat production increase between 1965 and 2008?
   - b How much extra land was being used for soybean production by 2009?
   - c Describe the relationship between increased yields and land used.

6.3 Barriers to increasing world food production

The United Nations predicts that by 2050 an extra 1.5 billion people will need to be fed. While the supply of food around the world has steadily increased, there are limits to how much food the world can produce.

Use of chemical agents

During the 1950s and 1960s there was a massive increase in the use of chemical agents in agriculture, as shown in Figure 6.9. Pesticides, chemical fertilisers and herbicides were all widely used, allowing food production to boom. However, many of these chemicals had disastrous side-effects. For example, the chemical DDT (dichlorodiphenyl-trichloroethane) was used to control insect pests throughout the world. But DDT poisoned wildlife and is suspected of causing a number of cancers, which led to many countries banning its use. The extensive use of chemicals to control pests has also led to many insect and weed species becoming increasingly resistant to chemicals. This has the potential to decrease food production, as pests reduce productivity.



6.9 The extensive use of chemicals to control pests has led to many pest species becoming resistant to the chemicals.

Changing attitudes

In addition to earth's systems simply not being able to support an ever-increasing human population, there are also important social factors that act as barriers to increased food production: the rise of **environmentalism** and the **organic food** movement.

SPOTLIGHT

Net primary production

Net primary production refers to the capacity of the earth to support life through its biophysical processes, for example through the capacity of soils to support plants growth. Human appropriation of net primary production (HANPP) is a measure of the extent to which humans have taken over the earth's systems to support themselves. Estimates of HANPP vary widely. Some studies have found that it is as high as 83 per cent while others put it as low as 35 per cent. Most researchers, however, believe that it is 50–60 per cent of the total net primary product of earth.

Even at the lowest estimate, the extent to which humans are consuming the world's resources is staggering, leaving less and less for the rest of the planet's species. Ultimately there is a limit to HANPP—and that limit is approaching. The world's fish stocks are an example. Over the last few decades the total number of fish caught has been in steady decline, despite the fact that fishing technology has improved considerably. There are simply fewer fish to catch, as humans have overfished many key species and fishing grounds.

Rise of environmentalism

Since the second half of the twentieth century there has been an increasing awareness of the impact of human activities on the earth's environment. This awareness has meant that society expects the needs of the environment to be considered along with the need for increased food production. For example, here in Australia the percentage of water available for irrigation has gradually declined in recent years as the need of river ecosystems for the water—environmental flow—has become more apparent. Many communities in the irrigation districts of the Murray–Darling Basin have argued that as environmental flows are increased, their capacity to grow food has declined. Environmentalists argue that without the environmental flows the entire river system could collapse.



6.10 Overfishing has seen global fish stocks decline. The total number of fish caught globally is in decline.

Organic food movement

Many scientists believe that modifying the genes of major food crops to increase their yields could be the answer for increasing world food production. However, there are considerable social barriers to this. Many people fear that genetically modified food may cause disease and other problems in the same way that chemicals such as DDT did in the past. Figure 6.11 shows a Greenpeace protest against the production of genetically modified foods.



6.11 Anti-GM protest, Berlin

ACTIVITIES

Knowledge and understanding

1. Explain how food production was increased throughout the second part of the twentieth century.
2. Outline the cause of chemical resistance among pest species.
3. Describe the concept of net primary production.
4. Explain why environmentalism can be seen as a barrier to world food production.

Applying and analysing

5. As a class, discuss the concept of whether humans have the right to appropriate net primary production. What are the implications of this for the world? Following your discussion, write an exposition outlining your views on the topic.
6. With a partner discuss the following topic: Feeding the world's population is more important than protecting the environment. List the views that you and your partner discussed.

6.4 Sustainable agriculture

Sustainability is central to the future of food production because it has as its aim the meeting of the needs of the present generation without compromising the ability of future generations to meet theirs. This involves farmers understanding the ecological processes that support their production of crops and livestock, and working with nature rather than against it.

Importance of sustainable agriculture

Sustainable agriculture involves growing crops and raising livestock in ways that mimic and support natural ecological processes. It uses farming practices that utilise organic fertilisers and biological pest controls, as well as minimising disturbance of the land surface, water use and the reliance on non-renewable fossil fuel energy.

The future of agriculture and the ability of the world's food system to provide food security for a growing population are closely linked to the improved stewardship of natural resources. Major reforms and investments are needed in all regions to cope with rising scarcity and degradation of land, water and biodiversity, with added pressures resulting from rising incomes, climate change and energy demands. There is a need to develop and implement the incentives needed to harness agriculture's environmental services, to protect watersheds and biodiversity, and to ensure food production using sustainable technologies.

More sustainable production

The world faces some serious long-term challenges to food production. These come from limits to the resources that support it, including land and water, as well as energy. The onset of climate change adds even more uncertainty. What is clear is that a strong natural resource base is crucial to the planet's capacity to produce food. This productive capacity must be maintained in order to provide the food security necessary for future generations.

Environmental costs of industrial agriculture

The main environmental impacts of industrial agriculture come from the conversion of **natural systems** to agricultural production systems. Modern industrialised agriculture is considered unsustainable because it violates a number of important principles that are considered fundamental to ensuring the future well-being of humans.

- It relies heavily on the use of fossil fuels to power farm machinery and for transport and food processing. Many of the agrochemicals that are used are petroleum-based. This adds greenhouse gases to the atmosphere, which is driving climate change.
- It reduces biodiversity, as natural habitats are cleared for farming. **Agrobiodiversity** is also being lost, which will limit the potential strains of crops that may be needed in the future, especially as climate change affects agriculture.
- As crops are harvested and removed for consumption elsewhere, the cycling of plant nutrients back to the topsoil is halted. This results in the need to use artificial fertilisers to support continued cropping.

Sustainability experts agree that future food supplies can only be assured if there is a determined shift to more low-input agricultural systems over the next few decades. Figure 6.12 lists the major components of more sustainable agriculture. Compared to the high-input industrial farming, low-input agriculture uses less energy per unit of yield and has lower carbon dioxide emissions. It also lifts topsoil fertility, can often be more profitable for the farmers and is especially helpful to poor farmers trying to feed themselves.

Sustainable farming practices

Sustainable agriculture is an approach to managing farming practices that will protect and enhance the resource base of the biophysical environment, thereby enabling continued productivity. This generally occurs through small-scale diversified farming systems that imitate nature and therefore need fewer inputs from outside the farm. It involves:

- minimal soil disturbance
- permanent ground cover
- a variety of crop/pasture species grown in rotation and/or association to retain soil fertility and guard against pests and weeds.

Sustainable agriculture encompasses a wide range of techniques, including organic, free-range (increasingly popular in egg production), low-input and biodynamic farming.

6.12 More sustainable low-input agriculture is based mainly on mimicking and working with nature.

Organic farming

Organic farming emphasises a holistic farm management approach, the benefits of which are shown in Figure 6.13. Crop rotations and animals play an important role in the production system. This approach to farming involves growing crops without any synthetic pesticides, synthetic fertilisers or genetically modified seeds. Livestock are raised without any feed additives or synthetic growth promoters.

More	• high-yield polycultures • organic fertilisers • biological pest control	• integrated pest management • efficient irrigation • perennial crops	• crop rotations • water-efficient crops • soil conservation	• subsidies for sustainable farming
Less	• soil erosion • soil salinisation • water pollution	• aquifer degradation • overgrazing • overfishing	• loss of biodiversity and agro-biodiversity • fossil fuel use	• greenhouse gas emissions • subsidies for unsustainable farming







Source: G Tyler Miller and C E Spoolman, *Living in the Environment*, 2012

6.13 Benefits of organic farming

Organic farming	• improves soil fertility • reduces soil erosion • retains more water in soil during drought years	• uses about 30 per cent less energy per unit of yield • lowers CO_2 emissions	• reduces water pollution by recycling livestock wastes • eliminates pollution from pesticides	• increases biodiversity above and below ground • benefits wildlife such as birds and bats







Source: G Tyler Miller and C E Spoolman, *Living in the Environment*, 2012

SPOTLIGHT

Ladybirds—friends to farmers

Ladybirds help farmers protect crops, as they consume plant-eating insects such as aphids. On organic farms, planting systems can place suitable habitat for ladybirds on the edges of paddocks. The ladybirds have been known to travel over 80 metres into adjacent crops to feed on insects. Field tests have demonstrated the benefit of strip harvesting a crop rather than clear-cutting an entire field. Strip harvesting leaves part of the plant behind, which the ladybirds can then feed on. This allows the ladybirds to survive.

Fertility and pest control

The fertility of the soil is enhanced with manure, compost or nitrogen-fixing legumes that replenish the soil in crop rotations. Harmful pests are kept at bay by planting crops that repel harmful bugs or attract good bugs, which then eat harmful bugs, as shown in Figure 6.15.

6.14 Ladybirds are a good insect to have within a crop. As soon as ladybirds hatch they begin to feed, taking out 5000 aphids in their brief 3–6 weeks of life.





6.15 Fennel is planted alongside other crops to ward off insects and rodents that are deterred by its smell.

How to feed a hungry world sustainably

The real challenge in coming decades is going to be how to expand agricultural output on existing agricultural land. The critics of industrial agriculture insist on a return to low-input, small-scale agriculture, but to do so would most likely lead to mass starvation. The reality is that both types of agricultural production are needed in order feed the world through the mid-century peak in food demand.

High-input agriculture will be necessary to grow the far bigger volumes of food for the huge urban-based populations. Low-input agriculture will not be able to achieve the higher yields in the staple grain crops that will be needed. However, there are a billion subsistence farmers in developing countries who could improve their output using organic farming. A 2008 study by the United Nations Environment Programme surveyed 114 small-scale farms in twenty-four African countries and found that yields more than doubled when organic farming practices were used.

The way forward may be a sustainable intensification of agriculture that makes more effective use of land and water resources without causing them any harm. This will require agricultural research into crop varieties that provide higher yields using fewer inputs such as water and fertiliser. Innovations used in precision agriculture are a move in the right direction to address adverse environmental impacts.

ACTIVITIES

Knowledge and understanding

1. Define the term 'sustainable agriculture'.
2. Outline the main principles that modern industrialised agriculture violates.
3. Describe the approach of organic farming.

Applying and analysing

4. Create a PMI chart about organic agriculture.

Investigating

5. Insectory plants are those that attract insects such as ladybirds. Investigate the role of insectary crops. Prepare an annotated visual display of a selection of such crops.
6. Investigate one of the following types of sustainable agriculture: free-range, low-input or biodynamic farming. Prepare a feature article for a rural publication to inform farmers about the benefits of this type of agriculture.

6.5 The environmental impacts of agriculture

The shift towards large-scale industrialised agriculture in the search for higher yields has damaged the environment, thereby restricting the resource base that supports it. The implications of this damage for the security of the global food supply is obvious and has prompted efforts to repair the damage done by agriculture and the development of strategies for making it more sustainable.

Threatened ecosystem

Many of the earth's natural resource bases show worrying signs of degradation. According to the Millennium Ecosystem Assessment, fifteen out of twenty-four ecosystem services examined are already being degraded or used unsustainably. These include the world's fisheries and water supply. In addition, actions to intensify other ecosystem services, such as those associated with food production, often cause the degradation of others. Soil nutrient decline, erosion, desertification, depletion of freshwater reserves, loss of tropical forest and declining biodiversity are clear indicators. Unless investments in maintenance and rehabilitation are increased and landuse practices made more sustainable, the productive potential of land, water and genetic (the diversity of plant and animal life) resources will continue to decline at alarming rates.

Environmental management

In too many places, increased production has been coupled with management practices that have degraded the land and water systems on which the production depends. Exposure of the damage done by chemical pesticides was a major factor in the rise of the environmental movement. Modern agriculture has moved well beyond the practices of industrialised agriculture that were justifiably criticised in the 1960s and the worst of the chemicals have been banned. They have been replaced by chemicals that are just as effective when applied at lower concentrations and are less persistent in the environment. Today, many chemicals are inert once they hit the ground. Total chemical use on farms in the United States of America peaked in the 1970s and has since declined.

Innovations that reduced the environmental impact of agriculture gained momentum during the 1970s and have continued to be developed. Responsible farmers embrace the importance of addressing the adverse impacts of their practices because they realise that the success of their future production lies with the ability of their land to continue supporting crops and pastures. Without such awareness their profits decline and the viability of their farms is put at risk.

Repairing the damage

Reducing the impact of agriculture on the wider environment has involved the adoption of farming techniques that protect soil cover and return its fertility, as well as using water resources efficiently and not loading them with pollutants.

Land used for agriculture must have fertile topsoil, which takes thousands of years to form. So the single most important aspect of achieving more sustainable agriculture is to stop soil erosion and repair the land. Soil conservation strategies include a variety of measures that reduce topsoil erosion by slowing down the rate of flow of water that carries away the soil particles, as well as helping retain the water within the soil for the crops to use (see Table 6.16).

DID YOU KNOW?

Precision agriculture in the future might involve small solar-powered robots moving through the paddocks digging out weeds, picking off insects and harvesting crops, without needing any agrochemicals or fossil fuels.

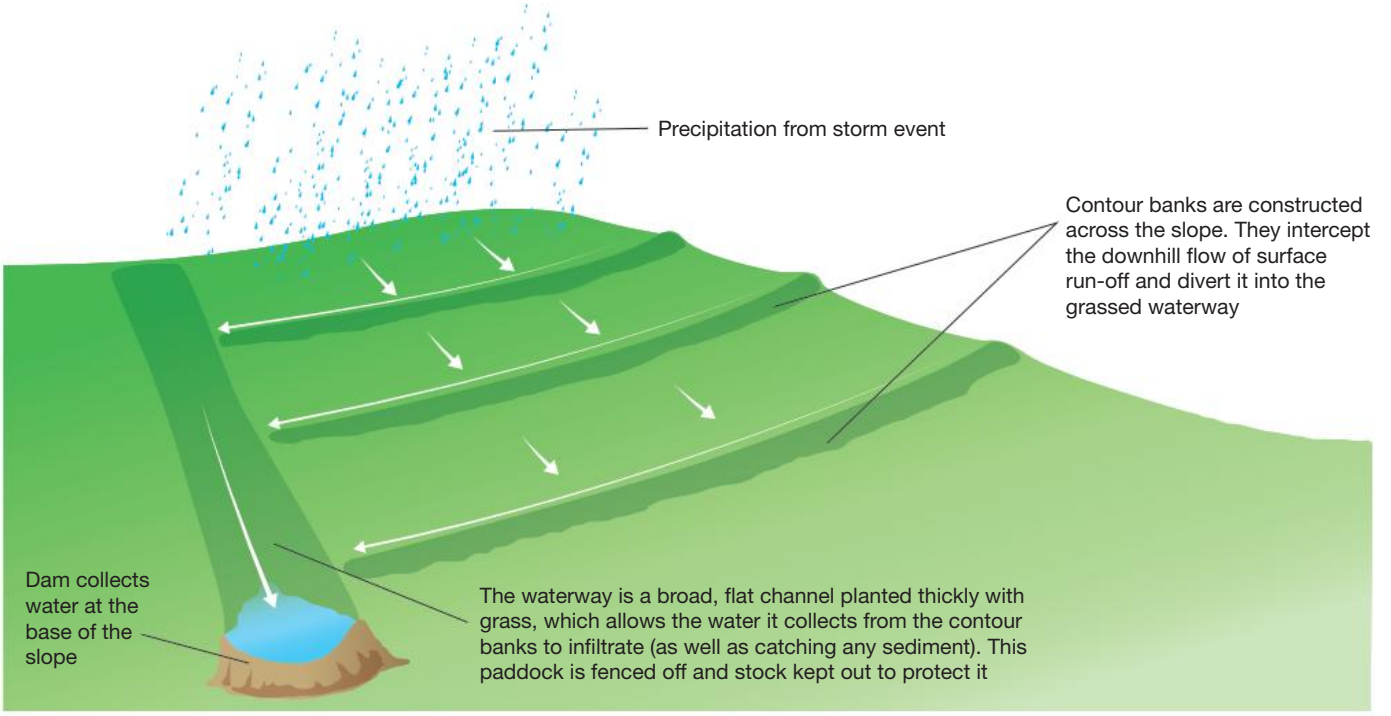
SPOTLIGHT

The greening of agriculture

The 'greening' of agriculture does not rule out technologies or practices on ideological grounds. If a technology works to improve farmers' productivity and does not cause undue harm to society and/or the environment, then it is very much part of the efforts for making agriculture more sustainable. Although natural methods of pest and weed management are an example of 'green' agriculture, the highly efficient and precise use of inorganic fertilisers, pest controls and technological solutions may also be included in the broad range of sustainable farming practices. So the greening of high-input agriculture, which has a high **ecological footprint**, could start by making use of inputs that are the most precise and efficient, gradually moving towards farming practices that have low or no ecological footprint.

6.16 Conservation strategies used to repair and protect the land used for agriculture

Conservation strategies		
Terracing		Terracing enables steep slopes to be cultivated by converting the slope to a series of broad, nearly level steps that run across the contour of the land. Small banks on the outer edge of each terrace also catch the water and retain it for the crop to use.
Contour planting		Running water can quickly cut into and erode a slope if it runs straight downhill. Ploughing and planting a crop across the slope following the contours of the land helps to slow run-off and reduce erosion. Farmers also construct contour banks that effectively divert the water across the slope. The water runs into broad flat, grassed waterways that safely discharge the water into a dam at the bottom of the slope.
Strip cropping		Strip cropping involves planting alternating strips of crops in various stages of growth. When one crop is harvested, or the soil is cultivated for planting, another crop that covers the ground will catch excess water running off. This will then infiltrate the ground and the plant cover will trap any soil particles being carried along by the water. The inclusion of nitrogen-fixing cover crops lifts soil fertility.
No-till farming		When crop residue or stubble is left lying on the ground after harvesting, it not only holds onto the topsoil, but also as it decomposes it returns nutrients to the soil. New technologies enable the farmer to direct-drill the seeds into the undisturbed topsoil without any cultivation or tilling, which leaves the land bare to wind or water erosion. No-till farming also reduces water pollution from sediments and agrochemicals in solution that may flow off unprotected, ploughed paddocks.
Alley cropping		With alley cropping, one or more crops are grown together in rows or alleys between orchard trees or fruit-bearing shrubs. The trees provide shade, help retain water and provide mulch and nutrients for the crops.

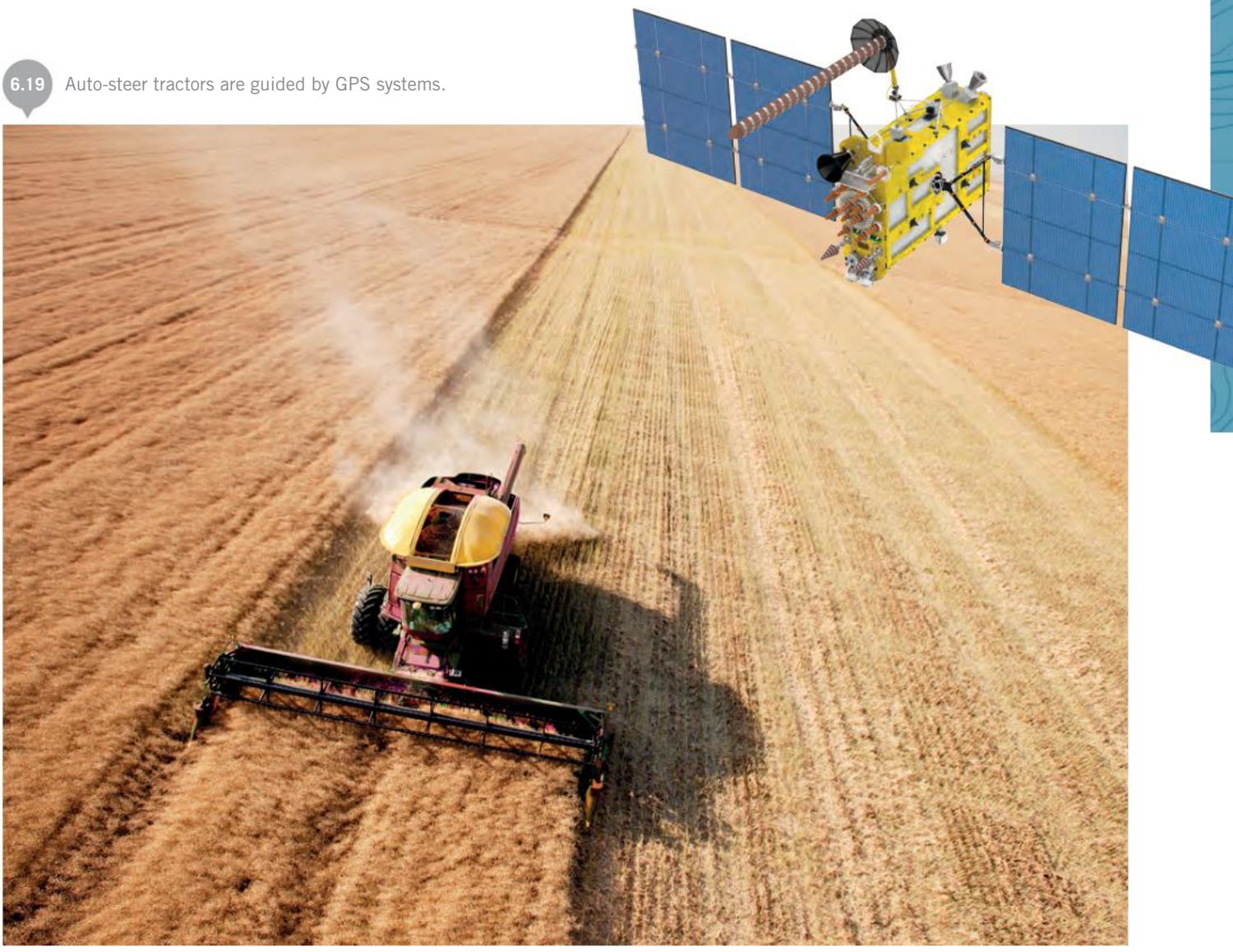


6.17 Contour banks are constructed across a slope to conserve soil and water resources.

6.18 Selected evidence on benefits and costs of soil management strategies

Strategy	Crop and country	Costs	Benefits	Trends in revenues and profits after including additional costs of greening
Use of nitrogen-fixing fodder and cultivating green manure	Cultivation of maize in Spain and rice in India, Indonesia and Philippines.	Costs varied depending on methods and country. Rice straw use (for green manure) costs ranged from US$18/ha in Indonesia and Philippines, to $US40/ha in India. Azolla (type of fern) for nitrogen fixing and green manure meant additional costs ranging from US$34/ha in India, to US$48/ha in the Philippines.	Maize crop yields increased approximately 40% in the first year, 5% in the second year and 20% in the third year. No significant increases in yields were observed in rice crops compared to the use of inorganic fertilisers but resulted in long-term soil improvements. Maize crop yields increased after the first year, by 28%, 30% and 140% in the last 3 years of the study. No impact was seen on soybean crop yields.	Revenues increased even though there was no difference in the costs of using green manure or inorganic fertiliser for rice crops.
No-tillage practices	Maize in Mexico, wheat in Morocco and cereal grain crop in England. Sorghum and maize in Botswana. Maize, sorghum and cowpea in Nigeria. Soybean in Australia.	The capital costs for a small-scale no-tillage planting system are estimated to be US$25 000 to $50 000. No-tillage system was cheaper by US$156/ha when rented from a contractor in England, compared to renting tilling systems. In Botswana, cost per household of tractor was US$218.	Maize yields increased by 29 per cent; wheat yields by 44 per cent. No impact on total cultivated areas, crop yields and total crop output in traditional tillage systems vs. animal power or manual usage (Botswana and Nigeria). An average yield increase in soybean yields of 27% over 14 years in no-tillage vs. till systems.	No-tillage systems are economically profitable, even after incorporating the costs of no-tillage systems.
Biochar use	Cultivation of maize intercropped with soybean (Columbia) and wheat (USA).	Biochar production costs range between US$87 and 350/tonne depending on source of inputs and mode of production.	Maize crop yields increased after the first year, by 28%, 30% and 140% in the last 3 years of the study. No impact was seen on soybean crop yields.	In the USA, wheat production increased sufficiently to generate a profit of US$414/acre, but only while using low-price biochar. Higher-cost biochar reduced profits.

6.19 Auto-steer tractors are guided by GPS systems.



Farming strategies

Figure 6.17 illustrates different strategies used by farmers to repair the land and conserve both water and soil resources. Evidence of the benefits and cost of such soil management strategies can be seen in Table 6.18.

Precision farming

Improvement in food security across the world will come from the sustainable intensification of agriculture on existing land. It will involve practices that make effective use of land and water resources without causing any damage. Environmental gains have been made by the emergence and acceptance of low-impact and precision farming. Practices such as drip-irrigation systems in laser-levelled fields, where peizometers (soil probes) are linked to computers that switch them off when optimum soil water levels are achieved, have improved water efficiency and prevented excess run-off. Infra-red sensors that assess the greenness of a crop enable farmers to then apply the correct amount of additional fertiliser needed.

ACTIVITIES

6.3

Knowledge and understanding

1 Assess the state of the resource base that supports agriculture.
2 Explain why concern for the environmental impact of agriculture arose.
3 Describe how this affected the use of fertiliser.
4 Identify the most important aspect of sustainable agriculture.

Applying and analysing

5 List the arguments for and against the following statement:
Agricultural production should return to natural methods that do not harm the environment.
6 Study Figure 6.16 and then draw photo sketches of each of the conservation strategies. Annotate each sketch to show how they are designed to conserve soil and water resources.

6.6 The restoration of ecosystems

Increasingly, research is being undertaken into developing agricultural systems that will function more like the natural ecosystems they displaced. In doing so, farming practices must work with the natural processes upon which they depend and not compromise the delicate balances that sustain both productivity and biodiversity.

Annual crops

When humans started cultivating wild plants 10 000 years ago they went for annuals, as they were fast-growing and, importantly, had large seeds. Since then, the seeds of the most productive plants have been replanted year after year. Now, all the grains that feed billions of people—wheat, rice, corn and soybeans—come from annual plants. They only last for a single season, as they will not regrow after the grain has been harvested and seeds must be resown to regenerate new plants every year.

While annual varieties have given big yields, the land used for growing them has suffered since agriculture began. Conventional methods of planting seeds for a new crop require the ground to be broken up, using ploughs, to create a fine seedbed. Every time a paddock is ploughed to plant an annual crop (and also when the crop is harvested), the land is left unprotected, and valuable topsoil is washed or blown away.

The problem is made worse by the shallow root systems of annuals. They occupy only the top 0.3 metres of the soil and die after harvest. The top layer of the soil is quickly depleted of nutrients, forcing farmers to apply large amounts of fertilisers to maintain yields. The plants usually take less than half of this up, with the rest washing into waterways. Annual crops need the frequent input of many resources to remain productive and fend off pests and diseases. Such agriculture is heavily dependent on fossil fuels, not only to power farm machinery, but also to manufacture many of the petroleum-based fertilisers and agrochemicals.

Reinventing agriculture

There is growing recognition of the merits of developing grain-cropping systems that will function much more like the natural ecosystems that agriculture displaced. The push is coming from agronomists, plant breeders and ecologists, who are seeking a more ecologically sustainable approach to agriculture that works with, rather than against, nature.

Maintaining annual monoculture is the problem in many places, and the solution may lie in restoring the functioning of ecosystems. This involves copying nature by growing a variety of **perennial crops** in diverse ecosystems that replicate nature. The key to sustainable food production may involve developing grain-cropping systems of perennials that can live for many years and develop deep root systems.

Perennial grains

Perennials may start off at a disadvantage when compared with annuals, as there is little to be harvested in the first year. Once they become established, however, the benefits soon become evident, as illustrated in Figure 6.20.

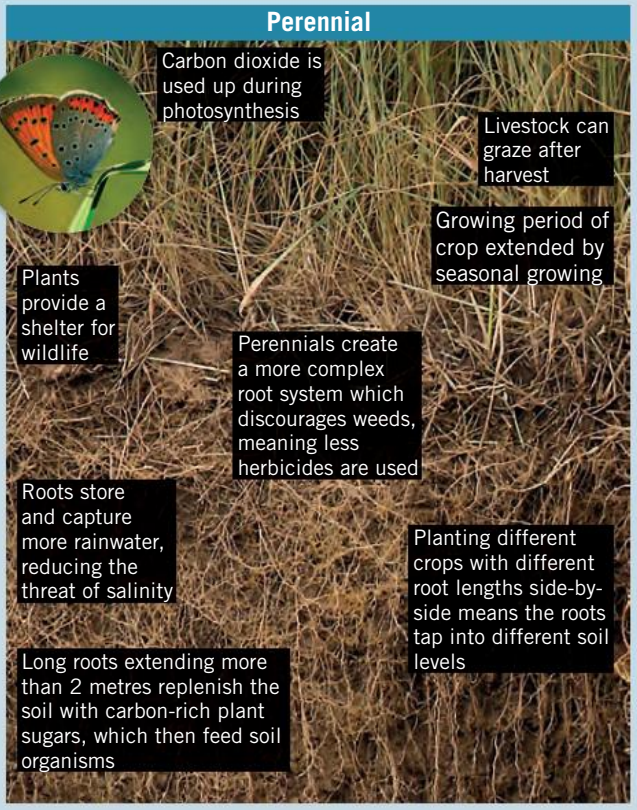
- They have deep root systems that protect soils. The massive underground root mat can extend to over 2 metres below the ground. This holds the soil particles in place and increases the infiltration of water. As perennial plants are long-lived, the land surface remains covered with vegetation and does not have to be ploughed for planting each year.
- They are efficient managers of water and nutrients. Perennials can capture both water and nutrients to a great depth, enabling the plants to cope with weather extremes. The roots host numerous micro-organisms that are critical to maintaining a healthy soil, as can be seen in Figure 6.21, and restore efficient nutrient cycling within the ecosystem.
- They exclude weeds and pests. As weeds find it difficult to get a hold in the dense cover of plants, herbicides are generally not needed. With the diversity of plants there is not a proliferation of the pests that are attracted to monocultures.

Ongoing research

The idea that the future of farming may well lie in returning to cropping that mimics natural ecosystem functioning using perennial crops is decades old, however it is still in the experimental stage. Significant advances are being made in the plant-breeding science to improve the yield of different varieties of perennial crops.

SUSTAINABLE FARMING: NEW VS NOW

The following diagrams compare growing a perennial grain crop (left) and annual wheat (right). By growing perennial crops farmers can use resources more effectively and be more productive in the long term. While annual, short-lived and short-rooted crops result in water and soil nutrient loss; perennial crops benefit their ecosystem.



6.20 Sustainable farming: new vs. now



6.21 Roots in the soil sample on right, collected more than 1 metre deep in a meadow of perennial prairie plants, feed the soil's many living organisms. The teeming life in turn builds dark healthy soils. The lighter soil on the left was collected at the same depth from an adjacent annual crop field.

ACTIVITIES

Knowledge and understanding

1. Define both annual and perennial crops.
2. Explain why the first farmers chose to domesticate annual plants.
3. Outline why the cultivation of annual crops may be responsible for the problems being experienced in current agriculture.

Applying and analysing

4. Study Figure 6.20 and assess how each approach to agriculture supports ecosystem functioning.
5. Why do you think large agribusinesses that produce seeds, fertilisers and agrochemicals oppose the development of perennial crops? Should more government funding be directed toward researching such sustainable technologies?
6. Conduct a class discussion before writing a letter to the editor of a national newspaper with your opinion of perennial cropping and its place in modern agriculture.

6.7 Case study: Perennial polyculture

The Land Institute is a research organisation in the United States of America focused on developing new kinds of agriculture that mimic ecosystem functioning. Researchers are developing new varieties of high-yielding perennial grain crops that can be grown within ecosystems similar to the original prairies where such grain-producing grasses originated.

SPOTLIGHT

Roots of the problem

... In the 1970s, Kansas plant geneticist Wes Jackson took a 10 000-year step into the past to compare agriculture with the natural systems that preceded it. Before humans boosted the abundance of annuals through domestication and farming, mixtures of perennial plants dominated nearly all the planet's landscapes—as they still do in uncultivated areas today.

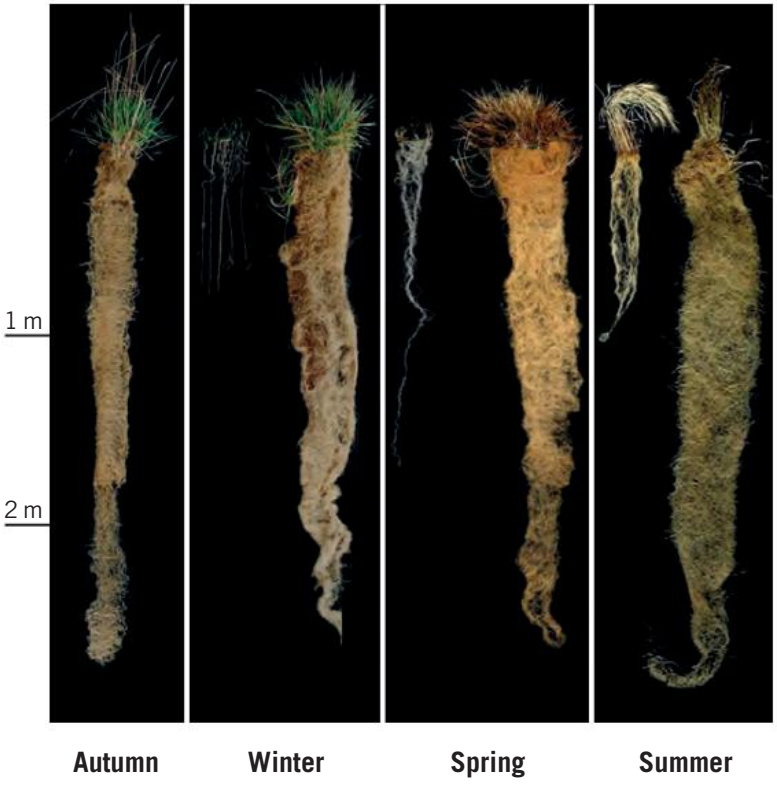
Jackson observed that the perennial grasses and flowers of Kansas's tall-grass prairies were highly productive year after year, even as they built and maintained rich soils. They needed no fertilisers, pesticides or herbicides to thrive, fending off pests and diseases. Water running off through the prairie soils was clear, and wildlife was abundant.

In contrast, Jackson saw that nearby fields of annual crops, such as maize, sorghum and wheat, sunflowers and soybeans, required frequent and expensive care to remain productive. The fields were mostly barren of wildlife. Sustaining annual monocultures in so many places was the problem, and the solution lay beneath Jackson's boots: hardy and diverse perennial root systems.'

Source: J D Glover, C M Cox and J P Reganold, 'Future Farming: A Return to Roots?', *Scientific American*, 2007

THE LAND INSTITUTE

6.22 Logo of the Land Institute



6.23 Perennial plants such as intermediate wheatgrass (at right in panels) have roots that extend to much greater depth than do the roots of annuals such as winter wheat (at left in panels).

Developing perennial grain crops

The Land Institute (see Figure 6.22) was co-founded in 1976 by Wes Jackson in Kansas with the goal of making agriculture more sustainable by stopping soil erosion. This approach to agriculture was built on the recognition of the role of perennial plants in anchoring the soil. An example of this is illustrated in Figure 6.23. **Perennial polyculture** is an agricultural system in which a diverse mixture of plants is dominated by edible perennial crops, which seek to reflect the diversity and plant structures of the natural prairie ecosystem.



6.24 Plant breeding trials in a Land Institute greenhouse

The research conducted by the Land Institute involves transforming conventional annual crop species into perennials through breeding programs in test plots and greenhouses, such as the one shown in Figure 6.24. It is a lengthy process and it may take decades to create high-yielding perennial crops.

The Land Institute collaborates with scientists working in a number of universities, both in the United States of America and throughout the world, in countries such as Canada, Argentina and Australia. They are currently focused on four main grains: wheat, wheatgrass, sunflower and sorghum, and plan to add corn and soybeans in the next decade. The Institute is also assisting the Yunnan Academy of Agricultural Sciences in south-west China with research into perennial rice varieties.

Changing the way food is grown

There are many difficulties in increasing agricultural production in order to feed the world's growing population. Throughout history there have been many civilisations that have collapsed largely because of the failure of their agricultural systems to continue to produce enough food.

The Land Institute believes that a new kind of agriculture can break away from this pattern. It is called 'natural systems agriculture' and the research agenda regards nature as the standard, or the measure, on which to base decisions in agriculture. The Land Institute wants to change the way the world grows its food.

For too long, agricultural practices have depleted ecosystems and interfered with their functioning. As problems have arisen, there has been a patchwork of responses to try to fix them. What this new approach promotes is having nature as the focus for decision making on farms. It requires recognition of how ecosystems build their natural wealth over time and how they efficiently sustain themselves. Natural systems agriculture produces food while protecting biodiversity.

What is significant about perennial polyculture is that it may enable marginal and even hilly land to be brought into food production, as the risk of erosion is removed. Perennial crops are also hardier and, with their deep roots systems, they are more able to cope with the increased droughts or deluges that may accompany climate change. This may well become increasingly important in the future.

ACTIVITIES

6.4

Knowledge and understanding

1. Define the term 'perennial polyculture'.
2. Describe the research being conducted by the Land Institute.
3. Explain how adoption of the Land Institute's natural systems agriculture would change the way the world grows its food.

Applying and analysing

4. Study Figure 6.22. Write a paragraph on your impression of what the Land Institute's logo represents.
5. Construct an issues map to identify the different perspectives that relate to monoculture and perennial polyculture.
6. Study Figure 6.23 then do the following tasks.
   - a Compare the root mass of the wheatgrass to that of the winter wheat.
   - b What do you notice about the summer panel? Why is this so?
   - c Explain the benefits of growing wheatgrass compared with wheat.

Review and reflect 2

Activity 1

Wetlands under threat

A developer wishes to construct a large resort on land now partly occupied by a freshwater wetland (AR0581). The resort will include a hotel, golf course, marina and housing estate, and will create 300 new jobs in the local community, which has high levels of youth unemployment. Local environment groups object to the development on the grounds that it will destroy a valuable wetland ecosystem. They are using the legal system to achieve their objectives. You are a judge of the Land and Environment Court.

Study Figure R&R2.1.

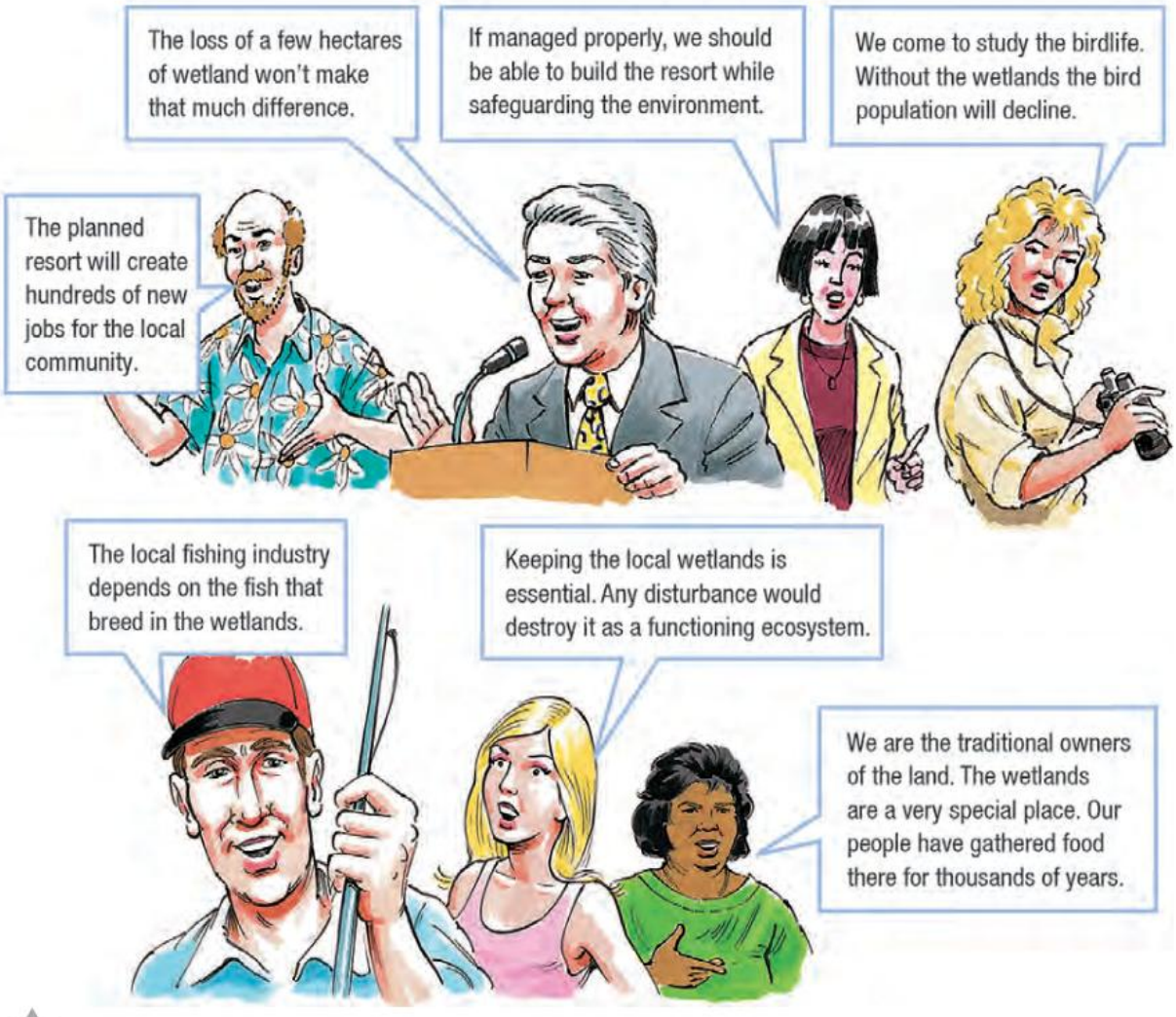
a List the statements that are in favour of building the resort and its facilities. Then list the statements that are not in favour of it going ahead.

b Which set of views do you agree with? Why?

c In small groups, discuss the statements about the proposed development. Reach agreement on what you think should happen. Be prepared to defend your group's viewpoint when you report to the class.

d Examine both sides. Have the people on each side of the discussion present the case for the other side, using exact arguments.

e Conduct a class debate on the following topic: The resort should go ahead.



R&R 2.1

Activity 2

River basin investigation

Investigate a river basin that has a high level of water scarcity. Prepare an annotated visual display of the basin that:

a includes a location map
b shows physical attributes (including statistics and facts and figures)
c identifies the different groups using the river basin
d shows level of food production
e indicates limitations on water availability
f outlines plans and solutions to water scarcity
g evaluates all solutions and proposes a solution.

Select one of the following river basins for your investigation:

- Okavango River, Africa
- Nile River, Africa
- Ganges River, Asia
- Tigris–Euphrates rivers, Asia
- Mekong River, Asia
- Jordan River, Middle East
- Aral Sea and Amu River, Central Asia
- Danube River, Europe
- Pilcomayo River, South America
- Paraná River, South America
- Rio Grande, North America

R&R 2.2



Activity 3

Applying principles of sustainability and social justice

All of humanity is at risk if global food supplies are not secured. However, it is those people who live in the poorer, developing countries who will suffer the most. Efforts must be made to make food distribution and consumption more equitable. It is also crucial that the maintenance of environmental quality is a priority and farming practices are ecologically sustainable.

Task 1

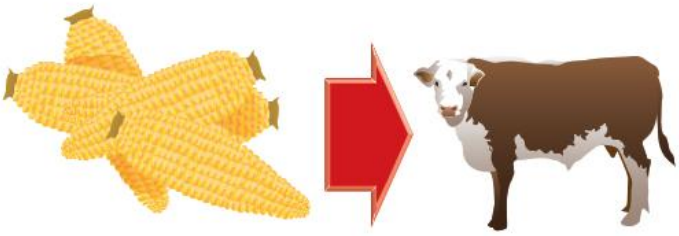
Study Figure R&R2.3. Working in groups of three or four, select four quotes that capture the issue of sustainability. Write each quote on one large piece of paper and add a few sentences that describe the thoughts behind each quote. Place the piece of paper around the classroom. Use these ideas to complete Task 3.

R&R 2.3

- Nature shrinks as capital grows. The growth of the market cannot solve the very crisis it creates—*Vandana Shiva*
- One individual cannot possibly make a difference, alone. It is individual efforts, collectively, that makes a noticeable difference—all the difference in the world!—*Dr Jane Goodall*
- Every aspect of our lives is, in a sense, a vote for the kind of world we want to live in—*Frances Moore Lappé*
- The frog does not drink up the pond in which it drinks—*Chinese proverb*
- The proper use of science is not to conquer nature but to live in it—*Barry Commoner*
- Plans to protect air and water, wilderness and wildlife are in fact plans to protect man—*Stuart Udall*
- When one tugs at a single thing in nature, he finds it attached to the rest of the world—*John Muir*
- What is the use of a house if you don't have a decent planet to put it on?—*Henry David Thoreau*
- I conceive that the land belongs to a vast family of which many are dead, few are living, and countless numbers are still unborn—*Nigerian Chief*
- Sustainability is about ecology, economy and equity—*Ralph Bicknese*
- Whatever befalls the earth, befalls the people of the earth. Man did not weave the web of life; he is merely a strand of it—*Chief Seattle*
- We never know the well of life till the well is dry—*Thomas Fuller*
- The end of the human race will be that it will eventually die of civilisation—*Ralph Waldo Emerson*
- A nation that destroys its soils destroys itself. Forests are the lungs of our land, purifying the air and giving fresh strength to our people—*Franklin D. Roosevelt*

Task 2

Because food is a traded commodity, any shortage in supply will trigger higher prices. Most of those living in developed nations can afford to pay the higher prices. However, they may not escape the effects of a food crisis as it might cause civil unrest and conflict in neighbouring countries and even destabilise governments. In the case of the poor, food shortages in a developing country may well mean starvation and death for themselves and their families. A number of trends evident in global food production are quite unjust and make the lives of the poor especially hard.



It takes 13 kilograms of grain to make one kilogram of beef

R&R 2.4

a Study Figures R&R2.4 and R&R2.5.

b Working in groups, discuss the point of view the cartoonist is seeking to communicate. Share your group's findings with the rest of the class.

c Having developed an understanding of the issues involved, conduct a class role-play showing the different perspectives on agricultural land use in a poor country.



R&R 2.5

Task 3

Members of your class are citizens of a poor developing country called Keswah. A large overseas company, Cornplus, wishes to purchase a thousand hectares of your best farming land to grow corn for export. Your task is to decide whether to grant approval for the sale of the land to Cornplus.

To enable your class to make an informed decision, a panel of experts has been enlisted. They have been allocated five minutes each to address the class and provide reasons for their proposed action. You will have the opportunity to question the panel to assist with your thinking. At the completion of the panel's presentation the class will vote on whether or not to approve the sale.

The roles to be allocated to students are listed below.

- Cornplus company executive: You are the Corporate Affairs Manager for Cornplus's Head Office in the United States of America. Your company is in the market to purchase the land to grow corn. It will be exported and used to make ethanol and produce feedlot beef in your company's diverse business enterprises. The US government subsidises your ethanol production. As most of the most suitable land in the United States of America is already under cultivation, you have identified fertile land in Keswah that you wish to buy and plant with corn. Your aim is to increase profits by lowering production costs. Labour costs are much lower in Keswah, there are no taxes and there are none of the environmental restrictions that make farming in the United States of America more expensive.
- The Keswah government's Minister of Planning: The government has been trying to attract overseas investment in Keswah to modernise the country. Cornplus will construct roads, railways and a port that they, the government, do not have the funds to develop. Such a venture will hopefully lead to other companies setting up operations. Large-scale operations will provide jobs and export revenue, and boost economic growth in the small country.
- Large landholder in Keswah: You currently lease the land that Cornplus is interested in to smallholders and you gain only a fairly small income from their rents. You would be able to sell the land at a huge profit and use the money to expand your own business interests. You and your family could live in luxury.
- Community worker for an Australian aid agency working in Keswah: You work with the poor people of this country on a daily basis. You are against the multinational corporation setting up its operations for a number of reasons.
  - The local people will be displaced from the land they currently use to grow a variety of food for themselves and their families.
  - If they do get a job on the Cornplus farm, they will work long hours and earn only a very low income. If they complain or strike for better conditions they will be sacked or the army will come in and put down any unrest.
  - They will be totally dependent on food grown elsewhere and subject to shortages and high prices.
  - The kind of industrial farming engaged in by Cornplus may be very damaging to the environment and harmful to the workers on the farm. Local groundwater and waterways may become contaminated. Local waterways are the main source of drinking water for the local people. People also fish in the waterways and these are their main source of protein.
  - The income earned by exporting the corn will be profit for Cornplus and flow onto their shareholders, rather than benefiting the local workers.

CHAPTER

7

ENGAGING AND CONNECTING WITH PLACES



We are all products of our surroundings. The place in which we live, together with all the things that make up the local environment, help to shape us as individuals. We are also part of a social network of people that links us to other places.

The environment around us therefore shapes our 'personal geography'—the way in which we view and make sense of the world around us.

As we get older, our personal geography widens and deepens. We see more places and learn more about the world around us and, for a while at least, the places in which we grew up in lose their attraction. Young adults may move away from home to find new experiences. Many, however, will return later in life to recapture some of their childhood memories.

In this chapter we focus on the perceptions people have of place, and how this influences their connections to different places.

KEY IDEAS

- To understand the concept of place
- To identify the factors that influence our perceptions and use of places
- To appreciate the relationship between place and identity
- To recognise the extent to which the media shapes our perceptions of places
- To know how to construct mental maps

GLOSSARY

mental maps	representations of what people know about the locations and characteristics of places at a variety of scales
perception	the identification and interpretation of sensory information in order to represent and understand the environment
personal space	the area surrounding a person which they regard as theirs
place	specific areas of the earth's surface that have been given meanings, or which have been shaped by people
place identity	the linking of aspects of identity with place
place making	the social and physical construction of places
place marketing	the process of reinterpreting, designing, packaging and selling places
place perception	people's awareness of places and the particular opinions they have about them
sense of place	the characteristics that make a place special or unique, as well as those that contribute a sense of human attachment and belonging
social justice	the protection of human rights, ensuring fairness and rectifying social wrongs
social space	a physical or virtual space such as a skate park or online social media, or other gathering place where people meet and interact with others
space	the three-dimensional realm or expanse in which all material objects are located and all events occur
spatial inequality	places in which people feel excluded from some of the privileges available to others
territoriality	the attachment of individuals or groups to a specific location

7.0 The Castellers de la Vila de Gracia demount a human tower, Barcelona, Spain, 2013.

7.1 Signs and symbols in places

Places contain signs and symbols, which send messages just like a language. When we are able to read the 'language' of a place we can gain an insight into its identity, values, beliefs and practices. Sometimes the signs and symbols (often called codes) are obvious and sometimes they are hidden.

Reading codes in places

Red and blue markings on taps tell us about the temperature of water. Paths can inform us about where to walk and a picture on a door will help us go to the right toilet. We use these simple codes all the time. We use more complex codes in places. When you see a **place**, such as that featured in Figure 7.1, you are able to know certain things about it. You can make a determination about the people who live or work there, perhaps even about how the place might be used.

Sometimes these codes are less obvious and require some background knowledge. A street corner with a shop displaying signs for international phone cards, for example, reveals information about the place. The international calling cards convey a sense that the area is inhabited or visited by people from other countries. If calling cards for specific countries are displayed, it could be inferred that many of the inhabitants are from one particular country. In the same way, a market place, such as that shown in Figure 7.2, with colourful flower garlands hanging from the roof and colourful clothing and material, might indicate an Indian community within the neighbourhood.



7.1 Even in the absence of explanatory text or signs you can draw conclusions about the nature of places. The codes present provide a lot of information about the place.



7.2 The Deepavali Festival Market, Singapore. There are numerous clues regarding the nature of the place.

Codes in urban places

Urban places are like a text to be read. They are filled with codes that can be deciphered. The codes in an urban context can include doors, the style of building, the material used in construction, pathways, fences and transport links. They may be experienced through sound such as the noise of a bus or traffic, the sound of dogs barking or the shouts of children playing. For urban areas, in particular, codes can also be experienced through smell. For example, the message provided by the smell of car exhaust differs from that provided by the smell of food being cooked.



7.3 Sounds from a typical neighbourhood. Sounds are also codes that enable you to read places.

Codes can indicate that urban places have particular allegiance. For example, the presence of national flags, national colours and football jerseys hung in windows all indicate that this urban place has a particular connection. Other signs, such as graffiti, indicate that a place has mixed or disputed allegiance. These are codes for contested places. The codes for sound are illustrated in Figure 7.3.

Codes in sacred places

Sacred places are those areas considered by individuals or groups as deserving of special attention due to their spiritual significance. Perhaps these places are sites for special religious events. Sacred places are not ordinary places and are maintained from generation to generation. Many sacred places are the destination for religious pilgrimages. For example, Christians travel to the Holy Land in Jerusalem, Muslims travel to Mecca for the Hajj, and the Hindus have many pilgrimage sites along the sacred rivers, such as the Ganges. Codes in sacred places usually indicate how people should behave; for example, in a church, pews show that people have to kneel. They provide messages about acceptable behaviour, in addition to notices placed at an entrance.

ACTIVITIES

Knowledge and understanding

1. Explain the importance of codes in our understanding of places.
2. Outline the nature of the codes found in urban areas. What might they tell us about the nature of the place?
3. Describe the nature of the codes typical of sacred places and how these influence our behaviour.

Applying and analysing

4. Study Figure 7.1. Discuss what the signs and symbols shown in the photograph reveal about the 'place'.
5. Use a photograph or draw a sketch of a public place in your local area. Using speech bubbles and sound bubbles (see Figure 7.3) record the noises being made. What do these codes reveal about your chosen place?
6. Consider and compare the appropriate behaviour expected at the place in Figure 7.1 with that in Figure 7.2. How do codes help convey this meaning?

7.2 Perception of use of places

The use of places is largely determined by how people perceive them. Many things affect perception, and these differ from person to person. The same place may be perceived (and used) differently from one person to the next.

Place perception

Place perception refers to our awareness of places and the particular opinions we have about them. It is our feelings and interpretations about the characteristics of a place that help develop place perception. Place perception influences the decisions we make about a location.

However, our feelings are not always well reasoned; sometimes they are irrational and result in **perceptions** that are not always based on reality. One example of this is the decisions we make about living in areas affected by natural hazards such as earthquakes, volcanic activity and tropical cyclones. Our perception of a place as attractive or desirable is very separate from our understanding of its hazard potential.

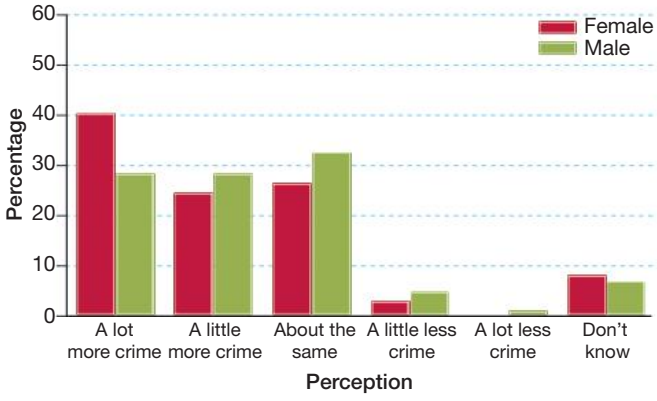
The perception of place is a very individual thing. People can perceive the same place very differently. For some, ordinary places can have a special meaning. The family vacation destination visited each year will be seen as very special to that family, even years after they have stopped going there. Your local neighbourhood will be viewed very differently by outsiders than by you. This is because the neighbourhood is a place with signs and symbols that provide personal meaning and significance.

Gender difference

When perceiving the dangers of places, there are quite a lot of differences in perceptions between women and men. Even though men are more likely to experience actual violence, many studies have shown that women's fear of violence is likely to be far greater. This is shown in Figure 7.4, in which women perceive a greater increase in crime compared to the actual statistics as shown in Figure 7.5. The reasons for this difference in perception has been linked to the nature of urban public spaces. Urban places tend to reflect a male-dominated social structure. This results in perceptions of familiarity and comfort for men, but much less so for women.

A recent study about tourists in London found that the perception of danger was greater among females than men. One reason that such studies are important for geographers is that the perception of danger influences behaviour and the use of leisure spaces. In countries where the roles of men and women are very distinct, women are less mobile than men. In these cases, women perceive the accessibility from place to place to be very important.

7.4 Australians' perceptions of crime trends



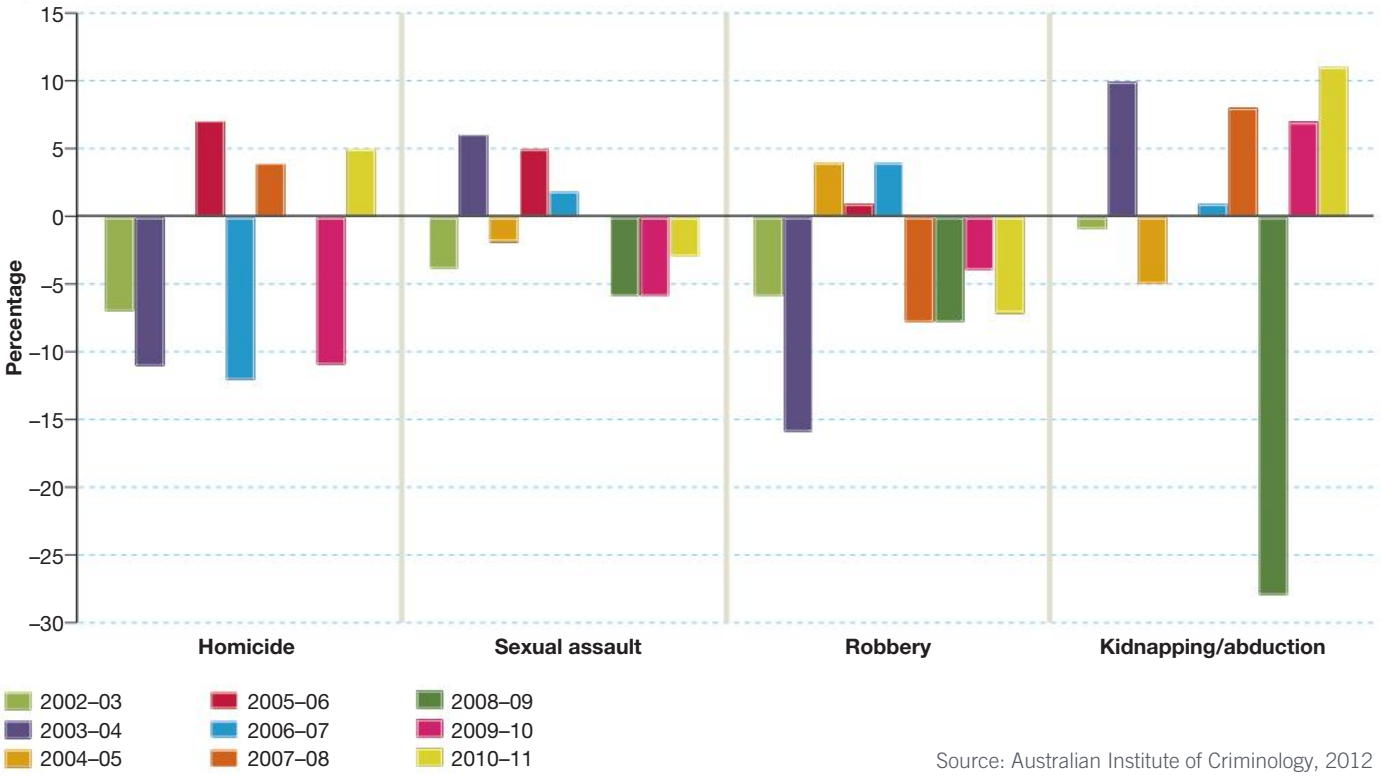
Source: Australian Institute of Criminology, 2010

Developing a perception

The perception of place is developed by direct and indirect experiences. In these experiences, people develop an understanding of their surroundings through 'filters'. These filters include personal or group characteristics such as race, gender, age, religious beliefs, and the time in which they live. For example, the perception and use of a park, similar to one shown in Figure 7.6, will most likely be different for a 5-year-old boy and a 68-year-old woman.

When people think about the places they perceive, they organise various parts of it into elements. These elements include paths, edges, districts, nodes and landmarks, as shown in Figure 7.7. These elements help people orient and navigate within a place. They may also segregate or alienate people.

7.5 Annual change in incidence of violent crimes, Australia, 2002–11



Source: Australian Institute of Criminology, 2012

Familiarity of places

Places that are well understood and easily read are places in which it is easier to get oriented and to navigate. The more familiar people are with a location, the more they will use it. This familiarity contributes to shaping particular aspects of people's behaviour. For example, the elements of a shopping centre can influence which one we might visit. Research about where people travel to shop reveals that their perception of the shopping district influences their choice. The chosen shopping centre may not necessarily be the closest, but it may be the one with the best parking or pedestrian circulation.



7.6 Parks are perceived differently by different groups of people.



7.7 The elements of the city

Perception and use of place

Mobility disability

People with a mobility-related disability are those who have very limited use of their legs. They may use walking aids or wheelchairs to move within places. Their perception of place will partly be influenced by how well these places accommodate their particular needs. For example, is there wheelchair-accessible parking? Are there wheelchair access ramps? Does the place have steep or unpaved terrain?

The perceptions held by people with a mobility disability are influenced by three factors. For many, the perceptions are affected by their own internal barriers, such as despair or feelings of been overwhelmed by their disability. This is particularly the case for people who have suddenly become disabled. The second factor relates to other people's attitudes towards the disability and how receptive they are to the presence of the person in a wheelchair. Finally, the physical inaccessibility of the environment affects the perceptions about places held by those with a mobility disability.



7.8 The vision-impaired use hearing to ride mountain bikes.

The desire of people with a mobility disability to experience wilderness areas and pristine places is similar to that of able-bodied people. Unfortunately, there are barriers to them experiencing these. In New Zealand, some groups have suggested constructing cable cars and gondolas to provide access to pristine wilderness places such as Milford Sound. In Australia, some walks that enable wheelchair access have been built in national parks, such as the Margaret Lester Forest Track in the Dandenong Ranges.

Vision impairment

People who have a vision impairment can perceive varying degrees of light. Perception, however, is more than just visual. Those with a vision impairment are able to use other senses, such as touch, sound and smell, to get a sense of their surroundings. So confident are many vision-impaired people with the perception of their surroundings that they are able to play sport, skateboard and mountain bike, as shown in Figure 7.8. In 2001, Erik Weihenmayer became the first blind person to reach the summit of Mount Everest.

Descriptions from others, sounds and touch allow vision-impaired people to build a mental picture. Although colour is often limited in this mental picture, the experiences do differ from one person to the next. People with a vision impairment tend to have a heightened sense of taste, touch and smell. This may allow detailed mental images to be constructed. The aspects of place that relate to touch, sound and smell are more powerful in influencing the use of place.



7.9 Tree roots have lifted the concrete path in this suburban street.

Figure 7.9 shows that place conditions are not always ideal for people with a vision impairment to navigate and use safely.

Public transport poses particular difficulties. People with vision impairment may not know when to get off the bus or whether or not their bus has arrived at the bus stop. Fears and difficulties in moving about places limits independent travel. This makes people with a vision impairment more likely to be homebound and isolated.

Public transport changes

The number of vision-impaired people in the state of Victoria's is projected to jump from about 200 000 in 2013 to 350 000 by 2020. To enable people with a vision impairment to access public transport the government is planning to upgrade Melbourne's 1770 tram stops. The average cost of those completed so far has varied from $500 000 to $1 million. The works involve laying tactile tracks, as can be seen in Figure 7.10, and installing audio bollards for arrival announcements and raised platforms for level access.

7.10 Tactile tracks can help people with a vision impairment to use trams.



ACTIVITIES

7.1

Knowledge and understanding

1. State what is meant by the term 'place perception'.
2. Outline how men and women differ in their perception of places.
3. Outline how we arrive at our perceptions of place.
4. Explain how people with a vision impairment develop their perceptions of places.
5. Outline the factors that shape the perception of place held of people with limited mobility.

Geographical skills

6. Study Figures 7.4 and 7.5. Outline the apparent contradiction in the data shown in the two line graphs.
7. Study Figure 7.7. Explain the concepts of path, edge, district, landmark and node. What role do they fulfill?

Applying and analysing

8. Study Figure 7.6 and contrast the differing perceptions of the area of a 10-year-old girl and a 65-year-old woman.
9. Identify a location near your school that could be considered to be a:
   - **a** path
   - **b** edge
   - **c** district
   - **d** landmark
   - **e** node.
10. Study Figures 7.9 and 7.10.
    - **a** Why is it important to consider how people with a vision impairment use public places?
    - **b** Describe the difficulties faced by people with a vision impairment when using public transport.
    - **c** How might the use of public transport be affected by the perception of public transport by people with disabilities?
11. To what extent should wilderness places be modified to cater for use by people with a mobility disability?
12. With a partner, walk around a place, such as your school, blindfolded for 20 minutes. Take turns and then describe what you felt, observed and thought. How different might it be when moving through a place you have not been to before?

7.3 Place making

Not only do people perceive and use places, they also create and modify them. People create places in response to the opportunities and constraints of their environment. In some cases this can be almost unconscious and incidental, while at other times it may conscious and purposeful. The social and physical construction of places is known as place making.

Place making and perception

How we perceive a place affects how we modify it. The modification of the place supports and reinforces our perceptions. A simple example could be how people arrange elements in their garden. The design and placement of objects such as outdoor furniture, reflects ownership of **space** and personal preference. Some communities modify places to reflect preferences.

Place making may also imply or result in the exclusion of other people, as shown in Figure 7.11, a gated community in California. This is because one aspect of place making is to reinforce who we are in contrast with other people. Consequently, place making often expresses **territoriality**.



7.11 A gated residential community, California

Territoriality

Territoriality refers the persistent attachment of individuals or groups to a specific location. The location provides security and a physical expression of identity. For example, the school playground has zones where certain groups go to during break times. There is a sense of ownership of these small places. The ownership is often recognised, not because there are signs or anyone on the group has purchased the space, as you would a house. The recognition comes about because of regular use.

Sometimes the ownership of place is challenged. The activity of defending and claiming this space further reinforces the need for place making. One extreme example of this is in the use of graffiti as markers of the territory, as can be seen in Figure 7.12. Although most graffiti is not the result of gangs, gangs do use it to mark their territory. Graffiti provides information to those who know how to read it. The information can include the name of the gang and its members, the names of other gangs that have an alliance, as well as warnings to other gangs.

Other organisations legally assert territoriality through place making in other ways. Businesses signal their territory using nicely manicured gardens, large sculpture-like signs and impressive buildings. The combination of these is a signal of territory and at the same time a reflection of perception about the company. In the same way, golf clubs and golf courses often appear as very distinct spaces. The way the places are regulated and used, and the provision of membership, reinforces the perceptions about what a golf course should be like.

Place and outsiders

Territoriality as a way of making places leads to exclusion. There is a distinction between the inhabitants and the outsiders. The inhabitants, known as the insiders, are identifiable by common vocabulary, dress, gestures and humour. The outsiders are people who visit on rare occasions or not at all. As the insiders shape the place to reflect what they perceive the place should be like, they also increase the feelings of separation between them and outsiders.

Place marketing

Many places are taking advantage of an increasingly connected world to improve the way that they are perceived. This is known as **place marketing**. Place marketing involves regularly reinterpreting, designing, packaging and selling places. The targets are people who normally live somewhere else and might normally be outsiders. Many places market themselves through the



7.12 Contested space: conflict over territory in Northern Ireland

deliberate manipulation of culture and features in order to appeal to potential visitors. These visitors might include wealthy tourists and organisers of business conferences. They are lured by a manipulation of tradition, lifestyles and cultures. Some examples are Darling Harbour, in Sydney and South Bank, in Brisbane.

Extreme place marketing can result in a process of Disneyfication; that is, local identity and historical character is replaced with a fabricated landscape of inauthentic settings. Examples are the Wild West in the fake cowboy town of Old Tucson, Arizona and a Bavarian village created in California, shown in Figure 7.13.



7.13 Leavenworth, USA—a Bavarian theme town

ACTIVITIES

7.2

Knowledge and understanding

1. Explain how place making can result in territoriality.
2. List expressions of territoriality in your neighbourhood. What groups are involved?
3. Describe your experience of feeling like an 'outsider'.
4. List places in which you consider yourself to be an 'insider'.
5. Define 'place marketing'.

Applying and analysing

6. Study Figure 7.11. Identify the aspects of this place that reveal territoriality.
7. Draw a map of your school, marking areas of different groups' perceived territory. Indicate how you know this is their territory.
8. Discuss the various perceptions of the place shown in Figure 7.12.
9. How is graffiti an illustration of place making and a challenge to ownership?
10. Study Figure 7.13. Analyse the deliberate changes made in order to create a place that is attractive to outsiders.
11. Do you think it is appropriate to create places that are not authentic, such as a fake cowboy town?

7.4 Knowing other places

Geography is much more than being able to name and locate places. However, geographers regularly use place names when describing the spatial distribution of geographical features, and when investigating geographical issues. Geographers use the following aids to accurately locate places: latitude and longitude, GPS references and grid references.

Accuracy of knowledge

For each of those places you know about from direct or indirect contact, you have probably formed an impression of them. You might perceive them as busy, ugly, grand, friendly, sunny, cold, flat, dry, colourful, drab, bare, noisy or quiet. These impressions might have come from a visit, or what you have read, heard or seen indirectly about the places.

Whatever the impression you have of a place, it is probably different from that of some other people, and it will probably change with more knowledge of the place. Impressions are good as starting points but they can become inaccurate stereotypes if they are not tested by new facts and observations.



7.14 Knowledge about places is not always accurate.

Place names and locations

Place names are an important part of Geography because they identify places. Look at the list of place names in Table 7.15. Some of the places you will recognise, while some will be new. You will know where some of the places are located in the world.

7.15 Selected place names

Alice Springs	New York	Washington (DC)
Sydney	Kangaroo Island	Minsk
Salt Lake City	Brasilia	Wagga Wagga
Cairo	Beijing	Jakarta
Coffs Harbour	Mumbai	Tajikistan
Helsinki	Jerusalem	Cape Town
Mexico City	Mecca	Singapore
Tokyo	Rome	Kabul

Place names are sometimes descriptive, for example Freshwater Bay, Cape Town, Magnetic Island. Some give us clues about where some of the early settlers came from, for example New York, Perth and Hahndorf (see Figure 7.16). Some are named as a tribute to well-known people of the time, for example Melbourne, Sydney and Adelaide. Others come from the language of the original inhabitants: Terowie, Wagga Wagga and Mississippi.

DID YOU KNOW?

How did Australia get its name?

Before Australia was visited by Europeans, a large landmass in the south was often shown on maps as 'Terra Australis', meaning 'Land of the South'.



7.16 Hahndorf, South Australia

Building knowledge about places

Think about the places you know well. Your thoughts about these places will be different from the thoughts of people around you. Neither your parents or siblings, nor indeed your friends, will have the same personal knowledge of places that you have. While your personal knowledge of places will have been built up mainly from the sources listed in Table 7.17, you may have individual circumstances in your life that have added to your knowledge of places.

7.17 Sources of knowledge about places

Direct knowledge	Indirect knowledge
Visiting relatives and friends	Reading books about places
Changing address	Viewing places on TV or films
Holidaying in other places	Talking to or emailing friends
Shopping	Learning about places at school
School excursions and camps	Watching sporting events
Riding your bicycle around your area	Watching the evening news
Competing in sporting events	Using the internet

ACTIVITIES

Knowledge and understanding

1 Explain why geographers have an interest in place names.
2 List the ways in which we can specify the location of places.

Applying and analysing

3 Make a list of the places you know well. Separate them into those you know from direct visits, and those you know from indirect sources.
4 For each of the places listed in Figure 7.15, write some words giving your impression of them. Compare your choice of words with those of other students.
5 Study the list of desired place information in the table below. Match each with the best source for the required information from the following list: world atlas, street directory, GPS (sat nav device), phone book, computer search engine, website.

Desired place information	Source of information
A suburb where a new friend is living	
A city you have heard about on the news	
A website that has useful sporting dates	
The location of a party you are attending	
The location of a cinema showing the film you want to see	
The postcode of an aunt you need to thank for a present	
The location of the nearest shop selling material for your hobby	
The places visited by a friend who is doing a world cruise	
The location of a resort in Thailand relative to the airport	

Investigating

6 See if you can discover how these cities got their names: Perth, Brisbane, Darwin and Canberra.
7 Using an atlas in book form, estimate the latitude and longitude of your location. Then use an electronic atlas, GPS or another source to get a precise figure. How close was your estimate to the exact figure?

7.5 Describing your local place

Think about the area you live in and how you would describe it. You could include the following in a description about your local area: the main visual features, the main sounds you hear, the smells that are most common and the particular textures that you often touch.

Describing your personal environment

Imagine that you want to give an impression of your personal environment to a friend living overseas. There are many ways in which you could do this, for example:

- drawing a sketch map
- taking a digital photograph
- writing a description
- recording sounds you hear
- sending a link to a story
- suggesting a song.





Your biophysical environment

Geographers divide elements of the environment into biophysical and human-made features. Figure 7.18 provides some examples of these. The physical features are those that are natural and existed before humans arrived in the area. They include the relief (hills, plains, valleys, rocks), rivers, lakes and beaches, the climate and weather, the natural vegetation and the native animals.

7.18 Australia's diverse biophysical and human environments





Many elements of your physical environment can be seen around you, but some are invisible. For example, the dryness or wetness (humidity) of the atmosphere may give a place a certain character, but it is an invisible feature.

Human or constructed environment

The elements of the human (or constructed) environment are those features that have been built or changed by humans. They include houses, roads, schools, offices, factories, power lines and dams. The human environment also includes non-visible features such as the culture of the inhabitants, their wealth and their education level.

Interactions between environments

There are places where the biophysical environment has a major influence on the human or constructed environment. For example, the biophysical environment of Bondi Beach, St Kilda, Glenelg, Cottesloe, Fanny Bay or the Gold Coast has a major influence on the buildings in those locations, the activities of people residing or visiting the locations, and the age groups and some characteristics of these people. Other places in Australia that have a human environment highly influenced by the biophysical environment are mining towns, for example Mt Tom Price, Mt Isa and Kalgoorlie; and ports, for example Newcastle, Gladstone and Port Hedland.

There are other places, however, where the human elements of the environment are much more important, and can even overwhelm the original biophysical landscape. Try to imagine Sydney Harbour without the Bridge, the ferries, the houses lining the shores and the clusters of the multistorey buildings. Look at any photograph of a suburban street and try to envisage what the physical landscape was like before rows of houses were built there. Look at a photograph of an industrial area such as at Wollongong, Geelong or Whyalla and try to see beyond the industrial buildings to a biophysical landscape that is now very well hidden.

Putting your perceptions together

When you have thought about the biophysical and human environment of your local area, think again about your feelings about different places within it. There may be places you now perceive in a different way, because they have particular purposes for some people. There may be other areas for which you see potential uses.

ACTIVITIES

Knowledge and understanding

1. List the ways in which you can describe your personal environment. Can you add to the list?
2. Describe how the biophysical environment impacts upon the human or constructed environment.

Applying and analysing

3. Study the photographs in Figure 7.18 then do the following tasks.
   - a. Write down your first reaction to each photograph as favourable or unfavourable.
   - b. Which places seem to be dominated by the biophysical environment, and which by the human environment?
   - c. Make a list of features you can see in each photograph.
4. Study the photographs in Figure 7.18. Either draw a line diagram of the features of each photograph, labelling the main features or scan each photograph and add labels on the computer to each main feature of the photograph. Look for examples of features listed in the text, and add descriptive adjectives as well as names of features. Label features as either biophysical or human.
5. Your personal environment may contain any of these features. Select those that your environment contains and give some details of them: houses, blocks of flats, shopping centres, service stations, hotels, rivers, parks, highways, trees, farms, factories, office blocks, hills, beaches, lakes.
6. Make a list of the good and bad features of your local environment. Which of these features could be altered? Can you have any influence on this?

Geographical skills

7. Draw a sound map of the area around your school. Start with a mental map and sketch the area of the school and the surrounding roads. Then draw arrows and labels on the map to show where sounds such as traffic noise, industrial noise, aircraft noise and other sounds come from. Below the map write comments about your reactions to these sounds in your personal environment.

7.6 Place and identity

Aspects of identity are often linked to place. This is referred to as 'place identity'. Place identity includes those landscape-related factors that help determine an individual's personal identity and sense of place. It comes about through a complex process involving conscious and unconscious ideas, feelings, values, goals, preferences, skills and behavioural tendencies relevant to a specific environment.

Special places

All of us have places that are special and have helped shape the person we are. The following questions will help you to clarify your thinking about your relationship to place and identity:

- Where is your favourite place?
- What draws you to that place?
- Are there particular memories about the place?
- How would you spend a perfect day there?

Identifying with place

Local

One way in which identity is connected to a particular place is by a feeling of belonging to that place, or having a **sense of place**. In this place you feel comfortable, or at home. How you define yourself is influenced by certain qualities of that place. This sense of belonging can occur at a range of scales. It may, for example, occur at a local scale. Sport is one activity that promotes a sense of belonging. Many Australian Rules football fans develop an almost tribal loyalty to their local footy team, as can be seen in Figure 7.19.

Regional

It is also possible identify a sense of belonging at a regional scale. In Rugby League, for example, the annual State of Origin series divides supporters into Blues (New South Wales) and Maroons (Queensland). Such state-based rivalries have been common throughout Australian history across a range of political, social and economic issues. The Australian Commonwealth, a federation of states, only came about after our political leaders were able to put aside their parochial, state-based interests.

National

At a national scale, Australians will unite against the foreign competitor whether it is in netball, cricket, tennis, swimming or soccer.

National identity

National identity is shaped by the way in which people view themselves and the way others see them. The national identity of a country is largely defined by legends and landscapes—by stories of the past, heroic deeds and enduring traditions. It might also be defined by homelands, with their sacred sites, landforms and unique scenery more generally.

Identifying against place

The idea that identity and place are connected because people feel they belong to a place is not the only connection between identity and place. People not only live in places and identify with them, they are sometimes alienated by them. Sometimes people establish an identity by contrasting the place that is 'home' with a place that is 'away'. For example, knowledge of the unique characteristics of Asian landscapes and cultures acts as a point of difference against which the uniqueness of Australia can be judged and appreciated.

Not identifying

Often we first become aware of our own sense of place and identity when we travel to unfamiliar places and begin to realise that our surroundings are different and that we do not feel 'at home' there. The landscape is different; the weather may be different; houses and towns are different; people are not the same; even things such as sounds and smells are not those that we are familiar with. In some instances, the strength of identity associated with one place, for example 'home', might be so strong that it is difficult for people to feel concerned for another place and its people.



7.19 Sport is one of those activities that promote a sense of belonging and place identity.

ACTIVITIES

Knowledge and understanding

1 Explain what is meant by the term 'place identity'.
2 Define the term 'national identity'.
3 Explain how other places can contribute to the development of 'place identity'.

Applying and analysing

4 Think of a place that is special to you.
   a Where is your favourite place?
   b What draws you to that place?
   c Are there particular memories about the place?
   d How would you spend a perfect day there?
5 a Write a description of the place with which you identify most strongly.
   b How many of these places make reference to landscape? Share your description with others in your class.
6 Outline an example of 'place identity' that has local, regional and national scales.
7 Construct a mental map of Australia, which includes the features that you think give Australia its distinctive identity. You might include landscape features, buildings, particular colours, names or people.

7.7 Media and perception of place

The media plays an important role in shaping our perceptions of places. By highlighting some and neglecting others, it increases our knowledge of places the media considers to be of interest at the expense of those it chooses not to focus on.

Geographical issues

The media also shapes perceptions about geographical issues. The media highlights some issues and ignores others. When using the media as a source of information about the world, we need to take be aware of its 'agenda-setting' role. We also need to understand that the manner in which information is presented often reflects the particular perspective or point of view of the 'author' or media organisation. The same can be said of material on the internet.

Shaping perceptions of places

It is important to recognise that our own culture, of which the media forms part, and our life experiences, shape the way we perceive places. Perceptions are the basis for understanding a place's location, extent, characteristics and importance. Throughout our lives, culture and experience shape our worldviews, which, in turn, influence our perceptions of places and regions.

SPOTLIGHT

Travel brochure photography

The role of the photographic image is to entice people to travel to distant places. Visual images, especially those in travel brochures and on travel-related websites, attract the attention and imagination of potential visitors. The images used in tourism advertising typically idealise and portray as exotic the people and culture of a particular place, while downplaying or even erasing any evidence of poverty or other forms of 'unpleasantness'—environmental degradation, crime, child exploitation, civil unrest, etc.

The images used promote a sense of 'otherness'—the quality of being distinct or different from that otherwise experienced or known. Elements of the physical and cultural environments are promoted as being unique and exotic. These images are carefully selected and framed, and on occasions edited to construct an intended meaning. The increasingly complex nature of images selected for tourism brochures reflects the need to satisfy the diverse needs and interests of potential tourists.



7.20 Travel brochures emphasise the exotic while avoiding any evidence of poverty or other forms of 'unpleasantness'.



7.21 The media tends to draw on the most graphic images to support its stories.

Role of the media

Today, the media (including the internet) is an important source of information about what is going on in the world. But media organisations seem more interested in some places and events than others. It is widely understood that the material presented by the media organisations is selective. Gatekeepers (editors and journalists) and some financial limitations and economic pressures mean that the media (with few exceptions) must survive as profit-making commercial organisations. These factors play a vital role when decisions are made to select, emphasise, interpret and, in some cases, manipulate coverage of places and events.

The media's agenda-setting role means that some places and issues are promoted while others are neglected and ignored. It also means that the media will have an impact on public opinion. People will be inclined to know about those places and issues that are highlighted by the media. They will know little about the places that are neglected or ignored.

Television and print media

The type of media is also important. Newspapers and magazines provide greater opportunity for the in-depth treatment of issues and places, with photographs playing only a supporting role. Television news reports, however, are often built around the visual image, with the commentary playing a supportive role. The more graphic the visual images, the more likely the story will be to make the evening news. The media's focus on Africa, for example, is often centred on the suffering of the continent's people. Contrast Figure 7.21 with the images promoting African tourism in Figure 7.22. It is often these visual images that we use to construct our perceptions of places.



7.22 This type of image is commonly used in posters and brochures promoting African tourism.

ACTIVITIES

Knowledge and understanding

1. Outline how the media shapes our perceptions of places.
2. Explain what is meant by the term 'agenda setting'.
3. State what is meant by the media's 'gatekeeping' role. Who are the gatekeepers?
4. Distinguish between television and print media in the ways they influence our perception of places.
5. Explain what is meant by the term 'otherness' in terms of travel brochure photography?

Applying and analysing

6. Think about the following places: Africa, Europe, USA, Bangladesh, Afghanistan, Uzbekistan.
   - **a** Working in groups, brainstorm all the words or impressions that come to mind when you think of each place.
   - **b** Compare your list of words or impressions of each place.
     - How do they differ?
     - Are there any similarities?
     - Is there greater knowledge of some places compared with others? Why might that be so?
   - **c** From where did you gain your knowledge of each place?

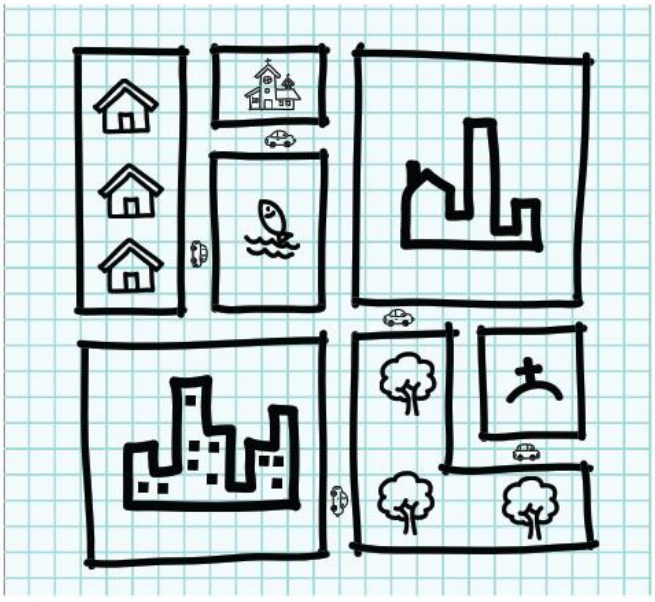
7.8 Geoskills: Mental maps

A person's awareness or perception of the world around them is known as their mental map. It is the mental representation of the person's known world—their 'personal geography'.

Drawing mental maps

If you were asked to draw a sketch map of the town or suburb in which you live, it is very likely that the area that you are most familiar with will be drawn in much greater detail than the rest of the town or suburb. It is also likely that the relative size of the area you are familiar with will be greater. Places you know well—your school, the local shopping mall and your favourite recreational facilities—are likely to feature more prominently than those you are only vaguely familiar with.

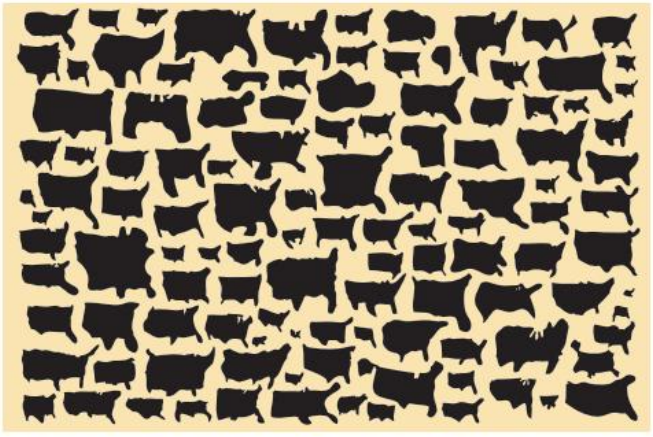
People often draw simple maps to show someone the way to get to a place, for example how to find their place of residence. Because such maps are drawn from memory, your ideas and your understanding of places, they give a good indication of what you think about a place, and how detailed your knowledge of particular features is. The signs and symbols you use to create your map reveal the elements of places that you perceive as being important. Figure 7.23 is an example of a **mental map**.



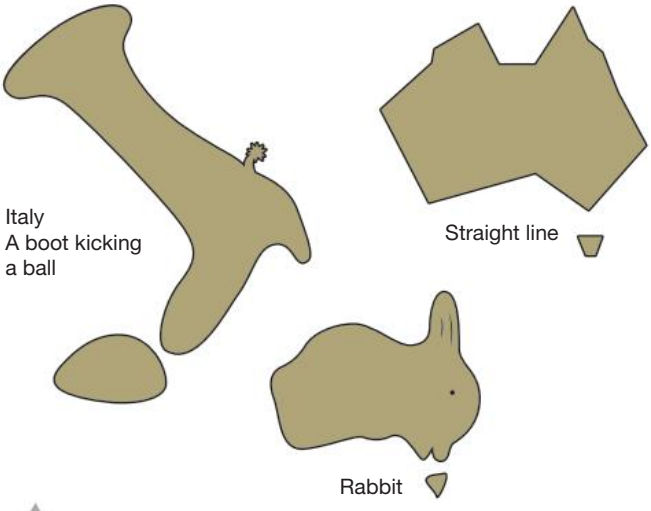
7.23 A mental map

Representations of places

Figure 7.24 is a piece of art made up entirely of the mental maps of the shape of the United States of America, as drawn by children. Figure 7.25 is an old illustration from a children's book, showing the shapes of countries as pictures, to help children remember the shapes.



7.24 Mental maps of the USA



7.25 Mental maps of Australia and Italy

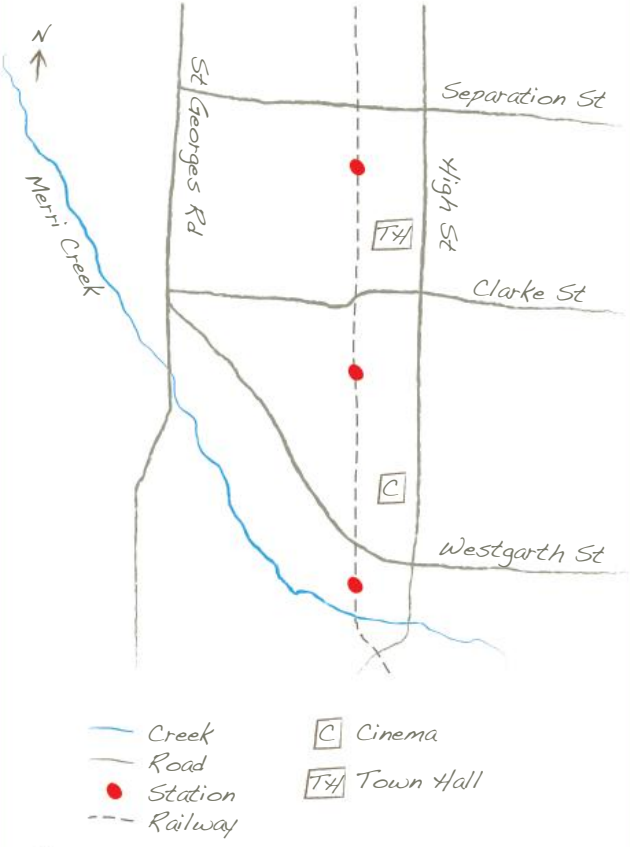
Skillsbuilder

Drawing a map of your neighbourhood

Before drawing a map of your neighbourhood, you would need to make some decisions.

1. What places would you choose as the limits and boundaries of your neighbourhood?
2. Which roads and streets would you include?
3. Which features of your neighbourhood are most important to you, and should be included?
4. What reference points would you include so that the map will be meaningful to someone else?

An example of a neighbourhood map is shown in Figure 7.26.



7.26 A local neighbourhood—Northcote, Victoria

Your neighbourhood

If you compare your map of your neighbourhood to those of other students who live in the same area, you will see all kinds of similarities and differences. These will probably tell you a lot about how all the map-drawers view their local neighbourhood.

Your state

For most people, drawing a map of their state or territory from memory is a difficult task. Most people would be able to locate borders and a few features such as the capital city, the sea/ocean and major mountain ranges, but including more details could be a challenge. The details one person knows will be different from the details that another person knows.

Your country

The shape of Australia is well known and easily recognised, but for most people hard to draw freehand. The features that people would include in a mental map of Australia will differ; details included would differ—from size, to capital cities, to landscapes. The features people include will be the features they think are important.

ACTIVITIES

Knowledge and understanding

1. Explain what a mental map is and what it reveals about your 'personal geography'.

Applying and analysing

2. a Draw a mental map of your 'place'. Include as much of your neighbourhood as you want to. Show the features that are important to you.
   b Compare your mental map with the maps of others who live in the same neighbourhood. What are the main differences?
   c What do these differences tell you about the interests, activities, families, length of residence and age of the map-drawers?
3. a Draw a mental map of your state. Include towns, regions and features that you know.
   b Compare your map with a map from an atlas. Describe the differences.
   c Write down some of the reasons why you included some places on your map and not others.
4. Draw a mental map of Australia. Include state boundaries, state capitals and places known to you.
5. Draw a mental map to give directions to a friend on how to get to a sportsground or shopping centre. Include only the information that they will need to get there. When it is finished, compare it to the map in a street directory or on-line, and comment on the differences.
6. Draw a mental map of a shopping centre you visit regularly. Can you remember the location of the shops that you do not use often? What does this tell you about your skills of observation and your visual memory?

7.9 Moving within your personal space

People's mobility within places is of interest to human geographers. Some people are very mobile; others are not. Some people travel extensively, others rarely move far from home. The mobility of young people generally increases as they get more independent and old enough to drive or use public transport.

Household mobility

How large an area of the world do you personally move in? Figure 7.27 shows some examples of the **personal space** moved in by five people living in the same household. Look at the way that the mapper (cartographer) has shown where each person moves regularly, and how often they visit that space. From your knowledge of other people in your household, and perhaps by questioning them, draw up a similar map for your family.

Personal and social space

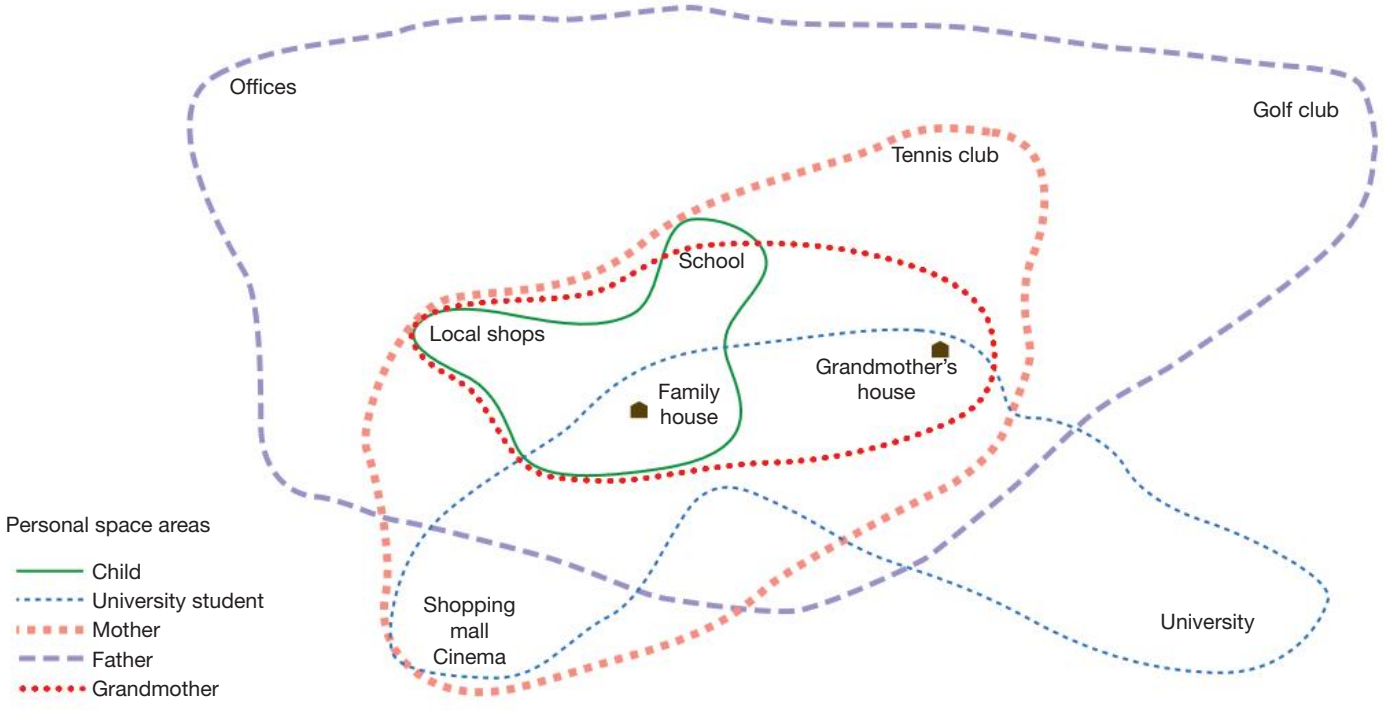
In which parts of your personal and **social space** do you spend most time? For most students of your age, home and school will dominate, but each individual will have other places that are part of 'their' space.

Personal space is the area surrounding a person which they regard as theirs. Most people value their personal space and feel uncomfortable or anxious when their personal space is encroached upon.

Social space is a physical or virtual space, such as a skate park (an example is shown in Figure 7.28) or online social media, or other gathering place where you meet and interact with others. Some social spaces, such as parks and beaches, are public spaces; others, such as shopping malls, hotels and websites, are privately owned and regulated.

As you get older, your personal and social space expands. As you mature and become more independent, your parents are less restrictive about where (and how far) you can go. Being able to use public transport on your own or with friends enables you to increase the distance that you can travel from home. Getting your driving licence greatly increase the size or range of your personal and social space.

7.27 Map of the personal space of a mother, father, child, university student and grandmother, with annotations



Your personal space through different eyes

Think about the area you move within from the point of view of others who also use it. To help you, imagine that you have a lens that can show you what another person thinks about a place. Try this from the point of view of:

- an unemployed person
- a child of 4 years of age
- an elderly resident
- a tourist
- a property developer
- a police officer
- a person with a physical disability
- a young person 18 years of age

Knowing your personal space

When you think about your personal and social space, and you have identified the space within which you move, think about some of the following aspects.

7.28 Spaces where young people gather are important social places within neighbourhoods.



Separate the parts of your personal space that you move in every week from other areas that you visit less often. Then think about the routes that you often take. People often take the same routes to places and rarely take different routes. Most people have 'tunnel vision' about their personal and social space; that is, they observe and remember only the features that are relevant to them. For example, you may know very well all the sportsgrounds in your personal and social space, but not the shops, or vice versa. You probably ignore any offices or facilities for older people because they are not relevant to you.

Increasing knowledge of spaces

There are a number of ways in which you can increase your knowledge of your personal and social space, such as:

- exploring your local area
- taking different routes to a place
- looking at Google Earth photographs of your local area
- talking to people who have lived there for longer than you have.

ACTIVITIES

Knowledge and understanding

1 Define the terms 'personal space' and 'social space'.

Applying and analysing

2 On a sketch map of your personal space, or your neighbourhood in general, mark the places where you spend time. Then draw the routes between these places.

3 Reflecting on the places and routes you have drawn on your map, add annotations about the ease of transport between places, the safeness or dangers of any particular places, and how busy or quiet the places and routes are.

4 Suggest ways in which your movements could be made more efficient. Are there other modes of transport, or different times of travel that could be used?

5 Think about the efficiency of the movements of other people in your family and those you know. How could any of their daily and weekly travel be made more efficient and use fewer resources?

6 Try a 'lens' activity with the roles listed in the text above, and other roles that are relevant to your particular place and space.

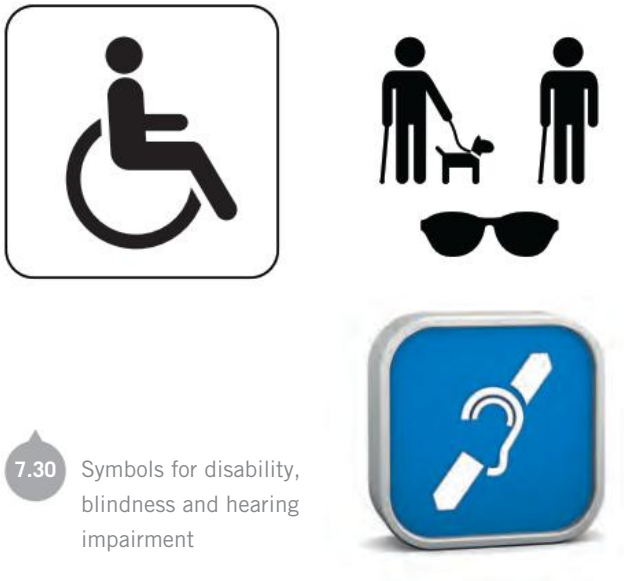
7 Take some digital photographs of places within the personal space of a number of members of your class. Show them to others and see if they can identify the places.

7.10 Spatial inclusion and exclusion

In your neighbourhood there are some places you are able to access and others you cannot. While some types of inclusion and exclusion might seem quite straightforward and reasonable, the notion of exclusion can have a more sinister outcome. It may, for example, involve the exclusion of group of residents on the basis of race, religion, income or origin, from access to the things a place has to offer.

7.29 Inclusion and exclusion

Places that you can freely visit/use	Places that you cannot visit/use without permission or appointment	Places that you cannot visit/use at all
Shops	Other people's homes	Factories
Playgrounds	Other schoolgrounds	Building sites
Parks	Hospitals	Waste dumps
Library	Offices	Electricity sub-stations
Roads		Mines and quarries
Footpaths		Licensed premises



7.30 Symbols for disability, blindness and hearing impairment

Accessibility

The degree of accessibility will be different for various people in your community. Adults have access to places that children do not. Workers in particular jobs have access to places necessary for the work they do. We generally accept that there are differences in the level of access that we have to various places. There are people and groups of people who cannot get to areas that others can. Some people are banned from certain areas because of their ethnic background, their language, a disability, or some other factor beyond their control. Freedom of access to places and information is an important part of **social justice**.

People with a disability

People who have a disability often find themselves unable to access places. There may be inaccessible steps, difficult doors, no public transport or no clear signage. In the last 30 years there has been more attention paid to making public places more accessible, but there are still plenty of examples of places that are difficult for all people to access. Some people with disabilities are able to afford expensive devices such as motorised wheelchairs and seeing-eye dogs, but many others do not have these aids.

Recent migrants

People who move into the local area from another country will find it quite different from where they came from. If they do not speak English they will encounter a range of impediments to moving around their new place. Road signs, street names, advertisements, information brochures, safety instructions and many other pieces of important information present a challenge.

Spatial inequality

There are many districts in cities, in Australia and other countries, where people feel excluded from some of the privileges available to others. There may be fewer health services, less choice of schools, more pollution and a less pleasant environment. Although people are not forced to live in these districts, most cannot afford to move into areas with better facilities. Wealthier people can always afford the best facilities and districts. One of the aims of people working towards better social justice is to increase the access to quality services for all people, regardless of their wealth and ethnic background.

SPOTLIGHT

Excluding others

Throughout history there have been many examples of restrictions made by one group of people and imposed on another. The extreme example of this is the enslavement of groups of people by others. However, there are many examples of groups of people wanting to preserve their own privileges by removing the privileges of others. Two examples are outlined below.

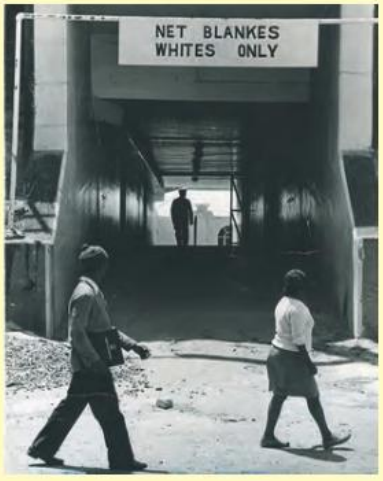
Ghettos in Europe

A ghetto is an area of a city or town that is populated mainly by one cultural, ethnic or religious group. Some ghettos develop because people with similar backgrounds wanting to live near each other, but other ghettos were created for more sinister reasons. For centuries, in many European cities, Jews were forced to live together in ghettos because they were not Christians. Such areas were sometimes surrounded by walls, and the communities living within them were sometimes tolerated and at other times persecuted.

7.31 Jews awaiting deportation in the Warsaw ghetto, Poland. Hundreds of thousands of Jews were deported from here to death camps in the summer of 1942.



The worst case of persecution was in Nazi Germany and the countries it conquered during the 1930s and 1940s. The Nazis persecuted the Jews by firstly removing their human rights, then confining them to the ghettos. They then took millions to concentration camps where they were exterminated. During the Holocaust the Nazis killed an estimated 5.9 million Jews. Also killed were 2–3 million Soviet prisoners of war, 1.8–2 million ethnic Poles, up to 1.5 million Romani, 250 000 disabled people and 15 000 homosexuals.



7.32 A central feature of apartheid was the segregation of races.

Apartheid in South Africa

Between 1948 and 1994, South Africa was ruled by a minority white government which administered a policy called 'apartheid'—meaning 'separate development'. The aim of the policy was to restrict access to jobs, education, housing and political power for the non-white population. The white population, who were in the minority, were able to be the rulers, and were able to maintain their privileged existence. Residential areas were segregated. Non-whites were told where they could or could not live. Beaches, buses, trains and many other public facilities had signs indicating where non-whites were not allowed to enter. There was much opposition to this policy, from both within and outside of South Africa, and eventually a new government representing the majority gained power in 1994.

ACTIVITIES

7.3

Knowledge and understanding

1 Describe what happened to Jewish people in Nazi Germany.
2 Define the term 'apartheid'.
3 Explain the term 'spatial inequality'.

Applying and analysing

4 Draw a mental map of your locality and mark on it any:
  a places where you cannot go at all
  b places for which you need permission.
5 Look closely at your school environment from the point of view of a person in a wheelchair. Most schools have now been made more 'user friendly' for wheelchair users, but look for any problems that still exist. Look not only for steps or problem surfaces, but also for levels of work desks and access to equipment. Use your research to make a report to the school authorities.
6 Think about the problems of social justice in relation to people's access to places. Put a case for equality of opportunity for all, regardless of their location. Then suggest some of the reasons why it is difficult to achieve this.

CHAPTER

8

CONNECTIONS WITH PLACES



The study of geography is critical to understanding the world, now and in the future. As the world becomes more complex and interconnected—a result of globalisation and improvements in transportation and communication technologies—the need for geographic knowledge, skills, and perspectives increases among the world's people.

Advances in transport and communications technology have transformed the way humans live, work and travel. Today, information flows almost instantaneously around the globe. For most of human history, however, the exchange of ideas between people in one place with those in another was limited by the speed at which people could travel. In the sixteenth century, the ability to spread information improved dramatically with the invention of the printing press, and by the seventeenth century the first modern newspapers were beginning to appear in Europe. In the nineteenth and twentieth centuries, the invention of the telegraph, followed by the telephone, radio, television, computer and internet transformed the ways people communicate, making individual connections more immediate and access to news and other information more efficient than ever before. Recent decades have seen a trend toward developing increasingly compact electronic devices that are affordable and convenient for an increasing share of the world's population.

In this chapter we focus on the way transportation and information and communication technologies are used to connect people to goods, services, information and people in other places.

KEY IDEAS

- To understand the ways that transportation and information and communication technologies connect people to other places
- To appreciate the ways in which technology is changing the way in which people access goods and services
- To recognise the impacts of technology in developing countries
- To investigate examples of interconnectedness

GLOSSARY

core	the countries and regions of the world with the greatest wealth and power
e-commerce	the buying or selling of products or services using the internet
globals	people who have a global outlook; they have influence because of the nature of the jobs they do, and have enough wealth to be able to travel freely
hinterland	area surrounding a place that is linked to that place through lines of exchange or interaction.
interconnectedness	being interconnected or linked to other people or places culturally, economically or socially
locals	people who are too impoverished to be able to move far from where they were born
mobals	people who move from their original place of living to somewhere else, solely for a better job or a better life for their family
periphery	the countries and regions of the world outside the core
social media	communication technologies through which users create online communities to share information, ideas, personal messages, and other content forms of content (e.g. videos)
virtual community	a community of people sharing common interests, ideas and feelings over the internet or using other collaborative technologies
virtual space	a computer environment that can simulate a physical presence in places in the real world or imagined worlds

8.0 Young Kyrgyz men using a mobile phone

8.1 Staying connected via transport

Technological and scientific advances in transportation have produced numerous improvements in transport systems. These improvements have enhanced the connections between people and places and led to an explosive growth in service-based industries such as international tourism and education. Transport improvements have also enabled the rapid expansion of world trade.

Transport innovations

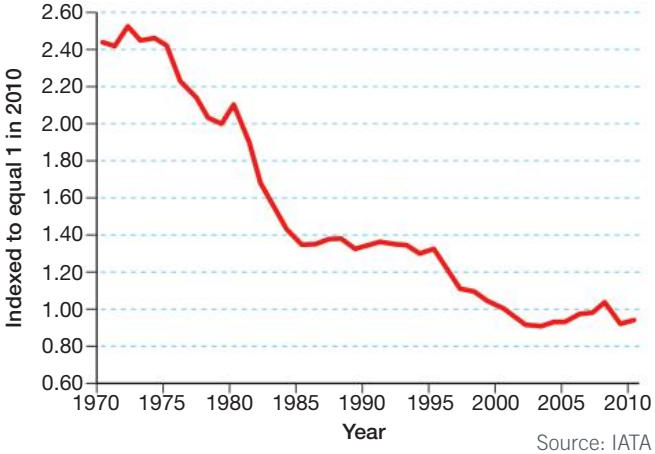
The most significant transport innovations have been:

- the development of high-capacity aircraft such as the Boeing 747 and the Airbus A380. The A380s, each of which costs US$390 million, are capable of carrying up to 853 people a distance of 15 400 kilometres at 900 kilometres per hour without refuelling. High-capacity aircraft have played an important role in reducing the cost of air travel. Figure 8.1 shows how the real price of air travel has decreased over the last 40 years. As a result, more people can afford to travel. Figure 8.2 shows that both world trade and airline passenger loads have grown much faster than world GDP.
- the advances in railway technology, especially the introduction of high-speed trains. These trains use specialised rolling stock and dedicated tracks to achieve speed well in excess of the speed of traditional trains. Japan, China, France, Germany, Italy, Turkey, South Korea and Spain all have high-speed trains capable of speeds of up to 400 kilometres per hour. The Shanghai Maglev Train is a high-speed magnetic levitation train that runs 30 kilometres from Shanghai to the Pudong International Airport. The train reaches a speed of 431 kilometres per hour.
- the development of megaships—vast ocean-going vessels capable of transporting people, raw materials and manufactured goods at relatively high speeds over long distances and for a low per unit cost. Large bulk carriers, oil tankers and container ships travel the seas, linking sites of production and consumption. Cruise ships are an important part of the rapidly growing global tourism industry. In 2013, the world's fleet of cruise ships carried over 20.9 million passengers, generating revenues of US$36.1 billion.

As a result of the innovations in transport, people have been able to take advantage of:

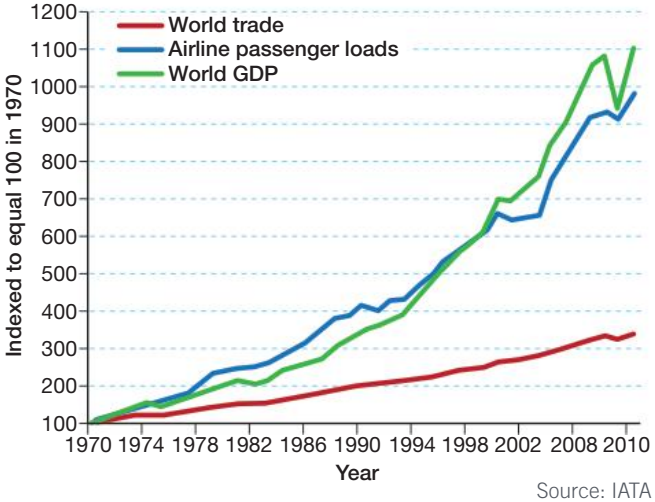
- decreased (real) travel costs
- increased capacity (passenger loads)
- improvements in safety and reliability
- increased travel and transport speeds
- greater comfort and convenience
- increased fuel efficiency
- declining environmental impacts, especially in the form of air pollution and noise emissions
- low-cost, same-day, next-day and just-in-time deliveries.

8.1 Real price of air travel, 1970–2010



Source: IATA

8.2 Increases in world trade and airline passenger loads, 1970–2010



Source: IATA

SPOTLIGHT

Allure of the seas

The world's largest cruise ship is Royal Caribbean's *Allure of the Seas*. The ship weighs in at 225 282 gross tonnes and has a displacement of 100 000 tonnes. It is the length of three and a half football fields (360 metres) and is capable of accommodating 5400 passengers and 2400 crew members.

8.3 *Allure of the Seas* is bigger than the largest aircraft carriers operated by the US Navy.



The future

Continuing research and development in materials and processes, and in computers and telecommunications will result in ever greater efficiencies in the movement of people, goods and information. At the same time, technological changes may alter travel patterns, travel behaviour and travel choices in ways that are not completely understood at present. These developments might include:

- intelligent transportation system (ITS) that result in smarter vehicles, highways and traffic monitoring
- new alternative fuels and vehicles for ground transportation
- new aircraft technologies, high-speed railways and megaships
- further developments in mobile phones and the internet, especially in terms of their potential to transform the travel experience.

ACTIVITIES

8.1

Knowledge and understanding

1 Outline the results of improvements in transport technologies.
2 Outline the technological developments in aircraft, railway technology and shipping.
3 Identify likely future technological advances in transport technology.

Geographical skills

4 Study Figure 8.1. Describe the trend in the real cost of travel.
5 Study Figure 8.2. Compare the growth in air travel with the growth in world trade and world GDP.

Investigating

6 Select one of the forms of travel examined in this unit. Using the internet, investigate recent developments and likely future developments, and the impact of these advances on interconnectivity.

8.2 Staying connected via ICTs

Advances in information and communication technologies (ICTs) have transformed the ways in which people interact. The technologies that many of us now take for granted have created new ways of connecting with our family and friends, and transformed the ways in which we work and shop. New online communities have emerged, defying the limitations once imposed by distance.

Changing communication

We once communicated with our family and friends using handwritten letters. In some cases it took weeks, even months, for the letters to reach their destination. From the mid-1850s until recently, urgent correspondence was transmitted electronically and then hand-delivered as a telegram—quite an expensive option. These messages could be sent long distance, initially using cables and, from the late 1880s, by wireless telegraphy. Australia Post shut down Australia's telegram service in March 2011.

Mobile phones

The first mobile phone call in public was made on 3 April 1973 in New York. The first mobile call in Australia was made less than 10 years later in August 1981. Figure 8.4 shows the growth in mobile phone usage since 1981. The way people use their mobile phones has also changed—increasingly the main form of communication is text messaging, as shown in Figure 8.5.

The internet

The internet began life in a USA Government Defence research lab in California in the late 1960s. The first connections were made between universities in 1969. In Australia, Melbourne and Wollongong universities exchanged files using computers via dial-up. The emergence of the internet as we know it today began in the 1990s. Since then, internet growth has risen dramatically around the world (see Figures 8.6 and 8.7).

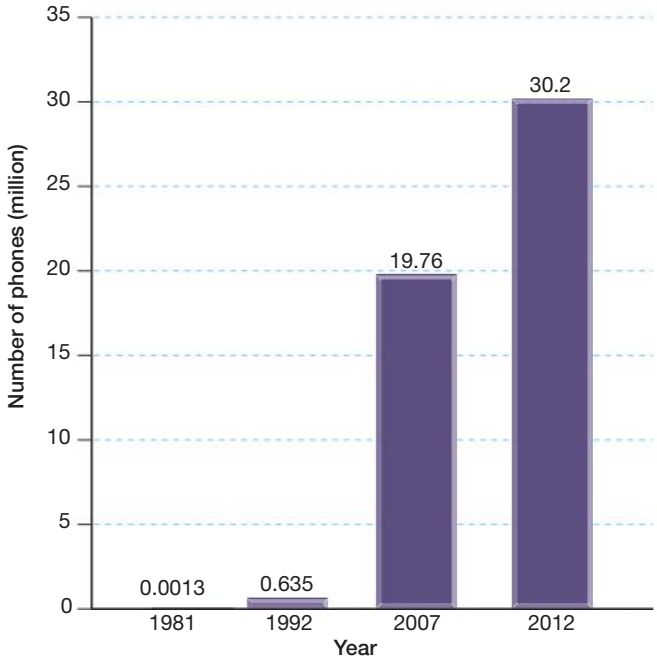
Social media

Today, people keep in touch using a range of fixed and mobile devices. The latter include smartphones, laptops and tablets. These devices, and their associated software, make possible the use of email, text messaging, blogs, Wikis, Skype, YouTube, Facebook, Twitter and photo sharing on sites such a Flickr and Instagram. These form what is often referred to as **social media**. Broadly speaking, social media is any means by which people create and exchange information and ideas.

The use of social media has encouraged the emergence of **virtual communities** and networks. A virtual community is any group of individuals who interact through social media. It might, for example, be a group of friends who use technology to keep up to date with what everyone is doing. It might also be a group of individuals with a common professional interest who use email distribution lists to communicate and share information. Alternatively, it might be a network of environmental activists pursuing interests or goals that cross geographical and political boundaries.

People's use of social media is growing rapidly. In Australia, 80.1 per cent of the population have access to the internet and by late 2012 there were 11 680 640 Facebook subscribers (53.1 per cent of the total population).

8.4 Growth in mobile phone use in Australia, 1981–2012

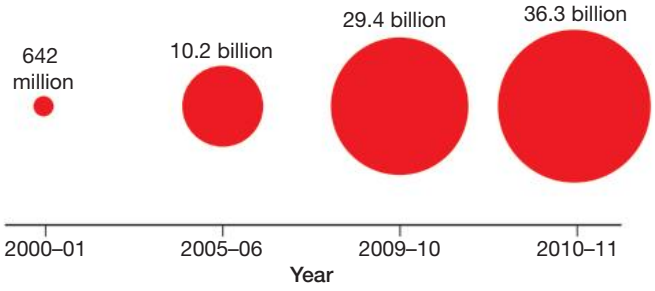


Source: *Sydney Morning Herald*, 5 April 2013

DID YOU KNOW?

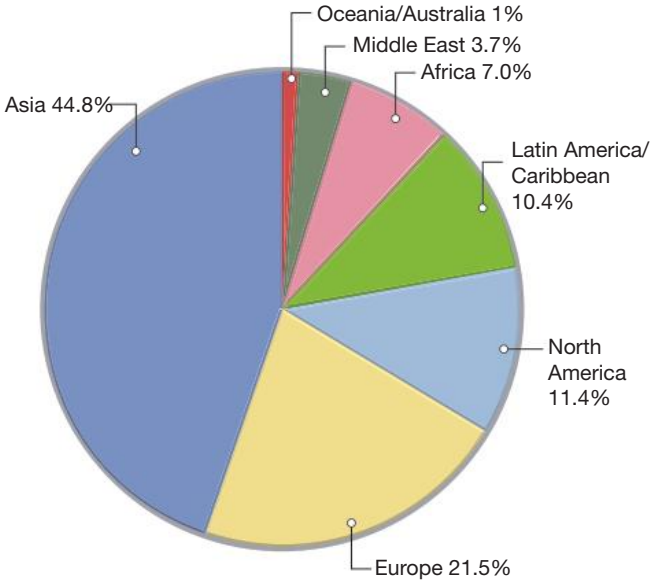
By 2012, there were 78 mobile phone subscriptions per 100 people in the developing world. In the developed world there were 122 subscriptions per 100—meaning every fifth person has two phones!

8.5 Text messages (number sent across all carriers in Australia), 2000–01 to 2010–11



Source: *Sydney Morning Herald*, 5 April 2013

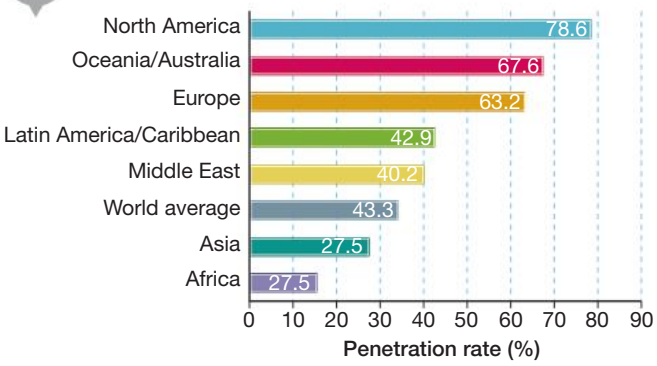
8.6 Distribution of the world's internet users by region, 2012



DID YOU KNOW?

The typical smartphone user spends an average of 12 minutes a day on phone calls. They spend more time playing games (14 minutes), listening to music (16 minutes), using social media (17 minutes) and browsing online (25 minutes). The most common use of all mobiles is to check the time.

8.7 Percentage of internet users by world region, 2012



Facebook facts (2012)

- Monthly active Facebook users now total nearly 850 million.
- Fifty-seven per cent of Facebook users are female.
- An average Facebook users has 130 friends.
- Twenty-three per cent of Facebook's users check their account five or more times daily.
- Over 250 million photos are uploaded to Facebook every day.

Twitter facts (2012)

- Since the introduction of Twitter, there's been a total of 163 billion tweets.
- There is an average of 175 million tweets posted per day.
- Thirty-two per cent of all internet users are using Twitter.
- Fifty per cent of Twitter users are using the social network via mobile.

Instagram facts (2012)

- By August 2012, Instagram had 80 million users.
- Nearly 4 billion photos have been shared on Instagram since its beginning.
- More than 5 million photos are uploaded to Instagram every day.

Effects of social media

People spend more time on social networks than on any other category of sites—roughly 20 per cent of their total time online via personal computer, and 30 per cent of their total time online via mobile devices. Facebook is the most-visited social network site.

Most people regard social media as a positive addition to their lives. Unfortunately, however, there appears to be a link between social media use and cyber-bullying. Online sexual predatory behaviours are also a problem, as is the decline in face-to-face social interaction.



8.8 Today, the number of networked devices is equal to the global population. By 2015, the number of networked devices will be twice the global population.

New technologies, new industries, new jobs

ICTs are also transforming the ways that people work and interact in workplaces. At one level they are changing the ways in which existing jobs are done. At another it has created whole new industries and new forms of employment. More flexible workplace arrangements are replacing the 9 a.m. to 5 p.m. office day. Work can now be performed in multiple locations (including the home and on public transport) and is no longer restricted to set hours.

New forms of economic activity have developed to take advantage of the potential of the internet and social media. The information media industry is a rapidly growing area of employment. Web-based publishing and broadcasting are now challenging the 'old' media—newspapers, magazines and television—and becoming the main means by which people access the information. They also provide forums in which they can comment on the events and issues being reported and discussed.

Such developments are not limited to the world's developed economies. In Africa, mobile phones are the continent's fastest-growing technology. There are now an estimated 650 million mobile phone subscribers in Sub-Saharan Africa alone. The World Bank credits the mobile phone industry with creating more than five million jobs in 2012.

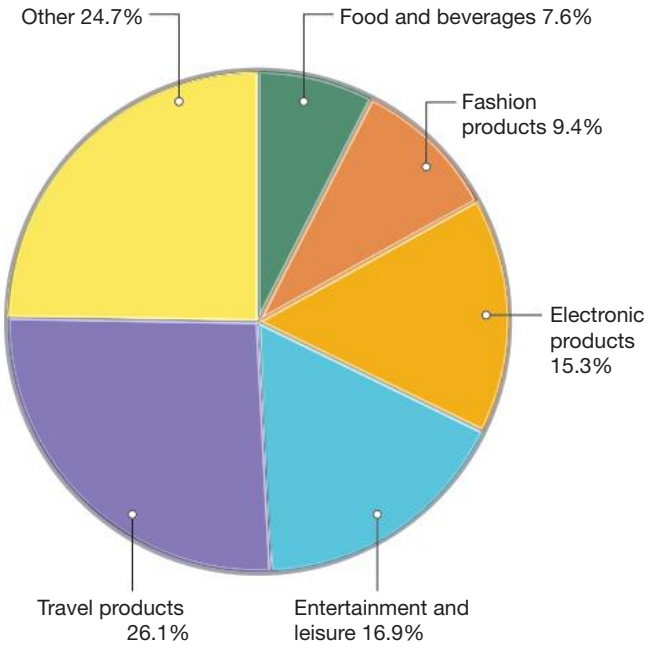
New ways of buying

Online retailing is a form of **e-commerce**. It allows consumers to directly buy goods or services from sellers using the internet. In Australia, online purchases reached $13 billion in 2012 or 5.8 per cent of traditional retail spending. At the end of 2012, online retailing was growing at an annual rate of 29 per cent per annum, compared with traditional retail sales growth of just 2.5 per cent. Travel products were the most popular category of goods bought online, as shown in Figure 8.9. In the United States of America, online retailing now accounts for about 8 per cent of all retail sales. In the case of clothing, online sales now account for 13 per cent of all transactions.

The key attraction of online retailing is convenience. Online stores are available 24 hours a day, and many consumers have internet access at home, at work and while mobile. In contrast, visiting a conventional retail outlet takes time, involves travel and must take place during trading hours. Comparing prices is also easier online and, because online retailers do not have the expenses of traditional 'bricks and mortar' retailers (for example the cost of maintaining multiple outlets in high-rent shopping malls), they can often sell goods and services at very competitive prices. Consumers are also able to access goods and services internationally. As a result, one-third of the top retail sites accessed by Australians are based outside the country.

The growth of online retailing has led to a rapid expansion in the international logistics industry. Transporting people's purchases to their homes is a massive undertaking and has created thousands of new jobs.

8.9 Online shopping expenditure by category, Australia



SPOTLIGHT

Young abandoning car ownership and driving

There has been a significant drop in the number of young people who own and drive cars. In the United States of America, the percentage of 18-years-olds with a driver's licence plunged from 80 per cent in 1983 to 61 per cent in 2010. In addition, the distance driven per person is below the historic peak by almost 9 per cent.

In Australia, there has also been a marked decrease in the proportion of under-35-year-olds holding a driver's licence. In 1998, 84 per cent of 25-year-olds held a licence. By 2009, the figure was down to 74 per cent.

The decline in car use appears to be part of a structural shift that is largely a result of changing demographics, especially the rise of so-called 'millennials'—today's teenagers and twenty somethings. Millennials are not driving cars. The reasons for this trend are complex but are thought to include the preference of the young for inner-city living, which is less car-dependent. Young people are also more likely to use public transport. The preference for the latter can be explained, at least in part, by the opportunity that public transport travel provides for engagement with social media—something that driving does not accommodate. Catch a train or bus these days and you will see people cruising the internet on their smartphones and tablets, working on their laptops or reading on their e-readers, all the while listening to music.

ACTIVITIES

8.2

Knowledge and understanding

1 Outline how personal communication has changed since the mid-1980s.
2 Define the terms 'social media' and 'virtual community'.
3 Outline the impact of the new technologies on the nature of work.
4 The ways people access information is changing. Explain how.
5 Explain why young people in Australia and the USA are driving less.

Geographical skills

6 Study Figure 8.4. Using data from the graph, describe the growth in mobile phone use in Australia since 1981.
7 Study Figure 8.5. Using data from the graph, describe the growth in text messaging in Australia since 2000–01.
8 Study Figure 8.8.
  a Write down what you do in an internet minute.
  b Compare an internet minute to your internet minute. Describe any similarities or differences.
9 Study Figure 8.9. Identify the three largest categories of online expenditure.

8.3 Global interconnectedness

In this unit we focus on some quotes and an article related to interconnectedness. Read the quotes and articles and think about the issues and questions at the end of the unit.

Paddy Ashdown

Paddy Ashdown is a British politician and diplomat. He has made many speeches about global **interconnectedness**. He states that it is a fact of life, but one that can be either a terrifying prospect or a cause for celebration and peace, in the sense that means that we all share a common destiny. He has listed the dangers and possibilities of global interconnections as follows.

Global interconnection: The dangers

'If you get swine flu in Mexico, it's a problem for Charles De Gaulle Airport in Paris 24 hours later.' (see Figure 8.10)



8.10 People protect themselves against catching swine flu in Mexico.

'Lehman Brothers (a global financial services firm at the centre of the Global Financial Crisis) goes down—the whole financial world collapses.'

'There are fires in the steppes of Russia—leading to food riots in Africa. We are all now deeply, deeply, deeply interconnected.'

'It used to be the case that if my tribe was more powerful than their tribe, I was safe. My country was more powerful than their country, I was safe. My alliance, like NATO, was more powerful than their alliance, I was safe. It is no longer the case.'

Global interconnection: The great possibilities

'If it is the case that we are now locked together in a way that has never been quite the same before, then it is also the case that we share a destiny with each other ... The advent of interconnectedness and of the weapons of mass destruction means that, increasingly, I share a destiny with my enemy.'

'When I was a diplomat negotiating the disarmament treaties with the Soviet Union, in Geneva in the 1970s, we succeeded because we understood that we shared a destiny with them. Collective security is not enough.'

'Peace has come to Northern Ireland because both sides realised that the zero-sum game couldn't work. They shared a destiny with their enemies.'

Chief Seattle

'The earth does not belong to man, man belongs to the earth. All things are connected like the blood that unites us all. Man did not weave the web of life, he is merely a strand in it. Whatever he does to the web, he does to himself.'

MOST OF WORLD INTERCONNECTED THROUGH EMAIL, SOCIAL MEDIA

Most of the world is interconnected, thanks to email and social networking sites such as Facebook and Twitter, according to a new poll released on Tuesday.

Eighty-five per cent of people around the globe who are connected online send and receive emails, and 62 per cent communicate through social networking sites, particularly in Indonesia, Argentina and Russia, which have the highest percentage of users.

More than eight in 10 Indonesians and about 75 per cent of people in Argentina, Russia and South Africa visit social media sites, the new Ipsos/Reuters poll showed.

Although Facebook and other popular social networking sites, blogs and forums, were founded in the United States of America, the percentage of users was lower at six in 10, and in Japan it fell to 35 per cent, the lowest of the 24 countries in the global survey.

'Even though the number in the United States was 61 per cent, the majority of Americans are using social media sites,' said Keren Gottfried, research manager at Ipsos Global Public Affairs.

The fact that more than six in 10 people worldwide use social networks and forums, she added, suggests a transformation in how people communicate with each other.

Email usage was highest in Hungary, where 94 per cent of people communicated online. The numbers were similar in Sweden, Belgium, Indonesia, Argentina and Poland.

Saudi Arabia, where 46 per cent of people said they communicate via email, had the lowest usage, followed by India at 68 per cent and Japan at 75 per cent. In all the other countries eight or nine out of 10 people were email users.

Source: Patricia Reaney, Reuters, 27 March 2012

Jacqueline Novogratz

'In today's world, the elites are growing even more comfortable with one another across national lines, yet at the same time, less comfortable with low-income people who share their nationality. How we create those bonds of community that are truly global as well as national is one of our generation's great challenges'—Jacqueline Novogratz, *The Blue Sweater: Bridging the Gap Between Rich and Poor in an Interconnected World*

Bono

'The planet is in a precarious place right now and extreme poverty affects a billion people who are living on less than a dollar a day, scrambling for their life. We have a great life in the West. If we want it to continue we have to feel our interconnectedness with the people who are living on less than a dollar a day.'

ACTIVITIES

Knowledge and understanding

1 a Explain the contrasting points that Paddy Ashdown is making in the first quotes.
  b What does he mean by: 'we share a destiny'?
2 Identify the key point that both Bono and Novgratz are making in their quotes.
3 Chief Seattle is talking about a different type of connectedness. Explain the point he is making.

Applying and analysing

4 Read the article above.
  a List the high rates of social network use described.
  b How does this use of interconnectedness compare with your own use?

8.4 Real versus virtual space

Think about the reasons why you, your family and your friends move around your personal and social space. Possible reasons might include going to school or work, shopping, visiting friends, visiting cinemas or sportsgrounds, going to play sport, taking the dog for a walk or going to the doctor.

Virtual space

Increasingly, a number of our day-to-day activities can be done in **virtual space**. For example, shopping can be done online; friends can be contacted by phone, email or text messaging; and even aspects of work and school can be done at home online. This is a twenty-first century development and it is changing some of the habits and patterns of people's movements and use of space. Virtual space is now taken for granted by people in countries such as Australia. It means that people have much wider access to people with similar interests, and much greater access to a variety of goods, information and activities. Virtual space is changing the way many people live their lives.

Shopping and entertainment online

Before the internet, shopping and most entertainment required travel to shops, cinemas and entertainment centres. Now, much of this is available in different ways through a home computer and a large screen. The percentage of shopping online is increasing, because of the greater range of goods, the ease of ordering at a computer, and the convenience of home delivery.

Working at home online

An increasing number of people are using online connections to work completely or partly from home. Occupations such as writing, editing and design are now possible to do at home and still retain contact with other people.

Education online

Education at tertiary level is already well developed online. Many tertiary students study courses based at universities in other states or even countries. Their notes are available online and they can submit assignments and contact their teachers online. Online learning will expand in the future. You will soon be able to watch, listen to and interact with lectures in 'real time'.

Medical applications

Medical diagnosis is already being developed online, so that people in remote areas have access to doctors at their fingertips. As the National Broadband Network expands, more people will have access to fast downloading and communications, and more business will be done using the internet.

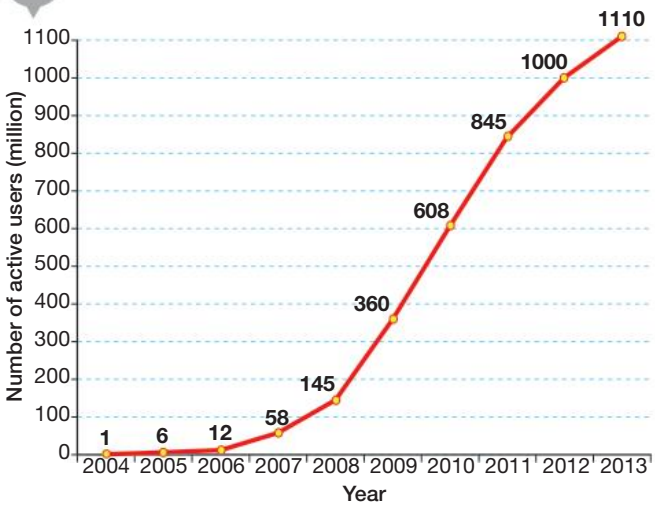
Virtual space inequality

For people who have low income and few assets, the new technologies are still of limited advantage. If it is difficult to pay the phone bills and broadband access accounts, after the rent has been paid and food has been purchased. There is also the isolation experienced by the aged, who sometimes find the technology difficult to master.

Facebook

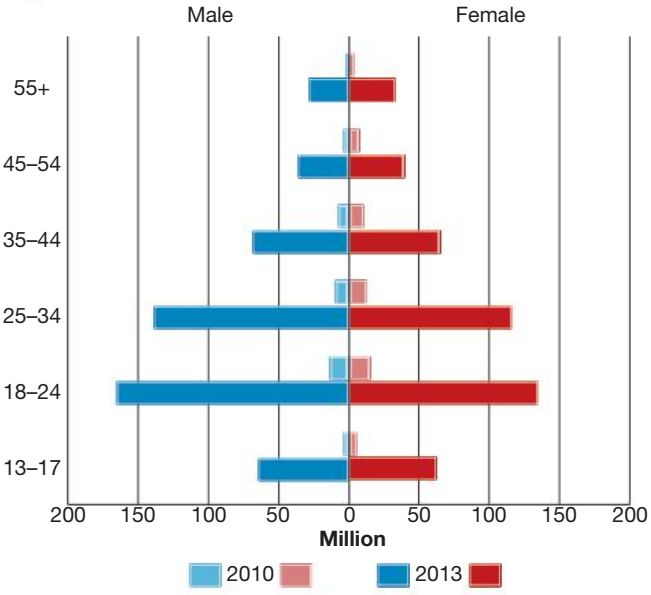
Facebook was introduced in 2004. It was originally just a network for students attending Boston's universities. However, it quickly expanded to include other students and then to the general public. The growth to over one billion users is shown in Figure 8.11.

8.11 The number of Facebook users, 2004–11





8.12 Facebook users by age group and gender, 2010 and 2013



Facebook is one of the many social media sites on the worldwide web, but it is the largest and probably the most successful. Figure 8.12 outlines the changing usage of Facebook from 2010 to 2013. The significance of Facebook is that it creates a new and much wider virtual space.

Facebook is part of a much larger social change, linked to the use of mobile phones and emails to exchange social information instantly and often. People have quickly become used to posting photographs of themselves and their activities in virtual space where they can be seen by their friends. They can issue invitations, arrange events, send greetings and keep up to date socially.

Facebook in some ways makes the world seem smaller, with its instant access to friends, wherever they are (see Figure 8.13). However, the map of Facebook links shows that the people throughout the world are not evenly engaged in Facebook activities. The main links are clearly in the wealthier countries.

8.13 World distribution of Facebook users. Paul Butler from Facebook created this map in 2010. Using the data from approximately 10 million Facebook's users, he tabulated the number of friends between each city, and the latitude and longitude of each friend. With the data he created a colour code: the more connections between two places, the lighter the line is; the fewer, the darker.

ACTIVITIES

Knowledge and understanding

1 Distinguish between 'real' and 'virtual space'.
2 Identify the activities that can take place in 'virtual space'.

Applying and analysing

3 a Make a list of the ways that new technology has changed how you and your family and friends do things.
  b Has it led to you moving around less, or has it just changed the spaces in which you move? Explain.
  c Which places do you think will remain as favourite visiting places in real space, and not be replaced by virtual space?
4 Create a PMI chart about the disadvantages and risks of the increasing reliance on virtual space.

Geographical skills

5 Study Figure 8.12.
  a Name the age group most likely to use Facebook in 2010 and 2013.
  b In which age group did usage increase the most between 2010 and 2013?
  c In 2013, were more females or males most likely to use Facebook? Explain.
6 Study Figure 8.13. Describe the patterns of Facebook connections shown in the map of the world.

8.5 Accessing goods and services

One of the main reasons for everyday travel was, and partly still is, the buying of goods and services. It ranks with the other main reason for everyday travel, which is travel to work. For hundreds of years in many different societies, these have been the major two reasons for travel.

Old patterns of access

When walking was the only means of transport for the majority of the population, the goods and services needed by people had to be available locally. People would walk to where they worked, to shops and markets for goods, as shown in Figure 8.14, and to places such as barbers, doctors and repairers. The population relied upon the local markets, stores and workshops. Goods and services that were needed less often were supplied by travelling salespersons who travelled from settlement to settlement.

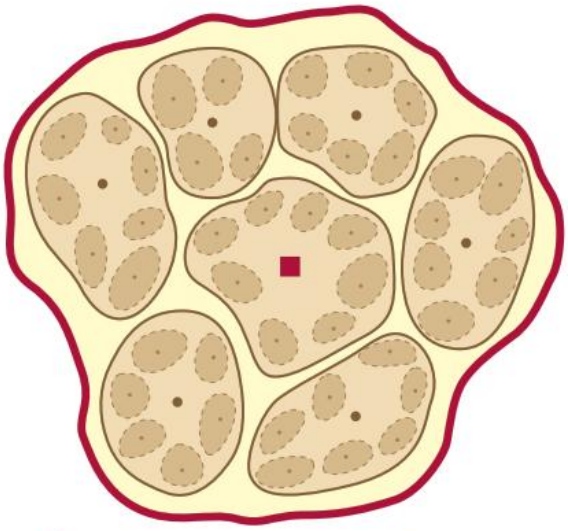
New patterns of access

Trains, buses and, more recently, privately owned cars made travel more widespread and longer in distance. People could now travel much further than a walking journey. As a result, people could visit distant places to purchase goods and services. Some places developed a more complex range of functions. This created a pattern of a few large towns with large trade areas overlapping the smaller trade areas of small towns and villages.

Patterns of travel and the consumption of goods and services can be mapped by geographers, as shown in Figure 8.15. Geographers can distinguish between larger towns, which supply many goods and services, and small towns and villages. They can also distinguish between places that supply high-order goods and services (needed only occasionally, usually fairly expensive, and people were willing to travel long distances to obtain them) and those that supply low-order goods and services (needed often, usually relatively inexpensive, and people did not want to travel far to obtain them). The area throughout which a good or service is consumed is referred to as the **hinterland** of a place (village, town or city).

8.14 A village shop: Supplying the basis needs of villagers





City and its trade area (high-order goods and services)

Town and its trade area (middle-order goods and services)

Small town/village and its trade area (low-order goods and services)

8.15 Map of trade areas



8.16 Westfields redevelopment in Sydney CBD

Emerging patterns of access

Since the introduction and spread of the internet, the provision of goods and services has changed greatly. Although many people still visit shops and offices for goods and services, the trend towards online purchasing of goods and services has grown very quickly. This is particularly true of some types of goods. Music and movies that were once purchased on CDs and DVDs are now more often than not downloaded, a process which does not involve any travel by the purchaser. Books, clothes and many specialist goods are also increasingly purchased online. These have to be physically delivered to the purchaser, but the courier, not the consumer, undertakes the travel. The trend towards ordering groceries online for a home delivery is growing, especially among people who are time-poor but relatively wealthy.

The next big area of expansion of online use is that of services. Medical advice and diagnosis, legal and financial advice, and education courses of all kinds are increasingly accessed online.

All these changes in accessing goods and services have consequences for shops and town centres. Already many shops have closed or changed greatly because of the increase in online purchasing. This trend will continue, but perhaps in ways so far unimagined. Even the giant shopping malls need to adapt. Most are now much more than just a shopping destination. In recent years, companies such as Westfields have spent billions transforming malls, such as the one shown in Figure 8.16, into entertainment destinations featuring cinema complexes and restaurants.

Differences in access to goods and services

Not everybody has access to these new ways of obtaining goods and services brought about by the internet. Within wealthy countries, which typically have high levels of internet use, there are still many people with limited access or no access at all. For them, the consequences of the changes, such as shops closing, still have to be borne without the advantages that others are enjoying.

ACTIVITIES

Knowledge and understanding

1. Explain what is meant by a low-order and high-order good or service.
2. Describe the changes in patterns of travel for goods and services.

Applying and analysing

3. Make a list of goods and services which fit into the categories of low-order and high-order.
4. Make your own list of goods and services that you know are readily available for purchase on the internet. What goods and services do you think it would be difficult to sell using the internet?
5. Which groups of people do not benefit from the increased availability of online goods and services?

8.6 The biggest consumers

The question of who consumes the most can be investigated on many different scales. Firstly, the global pattern can be investigated (global scale). Secondly, we can look at the different groups of people within Australia (national scale). Thirdly, we can examine our own family's consumption patterns (local and personal scale).

Inquiring at a global scale

There is not an overall statistic for consumption, so to discover which country consumes the most, we have to investigate a variety of statistics. Tables 8.17 to 8.19 provide a picture of the global pattern of consumption.

- consumption of energy per person
- consumption of food per person
- ecological footprint per person.

8.17 Consumption of energy per person

Top 10 countries	Average power per capita (watts)
Iceland	5870
Norway	2634
Canada	1795
Finland	1751
Sweden	1599
Luxembourg	1445
United States of America	1361
Kuwait	1361
Qatar	1131
Australia	1131
Bottom 10 countries	
Mali	4
Haiti	4
Burundi	4
Eritrea	4
Central African Republic	4
Somalia	3
Rwanda	2
Afghanistan	1
Chad	1
Sierra Leone	1

8.18 Daily dietary energy consumption per capita (kilojoules), 2005–07

Top 10 countries	Daily diet energy consumption (kilojoules)
United States of America	15 770
Austria	15 730
Greece	15 480
Belgium	15 440
Luxembourg	15 440
Italy	15 310
Malta	15 020
Portugal	14 980
France	14 850
Canada	14 770
Australia (38)	13 350
Bottom 10 countries	
United Republic of Tanzania	8450
Central African Republic	8200
Angola	8160
Ethiopia	8160
Zambia	7910
Comoros	7780
Haiti	7740
Burundi	7030
Democratic Rep. of the Congo	6650
Eritrea	6650

8.19 Ecological footprint per person (global hectares per person)

Top 10 countries	Ecological footprint (global hectares per capita)
United Arab Emigrates	10.68
Qatar	10.51
Bahrain	10.04
Denmark	8.26
Belgium	8.00
United States of America	8.00
Estonia	7.88
Canada	7.01
Australia	6.84
Kuwait	6.32
Bottom 10 countries	
Democratic Republic of the Congo	2.76
Mozambique	1.89
Timor-Leste	1.21
Malawi	0.70
Afghanistan	0.54
Pakistan	0.43
Bangladesh	0.38
Haiti	0.31
Palestinian Authority	0.16
Puerto Rico	0.14

Inquiring at a national scale

Investigations by the Australian Conservation Foundation have found that there are three groups of people who consume more, and as a result, create a higher ecological footprint than the average.

- People with high incomes spend more than the average on energy (petrol and electricity), on building (bigger houses) and more consumer goods.
- People living in the inner city spend less on transport but more on air-conditioning of apartments, and luxuries such as spa baths and elaborate lighting.
- People living in small households of one or two people—expenses as heating, cooking, water for gardens are spread only between one or two persons.

Inquiring at a local scale

The patterns of consumption also differ between individuals and different families within the same areas. Findings about consumption by families and individuals include the following.

- Food accounts for almost half of the average Australian's water use.
- Meat consumption increases a person's ecological footprint. This is because of the water, vegetation and other inputs necessary to produce the meat.
- Dairy products and rice require a lot of water to grow, despite being relatively cheap foods to buy. For each dollar spent on dairy goods, 300 litres of water is used.
- Electricity use is one of the biggest contributors to greenhouse gas pollution.
- Buying goods has a bigger impact on the environment than buying services such as entertainment, education and labour. Goods require large amounts of water and materials to produce.

ACTIVITIES

8.3

Knowledge and understanding

1 Identify the types of data that can be used to determine differences in consumption at a global scale.

2 State how variations in consumption can be measured on a local or personal scale.

Applying and analysing

3 Brainstorm a list of the goods and services that people with high incomes are likely to consume. How does this contrast with the consumption choices of people on low incomes?

Geographical skills

4 Study Tables 8.17 to 8.19.

a Copy the table below and list the continents in the first column (excluding Antarctica). Then place each country from the tables in the correct cell.

b Describe any patterns emerging.

Continent	Daily diet kilojoules		Electricity consumption		Ecological footprint	
	Top 10	Bottom 10	Top 10	Bottom 10	Top 10	Bottom 10

8.7 Trade: Connecting people and places

The goods and services we consume link us to places throughout the world. Even though we may not be aware of these connections, they exist and they play an important role in the world geography of production and consumption.

Thinking about our links

Think about all the places in the world that you have links with. You might start with family or friends, places visited or desirable to visit, and places that particularly interest you. When you have done this, think about some of possible connections from the list below:

- places where your clothes are made
- places where your electronic gadgets are designed and made
- places from where you have ordered online goods or services
- places that provide services that your family use (banks, airlines, internet provider)
- places that make films and television shows that you watch.

These connections are all part of **globalisation**, a process in which goods and services and the influences that accompany them become similar throughout the world.

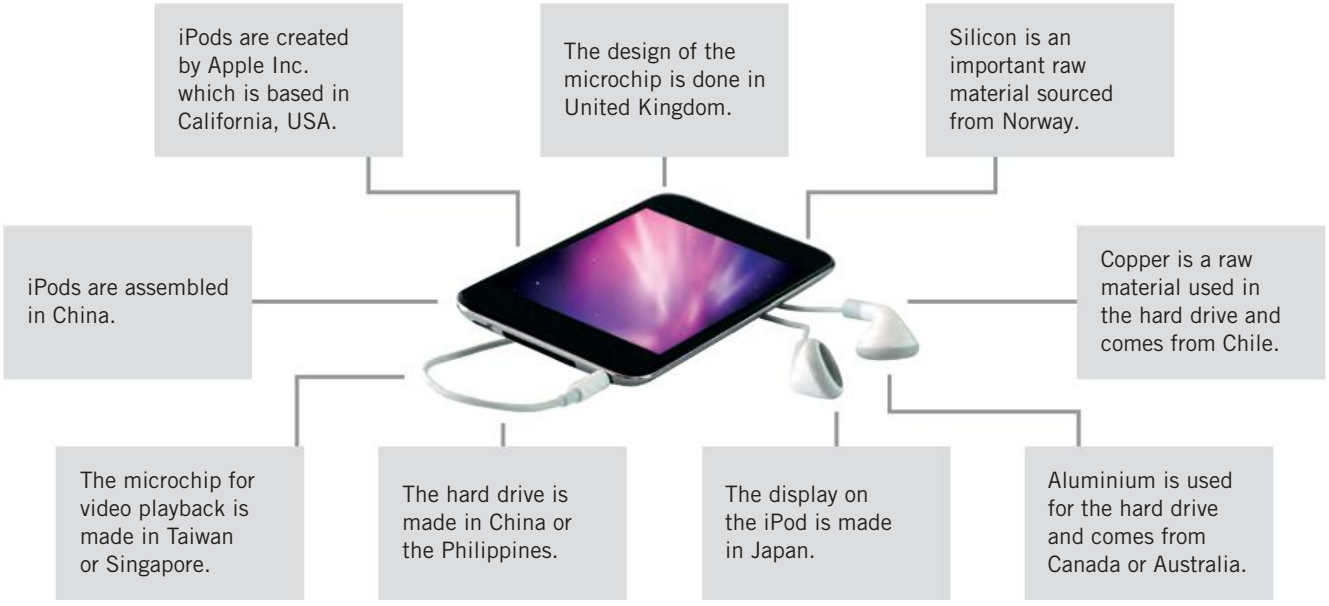
Origins of clothing

The chances are that your clothes may have been designed in the United States of America, Europe and Australia, but were probably made in an Asian country. This is now a very common pattern. Clothing companies might have their head offices and administration in one country, their design offices in another, and the actual manufacturers of the clothing in a number of other countries. They need to have their designers near the latest trends, but they want to use cheap labour and processing to produce the clothing.

Origins of digital devices

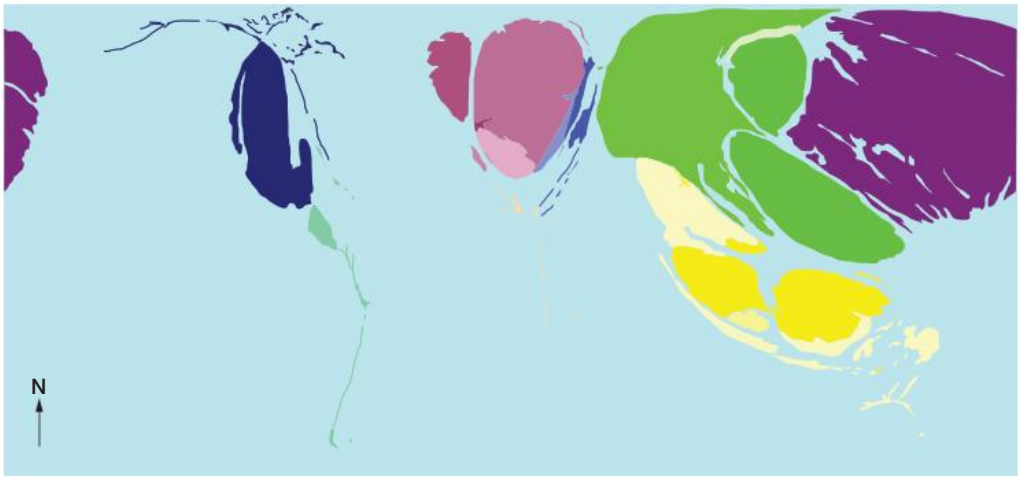
Digital devices such as iPods are widespread teenage and adult possessions. Look at the list of components and processes involved in the making of an iPod in Figure 8.20. This information is current at the time of publication, but the source of raw materials and the sites of manufacturing keep changing as costs and profitability change. Global companies are constantly assessing their costs and profits, and are prepared to shift their contracts to different suppliers in different countries if that improves their costs.

8.20 The design and production of an iPod is a worldwide collaboration.



Global electronics trade

The patterns of trade suggested in the iPod example are further illustrated Figures 8.21 and 8.22, which show the regions with the greatest exports and the greatest imports of electronic goods.



8.21 Worldmapper of electronic exports

- Central Africa
- South-eastern Africa
- Northern Africa
- Southern Asia
- Asia-Pacific
- Middle-East
- Eastern Asia
- South America
- Eastern Europe
- North America
- Western Europe
- Japan



8.22 Worldmapper of electronic imports

- Central Africa
- South-eastern Africa
- Northern Africa
- Southern Asia
- Asia-Pacific
- Middle-East
- Eastern Asia
- South America
- Eastern Europe
- North America
- Western Europe
- Japan

ACTIVITIES

Knowledge and understanding

1. List the metals that are used in the production of an iPod.
2. Name the countries that are involved in the production of an iPod.
3. Outline the clothing production process.

Applying and analysing

4. Demonstrate the influences globalisation has on your life.
5. List the places that you are connected with through the origins of your:
   - clothing
   - goods, such as smartphone, tablet etc.
   - favourite music or shows.
6. Look through the list of the countries and places throughout the world that you have any connection with. Which connections have come about recently through globalisation?
7. Do you think that globalisation is good or bad, and inevitable or changeable? Give reasons for your opinion.

Geographical skills

8. Study Figures 8.21 and 8.22.
   - a Name the regions with the largest levels of exports.
   - b Name the regions with the largest levels of imports.
   - c Describe the pattern that this shows.

8.8 Case study: Using ICT in developing countries

Much of South America, Asia and Africa has not had the wealth or the level of development to build communications infrastructure, but as this case study demonstrates new technologies are being put to good uses in innovative ways.

Santarem, Amazon River

Santarem, one of the most remote places in the world, is surrounded by forests and mudflats, which has made communications difficult. Phone lines using wires have been impossible to maintain. In 2012, two high masts carrying mobile phone aerials were built, and now an area stretching 45 kilometres along the river is connected. The masts have wind-powered and solar-powered generators to provide some of their power.

The broadcast signals are not only for mobile phones but also for a computer network in schools. A Swedish firm has connected school computers to a 'cloud server', which can be maintained far away, and set up the school with suitable apps. This means that the children have learning aids similar to children in much less remote areas.

This new communications development serves 170 separate communities. In addition to the educational uses, there are many advantages for businesses. A breadmaker is able to take orders electronically, and can bake the right quantities of each of the breads to be sold.



8.23 Distance learning in the Amazon forest project

Medical facilities have also been improved by the new network. Emergencies can be reported faster, and a boat that travels the rivers with doctors has links to better diagnostic help. Many locals believe that the new methods of communication, and the advantages to education, health and business, make the remote areas of the Amazon a better place for them to live.

Distance learning in the Amazon forest

Distance learning using the internet has been introduced into Amazonas, the largest state in Brazil. Amazonas has a population of 3.3 million inhabitants, half of whom live in the capital, Manaus. The rest of the state's population is spread out across small towns and villages, mostly accessible after a 21-day riverboat trip. Ninety-two per cent of its area is covered by the Amazon forest and the rivers of the Amazon Basin.

The initiative involves teachers transmitting live classes from three studios located in Manaus via a two-way video-conference link to 35 000 students in 300 secondary schools and 700 classrooms, throughout the 62 county districts. A teacher is also located at each classroom to support local activities. Figure 8.23 shows students engaged in distance learning.

Bringing the internet to Bangladesh's remote villages

Amina Begum had never seen a computer until a few years ago, but now she's on Skype regularly with her husband. A woman on a bicycle brings the internet to her. Dozens of 'info ladies' ride their bikes from one remote Bangladeshi village to another with laptops and internet connections, helping tens of thousands of people—especially women—get everything from government services to chats with distant loved ones (see Figure 8.24). It is a vital service in a country where only 5 million of 152 million people have internet access.



8.24 'Info lady' bringing interconnectivity to Bangladesh's remote communities

Digital technology, Kenya

Kenya is not a country where people have surplus spending money for consumer electronics. However, there have been ingenious ways of using digital technology for the benefit of local people. Instead of using connections to the internet from fixed broadband cables or telephone wires, 99 per cent of the connections to the broadband internet are through mobile phones, which are much cheaper than personal computers. Most of the mobile phones in use are relatively cheap, but they connect to the internet. In 2011, there was an 843 per cent growth in mobile internet use. In the five years before that, the coverage of Kenya by broadband increased from 19 per cent of the country to 87 per cent of the country.

8.25 Nairobi iHub



Kenya's iHub

Figure 8.25 shows iHub, a workspace and business incubator in Nairobi, Kenya. The iHub was founded by Erik Hersman, a blogger and entrepreneur. The facility provides a space where young entrepreneurs, mobile phone programmers, designers and researchers can receive mentorship, internet connectivity and access to capital.

ACTIVITIES

Knowledge and understanding

1 List the issues accessing communication technology in Brazil and Kenya.
2 Describe how internet use is spreading around Bangladesh.

Applying and analysing

3 The examples from Brazil, Kenya and Bangladesh tell us about the nature of economic activity in these countries.
   a How does it differ from that in developed countries?
   b How is technology enhancing the wellbeing of people in developing countries?

8.9 The location of call centres

Call centres are big business. They are centralised offices used for the purpose of receiving or transmitting a large volume of requests by telephone.

Rise of the call centres

It is now a common occurrence to find yourself talking to someone in another country when you have dialled a local business number. This situation is due to a number of developments that have occurred over the last 15–20 years.

- Internet technology has made international phone calls much cheaper.
- There has been a need for businesses to cope with large volumes of information-seeking phone calls.
- Some countries have had a labour force available with English language skills and a willingness to work for low wages.

Working at a call centre

Call centres are usually large in area, because they gain advantages from scale. Figure 8.26 shows a typical call centre, with rows of people sitting at desks, each with a phone and a computer terminal. Experienced staff members, to whom difficult questions or issues are referred, supervise the workers. Call centres may be used for inbound calls (queries, help lines), or outbound calls (trying to initiate or complete sales, or raise money for charities), or both.

Call centres around the world

The world's call centres are now a huge $150 billion industry. The greatest number of call centres and workers has until recently been in India. India advertises that it has major advantages, such as a large educated population with the largest number of English speakers after the United States of America. It also has well-developed call centre services, and it has a time zone that is 12 hours different from the United States of America, which is seen as an advantage in offering 24-hour services.

In the last few years, the Philippines has overtaken India in the number of call centres and people employed in the industry. It now has 400 000 workers, and by 2020 may have one million. The reason for this growth is not that the Philippines has cheaper labour; in fact their call operators are more highly paid than in India. It seems to be more a reaction to American consumer complaints about not understanding the voices of call centre operators.

8.26 Call centre in Mumbai, India



READY TO ANSWER AUSTRALIA'S CALL

Pinkey Barrozo says she has come to know Australians, even though she sits in front of a computer thousands of kilometres away.

Barrozo, a 35-year-old university graduate, is one of thousands of Filipinos who have been taught how to calm Australians when they are angry or frustrated and to know what football team they probably barrack for.

She is among the 638 000 Filipinos who crowd into open-plan offices in purpose-built centres across the Philippines in an industry that reaps a phenomenal $11 billion a year for the impoverished country, which is overtaking India as the biggest call-centre operator in the world.

An increasing number of large Australian companies are using what are known as business-process outsourcing (BPO) companies in the Philippines to make or receive Australian calls or to communicate with customers via the internet.

The seemingly well-motivated workers receive bonuses for making sales in a buzzing environment where their basic salary is between $327 and $421 a month, well above the average wage in the Philippines.

They are mostly university graduates or college-educated middle-class Filipinos in their 20s who work in jobs that are largely envied in a country where almost 3 million eligible workers are unemployed.

Promotion can come quickly from agent to trainer and eventually to a management role.

One of the main reasons for the extraordinary growth of call centres in the Philippines is that Filipinos speak English with a more neutral accent than Indians.

Wages in the Philippines are slightly higher than India but the Philippine accent demands a premium.

Companies that set up in the Philippines have tax breaks for up to eight years. There is also a ready-educated workforce in a country of 90 million people.

Source: Adapted from Lindsay Murdoch, *The Age*, 13 January, 2013

The Philippines advertises that, because it has had long cultural relationships with the United States of America, its employees speak a lightly accented American English, and understand the American culture.

There are also new centres in Eastern Europe to serve the Western Europe market, and in the Chinese city of Dalian, where there are many Japanese speakers, to serve customers in Japan.

The effects of call centres

Call centres in India and the Philippines are major industries. They employ thousands of workers, and they bring in large amounts of money from the overseas companies whom they service. Therefore, any expansion or decline in the industry has big effects on these countries. But this industry, like many other global high-tech industries is mobile. It is easy for a large company to abandon an office in one country and move to another. The set-up costs are small, the technology is portable, and English-speaking workers are widely available.

ACTIVITIES

Knowledge and understanding

1. State what a call centre is.
2. Outline the factors that led to the development of call centres.
3. List the functions of call centres.
4. Describe the global distribution of the global call centre industry. Why can this distribution change quickly?
5. Outline the impact of call centres on the host country.

Applying and analysing

6. Read the newspaper article then complete the following tasks.
   - a. List the benefits of the call centre industry for people in the Philippines.
   - b. Describe the average worker in a call centre.
   - c. Outline the reasons why companies set up call centres in the Philippines.
7. Create a PMI about the advantages and disadvantages of locating call centres in Australia.

8.10 Locals, globals and mobals

In our increasingly globalised world there are fewer differences between places. Some people refer to this new world as a 'flatter' world. It is certainly more homogeneous in terms of the goods and services produced and consumed. Globalisation has also had an impact on people's mobility.

Globalisation

While there are more people moving around the world for work or pleasure, there is an increasing number of people being born in poverty with few chances of moving anywhere. One field of geography has divided the world's population into three groups—locals, **globals** and **mobals**—to explain these differences.

Locals

Locals are the people who are too impoverished to ever be able to move far from where they were born. Their lives are spent in hard work with little reward. They include the peasant farmers of Asia, Africa and parts of South America. By this definition, a local is a person who will never have many contacts with people or places beyond where they live and work.



8.27 Refugees and asylum seekers are those mobals who flee from wars, persecution and famine.

Globals

Globals are the people who have power, resources, information, contacts and networks. They are people who have influence because of the nature of the jobs they do, and have enough wealth to be able to travel freely. This group includes business people.

Mobals

Mobals are those people who move from their original place of living to somewhere else, solely for a better job or a better life for their family. This group includes people who seek a higher-paying job in a far-off mine, and those who go to another country as a domestic worker. Many of this group see their migration as temporary, and send money back to their family.

There is another group of more permanent migrants—the refugees and asylum seekers who flee from wars, persecution and famine, such as the children pictured in Figure 8.27. They have few resources and few choices about where they can go. Examples of mobals in this category include the people trying to reach Australia in boats from Indonesia, and North Africans travelling by boat towards Italy to gain entrance to the European Union.

Opportunities in the twenty-first century

In this division of the world's people into three groups, it is the globals who clearly have all the power and opportunities. They certainly see their access to the world's resources and opportunities becoming greater. They benefit from faster air travel and faster internet communications.

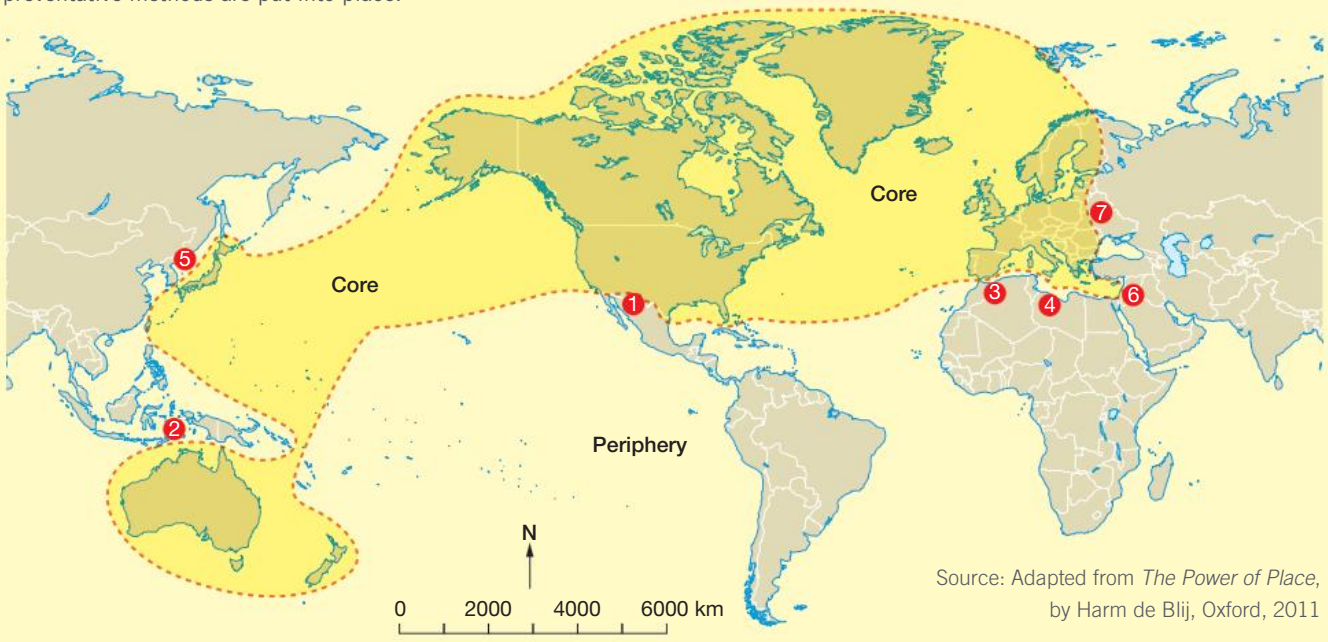
Mobals hope for better opportunities, but have little control over what happens to them. Mobals are risk takers, leaving their homes for unknown new places, hoping they will provide better opportunities.

SPOTLIGHT

Where are the barricades in the world?

Some geographers divide the world into the **core** and **periphery**. The core contains the countries and regions with greatest wealth and power. The periphery is the remainder. Mobals trying to get into the core are most numerous at a few points, and it is at these points that special patrols and preventative methods are put into place.

8.28 Core, periphery and barricades



Source: Adapted from *The Power of Place*, by Harm de Blij, Oxford, 2011

The group that is increasing in numbers at the greatest rate is the locals, the people who will live their life in one place, with few opportunities to improve it. Whereas the populations of most wealthy countries are growing slowly, if at all, the populations of the poorest countries have the highest birth rates. There will be millions of babies born into poverty and extremely limited opportunities.

Locals becoming mobals

There is still some debate as to whether locals can become mobals. For example, in the case of women who leave their village farm to work in a sweatshop, some may become mobals and gain further opportunities while others may find there are too many factors working against them.

ACTIVITIES

8.4

Knowledge and understanding

1 Explain your understanding of the terms 'globals', 'locals' and 'mobals'. Choose three examples of people in particular positions or places that illustrate each term.

Geographical skills

2 Study Figure 8.28 then answer the following questions.
- a Which continents make up the core region of the globe?
- b Name the continents that are definitely in the periphery.
- c Which continents appear in both categories? Can you suggest reasons for this

Investigating

3 Find out some facts about each of the 'barricades' to movement shown on Figure 8.28. Look for methods of preventing movement of people, and the numbers of people known to have crossed these 'barricades'.

CHAPTER

9

PRODUCTION AND CONSUMPTION



An important aspect of geography is the study of the spatial organisation of the economic, transportation and communication systems that support networks of trade in raw materials, manufactured goods, capital (both human and financial), ideas and services.

Resources are unevenly distributed on earth. No countries have all of the resources they need, nor can they produce all the goods and services their people want. People must therefore trade with others in increasingly complex global networks, which, in turn, promote global economic interdependence.

The spatial pattern of economic activity is increasingly complex. Raw materials may be shipped to locations thousands of kilometres away, where they are processed and transformed into consumer goods and then transported, again over long distances, to where they are sold to consumers.

In places such as China, millions of people are abandoning rural areas and moving to cities in search of jobs, some of which have been outsourced from industrialised countries. Elsewhere, technology and telecommunications have freed many jobs from being tied to specific locations. Work can be done collaboratively in different locations, with advantage taken of different time zones for increased efficiency.

In this chapter we study the ways that places and people are interconnected with other places through trade in goods and services at a range of scales. We also examine the effects of production and consumption on places and environments throughout the world.

KEY IDEAS

- To understand the changing geography of production and consumption
- To recognise the role of technology in transforming the pattern of production and consumption
- To investigate the effects of production and consumption on places and environments

GLOSSARY

brand loyalty	the tendency for people to purchase a particular brand repeatedly rather than those by other suppliers
consumer good	a commodity that is produced and subsequently consumed by consumers to satisfy their current wants or needs
digitisation	the process of transcribing data into a digital form so that it can be directly processed by a computer
human capital	the skills and knowledge of individuals that can be used to create economic value for the individuals, their employers, or their community; education increases human capital and contributes to higher productivity
infrastructure	the basic facilities necessary for a community to operate, including transportation and communication networks, power and sewerage systems, schools and hospitals.
sweatshop	a factory or workshop in which poorly paid workers work for long hours and under poor conditions
transnational corporations	large companies that operate in a number of countries but generally have their headquarters in one of the countries of the developed world
venture capital	money made available for investment in innovative enterprises or research, especially high technology, in which both the risk of loss and the potential for profit may be substantial.

9.0 Cotton selection in a textile factory, Madhya Pradesh (Central Provinces), Bhopal, India

9.1 The changing geography of production

One hundred years ago, the main areas of manufacturing were the midlands of the United Kingdom, the Ruhr Valley of Germany and the north-east of the United States of America. The global pattern of manufacturing is now quite different. Today, much of the world's labour-intensive manufacturing takes place in the low labour-cost countries of East and South-East Asia and Central and South America.

Changing distribution of production

The global distribution of the production of goods and services has changed over time. The reasons for this are often complex but include factors such as:

- technological change
- rising living standards and lifestyle aspirations
- the emergence of the **transnational corporation**
- the movement of labour-intensive manufacturing to low-wage countries of the developing world—an example of this is the Bangladeshi garment factory shown in Figure 9.1
- new ways of organising firms.

Transport and technology developments

Developments in technology and transport have enabled large international businesses to locate each of their functions in different parts of the world. The businesses are able to locate specific production tasks in one part of the world and their marketing, decision-making and product development divisions in another.

There are now two forces shaping the geography of production on a global scale. These include forces of concentration made possible by specialisation of business functions, and forces promoting dispersal (spreading) of a company's operations on a global scale. The geography of production today is one of highly clustered industries using technology to communicate over long distances.

DID YOU KNOW?

Japan has the world's largest concentration of electronics companies. They include Canon, Casio, Citizen, Fujifilm, Fujitsu, Hitachi, JVC Kenwood, Mitsubishi Electric, NEC, Nikon, Nintendo, Olympus, Panasonic, Pioneer, Ricoh, Seiko Group, Sharp, Sony, TDK and Toshiba. Other major concentrations are Taiwan, South Korea and southern China (mostly manufacturing).

DID YOU KNOW?

In the 1980s, 200 000 men and women were employed in the Australian garment industry. Today there are just 49 000. Most of these work in the high-end fashion industry, which can absorb the relatively high cost of labour in Australia.

Concentration

Science- and technology-based firms tend to cluster in particular regions and cities. These areas include Silicon Valley, Austin and southern California in the United States of America. By locating close together, these firms can share the latest technology and form networks with related businesses. Other service-based industries, including retailing, also tend to cluster. By concentrating stores into shopping districts and large planned shopping centres, customers can save both time and money.

Related manufacturing industries cluster in different locations across the world so they can be close to their suppliers of raw materials. The auto industry is clustered in southern China (Guangdong), southern Japan, Detroit and Toronto. In Australia, during the period of post-World War II industrialisation, whitegoods and automobile industries clustered in Melbourne and Adelaide, textiles and garment manufacturing in Melbourne and chemicals manufacturing in Sydney and Melbourne. Many of these manufacturing industries have now been outsourced overseas to countries where production costs are lower. Other industry clusters that emerged and continue to grow are the wine industries in locations such as the Barossa Valley in South Australia and Margaret River in Western Australia. More recently, new biotechnology clusters have emerged, often located near major universities.

While the manufacturing firms tend to cluster, suppliers providing intellectual inputs such as banking and legal services can be located some distance from the factories where production takes place, often in world cities on the other side of the globe.



9.1 Asia now dominates the global geography of manufacturing.

9.2 Key events in the changing geography of production

Date	Key developments affecting production	Impact on the geography of production
Early 1700s	The manufacturing of goods (for example textiles) was performed on a limited scale by individual workers (artisans). Packhorses were used to transport raw materials to production locations in homes and workshops.	Small-scale production with raw materials transported to individual houses.
Late 1700s	The development of the steam engine together with improvements in road, canal, rail and shipping infrastructure made it possible for industry to be centralised.	Yarn and cloth began to be produced in large centralised factories. The use of production lines (specialisation of labour) enabled factories to operate extended hours.
1900s	Specialised businesses developed to provide accounting, legal, finance, design and marketing services for manufacturers.	Specialised services did not need to locate close to the businesses they served. They clustered in cities such as Detroit, New York and Chicago so they could be close to the source of 'ideas' and maintain regular face-to-face contact with others in the industry. Intellectual services (e.g. lawyers) and specialised technical services (e.g. IT development firms) now cluster in world cities such as London, New York and Tokyo.
1951	Development of the first purpose-built container ship. Containers, together with specialised bulk carriers, greatly reduced the cost of handling and transporting raw materials and manufactured products.	Lowering the cost of transport and increasing the volume of goods that could be carried promoted trade and the globalisation of production.
1969	Boeing developed the first 747 aircraft designed to take either freight or passengers. Its introduction greatly reduced the real cost of travel.	Rapid expansion in international tourism and the trade in services such as education and healthcare.
1980–90s	The growth of transnational corporations and the beginning of large-scale economic restructuring—the movement of labour-intensive manufacturing to low labour-cost countries of Asia and South and Central America.	The emergence of Asia and parts of South and Central America as major centres of manufacturing.
1900–2000s	Technological revolution, especially the internet, enable service-based activities to move to low-cost countries.	Advanced producer services—the services used by large firms to help them manage their global operations (e.g. accountancy, advertising, banking/finance services and lawyers)—can now be outsourced to low-cost countries in the developing world. China and India re-emerge as global economic powers.

History of production

Table 9.2 outlines some of the developments in the changing global geography of production.

Forces of concentration vs. forces of dispersal

Clusters are geographic concentrations of competing, complementary or interdependent firms and industries that do business with each other and/or have common needs for talent, technology and **infrastructure**. The diagram in Figure 9.3 shows how clustering works.

Factors promoting concentration

Factors promoting concentration are:

- the importance of face-to-face contact
- close to the source of ideas
- opportunity to pool resources and gain a mutual competitive advantage
- favourable biophysical conditions
- access to low-cost labour
- geographical proximity to clients
- high costs of travel
- advantages of informal networks created by close proximity to related businesses.

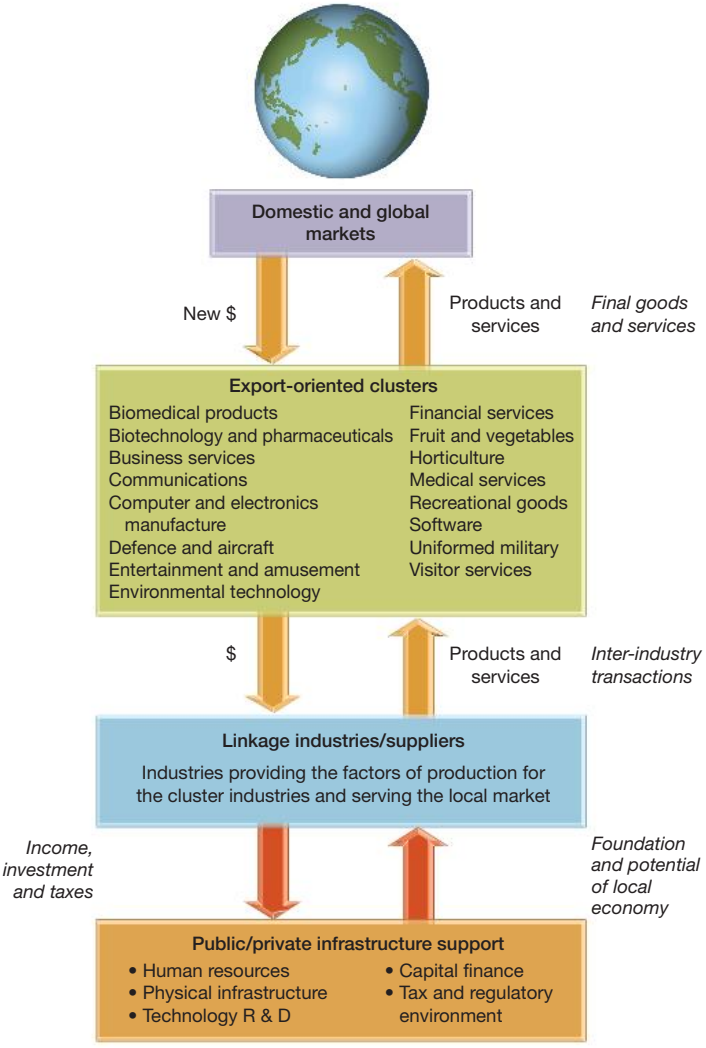
Examples of clusters are:

- historic know-how-based clusters, such as finance (London)
- biophysically driven clusters, such as viticulture (southern France), Hunter Valley (Australia), Napa Valley (California)
- high-tech clusters such as Silicon Valley (California)
- low-cost manufacturing centres, such as automotive production, electronics, or textiles (Cordoba, Argentina), electronics (Guangdong Province, southern China)
- low-cost service centres, such as knowledge-based services (Bangalore and Manila).

Factors promoting dispersal/ globalisation

Factors promoting dispersal/globalisation are:

- global differences in labour and resource costs
- location of specialist functions in areas or the world where they are most efficient and profitable
- differences in government support for industry and regulation on an international scale
- access to new markets, knowledge and experience overseas.



9.3 How clustering works

ACTIVITIES

Knowledge and understanding

1 Describe the geography of production in the early 1700s. Explain how raw materials were transported to businesses at this time.
2 Explain how the development of the steam engine altered the geography of production during the Industrial Revolution.
3 Describe changes in infrastructure required to support the growth of large centralised factories.
4 Define the term 'specialisation of labour'.
5 Outline the types of specialised services used by large manufacturing firms. Describe the location of these specialised services.
6 Explain how developments in technology have made it possible for companies to separate their production and decision-making functions on a global scale.

Applying and analysing

7 Use the information in Table 9.2 to construct a wall poster showing changes in the geography of production over time.
8 Working in pairs, brainstorm the advantages and disadvantages of:
   a separating production and decision-making locations on a global scale.
   b clustering similar types of businesses in the same location.
9 Demonstrate how businesses can cluster and globalise at the same time.
10 Study Figure 9.3 then do the following tasks.
   a Explain how industry clusters can support local communities and the local economy.
   b What role do governments play in supporting these clusters?

9.2 Global production and consumption

The global geography of product design, marketing and production has been made possible by developments in transportation, communication and the growth of transnational corporations (TNCs). Developments in transport and communications have enabled businesses to specialise on a global scale. This means that manufacturing can take place in parts of the world where it is most profitable.

Innovations in transportation

Air transport

Developments in aviation technology, especially the introduction of the Boeing 747 and the A380, have helped to lower transport costs and increase the volume of international tourism and trade between countries. Although lower volumes of freight are carried by air than by sea, the types of goods transported by air (mainly electronics products and perishable goods such as flowers) are more valuable. Airports are also located closer to areas where high-tech products are manufactured, making airfreight more attractive than other transport options.

Land transport

Increased levels of investment in rail and road infrastructure have made land transport faster and more competitive over longer distances. The introduction of high-speed rail systems and new cargo-handling equipment has, for example, cut delivery times and increased efficiency. Land transport plays an important role in the delivery of cargo to and from ports and airports.

Sea transport

Technological developments in shipping and cargo handling have been central to the expansion of international trade. As ships have increased in size, the cost of transporting goods has declined. Specialised bulk carriers, oil tankers and container ships lower costs and reduce the amount of time that ships spend in port being loaded and unloaded. Containerisation has revolutionised the way cargo is handled. Containers are capable of being carried by road, rail or ship. This eliminates the need for the multiple handling of goods.

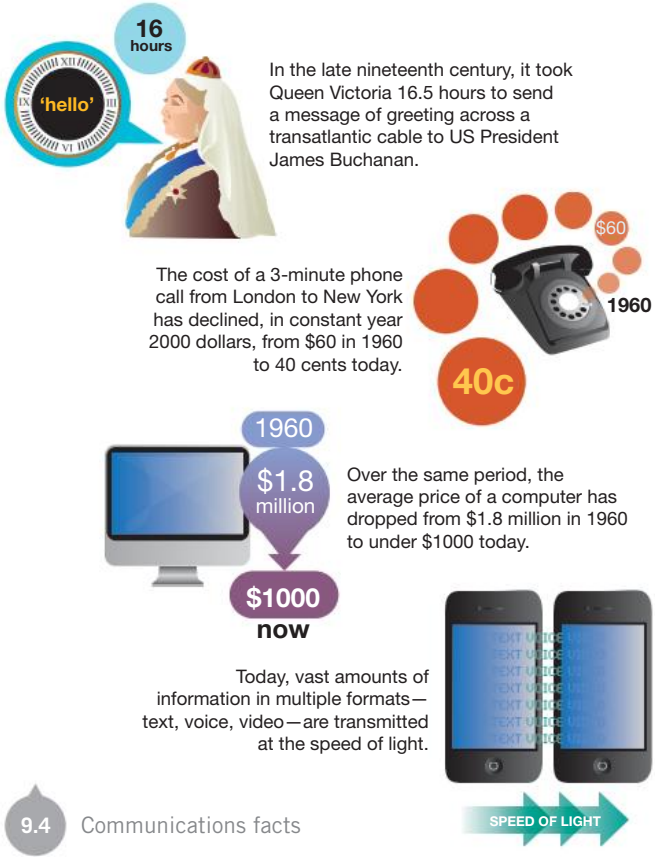
Impact of transport innovations

Developments in transport technology have made it easier for individuals to migrate from one country to another in search of employment. These migrations are of two main types: the movement of highly skilled, highly paid professionals (often employees of TNCs); and the movement of poorly paid, low-skilled workers.

Developments in communications technology

Developments in communications technology such as telephones, satellite communications and fibre optics have made it easier for people to communicate with each other over large distances, as illustrated in Figure 9.4.

The following developments have significantly improved communications on a global scale.



9.4 Communications facts

Transport facts

- The world's largest container ship, CMA CGM *Marco Polo*, shown in Figure 9.5, is 390 metres long and 56 metres wide, weighs 175 343 gross tonnes, and carries more than 10 000 containers. The ship's top speed is 25.1 kilometres per hour.
- The largest bulk carrier cargo ship in the world is the iron ore carrier *Berge Stahl*, weighing a massive 364 768 metric tons.
- The world's largest oil tankers are the TI class supertankers, which include the TI *Africa*, TI *Asia*, TI *Europe* and TI *Oceania*. Each of the four sister ships has a capacity of over 441 500 dead weight tonnes, a length of 380.0 metres and a cargo capacity of 3 166 353 barrels of oil.
- The largest ship ever built was the *Mont* (previously known as the *Knock Nevis*, *Jahre Viking*, *Happy Giant* and *Seawise Giant*). The supertanker (launched in 1979) weighed in at 564 763 deadweight tonnes and was 458.5 metres long. The vessel was sold to Indian ship breakers in 2009 and intentionally beached at Alang, Gujarat, India, then dismantled for scrap.



9.5 The world's largest container ship, CMA CGM *Marco Polo*

Increasing access to the internet

Networked computers make it possible for individuals and businesses to transfer large amounts of information around the world 24 hours a day, at high speed and low cost. The number of internet users worldwide currently exceeds 2.4 billion, or 34.3 per cent of the world's population.

The internet is an important tool in the promotion of the globalisation of trade, investment and culture. This technology has, for example, enabled large companies to locate their design and production functions in different cities. The internet has also enabled small businesses to market their products to a global audience 24 hours a day.

It is important to note that while the development of advanced communications and transport technologies has brought great benefits, especially to the cities of the developed world, many isolated and/or poor regions of the globe have little access to this technology. These countries have been effectively been shut out of the growing global networks in trade, transport, finance and communications. Africa, for example, with a population of more than 800 million people, accounts for less than 4 per cent of the world's internet users. In countries such as Uganda, Zimbabwe and Tunisia, less than 2 per cent of the population have access to the internet. Even in cities, internet access is often dial-up and very slow.

Increased availability of broadband

In Australia, the development of the National Broadband Network will significantly improve the access that many individuals and businesses will have to the internet. Costing $43 billion dollars, the network will be the single largest nation-building infrastructure project in Australian history. The network will connect 90 per cent of all Australian homes, schools and workplaces to broadband services with speeds of up to 100 megabits per second—100 times faster than those currently used by many households and businesses. The other 10 per cent of premises will be linked by next-generation wireless and satellite technologies that will deliver broadband speeds of 12 megabits per second.

Growth of satellite and microwave technologies

Satellite and microwave technologies include mobile phones, pagers, geographical positioning systems (GPS) and satellite television broadcasts. These communications systems have the advantage of being wireless and, therefore, are more flexible than traditional cable-based technologies.

Use of fibre-optic cable technology

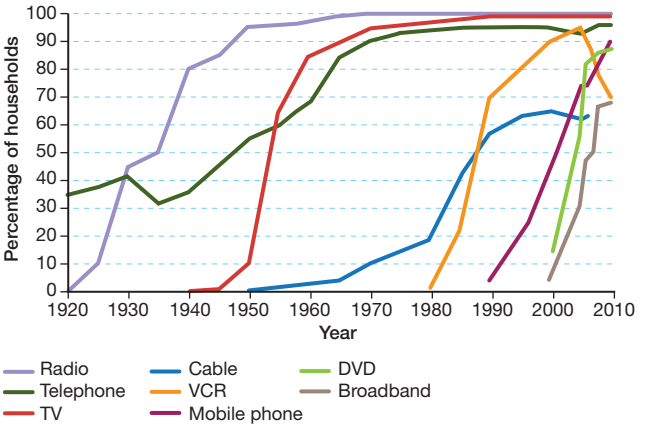
Australians currently have communications access to Asia, North America and Europe via an extensive network of cables and satellites. Fibre-optic technology enables the transmission of greater volumes of information at high speed. This has made global communications faster, more efficient and less costly.

Growth of hybrid technologies

Television and internet technologies are beginning to merge as a result of digitisation. Many media experts claim that digital television has the potential to revolutionise the way people live their lives by enabling them to use their televisions to undertake many of the functions currently available on the internet. The technology enables consumers to shop, send emails and do their banking in the comfort of their lounge rooms via their digital television sets.

Figure 9.6 shows the percentage of households with access to specific communications technologies over time. The graph shows the speed with which new technologies have been adopted. Each technology experiences a period of rapid growth followed by a slower phase as the market becomes saturated (most people have already purchased the product). In some cases, existing technologies have been completely replaced by new innovations (e.g. DVD replacing VHS videos).

9.6 Household take-up of innovations in communications in the USA, 1920 to 2010. New technologies are adopted at a rapid rate initially. Eventually the market becomes saturated (flooded) with products and sales drop off.

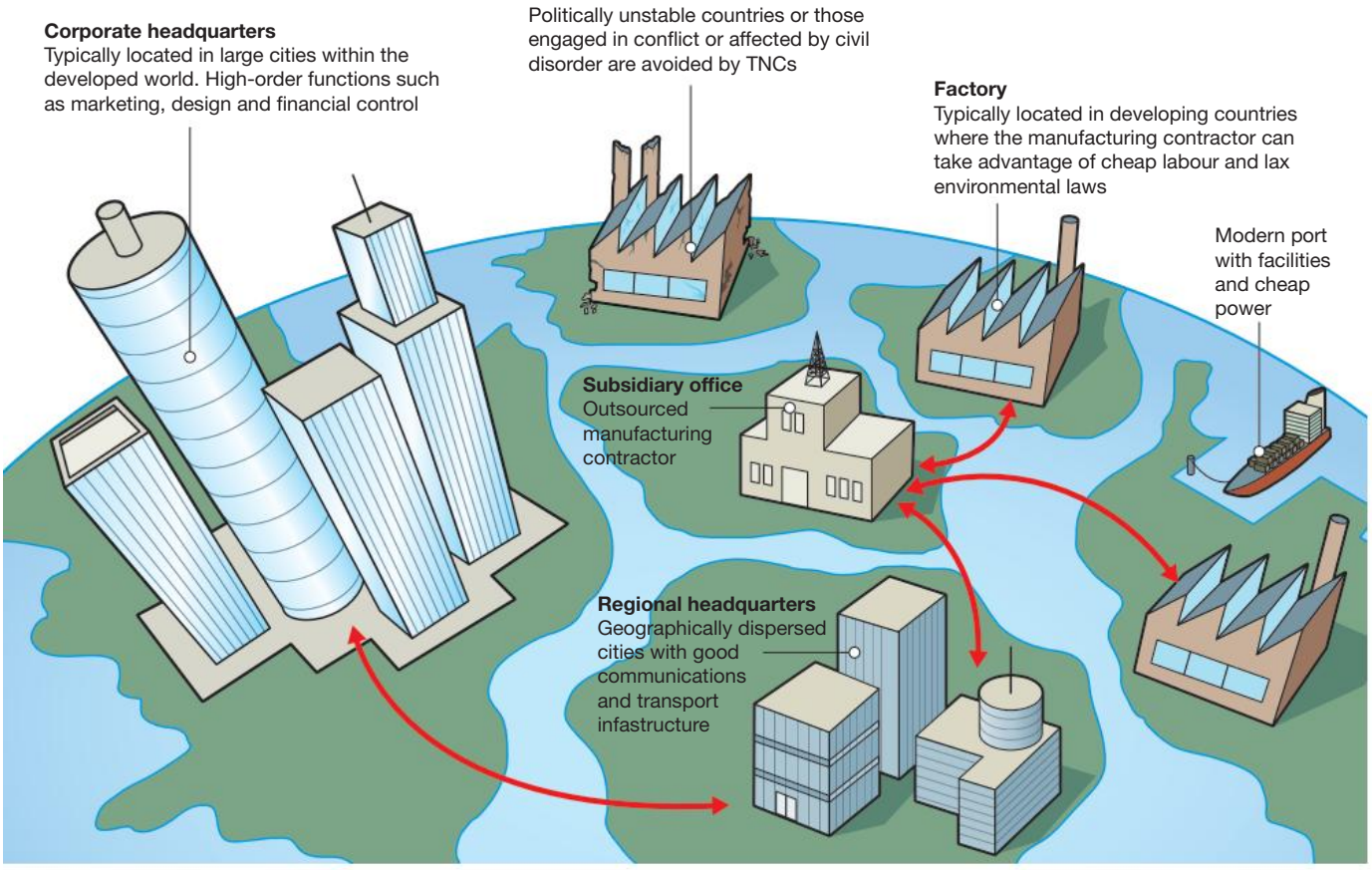


Growth of TNCs

Another factor shaping the global geography of production is the rise of transnational corporations (TNCs). TNCs are large companies that operate across a number of countries but have their headquarters in developed nations. Apple Inc., Kraft and Nestlé are all TNCs.

Within these companies, capital (funds) can be moved from one country to another with ease. These businesses can also locate their operations to take advantage of differences in resource costs and government regulations. The business links of TNCs create a more integrated world economy in which decisions made in one country can affect people in other parts of the world.

TNCs can be classified according to the nature of their operations. Some TNCs operate enterprises in different countries to produce the same or similar products, for example McDonald's, KFC and Starbucks. Other TNCs operate facilities in various countries to make products that serve as inputs to their production lines in other countries, for example the large automobile manufacturers. The organisation of a TNC is illustrated in Figure 9.7.



9.7 Global organisation of a TNC

ACTIVITIES

9.1

Knowledge and understanding

1 Explain how the development of transport has changed the way goods are manufactured and sold.
2 Explain the original reasons for the development of the internet. How has its use changed over time?
3 a List the four key developments in communications technology that have revolutionised the geography of production and consumption on a global scale.
  b What are the advantages of these new technologies?
4 What is a transnational corporation (TNC)? How do these firms decide where to locate production?

Applying and analysing

5 Discuss the theme that developments in communications have not benefited all individuals equally.
6 In small groups, use a 'think, pair, share' strategy to brainstorm ways to reduce information inequality.
7 a What do you think international transport and communications will be like in 2050?
  b What impact is this likely to have on your lifestyle (especially the types of products you consume and where you purchase them from)?

Geographical skills

8 Study Figure 9.6 then do the following tasks.
  a Identify the major innovations in communications in the United States of America since the 1920s.
  b Estimate the percentage of households with televisions in the United States of America in 1955.
  c Estimate the percentage of households with television in the United States of America in 1990.
  d Which technologies have been adopted most rapidly? Why do you think this is the case?
9 Study Figure 9.7. Write a description of the ways that TNCs operate.

Investigating

10 Interview some older people to find out what you can about changes in communications technology over time.
  a Prepare a series of questions (minimum of ten).
  b Consider how you will conduct the interview (video, recording, writing).
  c Present your findings to the class.

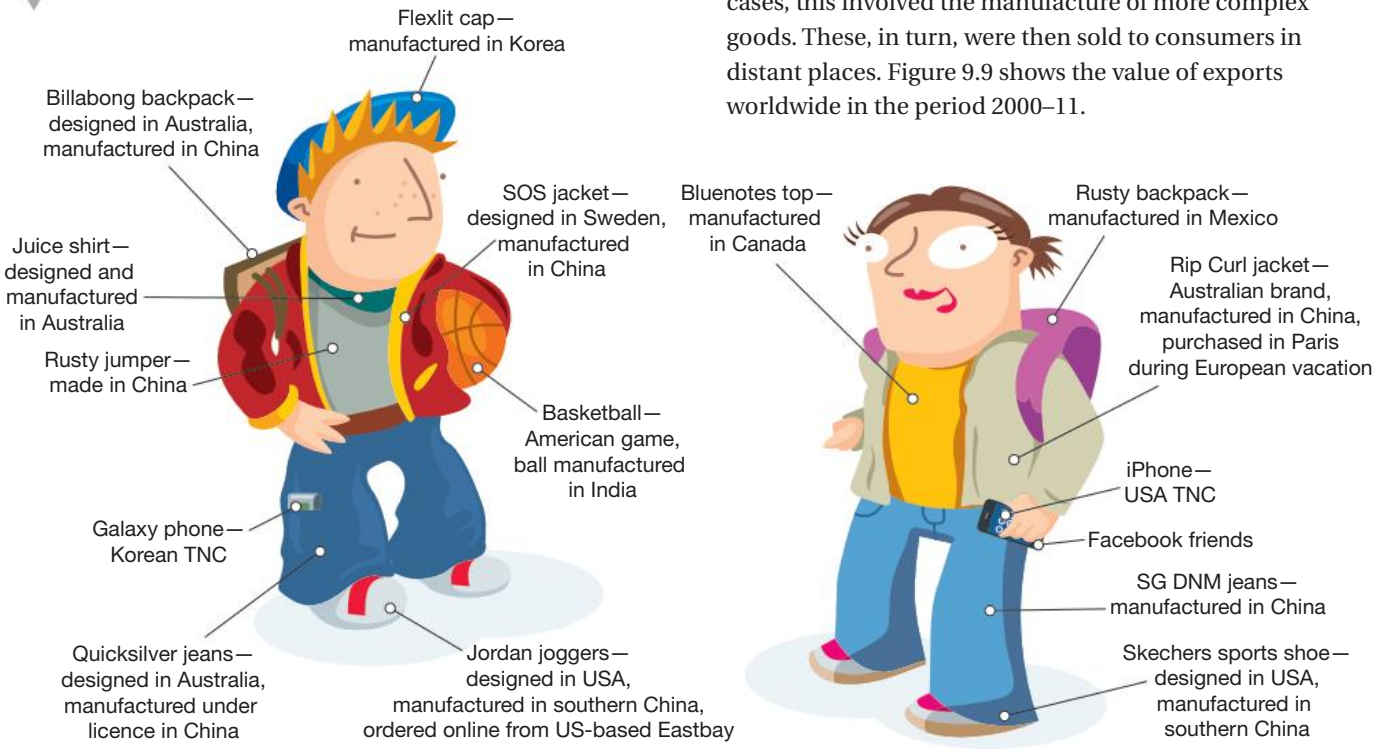
9.3 Patterns of production and consumption

Australians enjoy one of the highest standards of living on earth. Their homes are, for the most part, full of consumer goods. These include the latest electronic gadgets and high-definition, flat-screen televisions. Their wardrobes are likely to hold clothes that reflect the latest fashion trends and the chances are that the cars parked in the driveway have been imported.

Technology changing behaviour

The internet has enabled Australians to buy a rapidly increasing range of goods and services online. People can buy the latest fashions from online retailers in North America and Europe and download movies and music. Australians can Skype their friends on the other side of the planet and they can network with friends via Facebook and Twitter (see Figure 9.8). Developments in transport technologies (especially in the aviation and shipping industries) have greatly reduced the cost of transporting goods over long distances. The global pattern of production and consumption of these consumer goods and services demonstrates the increasingly complex pattern of global interconnections.

9.8 Globalisation of consumer choices

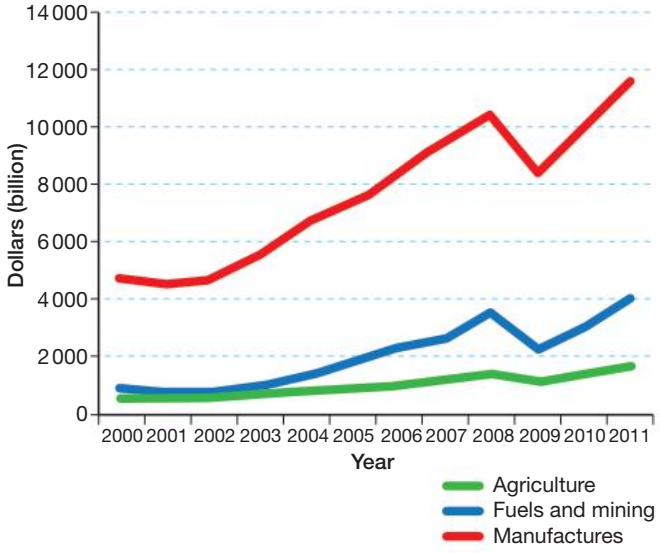


Origins of world trade

The distribution of raw materials over the surface of the earth is very uneven. Some places have large supplies of coal, while others might have supplies of gold, water, or good soil. Similarly the distribution of population and the ability to buy **consumer goods** is also unevenly distributed. Because of the uneven patterns of supply and demand, a system of trade has developed. Trade is now very important and very complex on a world scale.

The earliest societies bartered (exchanged) goods, but soon developed money as the medium of trade. The earliest trading involved the exchange of materials. For example, if one place had salt and another place had crops, they found that exchanging some of each was beneficial to both places. From this grew a more complex system of trade, in which some places supplied raw materials, while others processed them and then sold them to consumers. In some cases, this involved the manufacture of more complex goods. These, in turn, were then sold to consumers in distant places. Figure 9.9 shows the value of exports worldwide in the period 2000–11.

9.9 World exports by product value, 2000–11



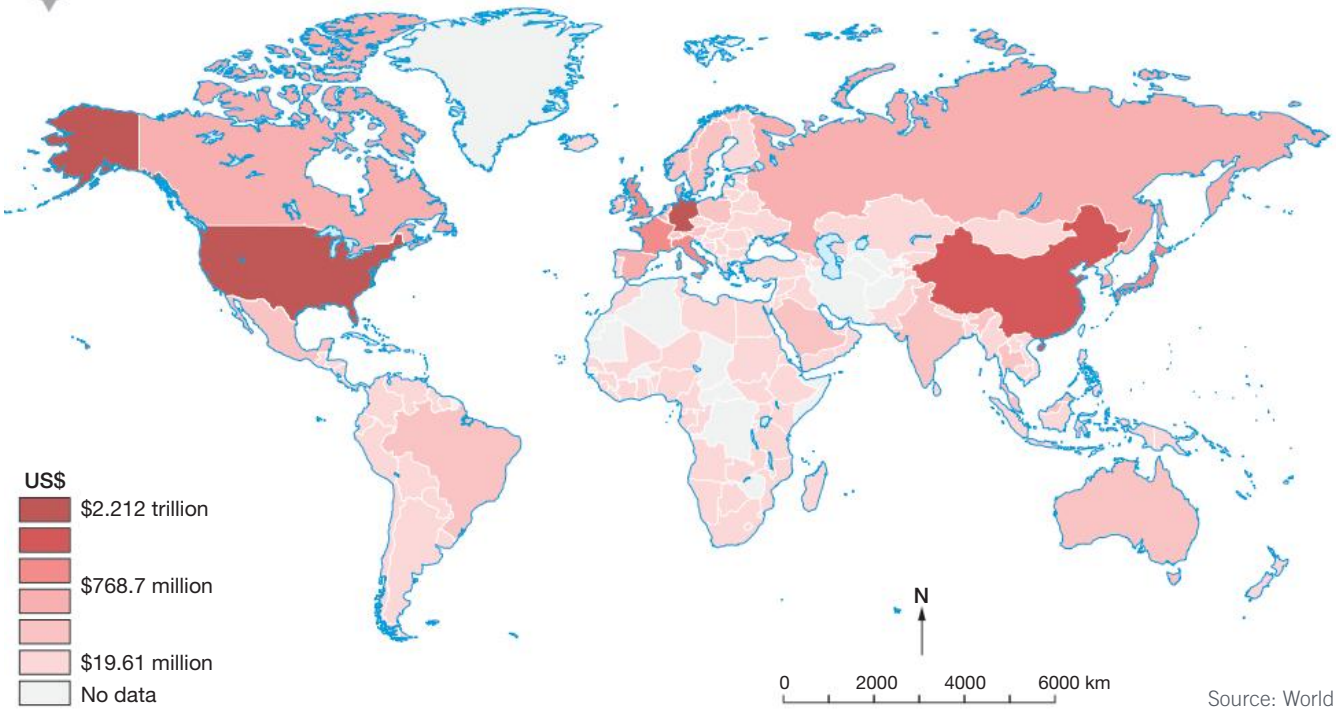
Global patterns of trade

The trading of goods, ideas, services, currencies and shares in companies is now a fully global and complex system.

There are a number of key points about the present pattern of world trade.

- World trade is dominated by the United States of America and the European Union, but Asia is becoming increasingly important (see Figure 9.10).
- More than 80 per cent of world trade involves the wealthier economies.
- There is little trade between countries with less developed economies.
- Less developed economies have high levels of specialisation in trading mainly one or two goods.
- About half of the world's trade by value is of manufactured goods.
- There have been important increases in the trade of high-tech goods.
- World trade is increasingly dominated by large global companies.

9.10 Exports of goods and services, 2012



Source: World Bank

ACTIVITIES

9.3

Knowledge and understanding

1 Identify the technologies that have increased the complexity of the global pattern of production and consumption.

2 Outline the key features of the current pattern of world trade.

Analysing and applying

3 Study Figure 9.8. A typical teenager in Australia, USA or Europe might have clothes made in Asia but designed in the USA or Europe, electronic gadgets made in China and designed in the USA, DVDs of American or European films, and computer games from Japan. Brainstorm a list of other consumer goods and experiences that Australian households purchase.

9.4 Technology transforming production

The rate of technological change is accelerating. Mobile phones, digital cameras and the internet are lifestyle-transforming technologies. The chances are that you cannot imagine the technologies you will have available to you when you are adults. It is these technologies and those that came before them that have determined patterns of production and consumption.

Pre-Industrial Revolution

For most of human history, manual labour was the basic power source, and the speed of travel was limited to the pace at which a person could walk or a horse could gallop. The production of most goods was, as a result, local. Many people made their own goods, such as basic furniture, cooking equipment and clothes. Cottage industry, as it was called, involved the production of goods in the home, but they were often sold at the local market.

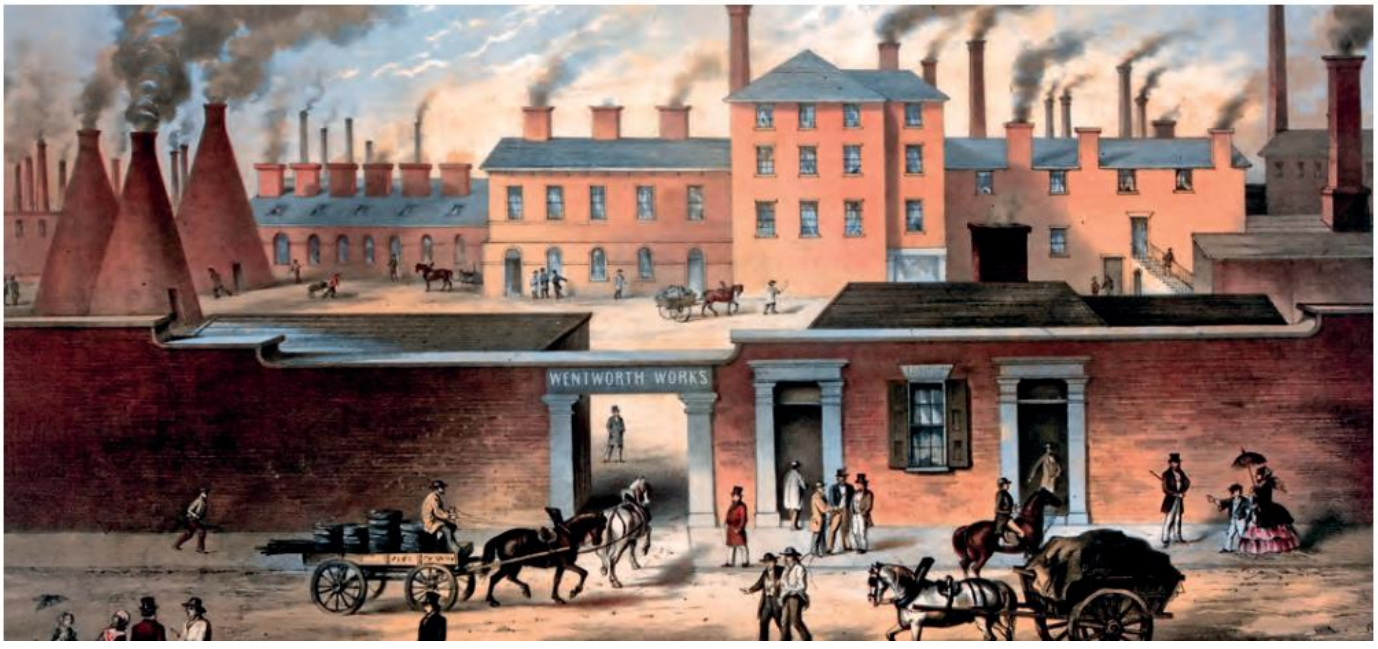
As people used their particular skills in a more specialised ways, they set up small industries such as wheel making, potting and ironsmithing. This was one of the factors that led to the development of cities. People could specialise in one craft, and use their earnings to buy goods produced by others. These small industries were powered by fire, running water, horsepower or human effort. The level of technology remained low.

During the Industrial Revolution

The Industrial Revolution, which began in Europe in the eighteenth century and spread later to other regions, came about when better methods of powering machines were invented. The effects of the Industrial Revolution on the landscape can be seen in Figure 9.11. Large factories were able to operate, making vast quantities of cloth, iron, steel and all of the products made from these materials. The new technology of steam engines drove many of these machines. The steam engine was also used to create a totally new form of fast transport—the railway.

Towards the end of the nineteenth century a new power source was developed—electricity. This could be produced in many ways, and had the advantage of being portable, transported through wires. Electricity could provide heat, light and movement.

9.11 The Industrial Revolution transformed landscapes. The major locational factor was the availability of an energy source such as coal.





9.12 Part of Melbourne's Foy & Gibson factory complex can be seen in Smith St, Collingwood.

SPOTLIGHT

Collingwood's Foy & Gibson factory complex

The Foy & Gibson factory complex dominates Melbourne's suburban Collingwood. The vast industrial complex, constructed to the design of renowned architect William Pitt over several decades from 1887, provided goods for Foy & Gibson department stores. The factories produced men's clothing and shirts, women's underclothing, millinery, furniture, hardware and bedding. Warehouses stored imported goods, and the complex was a major hub for home delivery, first using horse-drawn vehicles and later with motorised trucks. The complex employed about 2000 people in all stages of the production process. Today, most of the goods sold in Australia's department stores are imported from factories in China.

After the Industrial Revolution

During the twentieth century, innovations in the use of technology increased at an even faster speed. The combination of electricity, wealth, and changes in society meant that the goods produced by factories changed from mainly industrial goods to more and more consumer goods. These are goods purchased by individuals for their own use that address wants rather than needs. Goods such as cars, refrigerators and washing machines were the first big group of consumer goods. They were followed by radios and television sets. Later came stereo systems and small electrical appliances. More recently mobile phones, personal computers, digital cameras, tablets and similar devices are available everywhere, for a price.

From local to global

In this brief overview of changes in the nature of production, it is evident that there are a number of important factors that have changed the geographical pattern of production. When power sources were limited and not portable, things had to be made where there was a source of energy, for example running water or coal deposits. In the twenty-first century, power sources are not the most important location factor for industry.

Factories producing consumer goods today are located in places that offer the best and cheapest sources of labour. The world pattern of industry has changed from large factories located near coal deposits, to factories of all sizes located for a limited time near the best source of relatively cheap labour. This means that the consumer goods that we buy are probably not manufactured in a place near where we live. In fact, most of them will have been assembled from parts made in a number of different countries of the world. Clearly such a global system needs efficient transport and complex management of the process.

ACTIVITIES

Knowledge and understanding

1. Explain why few of the manufactured goods that we consume are made near where we live.
2. What does the Foy & Gibson factory complex illustrate about the changing global pattern of production and consumption?

Applying and analysing

3. Create a timeline explaining how technology transformed production and consumption. Start from the pre-industrialisation period.
4. Complete the following table by listing arguments for and against the following statement:
   The rise of consumer goods was brought about by the invention of fast and efficient manufacturing on assembly lines, which brought down prices.

Arguments for	Arguments against

9.5 Electronic consumer goods

It is now normal for many Australian homes to have flat-screen televisions, personal computers, laptops or tablets, sound systems, wifi, digital cameras and mobile phones. This is very different from the 1950s, when the typical household had only one radio and a telephone. Since that time there have been waves of new products hitting the market.

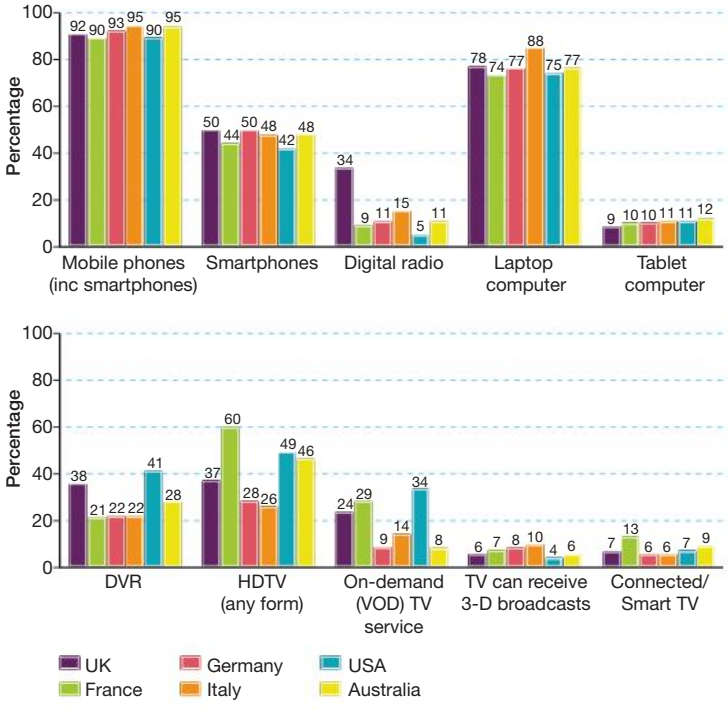
Declining costs of electronics

The main factor influencing the astounding growth of electronic products is the steady fall in the relative price of these products. This has been possible because of the development of mass production methods. Mass production is carried out in highly automated factories located in places with low labour costs.

Purchasing electronic goods

The countries with the highest average incomes have generally been those that have seen consumer electronics goods purchased in the largest quantities and spread most quickly. However, there are differences between countries with similar levels of wealth. The graphs in Figure 9.13 show the differences in usage of ten electronic products in six of the wealthiest countries of the world.

9.13 Ownership and use of electronic devices, 2011



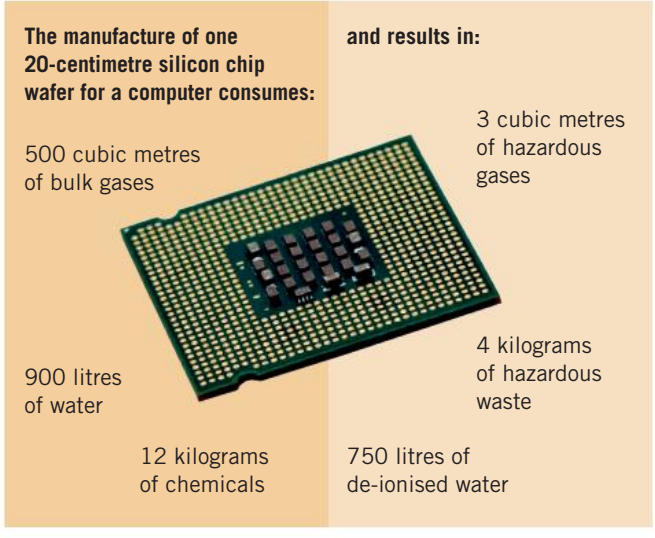
The raw materials for electronics

Metals

There is a range of metals used in the production of electronic devices. Copper has always been important because it conducts electricity well. Tin, silver, lead, aluminium, nickel and chromium are also found in many everyday electronic products.

Petrochemicals

Two of the other key raw materials in electronics are plastics, which are derived from petrochemicals, and silicon. Silicon is a commonly occurring mineral found in quartz, amethyst, flint and jasper. Petrochemicals are the chemical materials obtained from oil. Most of the electronic devices we use contain microprocessors, integrated circuits and printed circuits. These are all made from petrochemical-based products. The bodies of the electronic devices are also made mostly of plastics derived from petrochemicals. This is shown in Figure 9.14.



9.14 Making a silicon chip for a computer

Environmental effects of electronics

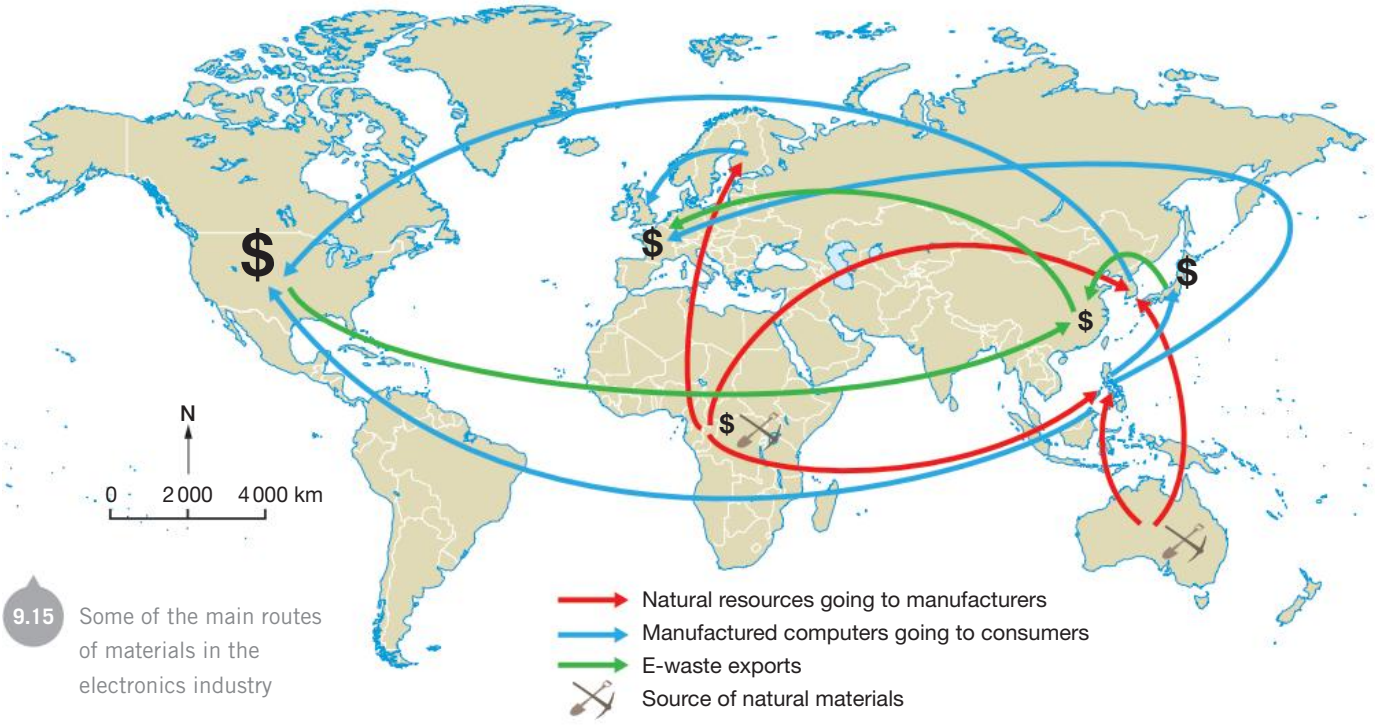
The standby power used by electronic devices in the home when they are not turned off accounts for 5 to 10 per cent of the electricity consumed in the average household.

Some electronic devices now carry 'energy stars' in a similar way to household appliances. Solid state drives use less power and are being used in an increasing range of devices.

Some electronic gadgets are now being promoted for their 'green-ness'. However, if you buy one of these and throw out an older item, you are in fact using more of the earth's resources, because of the amount of energy and raw materials used in making and transporting the new purchase.

World cycle of the electronics industry

Figure 9.15 shows some of the main routes of materials in the electronics industry. It is drawn to show generalised patterns, not the particular routes of every material. The raw materials are shown travelling from Australia and Africa, but these locations only account for metals and silicon materials. Petrochemicals come from many other countries which export oil. The manufactured computers are shown being transported from eastern Asia to Europe, Japan and the United States of America, but there are obviously many other buyers. The waste is then shown being taken back to China, as a representative country used for disposal of outdated electronic equipment. India is another major destination of electronic waste.



9.15 Some of the main routes of materials in the electronics industry

ACTIVITIES

9.2

Knowledge and understanding

1 Explain why the number of electronic goods in households in wealthy countries is growing so fast.
2 Outline the environmental effects of the electronics industry.

Geographical skills

3 Study Figure 9.13 then do the following tasks.
  a Identify the four devices with the highest take-up.
  b Name the countries that have the highest overall ownership of these four devices in general.
  c HDTV shows the greatest difference in take-up between countries—France at 60 per cent and Italy at 26 per cent. Can you suggest reasons for this?
  d Name the device with the next greatest difference in take-up.

Investigating

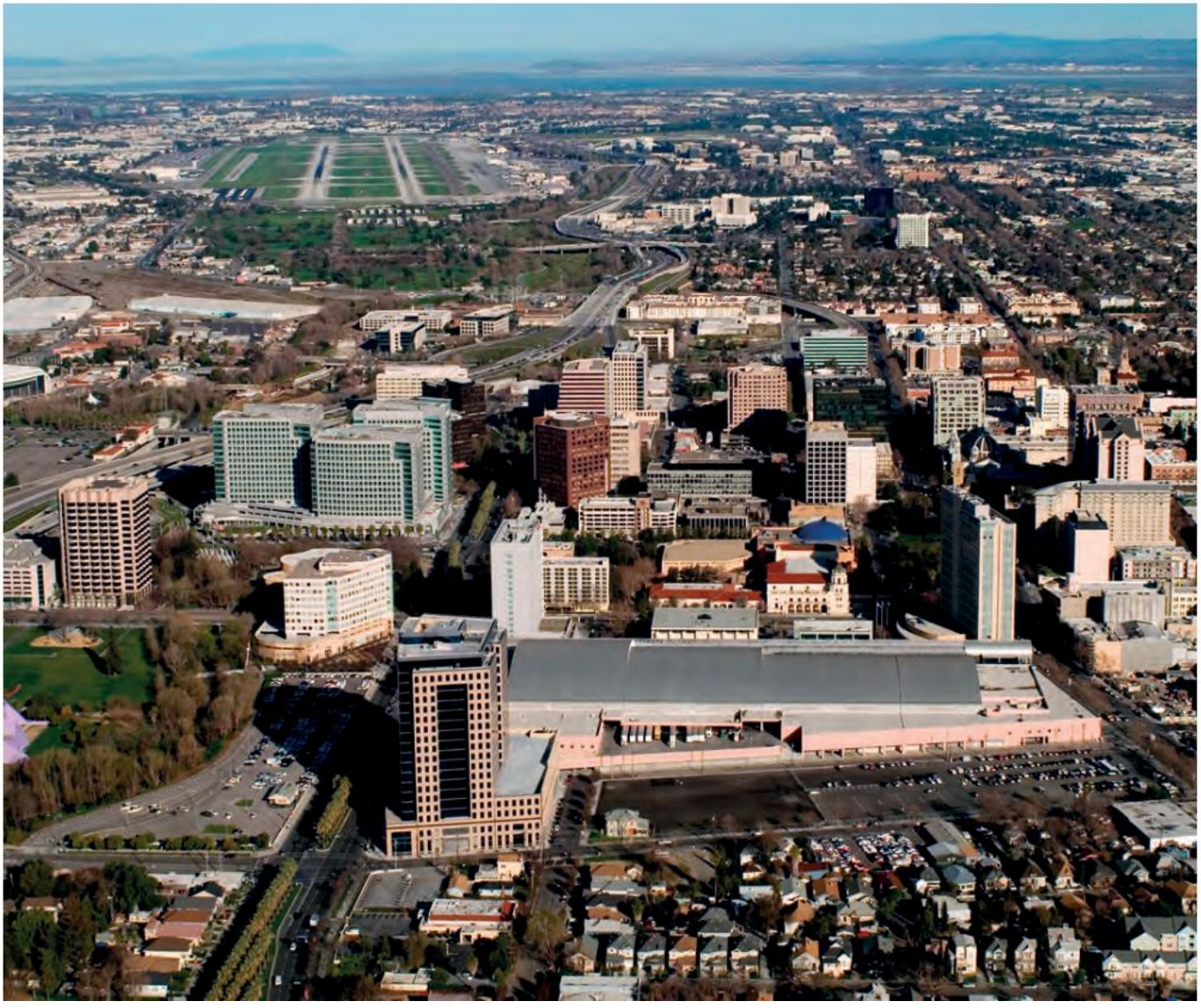
3 a Make a list of the electronic devices in your home.
  b Which of them do you have more than one of?
  c Ask your parents how many electronic devices they had in their homes when they were your age.

9.6 Silicon Valley

Silicon Valley in northern California, United States of America, is the region with the highest concentration of high-tech companies in the world. The name originally referred to the large number of silicon chip (microprocessor) developers and manufacturers that clustered in the Santa Clara Valley in the 1970s and 80s. Since this time Silicon Valley has become home to high-tech firms of all types.

Location

Silicon Valley, shown in Figure 9.16, is located in Santa Clara Valley at the southern end of the San Francisco Bay in California (see Figure 9.17). The area is located around Stanford University, one of the world's leading institutions in electronics and engineering.



9.16 Downtown San Jose, the principal urban centre in California's Silicon Valley.



9.17 Location of Silicon Valley

Reasons for growth

A number of factors have contributed to the rapid growth of the Santa Clara valley as a centre for innovation and high-tech industry.

The growth of Silicon Valley as an IT hub began in the 1950s, when Stanford University leased half of its land to establish a high technology industrial park. Within three years a number of large businesses had moved into the area, including General Electric, Hewlett-Packard and Lockheed. Stanford also established a research institute to promote collaboration with these firms. The aim was to create a community of 'technical scholars' by encouraging the business and the academic community to work together.

In the 60 years that followed, the area continued to grow and attract firms from a range of industries, including aeronautics, aerospace, computer programming, and software and internet development. A large number of **venture capital** firms (providing funds for start-up businesses) and semiconductor manufacturers also located in the region. Today, Silicon Valley employs more than 250 000 information technology workers and hosts the head offices of thousands of high-technology businesses, including IBM, Facebook, Adobe Systems, Apple Inc., eBay, Google, Hewlett-Packard, Intel, Xerox and Yahoo. The mix of businesses in the area is always growing and changing. Of the top fifteen companies in Silicon Valley, 80 per cent were formed in the past 15 years. These businesses account for more than $600 billion in revenue, and employ approximately three-quarters of the people in the region.

Why firms cluster in this area

A range of factors have made Silicon Valley an attractive place for high technology firms to locate. Proximity to other similar businesses is one of the key attractions. Being close together promotes a cross-fertilisation or sharing of ideas. By clustering, or grouping together, executives can keep up to date with the latest developments in the industry and conduct important business meetings face-to-face. These social networks give Silicon Valley its innovative edge and enable businesses to respond flexibly to changes in technology and economic conditions. The Silicon Valley also provides businesses with access to a large pool of highly skilled employees, including graduates of the neighbouring Stanford University and the University of California.

Another important advantage of this location is the large number of venture capital firms in the region. These firms provide start-up funds for new companies in return for a share of the future business profits. Many highly successful technology companies in Silicon Valley have used venture capital to establish themselves.

SPOTLIGHT

Timeline of industry development in the Santa Clara Valley

1891 Stanford University founded.

1900 Santa Clara Valley dominated by fruit orchards.

1909 First radio station in the United States of America established in San Jose. Over the next 10 years the world's first global radio communications system developed here for the US Navy.

1930s San Francisco Bay area attracts aeronautics and aerospace research firms.

1951 Stanford Industrial Park established, enabling high-tech businesses to work in close partnership with Stanford University.

1956 Nobel Prize in Physics awarded jointly to William Bradford Shockley, John Bardeen and Walter Houser Brattain for their researches on semiconductors and their discovery of the transistor effect.

1968 Robert Noyce and Gordon Moore form Intel (Integrated Electronics Corporation) and locate their offices in Santa Clara Valley.

1971 Intel creates the world's first microprocessor/ semi-conductor. The Santa Clara Valley becomes a magnet for a broad range of high-tech companies.

1990s At the height of the dot.com boom Silicon Valley employs 1.04 million people and hosts more than 500 000 high-tech businesses. One-fifth of the world's 100 largest high-tech companies have a presence in the valley.

2000 While the dot.com crash of the late 1990s results in a slowing of the Valley's economic and population growth rate, it retains its status as one of the top research and development centres in the world.

Challenges

The Valley's emergence as a high-tech centre brought with it a range of challenges.

Housing and environment

The emergence of the high-technology sector has promoted rapid population and urban growth in the Santa Clara Valley, or Silicon Valley as it is more widely known. Today, 1.8 million people live in the Valley's cities and towns. Much of the Valley's population growth has been fuelled by interstate and international migration.

While this growth has been good for local businesses it has also pushed up property prices, making housing less affordable. The increased population and housing density of the Silicon Valley has also created environmental problems. Traffic congestion has increased and employees are spending longer periods of time travelling to and from work. One response to this problem has been the development of housing to accommodate multiple families. The government has also developed an urban plan to ensure that new homes are built close to sources of employment.

Human wellbeing

Due to the concentration of highly skilled workers in the valley the region has one of the highest average incomes in the United States of America. It also has one of the highest costs of living in the country—60 per cent higher than the national average. The high cost of housing is a major contributor to this problem.

Levels of employment and average incomes in Silicon Valley are also highly dependent on the performance of the global high-technology sector. The economy has had to reinvent itself several times in response to a number of downturns in the industry, which are shown in Figure 9.18. The dot.com crisis of the late 1990s forced many businesses to close down, resulting in increased levels of unemployment. The number of new start-up businesses also declined from 3500 in the boom to approximately 1000 today.

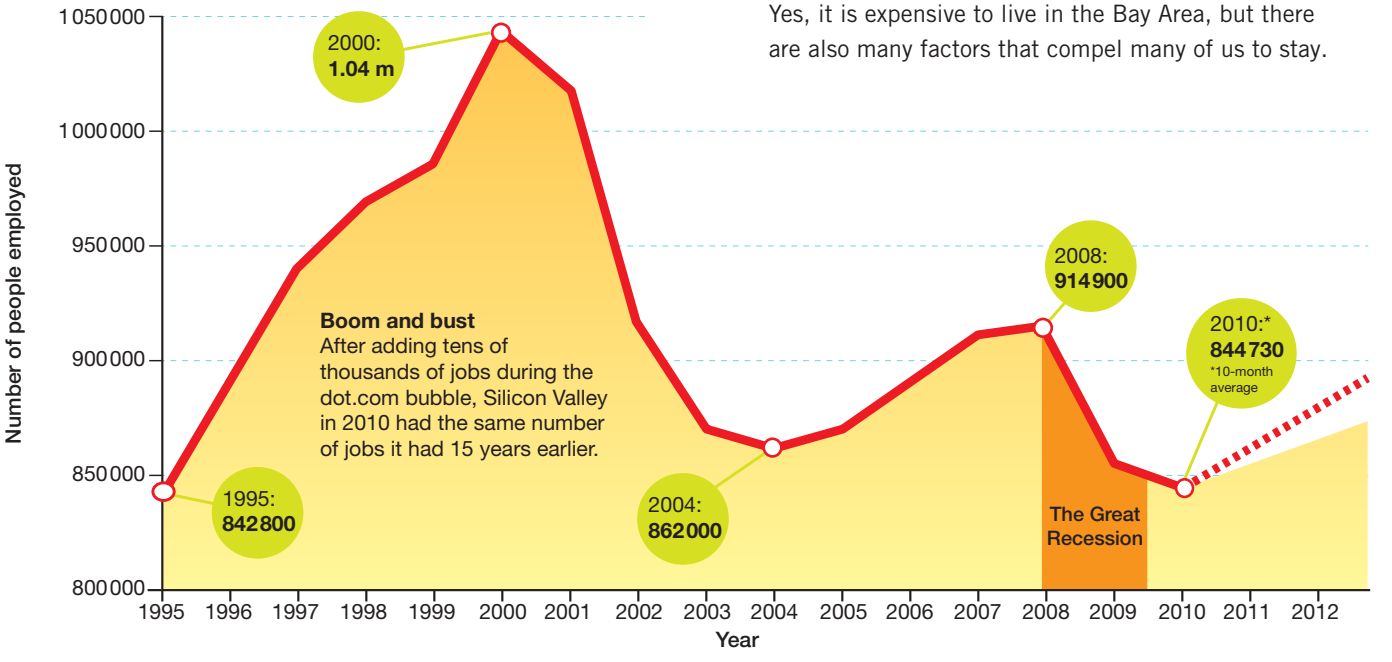
Demographics

Silicon Valley is also struggling to retain its highly qualified workforce. Many young workers leave the area when they decide to start a family. When compared with the total US population, Silicon Valley has a higher proportion of people of working age (25–64 years of age) and a lower proportion of children, as is shown Table 9.19.

Despite these disadvantages people continue to make the choice to live and work in Silicon Valley. One long-term resident and IT employee explained the reasons for this on his blog:

> … the Bay Area is the epicentre of innovation and education … the area has a rich history of offering many entrepreneurs and job seekers plenty of opportunities. (Lots of people have found their fortunes here with start-ups, stock options and, until recently, real estate). We also have incredible access to mountains, beaches, wine country, snow, and major metropolitan cities with numerous cultural venues, restaurants, shopping, waterways and more. You could ski in Lake Tahoe in the morning and make it back to San Francisco for an evening on the town. In addition, we enjoy some of the best weather in the country. Yes, it is expensive to live in the Bay Area, but there are also many factors that compel many of us to stay.

9.18 Employment in Silicon Valley, 1995–2010



DID YOU KNOW?

In 2010, the median house price in San Jose was US$602 000. The average house price in the USA was US$173 000.

9.19 Population statistics for Santa Clara County, California and the USA

Population quick facts	Santa Clara County (%)	California (%)	USA
Population change, 2000 to 2010	5.9%	10.0%	9.7%
Persons under 5 years, 2010	7.0%	6.8%	6.5%
Persons under 18 years, 2010	24.1%	25.0%	24.0%
Persons 65 years and over, 2010	11.1%	11.4%	13%
Female persons, 2010	49.8%	50.3%	50.8%
Persons reporting two or more races, 2010	4.9%	4.9%	2.9%
Foreign-born persons, 2005–09	36.0%	26.8%	12.4%
Language other than English spoken at home, aged 5+, 2005–09	49.7%	42.2%	19.7%
Bachelor's degree or higher, persons aged 25+, 2005–2009	43.9%	29.7%	27.5%
Home ownership rate, 2005–09	59.9%	57.9%	66.9%
Housing units in multi-unit structures, 2005–09	32.5%	30.7%	25.9%
Median value of owner-occupied housing units, 2005–09	$704 200	$479 200	$185 400
Persons per household, 2005–09	2.9	2.91	2.6
Median household income, 2009	$84 990	$58 925	$50 221
Persons below poverty level, 2009	9.1%	14.2%	14.3%

Source: US Census Database

ACTIVITIES

Knowledge and understanding

1 Describe the location of the Silicon Valley.
2 Explain the origins of the name 'Silicon Valley'.
3 Name five high-technology firms located in the Santa Clara Valley.
4 Explain why high-tech firms cluster.

Applying and analysing

5 Describe the impact of rapid population growth on the Silicon Valley.
6 Create a PMI chart about working and living in Silicon Valley.

Geographical skills

7 Study Figure 9.19 then answer the following questions.
   a How does the rate of population growth in Santa Clara County compare with the national average?
   b How does the age structure of Santa Clara County differ from the age distribution of the total US population?
   c What is the percentage difference in the average value of owner-occupied housing in Santa Clara County and the US as a whole?
   d What is the percentage difference between average household income in Santa Clara County and in the US as a whole?
   e Suggest possible explanations for the above differences.

Investigating

8 Select one high-tech firm located in Silicon Valley. Undertake research to find answers to the following questions:
   a What does the company produce?
   b When was it was established?
   c How is it connected to other businesses in the area?

9.7 Case study: Designing for the world—Cupertino, USA

Cupertino is a city in California, in the area known as Silicon Valley. It has this name because of the concentration of computer hardware and software firms using the silicon chip as the central invention of their business.

Major businesses

Cupertino hosts the headquarters of Apple Inc., one of the largest and most influential companies in the world. Oracle and Hewlett-Packard also have a presence there. Both companies have played an important role in the technological revolution that has changed the ways in which people work and interact. In total, sixty high-tech firms of different sizes can be found in the city.

Cupertino's growth and development

Until the 1960s, Cupertino was a small town in the centre of a fruit-growing area just to the south of San Francisco Bay. In that decade, some local landowners set up an industrial and technology park to attract firms specialising in the new growth area of electronics. Hewlett-Packard, a small firm making the newly invented electronic calculators, was one of the firms to buy land in the park.

Other firms making or designing computers, calculators or the software to run them were attracted to the area by a number of factors. There was the encouragement of local government and landowners. The area was easily accessible to the large and important cities of Los Angeles, San Francisco and the cities surrounding San Francisco Bay. Within these cities there were a number of world-class universities producing graduates with ideas, enterprise and knowledge.

The area also had a warm and pleasant climate that appealed to many of the graduates who wanted to live in a place which was at the centre of new ideas, but also appealed to their youthful outlook on good living, recreation and opportunity.

From its initial growth, Silicon Valley quickly gained a reputation for being the centre of the computer ideas industry of the world, and that reputation then attracted people from all over the world, and from Asia in particular.

Population and employment

The population of Cupertino is now 60 000, having grown from just a few dozen in the 1950s. The city's population is unusual in a number of ways. It has been described as one of the most highly educated small towns in the United States of America because of the university qualifications held by many of its residents. Furthermore, 63 per cent of residents are of Asian origin, attracted there by the opportunities that draw on their knowledge and skills.

The companies in Cupertino mostly work on ideas, development, design, promotion, software production and marketing. Most of the actual building of the computers and other pieces of hardware equipment is done in other countries, where labour is cheaper. Figure 9.20 shows Cupertino's largest IT employers and the number of workers they employ. The incomes of people working at the high end of the businesses are correspondingly high, leading to a high spending power for services and retail establishments in the area. The average household income in Cupertino is US$118 000 compared to the average for the whole state of California of US$58 000.

9.20 Largest IT employers in Cupertino

Employer	Number of employees (2010)
Apple	34 300
Oracle	8 000
Hewlett-Packard	3 000
ArcSight	512
Chordiant	285
Trend Micro	250



9.21 An artist's impression of Apple's new corporate headquarters under construction in Cupertino

Cupertino's constructed environment

Cupertino has no easily identified Central Business District. Instead, it has a number of shopping malls scattered throughout the city. The city is made up of districts based on housing developments set up at different times. Each of these housing developments has its own character and price range, but generally they are made up of relatively expensive housing for high salary earners. The average value of houses in Cupertino is about $900 000 compared to the average for California of $350 000.

Besides a major tertiary college and nearby universities, Cupertino has a number of schools that rank highly in the league tables of American schools.

The significance of Cupertino

Cupertino is an example of a new type of city—one that is based on the building of product ideas rather than manufacturing things. As a result, it does not have to be near a source of coal, or iron or some other raw material. It does not even have to be near a source of labour, because it can attract workers to it. What it needs nearby are universities and other educational institutions, and easy access to the rest of the world through good transport systems and excellent communications.

The development of information and computer technologies, particularly the World Wide Web, have meant that the headquarters of businesses (see Figure 9.21) do not need to be near the factories making their products, or in any particular location. They can be where the owners want to live, or where they can attract the best staff, or where they can be in touch with firms that give them business advantages.

ACTIVITIES

Knowledge and understanding

1 Identify the location factors that were most important in the early days of Cupertino's development. Which locational factors do you think are most important now?

2 Outline the ways in which Cupertino differs from the rest of the USA. Explain why.

Applying and analysing

3 Make a list of some of the new inventions in communications and transport that make it possible for the headquarters of a large company to be so far away from the factories manufacturing its products.

4 Make a list of the various reasons given in this unit for the main function of Cupertino as a headquarters for design and development of products, rather than a manufacturer of mass-produced consumer goods.

9.8 Case study: Apple Inc.

Products made by Apple Inc. are among the most desired consumer products in the world. Apple's bitten apple has become one of the world's most readily recognised icons. Young people queue for days outside Apple stores just to be among the first to buy the latest technology. Apple has achieved a level of brand loyalty rarely seen in the commercial world. Many Apple users will update their technology every time a new model is released.



9.22 Apple iPods, iPhones, iPads and Macbooks, the must-have electronic goods of the modern age

History of Apple Inc.

Apple Inc., manufacturer of the iPod, iPhone and iPad, is an example of a highly successful IT company with truly global links and strong **brand loyalty**. Apple employs more than 76 000 people globally and locates its various functions (design, marketing, manufacturing and assembly) in parts or the world where they are most efficient and profitable. Its worldwide annual revenue in 2012 totalled $156 billion.

Apple Inc.'s world corporate headquarters are located in Cupertino in the middle of Silicon Valley, California, United States of America (see Figure 9.22). This region of northern California hosts the headquarters of thousands of high-tech businesses. These companies cluster (locate in the same region) so they can benefit from each other's services, conduct business face-to-face and take advantage of the concentration of technically skilled people in the area.

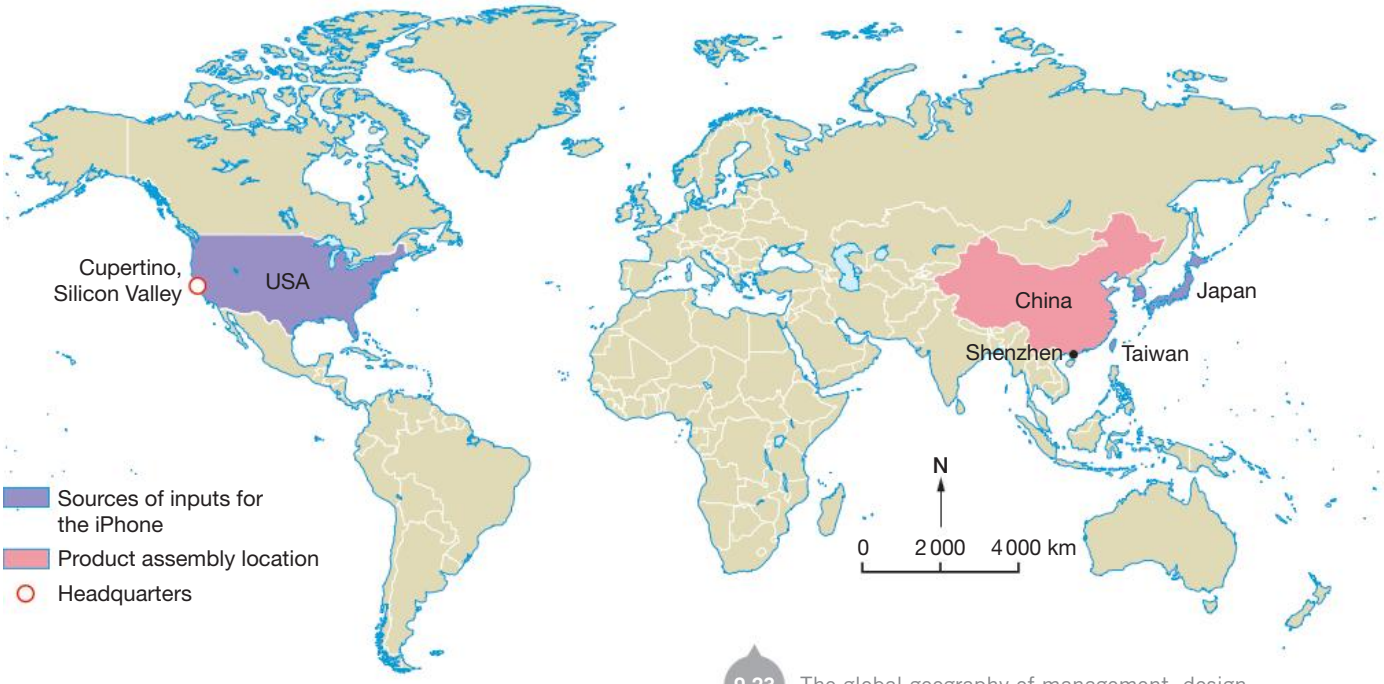
Effective marketing has been a key component of Apple's success. Marketing includes decisions about how products look and feel, what they are made from, where they are manufactured, how they are distributed and what prices they are sold for. Within Apple Inc., these strategic decisions are also made in the company's headquarters in Silicon Valley.

Geography of production

Apple has one of the world's most efficient and globalised production process, with manufacturing and final assembly taking place in several countries. The iPhone's components are from America, Taiwan, Korea and Japan. The final assembly of these products currently takes place in Shenzhen, China (see Figure 9.23). Apple uses numerous suppliers and allocates them specific tasks. This enables Apple to source a range of expertise and remain responsive to the demands of customers.

Apple also goes to significant lengths to protect its ideas. It keeps leaks to a minimum by providing suppliers with information on a 'need to know' basis and by allowing individual employees to see only a small component of the total production process prior to the launch of a new product. They also insist that suppliers produce customised inputs rather than mass-produced components, making it difficult for these firms to supply parts to Apple's competitors.

Secrecy is also maintained using high levels of security. According to some media reports, the Longshua manufacturing plant in China resembles a self-contained 'industrial fortress'. The plant has very high security and employees are checked with fingerprint scanners when they arrive for work. Metal detectors are also used to ensure that employees do not leave the factory with components of Apple products. The factory includes places for employees to sleep, along with food stalls, banking facilities and a post office. Employees have little need to leave the complex and this helps to keep production ideas confidential.



9.23 The global geography of management, design and production at Apple

Ethical issues

Over the past decade, Apple has faced a number of environmental and labour-practice challenges.

Environmental

Following a successful campaign by Greenpeace in 2003, Apple became the first laptop manufacturer to eliminate dangerous chemicals (PVC and BFRs) from its products. The company produces an annual report detailing the environmental impacts of its activities and has reduced its carbon footprint by changing the way its products are manufactured, used and recycled.

Labour practices

Apple has faced criticisms about labour practices and **sweatshop** conditions in the contracted companies producing its components. In 2006, a number of newspapers ran reports claiming that some of Apple's suppliers in China required employees to work more than 60 hours a week for salaries of less than $120 a month. The reports also claimed that workers were required to live on site and pay more than 50 per cent of their salaries back to employer to cover their rent and food expenses. In response to these challenges, Apple established a Supplier Code of Conduct, which states that contractors are required to provide 'safe working conditions, treat workers with dignity and respect, and use environmentally responsible manufacturing processes'. Since 2007, Apple has also conducted yearly audits of the working practices to ensure that suppliers are 'socially responsible' and comply with strict workplace regulations. These audits are made available to the public on Apple's webpage.

ACTIVITIES

Knowledge and understanding

1. Outline the measures Apple has put in place to protect its ideas (intellectual property).
2. Describe the changes Apple has made to reduce its environmental impact.
3. Outline the strategies Apple has put in place to address labour issues and ensure that its operations are socially responsible.

Applying and analysing

4. Explain why Apple uses multiple firms in different places to produce and assemble its products.
5. Describe the location of Apple's headquarters and marketing functions. Suggest two advantages of this location for Apple.
6. Brainstorm the advantages and disadvantages of subcontracting (using external businesses) to manufacture and assemble products. Think about the views of the global companies, employees and local communities.

Investigating

7. Access the Apple website and locate the company's latest environmental report. Draw up a table summarising the issues identified and the company's responses to these issues.

9.9 Case study: Shenzhen—the world's factory

Shenzhen is one of China's main industrial cities—only Beijing, Hong Kong and Shanghai are more important. Many of the world's top 500 enterprises and well-known multinational companies have established a presence in Shenzhen, including many of the world's top brands in the high-tech industries. The city is the country's richest urban centre on a per capita basis.

Special Economic Zone

The location of Shenzhen is shown in Figure 9.24. Until 1979, when it was named one of China's first Special Economic Zones (SEZ), Shenzhen was a small and fairly insignificant town. At the time, its population was just 300 000. Today the population is thirty times that figure and the city has grown to accommodate this increase (see Figure 9.25). The present population of 10 million includes 6 million immigrants, who are registered as temporary workers, nannies, service workers and cleaners.



9.24 Shenzhen's proximity to Hong Kong has been a key factor in the city's emergence as a major industrial centre.



9.25 In just over 30 years, Shenzhen has emerged as one of the world's great industrial and commercial centres.

Shenzhen's growth

The growth of Shenzhen started when it became an SEZ. This designation gave it advantages in exporting goods, obtaining labour, setting up joint ventures with foreign companies, and obtaining tax advantages. The other factor that gave it huge advantages was its proximity to Hong Kong. Before 1997, Hong Kong was not part of China. It was a British colony with booming industries, a major port and a free economy. The new leaders of China saw Hong Kong as a model and partner for the type of industrial city they wanted.

Shenzhen's industries

Shenzhen factories produce a range of consumer goods, with a focus on electronics. These include computer software, telecommunication equipment and medical instruments. Meanwhile, newer industries such as pharmaceuticals, medical equipment, biotechnology and new materials have also grown rapidly. Electronics and telecom equipment manufacturing remains the city's largest industry.

Toys are also a major product of the whole region. According to one estimate, one million workers produce about 50 000 different toy models in Shenzhen. The largest of these factories employ up to 15 000 workers, who work, live and sleep in the factory complex. Many of these workers go back to their homes in other regions of the country only once a year.

One Shenzhen-based company is now the second-largest battery maker in the world. Its factory is half a million square metres in size. Another Shenzhen firm makes 100 000 laptops each month and is aiming to be the world's largest computer maker by 2020.

New industrial parks

Shenzhen, like many other industrial cities, is now trying to locate factories in special industrial parks, away from residential and retail areas. There are advantages for the factories in transport, parking, power supplies and waste disposal. Shenzhen has recently established a high-tech industrial park and adjoining it a software park.

Population

The rapid growth of Shenzhen's population has been fuelled by young people migrating from other parts of China. The average age of the population is less than 30. Only one per cent is aged 60 years or above. The population can be generalised as fitting into two main groups. One of these is the highly educated people with specialist skills in electronics, computer software, design and management. The other group is the larger group of poorly educated migrant workers who have been attracted by the abundance of unskilled jobs.

Human wellbeing

There are both advantages and problems for the workers in Shenzhen. The enormous growth of industry and exports has provided millions of jobs to people who needed them. China's expanding population would have found it difficult to achieve a reasonable living without this kind of growth.

At the same time, the location of jobs in Special Economic Zones has meant that people have had to travel and live far from their home if they are to secure employment.

The jobs in industry pay wages that are higher than those in some other occupations and regions in China, but are low by world standards. Some factories have been accused of paying workers less than a dollar an hour, and making employees work long hours without adequate benefits.

Connections with the rest of the world

Almost all the products made by factories in Shenzhen are for export overseas. This was the purpose of the Special Economic Zones, and it has been highly successful in Shenzhen. The exported goods go mainly to the United States of America and Japan. Many of them also are sent to Hong Kong, where they may be repackaged before export. Shenzhen imports oil, foodstuffs, computers and electronic equipment from other countries, mainly USA and Japan. Because it is an industrial city, Shenzhen does not attract many tourists, but this is slowly changing.

ACTIVITIES

Knowledge and understanding

1 Name the three Chinese cities more important than Shenzhen.
2 Describe the demographic character of Shenzhen and the level of wellbeing experienced by its residents.
3 Outline Shenzhen's connections with the world.

Applying and analysing

4 a Describe the purpose of the Special Economic Zones in China.
  b Why do you think that China developed these zones?
  c What advantages have they created for China?
5 The average age of people in Shenzhen is significantly lower than the average age for China as a whole. Suggest some reasons for this.

9.10 Fashion: Going global

The market for fashion and footwear is now global. The factors contributing to this change include the emergence of global media networks and advertising campaigns, the associated spread of western popular culture, and the rise of transnational corporations. All over the planet, young people aspire to wear the very same brands of clothing.

Fashion and identity

Fashion is a form of self-expression and plays an important part in defining your identity. How you dress helps communicate who you are or want to be. Expressing who you are is especially important for teenagers. While clothing has always been the principal means by which people identify themselves in public spaces, the twentieth century witnessed a wider array of subcultural groupings that visually marked their difference from the dominant culture and their peers by adopting elements of commercial culture, especially clothing.

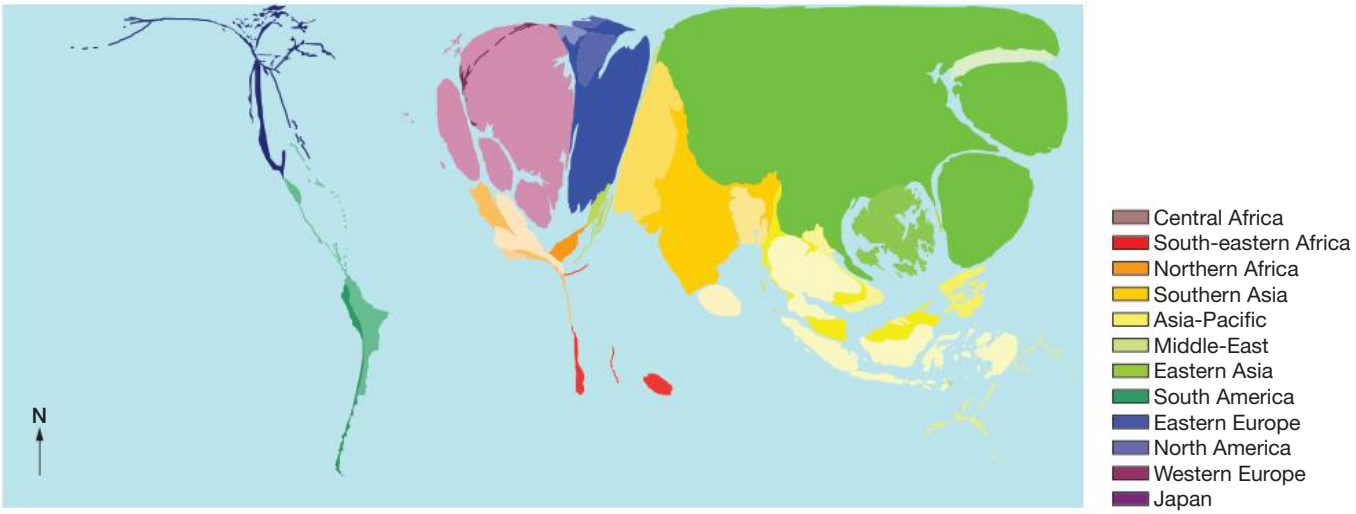
The global fashion industry

The global fashion industry is a product of the modern age. Until the mid-1880s, most clothing was custom-made by local dressmakers and tailors. The Industrial Revolution (and the new technologies that accompanied it), the rise of capitalism, the development of the factory system of production, and the advent of the department store and other forms of retailing, led to the mass production of clothing in a range of standard sizes. The scale of production achieved enabled the price of clothing and footwear to fall, bringing it within reach of an ever-larger number of people.

While the fashion industry originated in Europe and then spread to the United States of America, it is, today, a truly global undertaking, with clothing often designed in one country (see Table 9.26), manufactured in another, and then sold worldwide. An Australian owned surfwear company might, for example, buy its cotton fabric from Chinese mills, have the garments sewn and screen-printed in Vietnam and then ship the product to distribution centres in Australia, the USA and Europe to be sold by retailers internationally. High-end fashion houses might, for example, weave Australia's finest merino wool into cloth in Italian fabric mills before shipping the cloth to tailors in China, who transform it into expensive business suits using designs generated in the fashion houses of Milan, Italy (see Figures 9.27 and 9.28).

9.26 Familiar clothing brands and their countries of origin

Brand	Country in which based (headquarters)
Billabong	Australia (Burleigh Heads)
Calvin Klein	USA (New York)
Chanel	France (Paris)
Country Road	Australia (Melbourne)
Diesel	Italy (Molvena)
Duchamp	UK (London)
French Connection	UK (London)
Gant	Sweden (Nacka Strand)
Guess	USA (Los Angeles)
Hugo Boss	Germany (Metzingen)
Juicy Couture	USA (Los Angeles)
H&M	Sweden (Stockholm)
Levi Strauss	USA (San Francisco)
Louis Vuitton	France (Paris)
Mango	Spain (Palau-solità i Plegamans)
Prada	Italy (Milan)
Quicksilver	USA (Huntington Beach, Cal.)
Ralph Lauren	USA (New York)
Rip Curl	Australia (Torquay)
SABA	Australia (Melbourne)
Tommy Hilfiger	Hong Kong-based US company
Zara	Spain (Arteixo)



9.27 Worldmapper map showing clothing exports



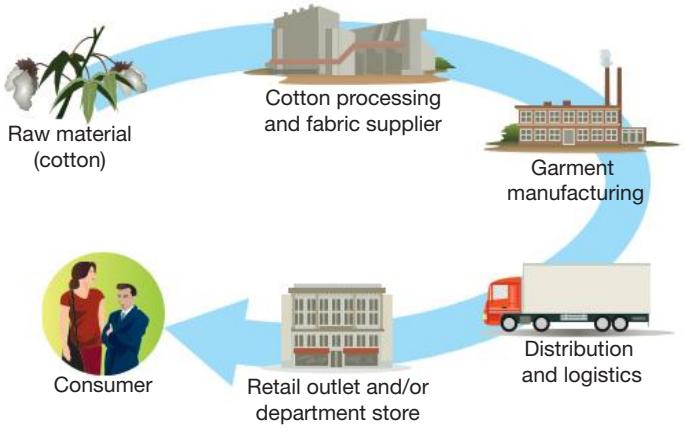
9.28 Worldmapper map showing clothing imports

Structure of the fashion industry

There are four key components of the fashion industry:

- the production of raw materials, principally fibres, textiles and leather
- the production process—designers and manufacturers
- advertising and promotion
- retailing.

The clothing manufacturing process is illustrated in Figure 9.29.



9.29 Key components of the fashion industry

Production of raw materials

The cloth used to make clothes is either woven or knitted using a variety of fibres, which can be natural plant and animal fibres or synthetics. Animal-based fibres include, silk, fur, wool, angora, mohair and alpaca. The most important plant-based fibre is cotton. Biophysical factors, especially climate, and production costs determine where these fibres are produced. Biophysical factors also influence the distribution of non-fibre clothing materials such as leather (an animal-based product) and rubber (a plant-based product).

Synthetic cloth is made from human-made fibres. Some examples of synthetic cloth are polyester, nylon, rayon, spandex, latex and kevlar. These fabrics have many different uses, some which are not possible for natural fibres. They can be used to create waterproof fabrics and fabrics that stretch, including those used in swimwear and lingerie. The chemicals used to make the synthetic fibres are derived from coal, oil, or natural gas.

Production process

Increasingly, the manufacturing of clothing is undertaken in the low-cost countries of East and South Asia, and Central and South America. Key elements of the creative process, however, remain concentrated in the countries of the developed world. The design of clothing continues to be determined in the world's great fashion capitals—Milan, Paris, London and New York. Global advertising campaigns also originate in agencies based in world cities.

Given the global nature of the industry, transport logistics is a critical link between centres of production and consumption. Fashions can change quickly, so it is important that designers and manufactures are able to respond to shifts in consumer demand. Once produced, garments and footwear need to be transported to distribution centres around the world. From these centres the goods are distributed to retailers. Given the highly competitive nature of the industry it is important that the length of time between design, manufacture and delivery to retailers is minimised.

Specialisation in China

China's cities have developed a high level of specialisation. This is particularly the case for those involved in the fashion industry. Datang, for example, makes one-third of the world's socks. Qiaotou's produces more than 70 per cent of the buttons for clothes made in China. Forty per cent of the world's neckties are made in Shengzhou and Songxia produces 350 million umbrellas every year.

Advertising and promotion

The global fashion industry is increasingly dominated by global brands. People's awareness of these brands is generated by worldwide advertising campaigns that seek to link the brand to the lifestyle aspirations of

SPOTLIGHT

Zara: Responding to changes in consumer tastes

Zara, the Spanish clothing company with annual sales of US$11.4 billion, has built a retail strategy based on responding to the fast-changing tastes of its customers. To do this, Zara has developed a supply chain that enables delivery of new fashions as soon as a trend emerges. Zara's parent company is Inditex, the world's largest clothing retailer (US$17.6 billion in sales).

A feature of this approach is the ability to deliver new products twice a week to its global network of 1751 retail outlets. This amounts to more than 10 000 new designs each year. It takes the company just 10–15 days to go from the design stage to having stock in stores.

Zara's whole approach is based on being responsive to the needs of its customers. Unlike many other clothing retailers who subcontract manufacturing to Asian-based companies, Zara has fourteen automated Spanish factories, where robots work around the clock cutting and dyeing fabrics, and creating the basis of their final products. These then go to a network of 300 small workshops in Portugal and Galacia in northern Spain. Here the base garments are transformed into finished dresses and suits.

9.30 Spanish retailer Zara's Sydney CBD retail outlet



SPOTLIGHT

H&M: Swedish fashion giant

H&M (Hennes & Mauritz), the Sweden-based company, is the second largest clothing retailer in the world, with more than US$17 billion in annual sales. The company operates 2800 retail outlets in forty-nine countries. The company's clothing collections are created in Sweden, where 150 designers and 100 buyers identify and respond to the latest trends in fashion. Production is outsourced to a network of 800 suppliers; 60 per cent of the production takes place in Asia, the rest in Europe.

Unlike Zara, H&M markets two main collections each year—one in spring and one in autumn. Within each collection H&M offers several sub-collections. This allows the company to refresh the stock it features in-store. The main collections have relatively long lead-in time, whereas the sub-collections can be turned around relatively quickly.

potential consumers. Glossy magazines, which target specific demographic, socioeconomic and social groups, are a popular way of promoting particular brands, as are television-based campaigns. Event sponsorship is another way of raising brand awareness.

The move towards a homogeneous global marketplace and the shift to brand dominance offers the large corporation a number of advantages. These include economies of scale in production and distribution, lower marketing costs, consistency in brand image, the ability to respond quickly to changing fashions (consumer demand), and competitive edge afforded to online retailers. What is lost is the rich local diversity in the way people dress.

Retailing

The retailing of clothing is also increasingly global. Australia's largest cities now host a range of international fashion retailers. Clothing manufacturers and retailers adopt strategies that help them to grow their business, generate profits and respond to changes in consumer tastes. The strategies adopted by Zara and H&M are good examples.

Online retailing

The internet is transforming the ways people purchase goods and services. It is also represents a challenge to traditional retailers (the bricks-and-mortar retailers). Consumers can now source their favourite brands from online retailers based anywhere in the world and have them delivered to their door within days. This has led to a massive expansion of the logistics industry, built around the delivery of online purchases.

ACTIVITIES

Knowledge and understanding

1. List the factors that have contributed to the globalisation of the fashion and footwear industries. What has been the outcome of this process?
2. Explain the relationship between fashion and identity. What trend has been evident?
3. Explain why the fashion industry is described as a 'product of the modern age'.
4. Outline the changing global structure of the fashion and footwear industries.
5. Identify the four key components of the fashion industry.
6. Identify the factors that determine where the raw materials of the fashion industry are sourced.
7. Outline the role of advertising and promotion in the fashion industry.
8. Outline the trends in the retailing of clothing and footwear.

Applying and analysing

9. As a class, discuss the relationship between fashion and identity. Summarise the finding of this discussion using a mind map.
10. With reference to the text describing the production process and Figure 9.29, write a paragraph outlining the distribution of the key components of the production process.

Geographical skills

11. Study Figures 9.27 and 9.28. Name the regions with the largest exports and imports of clothing.

Investigating

12. Study Figure 9.26. Select one of the fashion labels listed, or one of your preferred brands, to investigate. Include the following information:
    - the origins of the label: the location of the design and manufacturing of its apparel
    - the global reach of the label: the number of countries in which it is sold (include a map)
    - the number of branded retail outlets
    - the segment of the consumer market it targets and any strategies it employs to maximise the success of the brand.

    Present your findings as an annotated visual display.

9.11 Case study: Nike

Sports clothing has become a major consumer good and fashion item. Before the 1960s, people tended to wear basic shorts for exercise and t-shirts or team uniforms for sports games. Sandshoes were the usual footwear. They were made from canvas tops and flat rubber soles. With the invention of new materials, sports shoes became more complex. Designers produced shoes, which looked distinctive, and consumers began to want these new-look shoes with contoured soles and new colours.

Origins

Nike began as a small partnership in Oregon, run by two athletes who imported sports shoes from Japan. In 1965, they tried making sport shoes themselves, and in 1967 they opened their first retail store in California. From this store, they developed a marketing approach under the name Nike (the name of the Greek goddess of victory) for some of their shoes.

In 1978, the whole firm adopted the name of Nike, and by 1980 it had gained 50 per cent of the US sports shoe market. They then branched out into all kinds of sports clothing. Some of this sports clothing developed into much-desired streetwear for young people, increasing sales and promoting the brand's appeal to more potential consumers.

Nike still has its headquarters in Oregon, where the company originated, but it has offices in forty-five countries. It contracts firms to produce its goods in many Asian countries, notably Indonesia, China, India, Vietnam and the Philippines.

9.31 Nicholson's comment on Nike's workplaces



Global reach

Nike is one of the world's most recognised brands. It has been promoted by the use of expensive advertising campaigns, and through the sponsorship of high-profile sports stars who wear Nike clothing conspicuously, and in turn have their expenses paid by Nike. This model of sponsorship has also been adopted by many other global companies, especially those firms involved in sport.

Nike manufactures most of its products in Asia for a variety of reasons. Firstly, the labour costs are much lower than they would be in United States of America or Western Europe. Secondly, laws relating to labour conditions and factory conditions are generally not as stringent. These factors are common to many other global companies. Another important factor for Nike in particular was the desire to have a stepping stone into the huge Asian market. While competing firms such as Adidas were focusing on growth in Eastern Europe and Russia, Nike had its eyes on Asia.

Nike's critics

In the 1990s, there was a lot of criticism of the working conditions in Asian factories producing Nike goods (see Figure 9.31). The criticisms included allegations that:

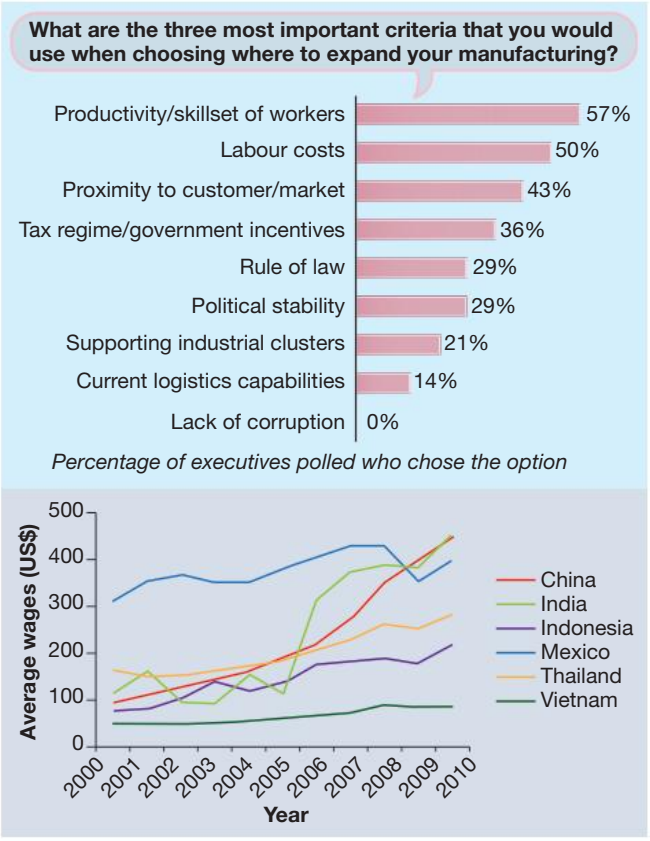
- factories did not pay the legal minimum wage
- some workers were forced to do overtime without appropriate pay
- pregnant workers were fired
- poor working conditions impaired the health of workers
- Asian factories took jobs away from Americans.

Some of these allegations were proved incorrect, such as the last one. The company has worked to address the other allegations. However, the criticisms and investigations have continued, and some factories have been found to still have working conditions that are often likened to 'sweatshops'.

Locational consideration

Labour costs are only one of the factors corporations take into account when determining where to outsource their manufacturing. Figure 9.32 shows the factors that firms take into account when deciding to locate their manufacturing plants. It also shows average labour costs for selected Asian countries. The rising cost of labour in China has been offset, at least in part, by the productivity of Chinese workers.

9.32 Average wages of selected Asian countries and the locational factors shaping the global pattern of manufacturing



ACTIVITIES

Knowledge and understanding

1. Outline the origins of Nike and how the company developed.
2. Describe Nike's global reach. Why are their shoes made in Asian factories?
3. Outline the criticisms made of Nike's corporate practices.

Applying and analysing

4. Study Figure 9.31. Outline the point that Nicholson is seeking to make about Nike's production processes.
5. Outline the factors that firms such as Nike take into account when deciding where to locate their manufacturing.
6. Study Figure 9.32 then do the following tasks.
   a. Compare the trend in average wages in the Asian countries shown in the line graph. What implications might there be for the future distribution of production? Why might China be able to retain its share of production?
   b. Identify the main factors that firms take into account when choosing where to expand their manufacturing.

9.12 Case study: Billabong

Since its founding in 1973, Billabong International Limited (a publicly listed Australian company) has grown into one of the world's leading designers, producers and distributors of surf and board sports (surfing, snowboarding and skateboarding) clothing and accessories for male and female markets.

Products and customers

Billabong's product range now includes over 2200 product lines in Australia, over 1300 lines in North America and over 1200 lines in Europe. Billabong's products are sold in more than 100 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. The company has 677 company-owned stores and employs 6000 people worldwide.

Over the past two decades, Billabong has further extended its international reach by purchasing brands and surf shops both within and outside of Australia.

Links to the world through marketing

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 board sport events around the world, such as the Billabong Pro contest held on the Gold Coast and Jeffreys Bay in South Africa, shown in Figure 9.33.

Billabong headquarters

While Billabong's international headquarters are in Australia, it has established regional offices in various parts of the world to oversee key markets. Offices are currently located in Brazil, Canada, Chile, France, Hong Kong, Indonesia, Japan, Korea, New Zealand, Peru, Singapore, South Africa, Thailand and the United States of America. Many of these countries also have dedicated sales offices with a specialised knowledge of each market and the needs of customers in these regions.



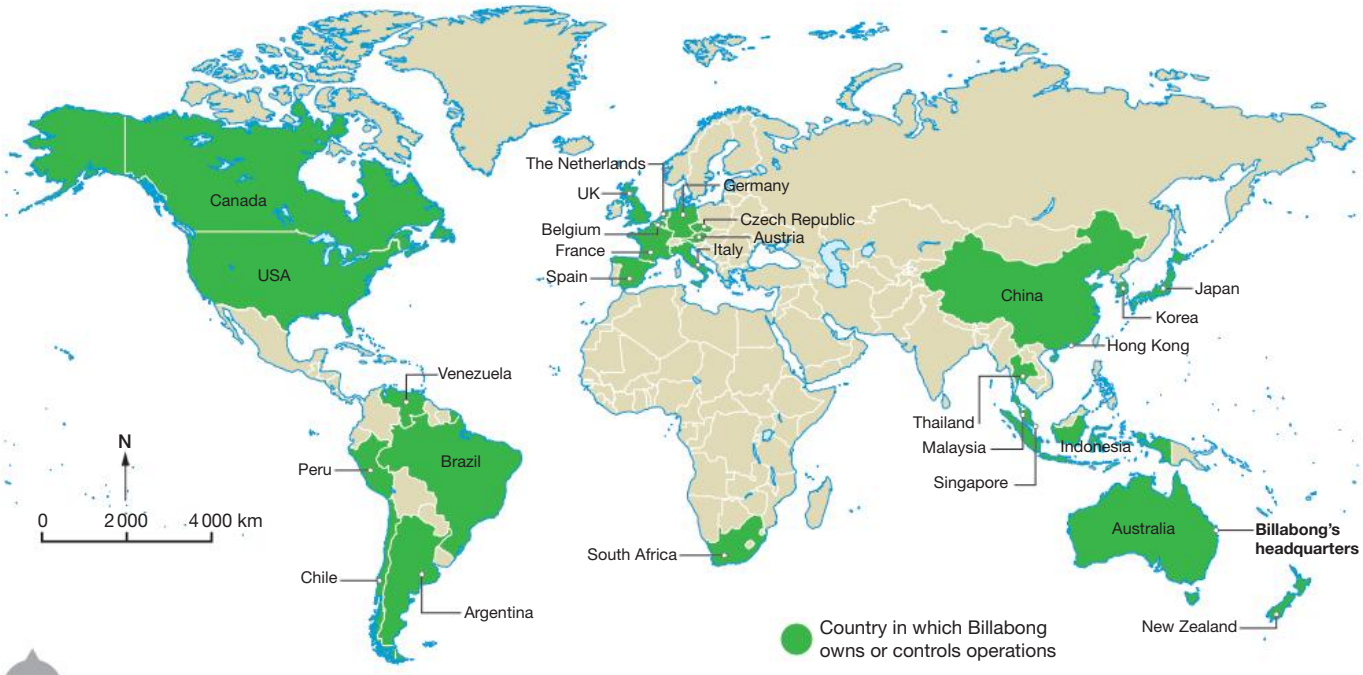
9.33 Billabong increases its global reach by sponsoring international sporting events.

Geography of production

In 1973, Gordon Merchant 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 during the 1970s, a factory was established at North Burleigh and then a larger one 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.

Figure 9.34 shows the extent of Billabong's global operations. In addition to Australia, Billabong manufactures its products in more than a dozen countries throughout North and South America, Asia and Europe. Billabong uses external producers in some countries so it can cater for local conditions and regulations, and deliver products to customers within a reasonable time. Since 1999, the company has managed its international suppliers from an office in Hong Kong.



9.34 Billabong's global operations

Ethical issues

Major surf wear companies often use images of the 'untouched' natural environment to promote their products. The production of surf clothing and accessories can, however, have a damaging impact on the environment. Fibreglass boards and rubber wetsuits have traditionally been produced using non-renewable resources such as oil-based products. Clothing and textile production also generates large volumes of waste and consumes vast quantities of energy and water. The production of one kilogram of fabric can consume up to 200 litres of water, and often involves the use of bleached cotton, toxic dyes and petroleum-based fabrics. When products are sold in excessive plastic packaging, the environmental impact can be even greater.

In recent years the big surf companies have become increasingly aware of the impact of their production processes on the environment and have made changes to their operations to reduce these impacts. Billabong makes ongoing changes to its work practices to reduce its impact on the environment. These changes include:

- the introduction of products made from organic and recycled materials, such as fabric made from recycled plastic PET bottles and water-based inks for printing
- the use of video conferencing in place of offshore travel
- the phasing out of paper-based purchasing systems
- the initiation or extension of recycling programs
- reductions in packaging
- the inclusion of environmental performance targets as achievement goals for staff.

Billabong monitors and reports its greenhouse gas emissions (carbon footprint) on an annual basis and provides ongoing support for a number of environmental groups.

ACTIVITIES

Knowledge and understanding

1. Describe the location of Billabong's customers.
2. Describe the methods Billabong uses to increase its market overseas.
3. Describe the location of Billabong's global and regional headquarters.
4. Outline the reasons for having multiple headquarters in different regions of the world.
5. Explain why Billabong manufactures in multiple locations.
6. Identify two ethical issues faced by surf wear companies.

Applying and analysing

7. Construct a timeline of the global expansion of Billabong.
8. Brainstorm the types of products produced by Billabong. Which markets would each of these products be sold in?
9. 'Globalisation in the surf wear industry is all about low-cost labour'. Prepare a list of arguments for and against this statement.
10. In small groups, develop strategies for reducing the impact of clothing production on the environment.

9.13 Exploitation of workers

In Australia there are laws to prevent the exploitation of workers. There are minimum wage rates, the 40-hour week, overtime payments and penalty rates for weekend work. There are also strict laws and inspections related to the occupational, health and safely conditions of workplaces, so that accidents and injuries are minimised. However, such strict laws do not apply in many countries.

Labour exploitation

Labour exploitation is defined by the International Labour Organization (ILO) as work obtained from people under threat (real or perceived) and for which people have not offered themselves voluntarily. There are a number of conditions in a society that contribute to the prevalence of worker exploitation. These are:

- high levels of unemployment, forcing people to take whatever jobs they can find
- the non-payment of the legal minimum wage by some employers
- a high level of poverty
- high levels of crime
- high levels of discrimination against women and other groups
- high levels of corruption in business and government organisations.

When these conditions apply, factory owners can pay their workers low wages and force them to work long hours. Trade unions are suppressed and little attention is paid to occupational health and safety issues. There are many examples of such factories operating in Asia and Africa. Most act as subcontractors to large, well-known global companies with headquarters in the United States of America or Europe and markets throughout the world.

Forced labour

According to the ILO, over 12 million people in the world are trapped in forced labour. Forced labour is outlawed by the ILO and takes one or more of the following forms:

- threats of or actual physical harm to a worker
- restriction of movement to other workplaces
- withholding of wages because of debts
- retention of passports or personal documents
- making threats to tell authorities that a worker is of illegal status.

Alternative perspectives

Some experts have argued that there need to be large numbers of sweatshops paying low wages at a certain stage in a developing nation's economy. They use the examples of countries such as South Korea and Taiwan, which were paying very low wages in the early stages of their development in the 1950s. In the present decade, more than 50 years later, these countries' wages are much higher, and their factories are producing cars, ships and complex electronic equipment.

Former World Bank economist Martin Wolf wrote:

> It is right to say that transnational companies exploit their Chinese workers in the hope of making profits. It is equally right to say that Chinese workers are exploiting transnationals in the (almost universally fulfilled) hope of obtaining higher pay, better training and more opportunities than would otherwise be available to them.

Anti-sweatshop activist groups such as Clean Clothes Campaign, SweatFree Communities and No Sweat all campaign to improve the conditions and human rights of workers in sweatshops. They argue that the exploitation of workers can never be justified.

Child labour

The ILO estimates there are 220 million children (5–17 years old) working as child labourers around the world. No one would argue that this is a good thing, but it is sometimes the only way in which a large family can support itself.

In India, 25 per cent of the workers in glass-making factories are children, while the chemical industry employs children as young as 3 years old in making matchsticks. Children are even employed in the manufacturing of arms and ammunition, a very dangerous occupation. There are also thousands of children employed as full-time miners in the diamond and gold mines of Africa, Asia and Latin America.

POOR CHILDREN MADE TO STITCH SPORTS BALLS IN SWEATSHOPS

THE footballs Australian children punt, pass and catch in weekend games are stitched by India's poorest children, who work in appalling, dangerous and illegal conditions for as little as seven cents a ball.

Two of Australia's most well-known football brands, Sherrin and Canterbury, have operations in India that use banned child labour.

A 12-month investigation by the *Herald* has discovered that despite significant reforms to India's massive but poorly regulated sports ball industry, children are still working, sometimes forced, in the painstaking and painful hand-stitching of footballs, netballs and soccer balls.

The children who stitch Sherrin and Canterbury balls are employed unofficially, through subcontractors, who pay them for each ball stitched …

Most child-stitchers earn between 50 and 60 rupees, about a dollar a day.

The children the *Herald* discovered stitching, sit, hunched on low stools, for between five and eight hours a day, six or seven days a week.

Stitchers often end up with chronic back injuries from the unnatural sitting position.

They regularly pierce their fingers with the sharp, heavy needles, or slice their hands on the wax-coated string.

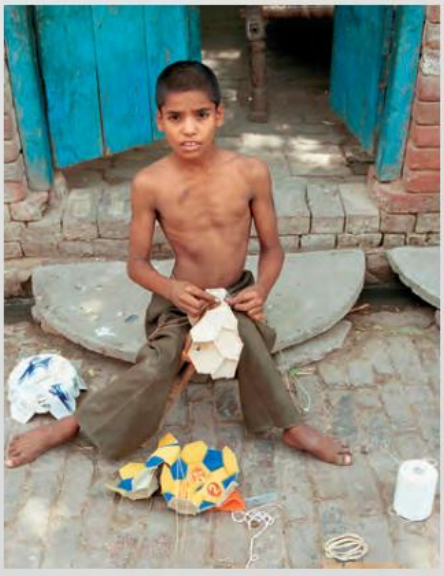
Working inside and in the dark, as most child labourers do to keep them hidden from authorities, strains child-stitchers' eyes and leads to vision disorders.

Keeping children from school to make them work is illegal in India. In 2010, the Right to Education Act made it compulsory for children under 14 to attend school.

Across Punjab's industrial cities, the *Herald* discovered children, almost all of them girls, and as young as seven, who have been pulled out of school to work in secret, stitching sports balls full-time.

Presented with the Herald's findings, both Canterbury and Russell (Sherrin) promised investigations.

Source: Adapted from Ben Doherty, *Sydney Morning Herald*, 22 September 2012



9.35 Child stitching sports balls

ACTIVITIES

Knowledge and understanding

1. Compare the treatment of workers in Australia and those in countries without strict enough labour.
2. Define the term 'labour exploitation'.
3. Outline the social factors that can contribute to an environment in which workers are exploited.
4. List the various forms of forced labour.
5. State the perspective of NGOs campaigning against sweatshops.

Applying and analysing

6. Explain in your own words your understanding of the term 'sweatshop'.
7. Make a list of arguments for and against the following statement.
   People are more concerned about cheap consumer goods than labour exploitation.

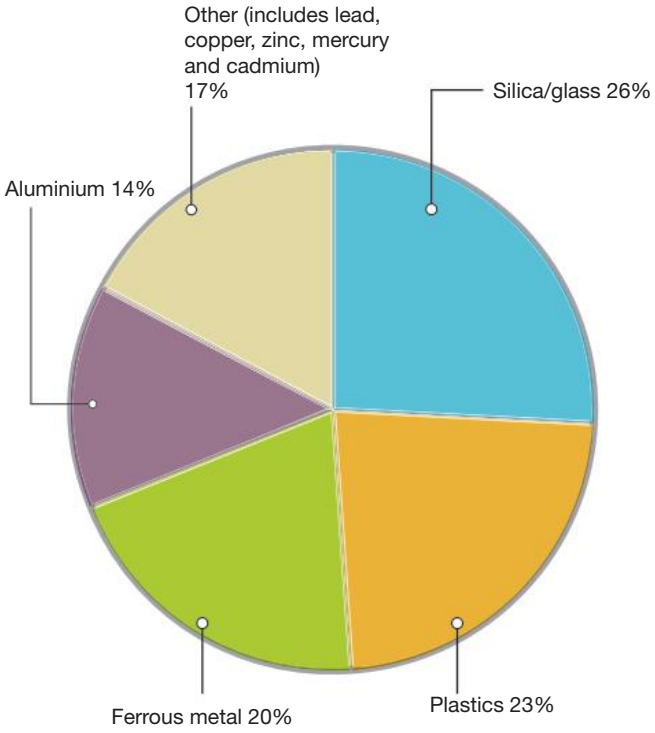
9.14 The hazards of electronic waste

The enormous growth in the production and consumption of electronic goods has had the side-effect of producing a different kind of waste. The materials used in manufacturing contain many kinds of materials that can be harmful to humans and to the environment.

Hazardous components

Personal computers contain small quantities of toxic heavy metals, such as cadmium, lead and mercury (see Figure 9.36). These are all chemicals that are monitored and regulated by environmental protection agencies in countries such as Australia and United States of America. The uncontrolled disposal of personal computers creates concentrations of these metals far above recommended levels.

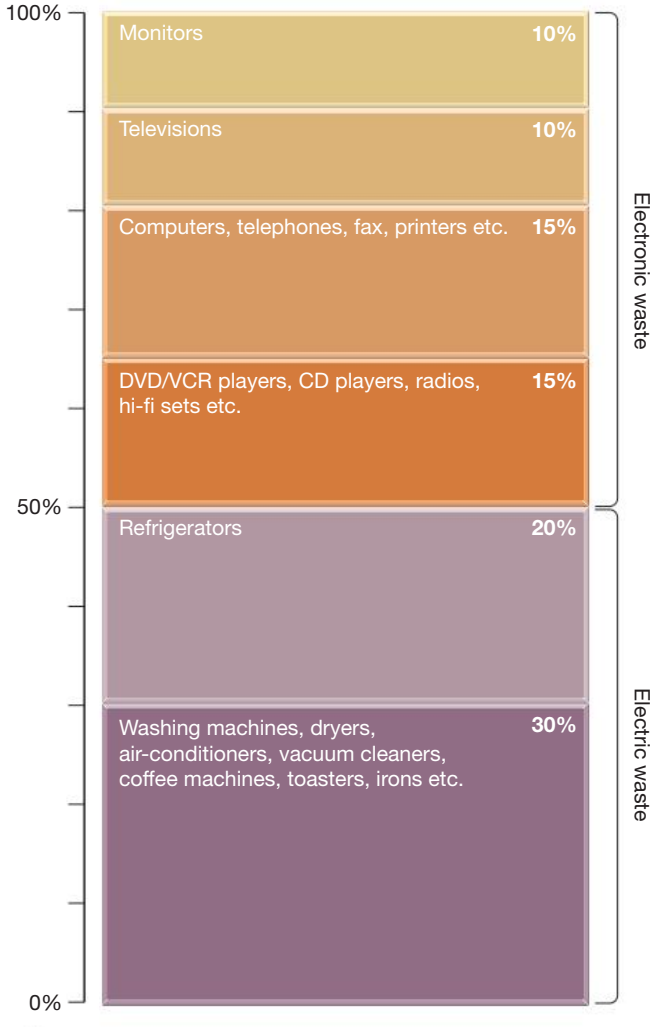
9.36 Computer components



Increasing electronic waste

The increase in the amount of electronic waste has been caused by two changes in computers.

- The number of computers purchased for home use has increased at an astounding rate.
- The average lifespan for a computer has dropped from about 5 years in 1999 to less than 2 years today.



9.37 The composition of e-waste

Most computers and other electronic items are thrown away, rather than recycled (only about 10 per cent are recycled). This means that the dangerous heavy metals leach into the subsoil, where they can contaminate groundwater. It is estimated that 50 million tonnes of electronic waste are produced each year. Europe discards 100 million mobile phones per year, and United States of America discards 30 million computers annually. Some estimates suggest that electronic waste may rise by 500 per cent over the next decade. Figure 9.37 illustrates the composition of electronic waste, approximately 25 per cent of which is related to computer waste. Pollutants found in electronic waste include:

- lead in cathode ray tubes and solder
- mercury in switches and housing
- arsenic in cathode ray tubes
- antimony trioxide as flame retardant
- selenium in circuit boards
- cadmium in semiconductors
- cobalt in steel for magnets.

Recycling computers and electronics

It is possible to recycle computers and consumer electronics. Recycling involves breaking down electronic items for their component parts and processing the materials from which they are made. Complicating the process, however, is the rapid rate of technological development. Electronics goods can be made redundant by new and upgraded technologies. Take, for example, the iPhone: From the time it was first released in mid-2007 until 2013, six increasingly sophisticated models were released. In many cases, consumers simply discarded the obsolete model in order to have the latest technology available.

DID YOU KNOW?

Seventy-five per cent of the three million computers purchased in Australia every year will end up in landfill.

SPOTLIGHT

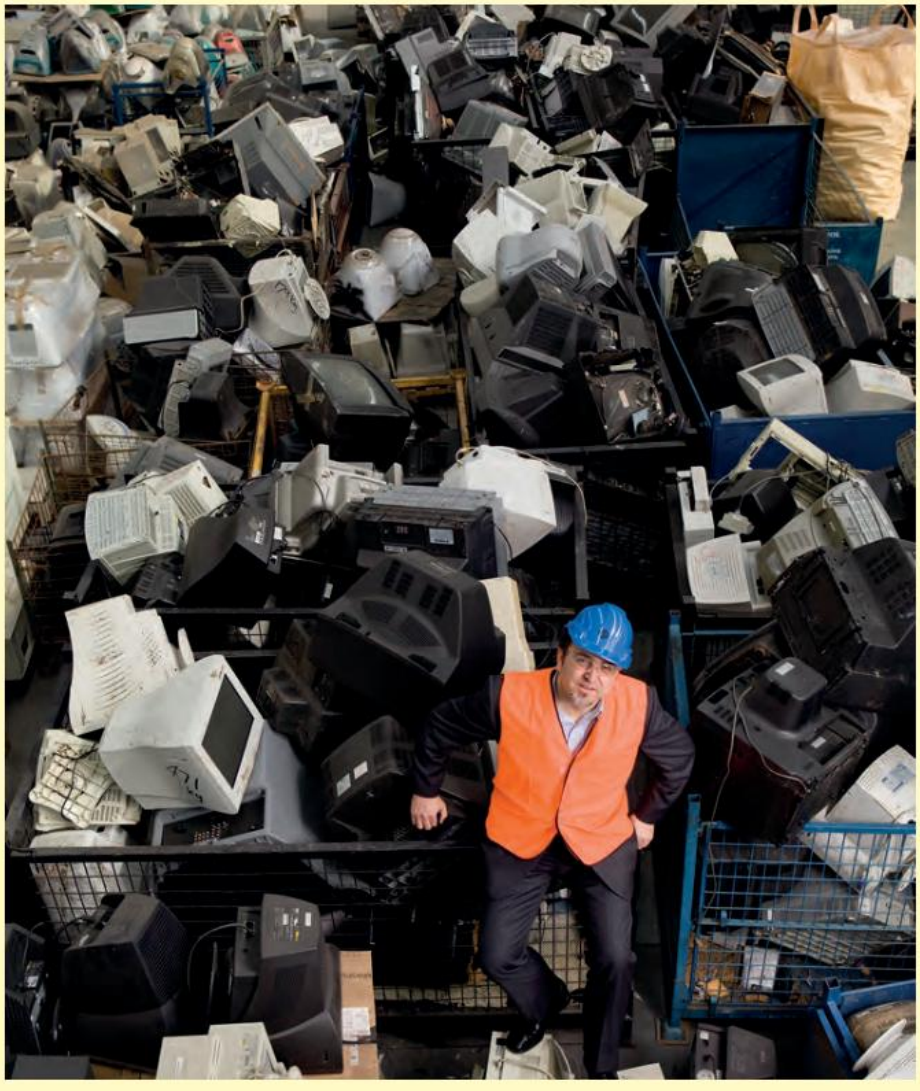
National Television and Computer Recycling Scheme

Electronic waste in Australia is increasing and is discarded rather than recycled. Less than 10 per cent of the 15.7 million computers no longer in use have been recycled. It is estimated that if 75 per cent of the 1.5 million televisions thrown out annually were recycled there would be savings of 23 000 tonnes of carbon dioxide equivalents, 520 megalitres of water, 400 000 gigajoules of energy and 160 000 cubic metres of landfill.

The National Television and Computer Recycling Scheme provides Australian householders and small businesses with access to free recycling services for:

- televisions
- computers
- printers
- computer products (such as keyboards, mice and hard drives).

Drop-off points have been established around Australia at recycling depots and retailers.



9.38 Electronic waste drop-off point

Processing of electronic waste

Both China and India have places that specialise in disposal of electronic waste. China has a site at Guiyu, and India has sites near Delhi and Bangalore. At these sites thousands of people are engaged in the dangerous recycling process. They separate toners, plastics and metals from wastes. In the process they come into contact with many sources of dangerous substances (see Figure 9.39). Furthermore, the uncontrolled burning and disposal of products cause chemicals and metals to discharge into the atmosphere, soil and groundwater. Figure 9.40 outlines the electronic waste traffic in Asia.

Spread of electronic waste

Many illegal shipments of electronic waste find their way to countries such as Ghana, bypassing the rules controlling the movement of such materials. Those responsible simply label the electronic waste as television sets for reuse or computers given as donations. When they finally reach the landfills in the country where they are to be dumped, they are scavenged by groups of children looking for microchips or other parts they can sell. The useless parts are smashed, burned and crushed.

Medical workers have found all kinds of health problems in people working on or scavenging from electronic waste tips. Children break open cathode ray tubes and expose themselves to lead poisoning. People who use acid to strip down circuit boards splash their skin with it and breathe the fumes.

9.39 Child labour being used to sort recyclables from e-waste. Such workers come into contact with hazardous substances.





9.40 Electronic waste movements in east and southern Asia

DID YOU KNOW?

One hundred and twenty-six million children are engaged in the worst form of child labour—slavery, armed conflict and hazardous work.

ACTIVITIES

9.4

Knowledge and understanding

1 State what electronic waste is.
2 Explain why electronic waste is now such a problem.
3 Outline why electronic waste is such a problem in countries with not as many computers or phones per person.

Geographical skills

4 Study Figure 9.40. Outline the movement of e-waste in South and East Asia.

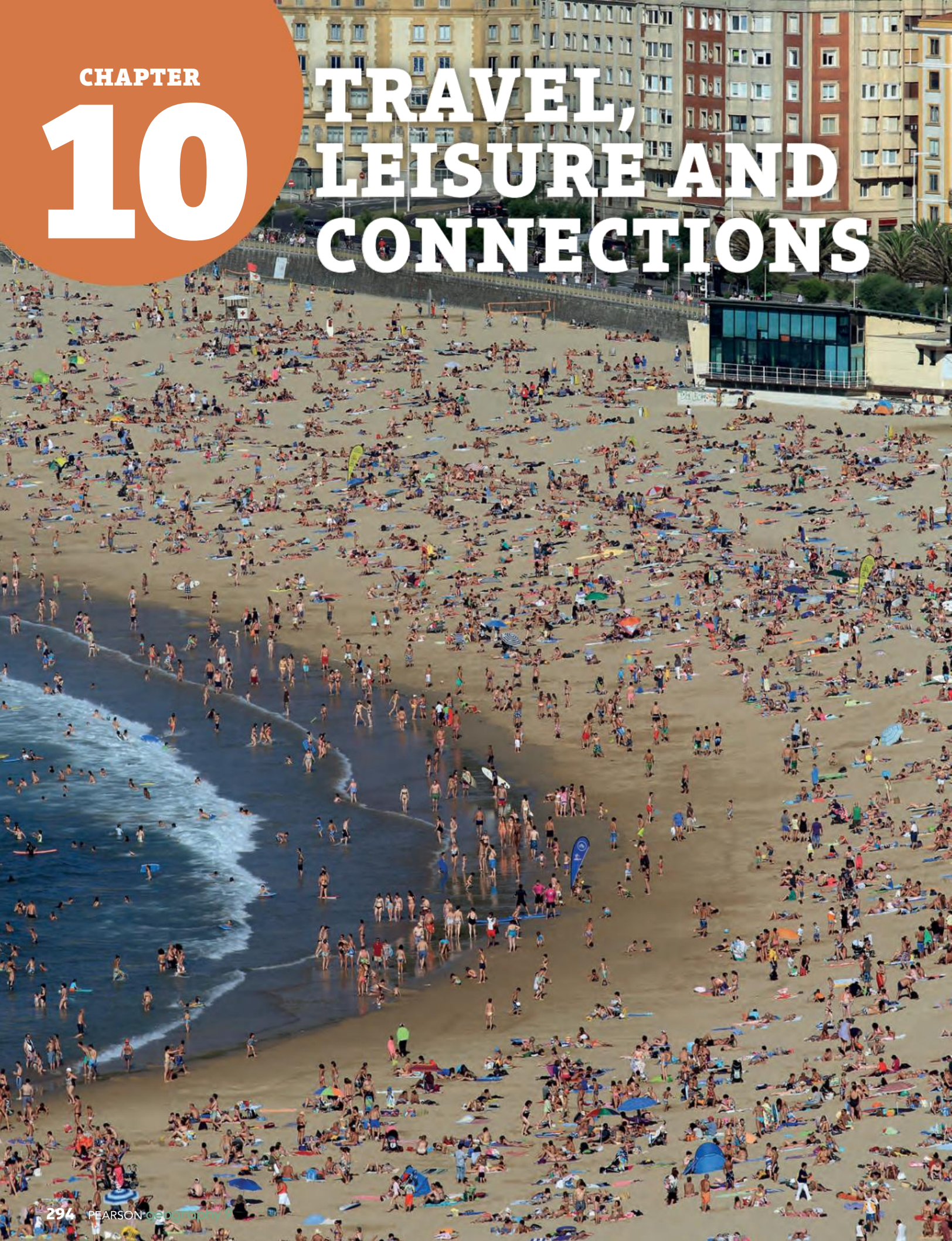
Investigating

5 Investigate local recycling schemes for batteries, computers and mobile phones.

CHAPTER

10

TRAVEL, LEISURE AND CONNECTIONS



Travel and leisure-related activities have an impact on the place in which they take place. One the positive side, tourism and leisure can promote cultural understanding, goodwill, tolerance and awareness. Communities can also benefit from the economic activity and employment opportunities generated and the infrastructure built to support such activities. On the negative side, tourism can corrupt local cultures. It can also be a source of environmental degradation. Overcrowding, misuse of natural resources, the construction of buildings and infrastructure, and other activities associated with tourism and leisure, can all have an impact on the environment. In general, such impact varies according to the number and nature of tourists and the characteristics of the site. The individual tourist normally has a relatively small impact. Problems arise, however, if the number of tourists is large or the resource overused.

In this chapter we study the effects of people's travel, recreational, cultural or leisure choices on places, and the implications for the future of these places.

KEY IDEAS

- To understand and explain the ways in which people's travel, recreational, cultural or leisure choices affect places
- To speculate on the implications of people's travel, recreational, cultural or leisure choices for the future of places
- To appreciate the nature and scale of the tourism, sport and music industries

GLOSSARY

cultural diffusion	the spread of cultural characteristics from one place to another
cultural group	a group made up of people of similar heritage who identify with others in the group through sharing the same language, the same ancestry and often the same religion
culture	a complex mixture of people's origins and heritage, language, religion, customs and ways of life
popular music	music that has wide appeal
tourism	travel for recreational, leisure or business purposes

10.0 Gros Beach, San Sebastian, Spain

10.1 Impact of people on places

The way that people's cultures contribute to the development of a 'sense of place' and the processes that produce the differences between places are at the heart of human geography. Other related factors, such as economics and wealth, history, technology, population and population movements, also play a role in shaping place.

Geographic features of places

If you think about the features of a place that make it distinctive, you might come up with a list that includes:

- its physical landscape
- its location in relation to the coast, mountains and rivers
- the impacts of industry or agriculture (see Figure 10.1a)
- the types of buildings and settlements (see Figure 10.1b)
- the appearance of the houses, streetscapes, transport and services (see Figure 10.1c)
- the invisible features, such as language, religion, culture and wealth.

People influencing places

Aspects of human behaviour that influence places are:

- culture
- economics and wealth
- history
- technology
- population density
- population movements.

Culture

Culture is a complex mixture of people's origins and heritage, their language, religion, customs and ways of life. It has an important influence on the appearance of a place through styles of housing, ways of using outdoor space, community buildings, and the different values placed on parts of the physical landscape. Places that have been strongly influenced by one culture over a long period often have very distinctive and recognisable landscapes.

It is important to recognise that no culture is static. Ideas, technologies, commodities and products, and people move from one place to another and when cultures come into contact with another through migration, trade or the latest telecommunications devices, they influence each other. In some cases a culture can be overwhelmed by another. In most instances, people adopt, adapt or reject the cultural influences they come in contact with.

Cultures have evolved in response to contact for thousands of years. But the pace of change has accelerated. In the past, the influences of distant cultures came slowly, delayed by long journeys. Today, because of the reach and speed of communication technologies, the expansion of world trade and the affordability of long-distance travel, cultural influences can spread across the planet as fast as the click of a mouse.

Economics and wealth

The level of wealth in a community is an important indicator of the extent to which people can transform places. In affluent societies there is more of a materialistic culture; large homes, sophisticated transport options and large-scale commercial, recreational and entertainment facilities dominate the landscape. Poor communities can afford to build only basic housing, use traditional farming techniques and undertake small-scale manufacturing.

History

The history of any place has an important impact on its 'sense of place'. Some places are still dominated by structures and street patterns built centuries ago. Towns dominated by castles or by narrow mediaeval streets develop part of their character from this history. Some places are well known for particular historic events such as battles or revolutions. This affects the ways that both the current inhabitants and visitors/tourists perceive the place.

Other places have their character dominated by their newness. Many places in Australia have similar cultural and economic influences as places in Britain, but look very different because of the recency of settlement.

Technology

Technology as a factor is closely related to levels of wealth, but it should be looked at separately because there is not a perfect correlation between these two as influences on places. The use of high technology might not even be obvious as a visual characteristic of a place, but it might still







10.1 **a** Siem Reap ricefields **b** Dubai city **c** French village

be present in the structure of buildings, the communication network, the power sources, the use of water, and the connections with the rest of the world. For example, Munich in Germany has its sophisticated fibre-optic telecommunications network buried out of sight below its cobbled streets.

Population density

Population density has a major impact on places. The contrast between rural and urban landscapes, multistorey and single-storey housing, and areas with parks and those without parks are just some of the clearly visible contrasts. Population densities range from 100 000 people in 1 square kilometre in some parts of some Indian cities to zero in large areas of the world.

Population movements

Movements by people from place to place can be either long-term or short-term. The long-term movements include migrations to new places. Such migrations have had major influences on the place receiving them, through the addition of different cultures, different languages, different skills and different age groups of people. Short-term population movements include daily commuting to work, and the movements of tourists to visit and see places. Each of these has influences on a place.

ACTIVITIES

10.1

Knowledge and understanding

1. List the features of places that contribute to their distinctiveness.
2. Identify the characteristics of people that influence places.
3. Explain how culture, history, economics and wealth, and technology, can have quite different influences on places.

Applying and analysing

4. Name some places that have been changed by specific impacts of people, and describe the particular impacts on each place.
5. Reorder the list of factors that influence places into the order of importance you think these factors have.
6. Study Figure 10.1 then do the following tasks.
   - **a** Identify as many differences between the places shown as you can.
   - **b** List the human behaviours that have influenced each of these places.

10.2 Cultural diffusion and adaptation

Culture can be defined as the sum total of ways of living built up by a group of human beings and transmitted from one generation to another. A cultural group is made up of people of similar heritage who identify with others in the group through sharing the same language, the same ancestry, and often the same religion. People often celebrate their cultural group through their food, music and dance.

Elements of culture

Our culture is made up of the following elements:

- language
- religion, or religious background
- political system and ideas
- ethnic background
- forms of social organisation
- customs and traditions
- arts and literature
- economic systems.

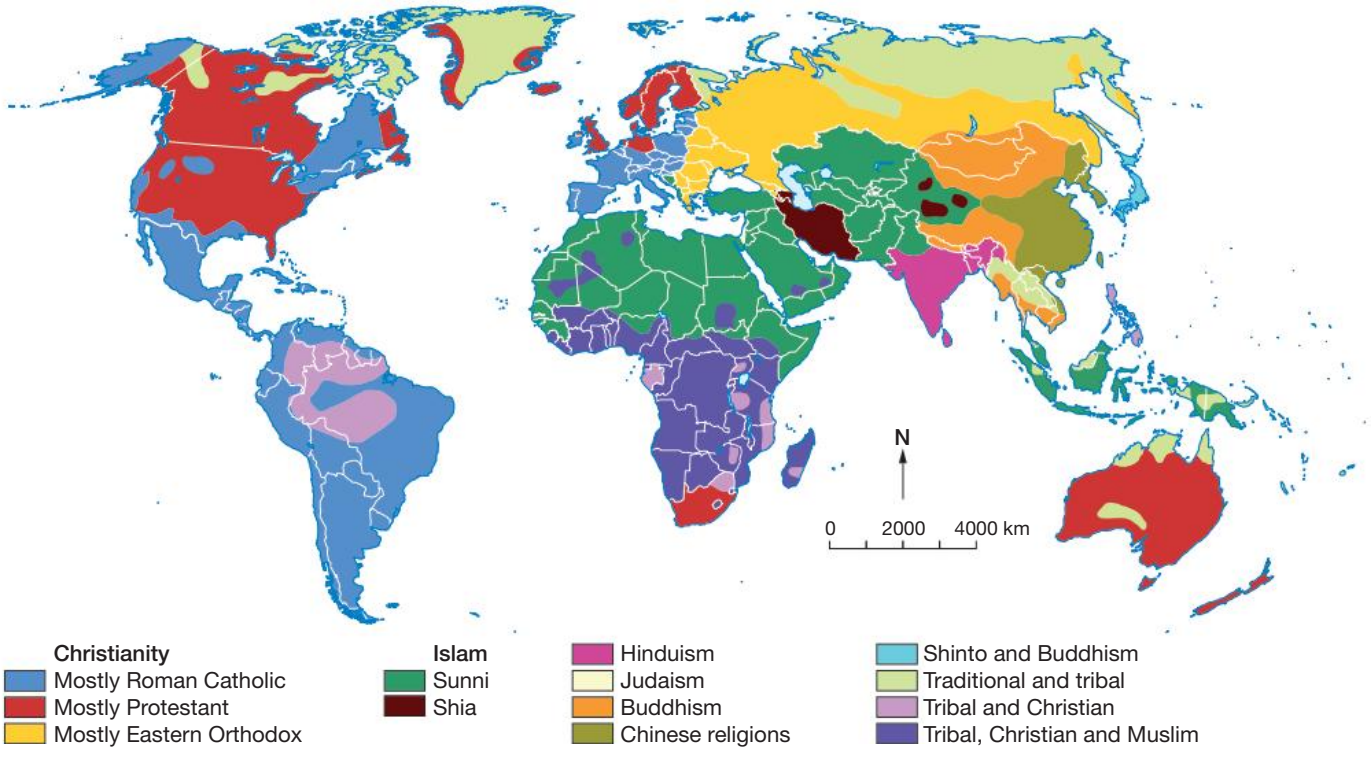
Together these elements spell out the main features of our culture. However, every person in our society will have a slightly different mix of these characteristics, even though they share the same general culture.

Human geographers are interested in how these aspects of culture differ across the world and how they contribute to a place's uniqueness, its 'sense of place'. They investigate why places are similar, and where they are different. They want to know where particular elements of culture originated and where they have spread. Above all, geographers are interested in the ways people adopt, adapt or resist the cultural forces or **cultural groups** that they come in contact with.

Cultural spread

The spread of cultural characteristics is called **cultural diffusion**. This cultural diffusion can be fast or slow.

10.2 Distribution of world religions



10.3 Number and diversity of restaurants in Sydney and Melbourne, July 2012

Cuisine	Number		Cuisine	Number	
	Melbourne	Sydney		Melbourne	Sydney
Chinese	692	603	Korean	125	72
French	133	125	Lebanese	116	29
Greek	92	132	Malaysian	111	154
Indian	369	420	Spanish	74	67
Italian	951	784	Thai	742	403
Japanese	477	319	Vietnamese	200	181

Source: Eatability Food and Drink Guide

Religion and political geography

Religion is closely linked to other aspects of culture, such as language and ethnic groups. In many countries it is also closely linked to government. For example, the Queen (or King) of England is still the head of the Church of England (Anglican). Throughout history the Pope (head of the Roman Catholic Church) has been a very powerful political figure. In present-day politics it is common to talk about the 'Islamic world', meaning the area of Asia and Africa where most of the population practise the Islamic (or Muslim) religion (see Figure 10.2).

Food

Each cultural and ethnic group has particular foods that they have traditionally eaten. In Europe and North America, wheat and corn are the major grains. In Asia, the main grain is rice. In Africa, corn, millet and sorghum are major grains in different cultural areas.

Roast beef, tofu, falafels, curries, pasta, biltong, hummus are all foods that have originated in particular cultures, often related to particular ethnic groups. As the ethnic groups have spread across the world, they have taken their foods with them. Initially, they consumed those foods only in their own houses, but soon restaurants were set up and the foods became known and liked by others (see Table 10.3 and Figure 10.4). Over time, many of them have become staple foods of other cultures.

Sport

Sport is now a global phenomenon. Yet there are still local sports only played in one region, and other sports confined to particular groups of countries. Many sports, however, have spread from their country of origin and are now played and watched by millions of people. Soccer, football, tennis, golf and basketball are played in many countries. The matches played by the top players are televised across the world and followed closely by millions of interested fans.

Like all aspects of culture, sports spread initially with colonisation and migration; as a result, some sports have a global spread, while others are still localised. People moving to new continents and countries take their sports with them. The opportunities given by television and other media have popularised many sports. Sponsorship by large companies has increased prize money and earnings, and this has meant that many sports have developed from mostly an amateur pastime into a full-time professional occupation.

10.4 Ethnic restaurant in Manly, Sydney. The streetscapes of Australian cities illustrate the cultural diffusion of foods from different cultures.



SPOTLIGHT

The global effects of the slave trade

In the seventeenth, eighteenth and nineteenth centuries there was a highly organised system of buying slaves in Africa and taking them to North, South and Central America. There they were traded and used by landowners, particularly on large plantations. The result of this long-running movement of so many people against their wills was that between 9 and 12 million Africans arrived in the Americas, and their descendants now make up a large proportion of the US population.

The African–American culture is very strong today in the USA. It is evident in religion, foods, speech patterns, music, particular sports and many other aspects of culture.

Even though slavery was abolished in the middle of the nineteenth century, prejudice against black Americans remained strong for over a hundred years, and profoundly influenced politics and work.



10.5 The African–American culture is very strong today in New Orleans, USA.

Australian sporting culture

For many Australians, cultural identity is strongly connected to sport. It is a way of sharing an interest, connecting with a group of like-minded people, and giving people a sense of belonging.

Cricket

Cricket is the best example of a sport spread via colonisation. It is very popular in countries that were once British colonies, but is hardly played at all in most other countries.

Movies, television and the internet

Movies and television can sometimes have the effect of teaching people more about their culture and allowing them to identify with it. At other times they can have the direct opposite effect—that of overwhelming a local culture by showing only US films and shows, and so promoting US language, beliefs, and ideas, because so many of them originate in the United States of America. In Australia, US movies have been the most commercially successful, as is shown in Table 10.6.

The internet has different cultural influences from movies or television. This is because it operates throughout the world in a large number of languages. It also allows individuals anywhere to communicate with each other through social networks. It has been said that it makes knowledge available to more people, and it has even been held responsible for allowing democratic protests to be more successfully organised.

10.6 Top 10 grossing films in Australia

Rank	Title	Release date	Box office ($)	Country of origin
1	*Avatar*	2009	115600481	USA
2	*Titanic*	1997	57650984	USA
3	*The Avengers*	2012	53250000	USA
4	*Harry Potter and the Deathly Hallows: Part 2*	2011	52611276	UK
5	*Shrek 2*	2004	50388327	USA
6	*The Lord of the Rings: The Return of the King*	2003	49370354	USA/New Zealand
7	*Skyfall*	2012	48333519	UK
8	*Crocodile Dundee*	1986	47707045	Australia
9	*The Lord of the Rings: The Fellowship of the Ring*	2001	47429619	USA/New Zealand
10	*The Dark Knight*	2008	46089622	USA

Source: Screen Australia

ACTIVITIES

10.3 10.4

Knowledge and understanding

1. Define the terms 'culture' and 'cultural group'. In what ways do people celebrate their culture?
2. Outline why human geographers are interested in culture.
3. State what the term 'cultural diffusion' means.

Applying and analysing

4. Construct a mind map featuring the elements of culture listed.
5. Name some sports you think of as closely related to Australian culture. Answer the same question about US, Chinese and Brazilian culture.
6. List the country of origin of the television programs you have watched in the last 24 hours. What proportion of these came from the United States of America?
7. Make a list of the foods that you have eaten in the last week. How many of them have originated in other countries?

Investigating

8. Investigate the number and diversity of restaurants in your local area. Present your findings in a table similar to Table 10.3.
9. Identify and lists of the main countries playing these sports: cricket, rugby, ice hockey, skiing, baseball, golf and ice hockey. Investigate the origins of each of these sports.
10. Identify the national cultures most strongly related to the following kinds of music: tango, country and western, grand opera, hip hop, jazz, gospel music.

10.3 Places with special functions

All cities and towns have multiple functions, even though one or two may dominate. People are attracted to such places by the opportunities available in these places—access to work, education, healthcare, culture and entertainment. These places supply functions that are needed by the people who live there and the surrounding area.

Cities and towns

Cities and towns have special functions. These may include:

- being a religious centre, such as a place of pilgrimage
- providing special artistic and cultural functions
- being a centre for a special festival
- providing special sport facilities.

Special religious function

Each religion in the world has places which have a special meaning for the people of that religion. Some of these places are where the religion first developed. Others are places of pilgrimage because of special events that occurred there. Examples of cities with special religious significance are:

- Rome—Roman Catholic Christian
- Jerusalem—Jewish, Christian and Islamic
- Mecca—Islamic (see Figure 10.7)
- Amritsar—Sikh
- Varanasi—Hindu.

As well as these cities of special significance, all religions have places within large cities that are special. These include cathedrals, temples and places where prophets, disciples, holy men and women, and saints lived, visited or were buried.



10.7 Mecca was the birthplace of Muhammad. A pilgrimage to Mecca (know as the Hajj) is obligatory for all able Muslims.

Artistic and cultural functions

Some places in the world are noted for their contributions to the arts and the culture of their country and the rest of the world. Such places are visited by millions of people who wish to see their art and architecture. They have a visual appearance which is distinctive, and they often have important collections of objects. Some also offer special activities, such as research, film making, or music, attracting people from all over the world. Examples of cities with special artistic and cultural functions are:

- Paris, France
- Kyoto, Japan
- Salamanca, Spain
- Hollywood (Los Angeles), USA
- St Petersburg, Russia
- Oxford, United Kingdom
- Florence, Italy
- Marrakesh, Morocco.

Special festivals

In many cities, festivals have developed that celebrate special characteristics of the city. Some of these festivals have been occurring for hundreds of years; others are relatively recent. The aim of these places is to attract visitors by providing an experience that is worth travelling long distances for. Some of these festivals are artistic, some are centred on food and drink, and some have a basis in religion.

Examples of cities with well-known festivals are:

- Rio de Janiero, Brazil, carnival
- Venice, Italy, carnevale (see Figure 10.8)
- Stratford on Avon, United Kingdom, Shakespeare festival
- Edinburgh, Scotland, arts and fringe festival
- Glastonbury, United Kingdom, rock music festival
- Adelaide, South Australia, arts and fringe festival



10.8 Venice's Carnevale

Sport facilities

Sport is now a major world industry. It employs many people, has a huge number of participants, and entertains millions of people. Whatever the sport, there are special places with facilities that are centres for that sport. These places attract the top sports people and large crowds of spectators. Sporting authorities around the world have invested large amounts of money in the provision of facilities and promotion of sport. Examples of these special places for sport are:

- Lord's Cricket Ground, London, for cricket
- Bells Beach, Victoria, for surfing
- Bathurst, New South Wales, for touring car racing
- Le Mans, France, for sports car endurance racing
- Wimbledon, London, for tennis

World cities

The largest cities of the world have so many people and are so complex that they have many of the special features described above, operating within their large-scale urban areas. For example, New York has large art collections, many religious centres, important sporting venues and numerous festivals. London, Paris, Tokyo, Los Angeles, Berlin and Shanghai also have many special cultural and sporting functions, as well as their business and political functions.

Protecting special places

When a place has special meaning to a group of people, it is important to protect it from decay, destruction, interference and lack of care. Most nations, states and cities now have laws aimed at protecting special places. Australia has heritage lists; the world has the UNESCO World Heritage sites; and many cities have their own ways of identifying and conserving special places.

ACTIVITIES

Knowledge and understanding

1. Explain what is mean by the term 'function'.
2. Define the term 'world city'.
3. Outline how special places can be protected.

Applying and analysing

4. Write down the name of a special place you have visited. Describe why it is important to you and if it has a special function.
5. Create a KWL chart about a special place you want to visit.

Investigating

6. Look at this list of world cultural landmarks, compiled from an internet survey of thousands of people, then answer the questions that follow.
    - The Pyramids and Sphinx, Cairo, Egypt
    - Taj Mahal, Agra, India
    - Stonehenge, England
    - Great Wall of China
    - Angkor Wat, Cambodia
    - Acropolis, Athens, Greece
    - Colosseum, Rome, Italy
    - Potala Palace, Lhasa, Tibet
    - Statue of Liberty, New York, United States of America

    a. Which are connected with a religion?
    b. Which is the oldest?
    c. Which was built most recently?
    d. Which are used as symbols of their country or city?
    e. Which would you like to visit, and why?

10.4 Travel: Expanding personal geographies

While tourism as an industry is a relatively recent development, it is one of the main sources of income for many countries and regions. Mass tourism relies on many people having a combination of leisure time and money to spend on non-basic items. Millions of people in wealthy countries have now travelled widely to other parts of the world. They have visited places that their ancestors could only dream of.

Personal geographies

A personal geography is:

- the idea that the environment (biophysical and constructed) shapes the individual
- the relationship between a person and their environment
- how a person views and sees the world.

This personal geography can be expanded by travel to other countries, cultures and environments. These experiences of travel to different places can changes people's views, opinions or interests.

World tourism

Tourism is one of the world's largest service-based industries. In 2013, for the first time in history, more than a billion people (almost one in seven of the world's population) travelled internationally, as is shown in Figure 10.9. This is a massive increase on the 25 million international tourists in the years immediately after World War II. Tourism also has a major impact on the character of places. In some popular tourist destinations, tourism is the dominant form of economic activity and is central to their 'sense of place' or character.



Source: World Tourism Organization

10.9 International inbound tourism 1995–2012

Most visited places

Table 10.10 shows the ten countries that attracted the largest numbers of tourists in 2012. Table 10.11 shows the ten countries whose inhabitants spent the most on international tourist visits.

10.10 The world's top tourist destinations, 2012

Rank	Country	International tourist arrivals (million)
1	France	83
2	USA	67
3	China	57.7
4	Spain	57.7
5	Italy	46.4
6	Turkey	35.7
7	Germany	30.4
8	UK	29.3
9	Russia	25.7
10	Malaysia	25
-	Australia	6.1

Source: World Tourism Organization

DID YOU KNOW?

According to the City of Niagara Falls, over 6 million cubic feet of water (approximately 170 000 cubic metres) hurls over the top of Canada's Horseshoe Falls every minute—enough to fill a million bathtubs to the brim in 60 seconds.

10.11 Ten biggest spenders on international tourism, 2012

Rank	Country	Amount spent on International Tourism ($ billion)
1	China	102
2	Germany	83.8
3	USA	83.5
4	UK	52.3
5	Russia	42.8
6	France	37.2
7	Canada	35.1
8	Japan	27.9
9	Australia	27.6
10	Italy	26.4

Source: World Tourism Organization

Most visited attractions

Tourism statistics do not differentiate between local and international visitors so it is difficult to know where tourists go within the countries they visit. Table 10.12 shows the world's most visited attractions, according to the magazine *Travel and Leisure*.

10.13 **a** Times Square; **b** Disneyland, Anaheim, California; **c** Niagara Falls

a



b



10.12 The world's most visited attractions, 2013

Rank	Attraction	No. of visitors (million)
1	Las Vegas Strip, Nevada	39.66
2	Times Square, New York	39.20 (see Figure 10.13a)
3	Central Park, New York	37.70
4	Union Station, Washington DC	32.85
5	Niagara Falls, USA and Canada	22.50 (see Figure 10.13c)
6	Grand Central Terminal, New York City	21.60
7	Faneuil Hall Market Place, Boston	18.00
8	Disney World Magic Kingdom, Orlando, Florida	17.50
9	Disneyland, Anaheim, California	15.98 (see Figure 10.13b)
10	Forbidden City, Beijing	15.30
11	Grand Bazaar, Istanbul	15.00
12	Tokyo Disneyland, Tokyo	14.84
13	Pier 39, San Francisco	14.00
14	Notre Dame Cathedral, Paris	13.65
15	Golden Gate Park, San Francisco	13.00
16	Tokyo Disney Sea	12.65
17	Disneyland Park, France	11.20
18	Epcot, Florida	11.06
19	Sacre Coeur, Paris	10.50
20	Tsim Sha Tsui Waterfront, Hong Kong	10.08

Travel and Leisure magazine, 2013

c





10.14 Cruising is a form of package tour

Modes of travel

The early tourists (before the twentieth century) were similar to explorers. They had to organise their own transport, and were subject to the hazards of poor roads, slow horse-drawn vehicles and uncomfortable seagoing vessels. Tourists today can choose from a wide range of transport alternatives, and can expect that all will be relatively fast and comfortable.

The most common forms of transport for tourists are cars (for local and national tourism), air (for longer distances and international tourism), cruise ships (for ocean and river journeys) and trains (for 'special experience' journeys and travel within Europe).

For the majority of tourists travelling by air, the experience is like being 'teleported' by a magic carpet. It is unlikely that this method of transport helps tourists to expand their personal geographies. On a trip from Australia to Europe they may pass over India, Afghanistan, Russia, Pakistan and a dozen other countries, but at an altitude of 12 000 metres they may as well be in outer space. Nor would tourists aboard cruise ships expand their personal geographies. Tourists may see glimpses of other places on one-day excursions at ports, but for much of the time they are in a luxurious version of their own home environment.

Package tours

Cruise ship travel, depicted in Figure 10.14, is an example of what the tourist industry calls a 'package tour'. Package tours are planned well before they take place. The costs of travel, accommodation, meals and entertainment are all paid for before departure. Travel companies rather than individual travellers put these packages together. This makes them cheaper, but it means that travellers do not have to do much thinking about their itinerary, the place they visit, or the people who live there.

Issues of tourism

The growth of tourism raises environmental, economic and social issues. The 'honeypot effect', whereby a few popular destinations attract the bulk of the tourism revenues while other places miss out, can also concentrate the negative impacts of tourism.

Environmental issues

Heavy transport on popular routes can damage roads and produce high levels of pollution. Wasteful tourists can overuse water supplies, and food for tourist consumption may take priority over food for locals.

Economic issues

Tourism brings money into the places tourists visit. Often, however, only a small amount of what is spent goes to locals. Much of it goes to airlines and hotel companies based in other countries.

Social issues

The effects of large numbers of tourists can have negative impacts on the culture and way of life of a people, as is illustrated by the cartoon in Figure 10.15. Longstanding customs can be altered to suit tourists and locals can become dependent on the tips and the spending of tourists. Scarce resources may also be used to finance tourist infrastructure and developments instead of education and healthcare.



10.15 Impacts of tourism

ACTIVITIES

Knowledge and understanding

1. Describe the term 'personal geography' in your own words.
2. Outline the scale and impacts of the global tourism industry.
3. Explain what is mean by a 'package tour'.
4. Explain in your own words what is meant by the 'honeypot effect' and give examples of tourist destinations that would fit this description.
5. Outline some of the tourism-related issues that might be of interest to geographers

Applying and analysing

6. List the main modes of travel. Which are more likely to expand a person's personal geography?
7. Study Table 10.12. For each place, suggest one or more reasons why it is visited by so many tourists.
8. Study Figure 10.15. Working in pairs, discuss the tourism-related issues addressed in each cartoon. List the issues you discussed.
9. Use some of the facts, statistics and suggestions in this unit to write a few paragraphs with the title 'How much do modern tourists expand their personal geographies?'.

Geographical skills

10. Study Table 10.10. With the aid of an atlas describe the location of the top 10 tourist destinations.
11. Study Table 10.11.
    a. Find out the population of each country and divide the expenditure by the number of people.
    b. Rank the countries from the highest to lowest amount of money spent per person.
    c. Has the ranking changed? Explain.

10.5 Australia's tourism industry

The tourism industry is of great economic importance to Australia. The revenue generated, both directly and indirectly, from tourist activities is an important source of economic growth.

Tourism

The Australian Tourist Commission defines tourism as 'travel away from your normal place of work and residence, including travel undertaken for business and pleasure'. The World Tourism Organization defines it as 'the activities of persons travelling to and staying in places outside their usual environment for not more than one consecutive year for leisure, business or other purposes'. Domestic tourism is travel within person's own country.

Economic importance

Australia's domestic and international tourists consume more than $93 billion in goods and services each year and the industry accounts for 2.6 per cent of Australia's gross domestic product (GDP); that is, the total value of goods and services produced in the economy in a year. A further 4 per cent of our GDP is indirect revenue from tourism—the flow of benefits, including increased output and employment, that result from tourists consuming goods and services. Tourism is one of Australia's largest service export industries. Tourism is also an important source of employment in Australia. Approximately half a million people are directly employed in tourism-related industries. This represents more than 5 per cent of the workforce.

Inbound tourism

Australia receives approximately 6.1 million visitors a year. It is predicted that by 2020 there will be 8.4 million visitors per year. The reasons for visiting Australia are varied. Approximately 44 per cent of all visitors in 2011 came here on holidays, 24 per cent were visiting friends and relatives, 12 per cent were on business trips and 6 per cent visited for educational purposes. There has also been an increase in the number of backpackers visiting Australia. This market has become an important source of revenue for the Australian tourism industry.

Traditionally, New Zealand, Europe and North America have been the main sources of inbound tourists in Australia, although there now is a growing number of visitors from South-East Asia. The top source countries for visitor arrivals in 2011 were, in descending order, New Zealand, the United Kingdom, China, the United States of America and Japan, as shown in Table 10.16.

10.16 Inbound travel to Australia, top 10 markets, 2011

Country	Total inbound economic value 2011 ($ billion)	Arrivals 2011 ('000)
China	3.5	542
United Kingdom	2.6	608
New Zealand	2.0	1173
United States of America	1.8	456
Japan	1.1	333
South Korea	1.1	198
Singapore	1.0	318
Malaysia	0.9	241
India	0.9	148
Germany	0.7	154
Total inbound	**23.9**	**5874**

Source: ABS

DID YOU KNOW?

The 'Come and say g'day' or 'Throw another shrimp on the barbie' 1984 TV advertising campaign featuring Paul Hogan and created by the Australian Tourism Commission was so successful that Australia moved up from number 78 to number 1–2 on the 'Dream vacation list' for Americans in just over three months.

Tourist destinations

Australia's five largest tourism regions are Sydney (see Figure 10.17), Melbourne, Brisbane, Gold Coast and Perth. Together these regions make up about 47 per cent of total tourism expenditure. Some regions in Australia are highly dependent on the income generated by tourism. These regions are Central Northern Territory (Alice Springs/Uluru), Phillip Island, the Whitsundays, the Snowy Mountains and the west coast of Tasmania. These tourist regions receive only about 3 per cent of Australia's total tourism expenditure.

Outbound tourism

More Australians travel overseas today than ever before. Rising standards of living, changing lifestyle expectations and reductions in the real cost of travel have made this possible. The top destinations for Australian residents departing for short-term travel in 2011 were New Zealand, Indonesia (including Bali), the United States of America, Thailand and the United Kingdom, as shown in Table 10.18.

10.18 Outbound tourists' top 10 destinations, 2011

Country	Departures	Proportion of total (%)
New Zealand	1 100 700	14.1
Indonesia (incl. Bali)	877 900	11.3
United States of America	798 000	10.2
Thailand	552 500	7.1
United Kingdom	488 500	6.3
China	369 100	4.7
Fiji	337 200	4.3
Singapore	288 000	3.7
Malaysia	258 000	3.3
Hong Kong	224 500	2.9
Total	**7 795 100**	

Source: ABS

10.17 Taronga Zoo, Sydney. The Sydney region accounts for about 15 per cent of total visitor expenditure in Australia.



SPOTLIGHT

Backpackers

One of the fastest-growing components of Australia's tourism industry is the backpacker market. Australia is consistently ranked by backpackers as one of the world's top destinations. Each year, Australia is visited by more than 500 000 backpackers, who spend a significant amount of money in the local economy—on average, more than twice as much as other tourists. In the year to 30 June 2011, for example, each backpacker spent an average of $5242 on food, drink and accommodation, and education fees during their stay in Australia. Their average expenditure per night was $75.

The Australian Government provides a 'working holiday visa' for young people aged between 18 and 30 from selected places, including the United Kingdom, Canada, Republic of Ireland, most western and northern European countries, Japan and South Korea. New Zealand citizens do not require a visa to work in Australia.

Backpacking is a unique form of travel that focuses on freedom and exploration. Most backpackers do not make specific plans before they reach Australia. They generally prefer to start with very general travel ideas and make more detailed arrangements when they arrive in the country. These travellers use word of mouth and the internet as sources of information. Of all backpackers visiting Australia in 2011, 76 per cent visited New South Wales, 57 per cent visited Queensland and 45 per cent visited Victoria.

10.19 Backpacking is popular among young people wanting to engage in the adventure of international travel on a limited budget.

10.20 Backpacker visitors by country of residence (year ended 30 June 2011)

Country of residence	Visitors ('000)
United Kingdom	107
Germany	56
USA	50
New Zealand	38
France	36
Korea	28
Scandinavia	27
Japan	27
Canada	23
Taiwan	14
Netherlands	14
Switzerland	14
Others	46
Hong Kong	10
Singapore	12
Other	165

Source: Department of Resources, Energy and Tourism, International Visitor Survey, June 2011



More than 70 per cent of backpackers visiting Australia are under the age of 30. These backpackers tend to spend more time in Australia than those aged over 30. The average length of stay for a backpacker is 70 nights. This is more than twice as long as the average length of stay for all visitors.

10.21 International backpackers, average duration of stay and expenditure by country (year ended 30 June 2011)

Country of residence	Average duration of stay (days)	Average Expenditure all items ($)
New Zealand	24	1 868
Japan	95	4 954
Hong Kong	67	6 333
Singapore	26	3 884
Malaysia	29	3 042
Indonesia	89	8 966
Taiwan	148	6 802
Thailand	65	5 833
Korea	133	8 090
China	76	7 754
India	110	17 827
Other Asia	81	8 334
USA	46	4 636
Canada	74	6 093
United Kingdom	68	5 104
Germany	68	4 717
Scandinavia	66	5 369
France	79	5 261
Italy	102	6 521
Netherlands	70	5 443
Switzerland	54	5 724
Other Europe	73	6 026
Other countries	65	4 993

Source: Department of Resources, Energy and Tourism, International Visitor Survey, June 2011

ACTIVITIES

Knowledge and understanding

1. Define the term 'tourism'.
2. Outline the importance of tourism to the Australian economy.
3. Identify the main reasons why tourists visit Australia.
4. Explain the meaning of the term 'outbound tourism'. Where do Australians visit when they travel abroad?
5. Outline the importance of the backpacker market to the Australian tourism industry. Provide statistics to support your answer.

Applying and analysing

6. Working in small groups, develop an advertising campaign to promote Australian tourism in our key source markets. Your campaign could include a jingle, a video, a dramatisation or poster. Present your advertising campaign to the class.

Geographical skills

7. Select the most effective way to graph the information in Table 10.18. Construct the graph. Using the information in your graph, write a report describing the destinations of outbound travellers.
8. Study Table 10.16. Locate these countries on a map of the world. Develop a key to indicate the contribution of each country to inbound tourism in Australia.
9. Study Table 10.20. Name the continent from which the majority of backpackers came.
10. Study Table 10.21. Calculate the average expenditure per day for the following countries: New Zealand, Indonesia, China, India, United States of America, the United Kingdom and Germany.
11. Study Tables 10.20 and 10.21. Write a report outlining the nature of the backpacker component of the Australian tourism sector.

Investigating

12. Update the statistical information provided in this unit by accessing the following websites:
    - Australia Bureau of Statistics
    - Tourism Australia
    - Department of Resources, Energy and Tourism
    - Australian Tourism Export Council
    - Department of Foreign Affairs and Trade (see the 'Australia in Brief' section).

    Present your research as a series of graphs.

10.6 Case study: Contrasting tourism places

No two tourist destinations are alike. Each has its own unique physical and cultural setting. Each offers a different range of experiences. Featured below are three destinations that highlight the extent to which a person's personal geography can be shaped by the tourism experience.

Pattaya, Thailand

Pattaya, shown in Figure 10.22, is now one of the major beach resorts in South-East Asia, attracting more than 12 million tourists each year. An improvement in road access to Bangkok and the construction of US military bases in the 1960s were the stimulus for the building of the first hotels. These have now expanded into numerous tourist facilities that cater for both the luxury and the budget traveller. A 12-kilometre beach frontage now has dozens of hotels, shops and luxury resorts. Visitors were originally attracted by Pattaya's beaches, the warm climate and the affordability of its accommodation. Now the area has luxurious accommodation and a variety of entertainment venues.

Expanding personal geographies

Apart from being able to say they have been to Thailand, and returning with a few souvenirs, most people's personal geographies would not have been expanded by a visit to Pattaya. Most people spend their time around the hotel pool, on the beaches, in shops, and at entertainment venues. Pattaya is not where the average Thai person lives.

10.22 Pattaya, Thailand



Okavango Delta, Botswana

The Okavango Delta, shown in Figure 10.23, is a wetland zone in northern Botswana with extraordinary concentrations of African wildlife. It is the most frequently visited part of Botswana by foreign tourists, attracting 50 000 per year. Accommodation ranges from camps to luxury lodges, and visitors spend much of their time looking at animals such as the elephant, buffalo, hippopotamus, wildebeest, lechwe, giraffe, crocodile, lion, cheetah, leopard, hyena, antelope, rhino, warthog and baboon.

The government of Botswana has promoted the Okavango as a tourist destination to attract foreign tourists who could bring much needed money to the country. The foreign tourists have come, but the wealth that was expected has not eventuated. Most of the tourist operations, such as transport and hotels, are owned by foreign companies, so the profits go to them. Even food supplies to the hotels mostly come from outside Botswana. Because the companies are registered outside the country, few of them pay taxes to the Botswana Government. Even the growth of employment of local people has not been a great success. Most of the jobs taken by locals are low-skilled and low-paid, while the higher level jobs are taken by foreigners.

Expanding personal geographies

Tourists certainly see different environments and plenty of animals. However, there is often little interaction between tourists and local people, so most learn very little about the society and ways of life of the people.

Machu Picchu, Peru

Machu Picchu, shown in Figure 10.24, is the site of an ancient Inca city in the Andes mountains of Peru. The ruins are very remote. The Incas started building the city in 1430 AD but it was abandoned about 100 years later. The ruins are mostly in reasonable condition and are well excavated. The walls are made of polished dry-stone (stones without mortar to hold them together). Buildings such as gateways and temples can be visited.



10.23 While the biodiversity of the Okavango is a major tourist attraction, visitors generally have little engagement with the local people.

Travelling to Machu Picchu, the only ways to reach the ruins are by walking on the Inca Trail, or by catching a train to the town of Aguas Calientes and then taking a bus and walking to Machu Picchu.

10.24 Visiting Machu Picchu involves an active engagement with the landscape and the local people.



Expanding personal geographies

Although most walkers on the Inca Trail go with a group organised by a tour company, they must put a lot of personal effort into getting to the ruins, and they must experience the weather, the mountainous terrain and the other difficulties of such a remote location. They also have plenty of contact with the locals, who act as guides. As a result, their personal geographies are expanded.

ACTIVITIES

10.2

Knowledge and understanding

1 Present your reasons for wanting to visit one of the tourism destinations featured in this unit, and then your reasons for not choosing another destination.

Applying and analysing

2 Draw up a table to compare the three case studies of tourism destinations featured in this unit. Compare and contrast the level of comfort, the sights seen, the experiences likely for a tourist, the impact on the environment and the extra knowledge about the world available to the traveller.

3 Discuss the following topic:
Tourists want to see a sanitised version of any place they visit.

Investigating

4 Look up in an atlas the location of each of the tourism destinations described. Then look up the comparative GDP per capita (or another measure of wealth) of each country. Compare this figure with that of Australia and the United States of America, where a lot of the tourists to these places originate.

10.7 Sport

Sport is an important part of the Australian culture and lifestyle. According to the legendary cricketer Sir Donald Bradman: 'Sport is embedded in the fabric of Australian life.' Data collected through the Australian census indicates that one in three Australians aged 15 years and over participates in sports and recreational activities two or more times a week. Australia has a long history of involvement in sport on an international scale. Our passion for sport connects us with the rest of the world in a number of important ways.

Colonial links and international migration

The types of sports played in Australia have changed as our links with other countries have changed. Colonisation and international migration have influenced the types of sports played in Australia. Many popular Australian sports (such as cricket, rugby league, rugby union and tennis) originated in the United Kingdom and spread to the colonies, including Australia, as a result of migration. Events such as the Olympics have also introduced new sports to Australia.



10.25 Australian hurdler Sally Pearson after winning a gold medal in 2012

Hosting international events

Australia has world-class sporting facilities and an excellent reputation for the successful hosting of international sporting events. The largest event was the 2000 Sydney Olympic Games. Other important sporting competitions hosted by Australia were the Commonwealth Games, Rugby World Cup, Australian Open (golf and tennis), Australian Grand Prix, Cricket World Cup, World Short Course Swimming Titles and Rip Curl Pro Surfing Titles at Bells Beach.

Sydney Olympics

In September 2000, athletes from 200 countries converged upon Sydney to compete in over 300 events. The Games also served as a magnet for domestic and international tourism, attracting more than 110 000 international visitors over the seventeen days of competition. In total, more than 5.5 million people attended Sydney Olympic Park across the Olympic and Paralympic Games. The Sydney Olympics exposed Australians to a diversity of global cultures as well as giving many people from overseas the opportunity to experience Australian culture.

By the end of the Games, Australia had won a record fifty-eight medals (including sixteen gold), as well as 149 medals (including sixty-three gold) at the Paralympic Games. Our athletes won gold in archery, athletics, beach volleyball, cycling, equestrian, hockey, sailing, shooting, swimming, taekwondo and water polo.

International participation

Australia actively promotes sporting cooperation and knowledge/resource sharing between countries. The International Section of the Australian Sports Commission operates a number of community sports development programs in the Pacific, southern Africa and the Caribbean. These programs provide foreign athletes and sporting organisations with access to Australian sporting services, facilities and expertise.

Despite Australia's relatively small population, it consistently produces world champion teams and elite athletes in a number of sports (see Figure 10.25). Our athletes and teams travel widely to compete in international sporting competitions, such as the Davis Cup, the Tour de France, the US PGA Golf Tour and the Association of Surfing Professionals tour.

TNCs and international branding

The growth of transnational corporations (TNCs) and international branding and marketing of sport has had a significant impact on the types of sports played in Australia. American sports, such as baseball and basketball, have become increasingly popular in Australia as a result of the marketing efforts of the global media corporations and TNCs in the textiles, clothing and sportswear industries. The branded stars of the US NBA (National Basketball Association) are everywhere. Their faces are found in television and magazine advertisements for sportswear companies (such as Nike and Reebok), on billboards, on breakfast cereal packaging and in Hollywood movies. Australian teenagers are not only playing these sports but collecting branded clothing and accessories in the colours and logos of their favourite American baseball, basketball and football teams.

SPOTLIGHT

Extreme sports

A recent trend on the Australian sporting scene has been the increase in popularity of extreme sports. 'Extreme sports' is a term used to describe a broad range of non-traditional adrenaline-based activities. Examples of these sports are wakeboarding, kite surfing, aerial freestyle BMX, snowboarding, downhill skateboard racing, whitewater rafting, mountain biking, motocross, waterskiing and mountain boarding. Some extreme sport events are the X Games in the United States of America and the Planet X summer and winter games in Australia. The growing popularity of these sports is reflected in the International Olympic Committee's decision to include BMX racing in the Olympics.



10.26 Freestyle Moto X final at the X Games XII

ACTIVITIES

Knowledge and understanding

1. Explain how colonisation and international migration have influenced the types of sports played in Australia. Provide examples to support your response.
2. Outline how the Australian Sports Commission promotes increased cooperation and resource sharing between countries.
3. Explain how the 2000 Sydney Olympic Games demonstrated Australia's sporting links with the rest of the world.

Applying and analysing

4. Explain how the growth of transnational corporations and international sports marketing has influenced the range of sports played in Australia.
5. In small groups, discuss the importance of sport to Australia's culture. Record your responses and share your group's findings with the rest of the class.

Investigating

6. Undertake research to find out which international sporting events Australia has hosted, as well as those we have participated in overseas, in the past 12 months. Present this information in a table. Undertake research to find out about the origins of each of these competitions.
7. Select an Australian sport that is of interest to you. Undertake research to find out more about the origins of this sport. Include the following information in your response.
   - When and where was this sport first played?
   - When and how was the sport introduced to Australia?
   - How have the rules been adapted to suit an Australian context?

10.8 Sporting events and places

The hosting of major sporting events is sought after by cities and countries because of the international attention such events attract. Authorities hope that the international coverage of the event and the increase in the number of visitors will have a range of economic benefits. Authorities hope that these benefits will enhance the prestige of the city or country.

Car races

On a world scale, the Formula One Grand Prix races are the biggest of the many types of car races. It is estimated that each of the seventeen F1 races attracts 200 000 spectators, with a combined annual total exceeding three million. Many millions more watch on television.

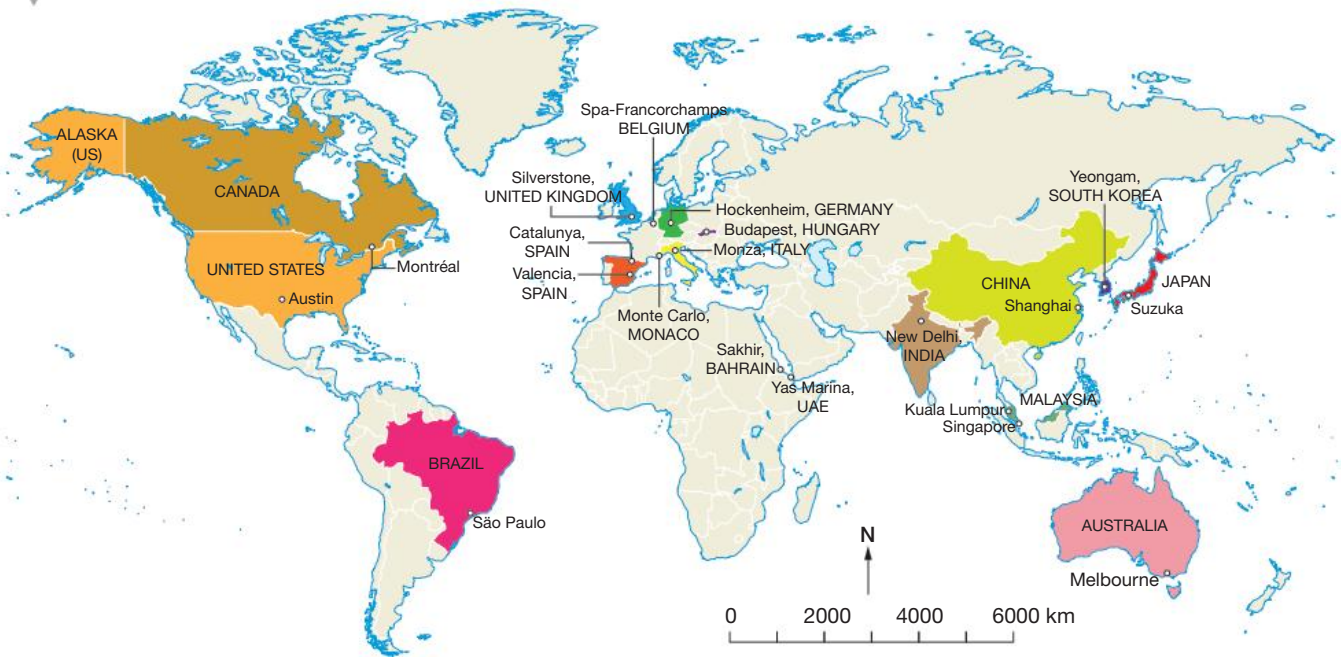
There is always competition among countries and cities to host these events, even though they can be costly to stage, disrupt the routines of citizens and cause congestion, especially if they are street circuits. The host cities hope to gain from the money spent by the fans, the race teams and their support crew. Current hosting countries are shown in Figure 10.27.

Other car races, although they do not involve as much money, can still have major impact on cities, which compete to host them. Bathurst, for example, attracts thousands of people every October for its saloon car racing at the Bathurst 1000. Adelaide, when it lost the Australian Grand Prix to Melbourne, was successful in a bid to host a weekend of saloon car racing every March. Community response to the race has been very divided, because the race is through city streets and creates congestion. The Gold Coast 600 is also divisive because it is held on the streets of Surfers Paradise.

Cycle races

The most prestigious cycle race is the Tour de France—a series of twenty-one race stages held over three weeks in many different regions of France. It has a huge following. Large support teams, tens of thousands of spectators and a large media contingent follow the race as it progresses through France. Millions watch on television. The finish of the Tour de France on the Avenue des Champs-Elysées, Paris is shown in Figure 10.28. The Giro d'Italia and the Tour of Britain are similar but less prestigious events.

10.27 Locations of Formula One races, 2013





10.28 The Tour de France

Australia has copied the European cycling race format with the Tour Down Under, run every January since 1999 in the area around Adelaide. For this event, country towns and suburbs of Adelaide seek to host starts, finishes or special events, hoping to attract visitors, money and prestige to their area.

Olympics

The best-known sporting event on a world scale is the summer Olympic Games, held every four years. This is awarded to the city that has submitted the best bid. The city then has seven years to prepare for the Games. Because the Olympics feature so many sporting events, a range of venues needs to be built (see Figure 10.29). Other major aspects of the undertaking include the coordination of sporting organisations and the building of the infrastructure needed to support large numbers of spectators.

10.29 Rio's Olympic Park. The 300-acre waterfront venue, built on the old Brazil Grand Prix track, will host fifteen sports, including swimming and hockey, and eleven Paralympic competitions.



Until the 1980s, the Olympics were often run at a loss because of the huge costs involved in staging them. Since 1996, however, sponsorship deals have reduced the financial risk to the host city. The number of cities bidding to host the Olympics has risen in recent years.

Cities in recent years have used the Olympics to revive rundown urban areas. The site of the Olympics in 2012 was a rundown area of London's East End. The games revitalised the area. New train stations, huge shopping centres and new housing estates were built, in addition to the stadium, swimming centre and other sporting facilities.

The cities and nations hosting the Olympics hope to gain short- and long-term benefits from them. Both Beijing (2008) and Rio de Janeiro (2016) wanted to show that they were world cities. All cities hope to gain increased tourists in both the short term and long term. Yet for three years after the Sydney Olympic Games (2000) tourist numbers actually fell. Fewer tourists visited Beijing over the whole of 2008 than in non-Olympic years, and Athens had 10 per cent fewer tourists when it hosted the Olympics in 2004, possibly due to fears of overcrowding.

10.30 Key economic benefits and costs of the Olympic Games

	Benefits	Costs
Pre-Games phase	Tourism Construction activity	Investment expenditure Preparatory operational costs (including bid costs) Lost benefits from displaced projects
Games phase	Tourism Stadium and infrastructure Olympics jobs Revenues from Games (tickets, TV rights, sponsorship, etc.)	Operational expenditure associated with Games Congestion Lost benefits from displaced projects
Post-Games phase	Tourism Stadiums and infrastructure Human capital Urban regeneration (renewal) Enhanced international reputation	Maintenance of stadiums and infrastructure Lost benefits from displaced projects

Source: PricewaterhouseCoopers, European Economic Outlook, June 2004

The overall economic effects of hosting the Olympics are difficult to determine. Cities hosting recent Games have aimed to break even on basic costs, and make profits from visitors spending money on non-Olympic related purchases. The Sydney Olympics in 2000 added 1 per cent to Australia's GDP, a fairly modest boost. Sydney clothing shops, cafes and restaurants did well, but retail sales declined sharply in the months after the Olympics. There have been long-term benefits in terms of urban renewal and better environmental quality, however. Sydney had a policy of 'greening' the Games, which led to better waste disposal and lower energy use. Both Athens and Beijing tried to improve the quality of their air, and London tried to make its Olympics carbon neutral by offsetting the production of carbon. The costs and benefits of hosting the Olympic Games are summarised in Table 10.30.

SPOTLIGHT

Golf in Japan

The game of golf in Japan is an example of how one sport can influence a whole country and the wider world. Golf is one of the most popular sports in Japan, but because of the facilities needed to play the game it is very expensive. The number of golf courses has risen from 72 in 1956 to over 2500 today. Golf courses occupy a lot of land, and Japan is a small country with only a quarter of the land flat enough for settlement and industry. As a result, golf courses have had to be built in mountain areas.

Building golf courses in the mountains has led to environmental problems. Forests containing valuable timber have been cut down. Rainfall then runs off fairways and greens into rivers, causing flooding. Tonnes of pesticides and herbicides are used on the golf courses, and these are washed into waterways. The scarcity of land and problems of constructing golf courses has led to Japanese companies building courses in other Asian countries. As a result, golf-related tourism has become an important feature of Japanese leisure time.



10.31 Due to land shortages many Japanese golf courses are constructed in mountainous areas.



10.32 Riots and demonstrations in Rio de Janeiro against the planned staging of the 2014 World Cup in Brazil

World championships and cups

There are world and regional championships in almost every sport, hosted by different cities in rotation. Some of these are relatively small, but others have a large economic and social impact. The largest of these is the soccer World Cup. This is held every four years, and is hosted by a different country each time. The matches are spread over a number of cities in the country, but this means that they each need a world-class stadium. The cost of preparing for this event is huge.

South Africa

South Africa spent $5 billion on the World Cup in 2010, and recovered only an estimated one-tenth of this.

South Africa did, however, gain a set of high-quality stadiums, upgraded airports and better transport systems, and was the focus of the world's attention. Unfortunately, the attendances at games were less than anticipated, and many of the stadiums are now underused. The long-term effects on soccer interest and participation are still to be evaluated.

Brazil

In the lead-up to the 2014 World Cup in Brazil there were riots in the streets, as shown in Figure 10.32. Many people were angry at the money the government was spending on sports stadiums and facilities while infrastructure and services deteriorated. The catalyst for the riots was increases in public transport fares.

ACTIVITIES

Knowledge and understanding

1 Explain why major sporting events are so keenly sought after by cities.
2 Outline why playing golf in Japan is very expensive.

Applying and analysing

3 Prepare a case for or against the following proposition:
Hosting the Olympic Games is worth more to a city than monetary profit or loss.
4 Think about the effects that an important sporting event would have on your town or city.
   a Suggest some events that would fit the size of your town or city, and then suggest preparations that would have to be made.
   b Which people would be affected the most?
   c What benefits would you consider to be most valuable to your town or city?

Investigating

5 Research how a city or country is preparing for the next Olympic Games (summer or winter), or the next World Cup in soccer, cricket or rugby. Find out the following information:
   - building preparations
   - transport and accommodation
   - special features they are promoting
   - opposition and criticism to the sporting event.

10.9 Case study: Melbourne's Grand Prix

Melbourne has been the venue for the Australian Grand Prix since 1996. From 1985 to 1995 the event was held in Adelaide, but moved because a group of business people in Melbourne offered a better deal to the managers of Formula One car racing. Both Adelaide and Melbourne have been very keen to host this major sporting event, but many people question its value in economic, social, environmental and sporting terms.

Attraction of the Grand Prix

The Formula One Grand Prix series is certainly one of the best-known major sporting events in the world (see Figure 10.33). The cars are some of the fastest and most highly developed vehicles of their time, and the top drivers are well-known celebrities. Each of the Grand Prix races is televised globally and watched by a large audience. Some of the Grand Prix venues, such as Monte Carlo, have well-known associations in the public mind with car racing. As a result, many cities would like the prestige and publicity of hosting this event each year.

The Melbourne GP event

Each Grand Prix race is a four-day event—three days of preparation and time trials for pole position (the order of starting), and then the actual race on the fourth day. Some of the spectators attend every day, but most people attend only on race day.

The Melbourne event is held on a circuit surrounding a lake in Albert Park, as shown in Figure 10.34. The circuit follows roads used by traffic at other times, as well as some purpose-built track. About a month before the event, safety fencing, grandstands and pedestrian overpasses are erected. They are removed by six weeks after the race. Street circuits and inner-city venues, such as Melbourne, are popular with cities wanting to show themselves to the world, because the landmarks of the city are on view to the international television audience.

10.33 The Melbourne Grand Prix





10.34 The Albert Park Grand Prix circuit

Benefits of the event

The Grand Prix attracts over 100 000 spectators and another 15 000 people who are part of the racing crews, media and officials. Surveys of the spectators have found that about 10 per cent are visitors from overseas and about 25 per cent are from interstate. Obviously, these are the two groups who are most desired by the organisers and the city, because they bring money into the state. An estimate of the money spent by overseas visitors during their stay is $15 million, and $26 million by interstate visitors.

Costs of the event

The $40 million brought into the state from the overseas and interstate visitors has to be balanced against the expenses of running the event. Each year the government pays a total of about $50 million in fees, licences and set-up costs. This means that there is a loss of about $10 million a year. This loss is defended by government ministers, who argue that the ongoing publicity for Melbourne is worth the cost.

Opposition to the event

From the time it was first announced that the Grand Prix was being transferred from Adelaide to Melbourne, there has been vocal opposition to the staging of the event. Opponents have been critical of the costs to the taxpayer, the inconvenience to local residents and road users, and the takeover of a public park for such an event.

The main opponents formed the Save Albert Park Group. Their arguments against holding the Grand Prix at Albert Park include the following.

- Albert Park is a public park and should provide free and unrestricted access to people every day of the year.
- Motor racing is an environmentally insensitive activity that is totally inappropriate for a public park.
- Motor racing is also inappropriate for a venue so close to densely populated areas because of the din it creates and the disruption it causes to local residents and businesses. Racing cars, particularly the Formula One machines, which travel at up to 300 kph, emit a dangerous level of exhaust noise. In addition, there are continual overflights by helicopters and aircraft used in aerial displays. Earplugs are recommended for spectators and nearby residents. Pets have to be kept inside. Residents have to put up with restrictions on normal freedom of travel.

ACTIVITIES

Knowledge and understanding

1 Explain why many cities want to host a Grand Prix race.

2 Make a list of the arguments for and against holding the Grand Prix in Melbourne.

Applying and analysing

3 Melbourne holds the rights to the Grand Prix race until 2015.

a Working in groups, discuss the range of impacts that a Grand Prix has on a large city such as Melbourne.

b Make a list of these impacts and then add others that you can think of. Copy and complete the following table by placing each impact as a reason to keep or not to keep the race.

Melbourne should keep the event	Melbourne should not keep the event

c In your opinion, which argument is stronger—to keep or not keep the race? Explain.

10.10 Case study: Rio's Olympic and Paralympic Games, 2016

Rio de Janeiro is the city selected to host the 2016 summer Olympic Games. Rio is the first city in South America to be awarded the Games, which will follow another major world sporting event being held in Brazil—the 2014 Football World Cup. Rio won the Games in competition against Madrid, Chicago and Tokyo.

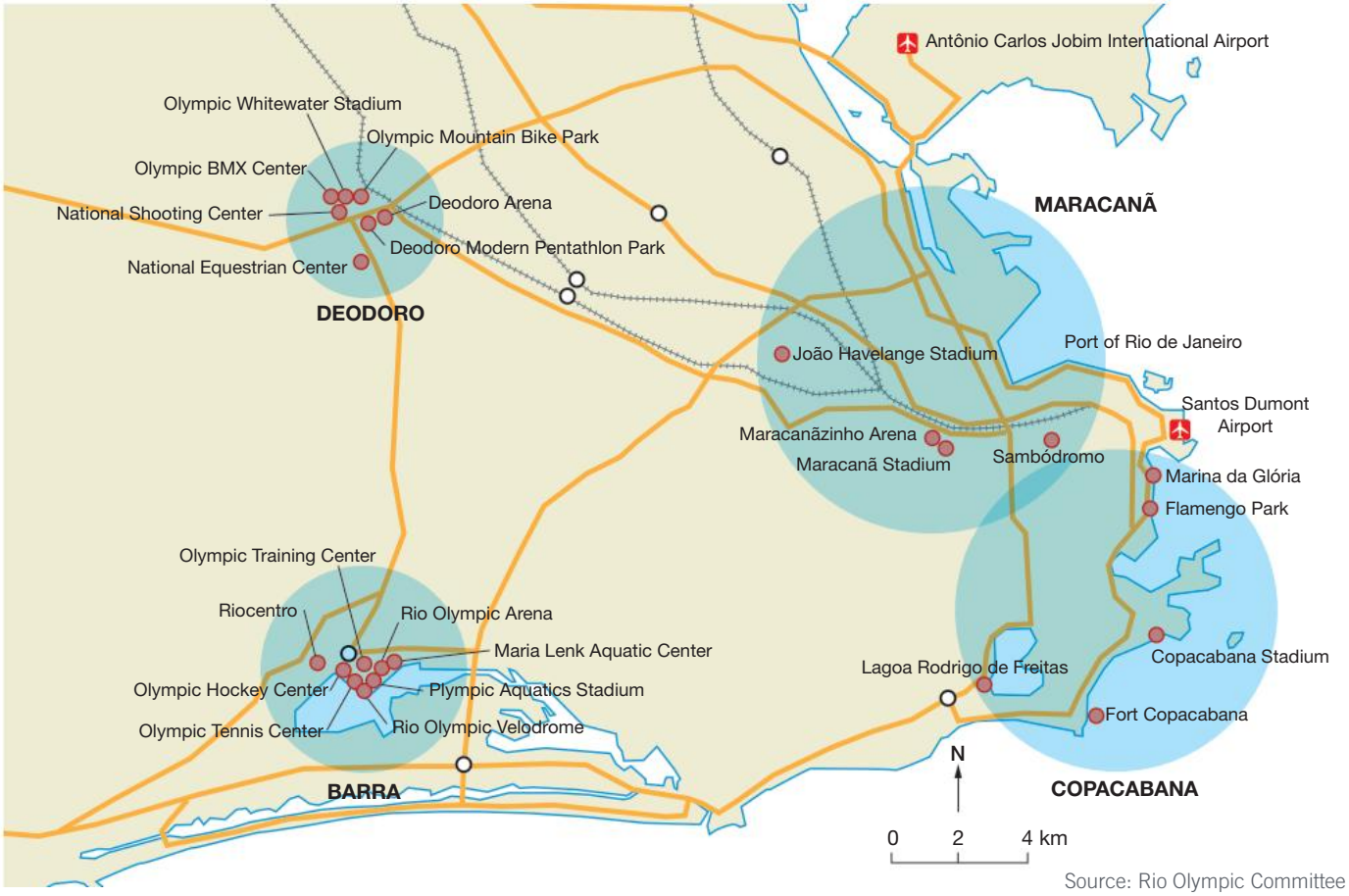
Location

Rio de Janeiro will hold Games events in four zones of the city, as outlined in Figure 10.35: Barra de Tijuca, Copacabana Beach, Maracana, and Deodoro. The Barra de Tijuca area of south-west Rio will host the most sports. The Olympic Village is located in this zone. Copacabana, with its famous 4-kilometre beach, will be the site for water sports. The Deodoro zone will be used for seven Olympic competitions—modern pentathlon, shooting, equestrian, cycling, canoeing and fencing. The Maracanã district houses the Maracanã Stadium, the site of the opening and closing ceremonies and some football matches.

Getting ready

Like many of the recent Olympic Games host cities, Rio is using the event to redevelop a rundown area. The historic centre of Rio and the port area are being redeveloped. A large Olympic park, which will contain a range of sporting venues, is being built partly on reclaimed land. New roads, tunnels, bike paths, water supplies and trees are being planned for this area.

10.35 Rio's Olympic Games venues



Source: Rio Olympic Committee

Challenges

Rio has two underground railway lines. Six more stations will be added to one of these for the Games. Improvements to bus and other train lines are also being made (see Figure 10.36). As in any Olympic city, transport will be a major issue because of congestion for a few weeks, and the expense of creating new services just to cater for that short period of time. London in 2012 used special traffic lanes on major roads just for competitors and officials, but these were not popular with the public.

Rio also has a range of crime-related problems. These are especially apparent in the city's favelas (shanty towns), where poverty is a major issue. There have been murders and robberies as part of the drug war between rival gangs. Again, this is not a new problem for large cities. London was rocked by a week of riots a year before its Olympic Games, but it managed to keep the Games period free of outbreaks of civil disorder.

A crime that is much less visible but potentially more serious is fraud and corruption. It is especially a problem in the awarding of Games-related contracts, and in the behaviour of companies working to prepare for the Games. Brazil is aware of the problem and has special campaigns in place to prevent fraud, tax evasion and corrupt practices. There are always people who take the opportunity to make money by raising prices unnecessarily, by tricking people, or by not doing what they have been paid for. In London, one problem, which arose in the weeks before the Games, was the admission by a major security firm that it had not employed enough people to fulfil its contract. The government was forced to bring in the military to provide security at the last minute.



10.36 New infrastructure in Rio—a new tunnel for the expressway called Transolimpica

After the Games

The major legacy is a number of large sporting venues. These are sometimes too large to be of much use for sports events during normal times, and in Sydney, Beijing and London, the largest of the venues were built with temporary grandstands that were taken down after the Games. The maintenance of these buildings remains an issue for every Olympic city far into the future. The other legacy is the Olympic Village, which houses the competitors and officials. It is common practice to build such complexes so that the housing units can be sold to the public after the Games.

Every city hosting the Olympic Games hopes that the publicity from holding them has a long-term impact on business and tourism. The officials of the city hope to promote the city's attractions and downplay its problems. They hope that the impression given to the world is one that will attract interest, curiosity and future business and visits.

ACTIVITIES

Knowledge and understanding

1 Name the major sporting even Rio will host before the Olympics.
2 Outline the challenges and potential benefits for Rio de Janeiro as the host of the 2016 Summer Olympic Games.

Applying and analysing

3 Make a list of the things that would attract you to Rio during the 2016 Olympic Games. Then list the factors that would deter you. Compare your list with those of others and see which factors are commonly mentioned.
4 Crime is a particular problem of large cities. What are the characteristics of crime in Brazil and Rio?

Geographical skills

5 Study Figure 10.35.
   a Calculate the distance by road from the Olympic Training Centre, Barra to:
      i Santos Dumont Airport
      ii Fort Copacabana
      iii National Equestrian Center
      iv Maracanã Stadium.
   b Suggest solutions to address the distances that athletes and officials will need to travel from the Olympic Training Center to the various Olympic centres.

10.11 The geography of popular music

Music is one of the defining features of any culture. Even in the most remote places there is some form of musical expression. The simplest forms use the voice and some type of percussion instruments, such as drums. At its most sophisticated, music includes a range of instruments, including those created using computer-based technologies. Globalisation has resulted in the spread and mixing of musical traditions.

Popular music

Until the twentieth century, **popular music** (music that has wide appeal) was largely limited to what is commonly referred to as 'folk music'. This is the kind of music developed by people in the local community, and passed down from generation to generation. During the twentieth century, advances in communication technologies enabled the music of different cultures to be recorded and broadcast on radio. As a result, many types of music became known to a wider audience and influenced the creative work of musicians worldwide.

Many of these once-local forms of music have become popular with millions of people. Migration has also assisted in the spread of musical traditions worldwide. In multicultural cities such as London and New York it is possible to find music from around the world. The origins and spread of these is a fascinating geographical case study.

Country and western music

Country and western music is generally associated with the spread of European settlement across the 'wild west' of the United States of America during the nineteenth century. It is known for its nostalgic and emotional ballads performed by a singer with a guitar. Its origins, however, lie with the Celtic people of Ireland and Scotland. They initially settled in the Appalachian Mountains, inland from New York, and sang about their homelands, their work and their loves in their cabins during the long nights. When the descendants of these settlers moved west, they took their music with them and developed it further. Eventually it became one of the favourite sounds of the west, and places like Nashville, Tennessee became associated with country and western music.

Jazz

Jazz is commonly associated with New Orleans in the south of the United States of America. It originated from the music of African–Americans whose ancestors came to the United States of America as slaves. It also owed a lot to the Dixieland marching band music, which originated in other parts of southern states. There were also influences from nearby Cuba. Early jazz was often called 'ragtime' and was very popular in the early 1900s. Jazz bands, such as those led by Louis Armstrong, became very popular. Over time, jazz became increasingly diverse and had an impact on other music forms including classical music and rock.

Calypso

Calypso comes from the West Indies. It originated with freed slaves in the nineteenth century. These slaves had been brought to the West Indies from Africa to work on plantations. The slaves brought with them their African folk music. When it merged with Latin American tunes and rhythms it developed into a fast and bouncy music style known as calypso.

Reggae

Reggae music developed in the 1960s in Jamaica. It emerged out of a mixture of calypso from other West Indies islands, and rhythm and blues broadcast from the United States of America. The main exponent of reggae was Bob Marley.

Flamenco

Flamenco originated in southern Spain. Initially, it was played on the guitar and was often accompanied by singing. It was typically played and sung with passion. It was dance music with strong rhythms. Because Spain had strong links with North Africa, it contained many African influences. From Spain it has spread throughout the world and influenced both popular and classical music.

Samba

Samba music comes from Brazil. It is a dance music that combines styles from three countries. It has elements of the polka, a dance from Eastern Europe, rhythms of the habanera from Cuba, and a particular beat from West Africa.



10.37 The Trillectro Festival in Washington, DC, 2013. It is marketed as 'the sweet spot where cultures converge'.

Cultural diffusion

The spread of these styles of music from their place of origin to new continents and countries is a good example of cultural diffusion—the spread of ideas and customs across the world as shown in Figure 10.37. The enforced transportation of slaves from Africa to North America and the West Indies has had a powerful influence on music.

Diffusion of music has been able to take place more quickly in the last hundred years because of the invention of recording and broadcasting techniques. Diffusion of music continues to evolve. For example, young London musicians of English, Caribbean and Indian descent have begun to create new cross-rhythms of black reggae, white trance and Hindu rap.

ACTIVITIES

Knowledge and understanding

1. State where the kinds of music described had their origins.
2. Explain why the spread of different styles of music was so much faster in the last hundred years.

Geographical skills

3. Use a map of the world to locate the places of origin of the different types of popular music. Can you add any more to the map?

Investigating

4. Choose one of the style of music described here, and find one example of it on YouTube or iTunes. Play it to others and briefly describe where it originates from.
5. Choose one of the countries listed here, or any other, and find out more about the music they have given to the world. Examples you might choose are India, China, Japan, Indonesia and Argentina.

10.12 Case study: The spread of rock music

The development and spread of rock (or rock and roll) is a fascinating study for geographers as well as musicians. It is the music best known to teenagers, and has been heard since the 1950s. In fact, the term 'teenager' was first used at the time rock emerged as major musical force. The spread of rock and roll is a good example of cultural diffusion over space and time.

Heritage of African slaves

The origins of rock and roll can be traced back to slavery. From the sixteenth to the nineteenth centuries, an estimated 12 million Africans were shipped as slaves to the Americas. They brought with them their own style of music. The hardships they endured as slaves allowed them few pleasures, but singing was one. They sang songs about their misery, their hopes, their religion and their hardships. They used the rhythms that were passed on to them from their parents and their African ancestors.

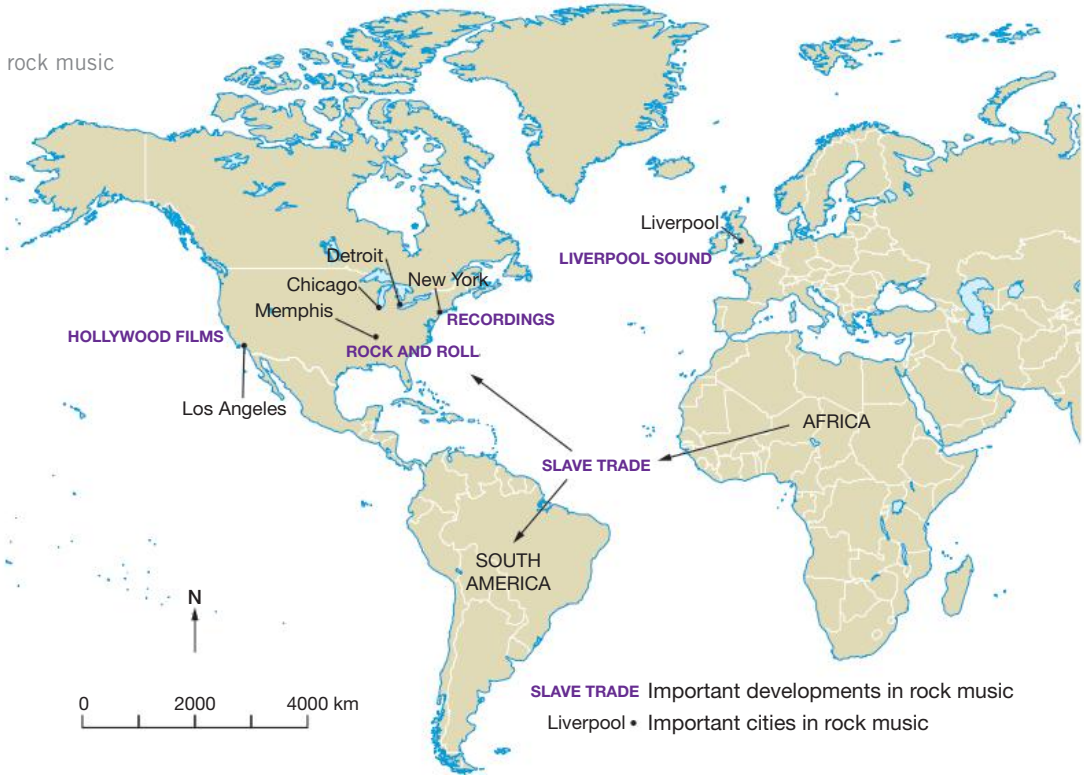
Most African slaves were in the south of the United States of America, and so it was in this region that this music tradition began. The songs about troubles were called 'the blues' or 'rhythm and blues', and the faster songs were called 'rock and roll'. They were all intertwined with the development of jazz music in the same region, but in the 1950s jazz and rock went on very separate paths.

Rock music spreads

By the 1950s, the black singers of rock and roll could be heard on some radio stations by white teenagers in other parts of America. Perhaps the protests and pain of the songs appealed to teenagers wanting change; perhaps the new rhythms appealed to teenagers' love of dance movement; perhaps the teenagers were just looking for something new. Whatever it was, the music appealed to them.

Rock and roll spread very quickly across United States of America, through the use of radio and then via the movies. Black singers such as Little Richard and Fats Domino were the first of the rock stars. They were followed by white singers such as Bill Haley and Elvis Presley, both of whom used film, as well as recordings, to spread their music. The new centres of rock and roll were now in the northern and western cities of New York and Los Angeles, the cities that controlled the record and film industries.

10.38 Global distribution of rock music



The world starts to rock

The popularity of rock and roll spread quickly among teenagers in other countries, firstly in the English-speaking world, and then elsewhere (see Figure 10.38). In the 1960s, Britain became the new hub of rock music, producing the Beatles, shown in Figure 10.39, and their 'Liverpool sound', followed by the Rolling Stones and other such groups. Some of the music of the 1960s was 'protest music', protesting against war, authority and a complacent society. This was a reaction to the arms race, the Vietnam War and racial discrimination. By the 1970s, rock music had spread throughout most of the world in various forms. In France, the dance clubs were called 'discothèques'. That name was soon abbreviated to 'disco', and this became a particular form of rock music.

In the automobile manufacturing city of Detroit, black rock groups developed another variation called 'motown', short for 'motor-town'. In the African–American areas of cities such as New York and Chicago, another variation appeared, called 'rap', and this developed into 'hip hop', both with a new input of black rhythms of speech.

Rock music saves the world

In the 1980s and 1990s the link between rock music and protest expanded into large-scale projects such as 'Band Aid', 'Live Aid' and 'We Are the World'. Some rock stars, such as Sting, Bono and Bob Geldof, became prominent in the cause of helping less developed countries, reducing poverty and making people aware of threats to the environment.

DID YOU KNOW?

The term 'teenager' dates from the 1950s when it became necessary to label the stage of life between childhood and adulthood. Before that young people typically went into the workforce at the age of 15.



10.39 In the 1960s, Britain became a new hub of rock music, firstly producing the Beatles and their 'Liverpool sound'.



10.40 People around the world have embraced rock. Here, an American Islamic group, Native Deen, perform on the final night of the Ramadan festival in Surya Park, Surabaya, Indonesia, in 2011.

Rock music is global

Whether it is a village in South America, an island in the Pacific, or a street in Australia, you are likely to see young people listening to the latest rock music on MP3s. It may have been recorded in Nashville, in the United States of America (now one of the main recording centres) and made available around the globe via sites such as iTunes. Rock music is performed all around the world (see Figure 10.40), far from its origins in the United States of America.

ACTIVITIES

10.5

Knowledge and understanding

1. Identify the features of slavery that had an important impact on rock music.
2. Identify the origins of the term 'teenagers'.
3. Outline the origins and spread of rock music.

Applying and analysing

4. The information given in this unit is only a summary of the overall spread of rock music. You probably have much more information about one type of rock music, or some of your own favourite singers or bands. Choose one of these that you like, and find out:
   - where it/they came from
   - the style of that particular kind of music
   - which music has influenced the group or kind of music most
   - where it/they are best known
   - if it/they spread their music through live concerts, internet, CDs or radio.

Review and reflect 3

Activity 1

Global futures

Working in groups, consider each of the following questions. One student should act as a recorder.

1 a What are your predictions for the future uses of the internet? Expand on each of the following areas with your own ideas:
- playing games
- accessing information
- social networking
- getting a job
- buying goods
- getting medical information.

b Divide your ideas into those that you consider to be desirable/good and those that you consider to be undesirable/bad.

2 a What are your predictions for the future of world transport? Expand on each of the following areas with your own ideas:
- air transport
- private cars
- urban transport—buses/trams/light rail.

b Divide your ideas into those that you consider to be desirable/good and those that you consider to be undesirable/bad.

3 a What are your predictions for the future changes in consumer goods? Expand on each of these following with your own ideas:
- mobile phones
- home theatres
- television sets
- mobile personal music players.

b Divide your ideas into those that you consider to be desirable/good and those that you consider to be undesirable/bad.

4 a What are your predictions for changes in the lives of workers? Expand on each of the following with your own ideas:
- migration from home to new places of work
- increase or decrease in wealth
- changes in work conditions
- differences and changes in the work of women and men.

b Divide your ideas into those that you consider to be desirable/good and those that you consider to be undesirable/bad.

5 a What are your predictions for future changes in large global companies? Expand on each of the following with your own ideas:
- companies growing larger and having more power
- government controls of large companies
- locations of factories, head offices.

b Divide your ideas into those that you consider to be desirable/good and those that you consider to be undesirable/bad.

6 a What are your predictions for the future of large sporting events? Expand on each of the following with your own ideas:
- Olympic Games—Where? What size? Which sports? What costs?
- World Cups
- Championship series, for example Grand Prix.

b Divide your ideas into those that you consider to be desirable/good and those that you consider to be undesirable/bad.

7 a What are your predictions for the future of highly connected large world cities? Expand on each of the following with your own ideas:
- use of energy and conservation
- changes in lifestyle for people living in the cities
- changes in the planning of the cities.

b Divide your ideas into those that you consider to be desirable/good and those that you consider to be undesirable/bad.

8 Compare you responses for Questions 1–7 with other groups in the class. What common themes emerge? What differences are there between the groups?

9 Use the knowledge gained from this activity to debate the topic: On balance the future is something to look forward to.

Activity 2

Places to visit, find out about and investigate

Many people have compiled lists of 'Seven wonders of the world' in response to the original list of Seven Wonders of the World from ancient times. Only one of the original list is still standing—the Great Pyramid of Giza.

The American Society of Engineers drew up the following list of Seven Wonders of the Modern World:

- Channel Tunnel
- CN Tower, Toronto
- Empire State Building, New York
- Golden Gate Bridge, San Francisco
- Itaipu Dam, Brazil
- Netherlands North Sea protection works
- Panama Canal.

CNN compiled a list of Seven Natural Wonders of the World in 1997:

- Grand Canyon
- Great Barrier Reef
- Rio de Janeiro Harbour
- Mount Everest
- Northern Lights
- Parícutin Volcano
- Victoria Falls.

A new list of Seven Wonders of the World was compiled by people voting online in 2007:

- Chichen Itza (a Mayan city), Mexico
- Christ the Redeemer statue in Rio de Janeiro, Brazil
- The Great Wall of China
- Machu Picchu, Peru
- Petra, an ancient city in Jordan
- The Colosseum, Rome
- Taj Mahal, India.

1 *Time* magazine made a list of the 100 most influential places in history. Below is a selection of some of these places. Write one to two sentences about each:

- Sequoia National Park
- The Grand Canyon
- Wall Street, New York
- New York City
- Cape Canaveral
- Stonehenge, Britain
- Waterloo
- The Galápagos Rift
- The Bastille, Paris
- Athens
- Calvary Hill, Jerusalem
- Istanbul
- Mecca
- The Great Pyramid and Sphinx, Giza
- Timbuktu
- Taj Mahal, India
- Angkor, Cambodia
- Great Barrier Reef, Australia
- Sydney Opera House.

2 **a** Use the information in this section, as well as your increasing knowledge of places in the world, to draw up lists of any three of the following:

- places you want to visit some time in your life
- places you want to visit while you are young
- places where you would like to spend time working or studying
- places you want to visit before they change too much.

b Think about the places you have already visited close to where you live. List between five and ten of these places and for each place give at least one reason why you think it is worth visiting. What gives it a distinctive character?

c There are many places mentioned in the lists in this section about which you may not have much knowledge. Choose five that sound interesting to you and find out more about them. Your investigations should include:

- a map showing the location
- information about the destination
- images from the destination
- reasons why you want to visit this location.

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