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# INSIGHT GEOGRAPHY

AUSTRALIAN CURRICULUM FOR NSW

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STAGE

5

DREW COLLINS  
RICHARD CRIGHTON  
KERRY McEWAN  
MARK EASTON

OXFORD



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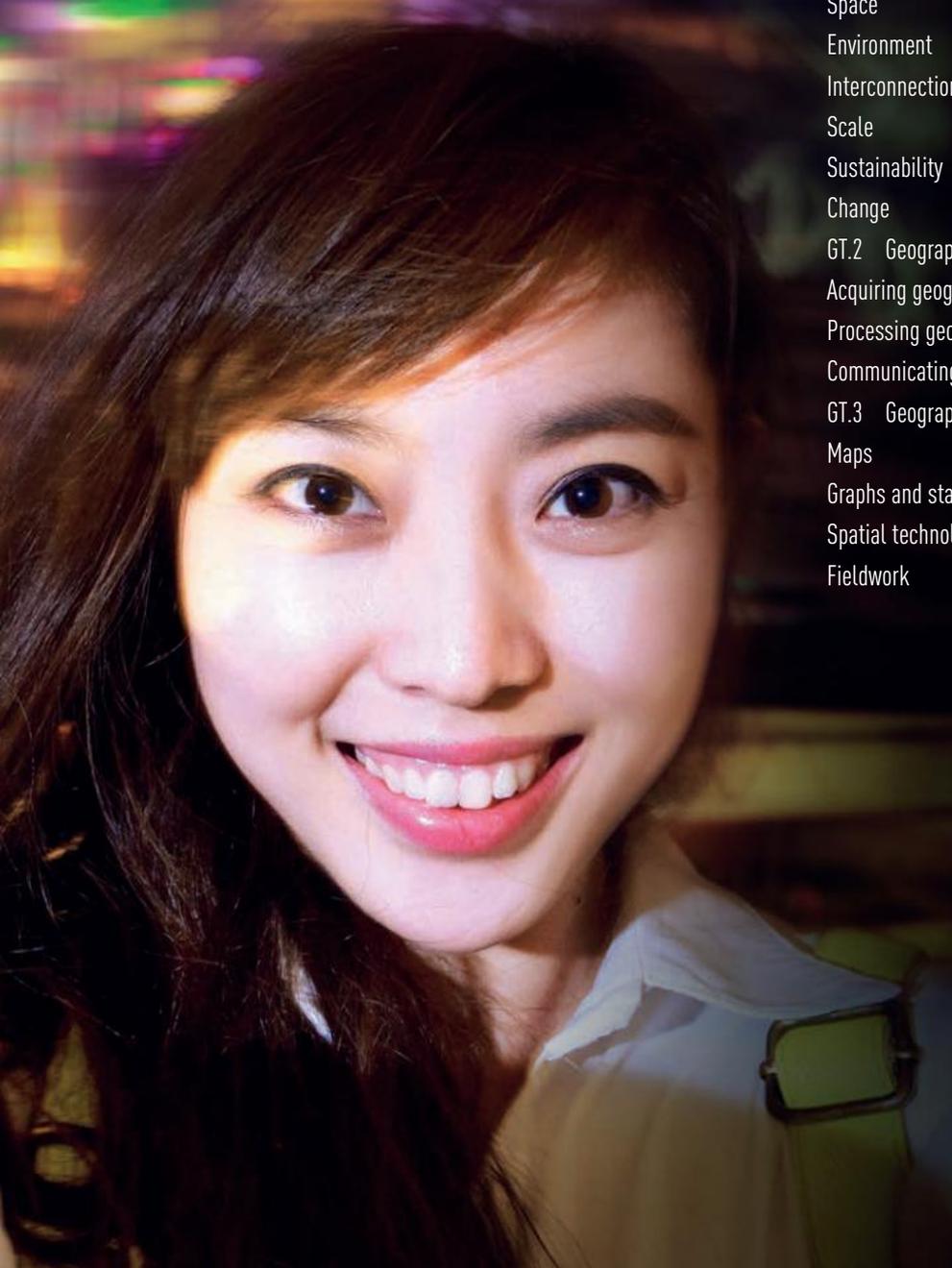
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# CONTENTS

Skills checklist	v
Using <i>Oxford Insight Geography</i>	vi
NSW Syllabus for the Australian Curriculum: Geography Stage 5 – Scope and sequence	x

## THE GEOGRAPHER'S TOOLKIT 2

GT.1 Geographical concepts	4
Place	4
Space	5
Environment	6
Interconnection	7
Scale	8
Sustainability	9
Change	10
GT.2 Geographical inquiry skills	12
Acquiring geographical information	12
Processing geographical information	16
Communicating geographical information	22
GT.3 Geographical tools	24
Maps	24
Graphs and statistics	26
Spatial technologies and visual representations	29
Fieldwork	33



## **UNIT 1: SUSTAINABLE BIOMES 38**

### **CHAPTER 1: INVESTIGATING BIOMES 40**

- 1.1 What are the main characteristics that differentiate the world's biomes? 42
- 1.2 How do people use and alter biomes for food production? 56

### **CHAPTER 2: FOOD SECURITY: FEEDING A HUNGRY WORLD 68**

- 2.1 Can the world's biomes sustainably feed the world's population? 70
- 2.2 What are the environmental challenges to food production? 88
- 2.3 What strategies can be used to increase global food security? 106

## **UNIT 2: CHANGING PLACES 122**

### **CHAPTER 3: URBANISATION: LIFE IN DIFFERENT CITIES 124**

- 3.1 Why has the world become more urbanised? 126
- 3.2 How does urbanisation change environments and places? 138
- 3.3 What strategies are used to manage environmental change in urban places to enhance sustainability? 150

### **CHAPTER 4: MIGRATION: PEOPLE ON THE MOVE 160**

- 4.1 How does internal migration impact on the concentration of people into urban places? 162
- 4.2 How does international migration impact on the concentration of people into urban places? 178

## **UNIT 3: ENVIRONMENTAL CHANGE AND MANAGEMENT 190**

### **CHAPTER 5: ENVIRONMENTS 192**

- 5.1 How do environments function? 194

### **CHAPTER 6: CHANGING AND MANAGING THE ENVIRONMENT 202**

- 6.1 How do people's worldviews affect their attitudes to and use of environments? 204
- 6.2 What are the causes and consequences of change in environments and how can this change be managed? 240

### **CHAPTER 7: INVESTIGATIVE STUDY: COASTAL CHANGE AND MANAGEMENT 252**

- 7.1 Why is an understanding of environmental processes and interconnections essential for sustainable management of coastal environments? 254
- 7.2 What are the causes and consequences of environmental change? 262
- 7.3 How can coastal changes be managed? 274

## **UNIT 4: HUMAN WELLBEING 294**

### **CHAPTER 8: GEOGRAPHIES OF HUMAN WELLBEING 296**

- 8.1 What makes human wellbeing a geographical issue? 298
- 8.2 How can the spatial variations in human wellbeing and development be measured and explained? 314

### **CHAPTER 9: IMPROVING INEQUALITIES IN WELLBEING 346**

- 9.1 What are the economic, social and environmental impacts of variations in development and wellbeing? 348
- 9.2 How do governments, groups and individuals respond to inequalities in development and human wellbeing for a sustainable future? 358

Glossary 376

Index 381

Acknowledgements 389

# SKILLS CHECKLIST

	GEOGRAPHER'S TOOLKIT	SUSTAINABLE BIOMES	CHANGING PLACES	ENVIRONMENTAL CHANGE AND MANAGEMENT	HUMAN WELLBEING
<b>Map types</b>					
relief				215	
political	48	58, 64, 70, 84, 93, 95, 102	132, 139		315
physical	19	42, 48, 55, 58, 64, 70, 91	137	241	
topographic	24	53		215, 225, 231, 281	
choropleth		82, 102, 109, 112	130, 132, 139, 140, 149, 166, 177, 179, 183		298, 302, 304, 306, 329, 336
flowline			170	288	322
cadastral					346
thematic		70, 71, 75, 78, 82, 84, 91, 93, 95, 99, 102	135, 177, 184	193, 211, 217, 224, 242, 259, 269	315, 315, 319, 330, 333, 344
land use					
precis			142	238	311
special-purpose		70, 120	129, 161	223, 266	368
cartograms	25	44			298, 369
synoptic charts					
<b>Fieldwork</b>					
fieldwork	33–7				
<b>Graphs and statistics</b>					
data tables	29	60, 82, 92	138, 143, 145, 171	235	326, 339, 344
pie graphs		109	169, 173, 174	212, 236	366
column graphs		78, 86–7, 90, 98, 102, 115	122, 145, 146, 147, 159, 173, 179	212, 220	311, 345, 351
compound column graphs	26	56, 66, 84, 110		207	304
line graphs		84	145, 173, 174, 180	205, 220	351, 358
scatter graphs	28				300
climate graphs	26		140		
population profiles	27		173		326
multiple tables and graphs presented on a geographical theme		66, 78, 84, 86–7	140, 145, 173, 174	204–5, 212, 258	300, 340–1, 348, 350–1
statistics to find patterns and trends, and to account for change	17	66, 84, 92	145, 173, 174	258, 265	339
<b>Spatial technologies</b>					
virtual maps	25		176	268, 274–5	299
satellite images		58	131, 140, 155	197, 220, 227, 229, 247, 263, 274–5	
global positioning systems (GPS)		80		274–5	
geographic information systems (GIS)	30	80		274–5	299
remote sensing data				274–5	
augmented reality				274–5	
<b>Visual representations</b>					
photographs	all chapters	all chapters	all chapters	all chapters	all chapters
aerial photographs	all chapters	all chapters	all chapters	all chapters	all chapters
illustrations	all chapters	all chapters	all chapters	all chapters	all chapters
flow charts		50			
annotated diagrams	all chapters	all chapters	all chapters	all chapters	all chapters
multimedia	all chapters	all chapters	all chapters	all chapters	all chapters
field and photo sketches	30, 32, 37	85			
cartoons		98		203	308
mind maps		105, 118			
web tools	all chapters	all chapters	all chapters	all chapters	all chapters

# USING OXFORD INSIGHT GEOGRAPHY

*Oxford Insight Geography* has been developed and written by a team of experienced NSW Geography teachers to meet the requirements of the NSW syllabus for the Australian Curriculum: Geography. *Insight Geography* comprehensively covers all syllabus content to help students successfully meet all of the required outcomes. *Insight Geography* takes the guesswork out of the new syllabus: chapters are organised around the key inquiry questions from the syllabus while geographical concepts, geographical inquiry skills and geographical tools are integrated meaningfully into every chapter. The features, structure and design of the Student book, Student obook assess and Teacher obook assess will help you:

- » optimise student understanding
- » personalise teaching and learning
- » deliver better results.

## OPTIMISE STUDENT UNDERSTANDING

Each chapter of *Oxford Insight Geography* is sequenced according to the NSW Geography syllabus and structured around the key inquiry questions from the syllabus. Content dot points clearly map the learning sequence for students. Concepts, skills and tools are integrated in every chapter and mapped on the chapter opener.

The learning sequence for each chapter is structured around the key inquiry questions and content dot points taken directly from the syllabus.

Checkpoint activities at the end of each section are clearly identified.

**CHAPTER 1**

**INVESTIGATING BIOMES**

A biome is a region that shares similar and distinctive climates, soils and vegetation. The tundra lands biome, for example (Source 1.1), is characterised by very cold climates, extreme winds and very limited plant and animal diversity. In contrast, the tropical rainforest biome is characterised by a warm and wet climate, highly weathered soils and thick, lush vegetation. Geographers are interested in the diverse physical features of biomes, their spatial distribution and the way that humans use and alter biomes for food, fibre and material production. In this chapter you will explore eight diverse biomes: polar lands, tundra, boreal forest, mountain vegetation, temperate forest, grassland, desert and tropical rainforest.

Source 1.1 The tundra biome is the coldest of all the biomes. Tundra comes from the Finnish word *tunturi*, meaning 'treeless plain', and covers about 20 per cent of the Earth.

**1.1 SECTION**  
WHAT ARE THE MAIN CHARACTERISTICS THAT DIFFERENTIATE THE WORLD'S BIOMES?  
In this section you will investigate:  
• the distribution and physical characteristics of biomes.  
**CHECKPOINT 1.1**

**1.2 SECTION**  
HOW DO PEOPLE USE AND ALTER BIOMES FOR FOOD PRODUCTION?  
In this section you will investigate:  
• the human alteration of biomes to produce food, industrial materials and fibres and the environmental effects of these alterations.  
**CHECKPOINT 1.2**

**GEOGRAPHER'S TOOLKIT**

**Geographical concepts**

- **Space:** location of biomes and the spatial distribution of urbanisation, global patterns of food, industrial materials and fibre production and variations of human wellbeing
- **Environment:** the function and importance of environment; approaches to environmental management
- **Sustainability:** sustainable environmental worldviews and management approaches
- **Change:** biomes altered to produce food, industrial materials and fibres and the environmental effects of these alterations

**Geographical inquiry skills**

- **Acquiring geographical information**
- **Processing geographical information**
- **Communicating geographical information**

**Geographical tools**

- **Maps:** thematic maps, regional and country maps, choropleth maps
- **Graphs and statistics:** column graphs, pie graphs, composite graphs, data tables
- **Spatial technologies:** satellite images
- **Visual representations:** photographs, flow charts, annotated images, sketches

41

Geographical concepts, Geographical inquiry skills and Geographical tools are integrated meaningfully into every chapter and highlighted here on every chapter opener.

Each topic covered in the Student book is supported by a range of maps, graphs and statistics, visual representations, spatial technologies and fieldwork suggestions designed to engage and challenge a range of students. Key concepts are integrated into every chapter in the key concept boxes. Geographical inquiry skills are used to structure rich tasks and fieldwork suggestions.

Chapter content is organised into discrete two- or four-page units to support teaching and learning.

### THE INFLUENCE OF LOCATION ON SPATIAL VARIATIONS

**STRANGE BUT TRUE**  
When ships are caught in storms, they often lose cargo to the oceans. The following are just a few of the strange items that have washed up on shores.

- In 1990, five shipping containers of Nike sneakers and work boots were lost to the Pacific Ocean in a storm. People in Washington and Oregon snatched up the shoes on shore, holding swap meets to find matched pairs to wear or sell.
- In 1992, rubber ducks floated in the Pacific Ocean when a ship lost tens of thousands of bathtub toys. The ducks were accompanied by turtles, beavers and frogs.

**Source 8.37**  
Source: Oxford University Press

**Access to trade routes**  
All of the world's great empires were built partly on their ability to transport goods and people. Large volumes of goods were usually transported by water. Ancient Egyptians used the Nile River, the Greeks and Romans used the Mediterranean Sea, and the British used the oceans of the world for trade. Countries and empires with ports close to major shipping routes had a natural advantage. Little has changed in the ways goods are transported today. The United States, for example, has been able to maintain high levels of wellbeing for centuries through its ability to trade from large ports on its west, east and south coasts. China, one of the world's fastest-growing economies, is the world's largest exporter and second-largest importer. Six of the world's eight busiest ports are located in China and an estimated 121 million shipping containers pass through them every year. China is using trade from its many ports as a way to improve the wellbeing of hundreds of millions of its citizens.

**WORLD: MAIN SHIPPING ROUTES AND LARGEST CONTAINER PORTS**

**Source 8.40** An oblique aerial photograph showing part of the Port of Singapore

**KEY CONCEPT: INTERCONNECTION**  
Singapore and the importance of location  
Singapore is one of the world's smallest countries with few natural resources. Most of the land area is used for urban development, so little remains for food production; there are no significant rivers and no mineral reserves. And yet, Singapore has one of the world's highest levels of wellbeing with an average life expectancy of over 84 years and one of the world's highest levels of GDP per person. Singapore's wealth is based largely on its geographic location at the tip of the Malay Peninsula.  
Ships moving between the world's major exporters and importers have used the port of Singapore as a trading centre for hundreds of years. The Port of Singapore is connected through shipping to more than 600 ports in 123 countries around the world, making it the gateway to Asia. This central location has enabled Singapore to thrive in other global industries. Singapore also imports raw materials, which it turns into valuable commodities such as electronic and telecommunication goods for export. Lastly, the country is home to major oil refineries and other mineral treatment plants and is a major centre of finance.  
For more information on the key concept of interconnection, refer to section G1 of 'The geographer's toolkit'.

**REVIEW 8.2.7**  
**Remember and understand**  
1 How does Singapore's location help to explain the high levels of wellbeing there?  
2 How can countries with little in the way of natural resources work to improve their wellbeing?  
**Apply and analyse**  
3 Use the World Bank website to describe the overall levels of wellbeing in Singapore.  
4 Consider Source 8.39.  
a Describe the location of the busiest shipping routes.  
b Design the course of a container ship that travels from Beijing, around the world, and back to Beijing following the busiest shipping routes. Use an atlas to make a list of the ports and countries where your ship would dock.  
c Use the World Bank website to explore the levels of wellbeing in the countries where your ship would dock.  
d What does this map tell you about the advantages of coastal nations in accessing trade?  
e How does this map help to explain the high levels of wellbeing in the United States, China and Singapore?  
**Investigate and create**  
5 Create a PowerPoint presentation, or similar, to highlight all of the ways in which location influences a country's wellbeing.

**Key concept boxes encourage students to think geographically.**

Key concept boxes encourage students to think geographically.

Skill drills support an explicit focus on geographical skills.

Strange but true boxes present a range of weird and wonderful geographical facts designed to entertain and provoke discussion.

Case studies expose students to a range of sources.

### ECOSYSTEM DECLINE: DISAPPEARING FORESTS

One of the leading causes of land degradation on a global scale is **deforestation**. Forests have been cleared by humans for thousands of years. Traditionally, forests have been cleared for farming, to make way for human settlements and to provide building materials. Today, two key economic realities continue to drive deforestation:

- Trees grow slowly and other crops such as soy beans grow quickly. As populations continue to grow and expand, and people tend to their current needs rather than provide people with income and food.
- Many ecosystem services provided by forests, such as absorbing and storing carbon and filtering water, do not have a monetary value and cannot be bought and sold. Produce from farms and timber from forests are easily bought and sold so are seen as more valuable to local populations than intact forests.

**CASE STUDY**  
**The Amazon rainforest**  
The Amazon, the world's largest tropical rainforest, provides an example of the changes that are sweeping across many forest biomes today. Well known as a biodiversity hot spot due to its large numbers of plant and animal species, the Amazon is now considered to be an environmental hot spot. The Amazon covers an area roughly the size of Australia, but since the 1970s, an area the size of New South Wales has been cleared for other uses. In recent years, rainforest clearing has slowed but still continues. Source 6.37 shows deforestation levels since 1990. Some climate scientists believe that unless the remaining rainforest is protected, a combination of climate change, droughts, fires and deforestation will gradually turn the rainforest into **savannah** and **grasslands**.

**Source 6.36** A section of Amazon rainforest in Brazil. The red has been cleared for cattle ranching.

**Source 6.37** Annual and cumulative deforestation of the Amazon rainforest in Brazil.

**224 OXFORD INSIGHT GEOGRAPHY AUSTRALIAN CURRICULUM FOR NSW STAGE 5**

Every two- or four-page unit concludes with a **Review** question box with differentiated **Remember and understand**, **Apply and analyse** and **Investigate and create** tasks to provide a range of activities for different abilities and learning styles.

### Using satellite images to analyse environmental change

Dual satellite images are a useful tool for observing change over a large region of the Earth's surface. By examining them closely, you can describe changes that have occurred and suggest explanations for these changes.

**Step 1** Examine two satellite images taken at the same location at different points in time.  
**Step 2** Locate the area on the Earth's surface using an atlas.  
**Step 3** Look closely at the first image. Describe the natural and human features that you can see.  
**Step 4** Describe the differences between the first image and the second one.

**Step 5** Try to quantify the changes. For example, if there has been desertification, calculate the area of desert shown in each of the images. The difference will give you the area that has changed over time.  
**Step 6** Suggest an explanation for these changes based on your observations.

**Apply the skill**  
1 The two satellite images in Source 6.38 show a section of the Amazon rainforest in the state of Rondônia, western Brazil, in 1975 and 2012. Follow the steps above to describe the satellite images shown, and explain the changes that have taken place in this section of the rainforest over the 37-year period.

**Source 6.38** Two satellite images of a section of the Amazon rainforest in the state of Rondônia, western Brazil. The image on the left was taken in 1975 and the image on the right was taken in 2012.

**REVIEW 6.1.11**  
**Remember and understand**  
1 Why are forests cleared?  
2 What do many climate scientists believe may happen to the Amazon rainforest in the future?  
**Apply and analyse**  
3 Look closely at Source 6.37.  
a Describe the trend in Amazon forest loss since 1990.  
b Roughly calculate the average amount of rainforest lost each year.  
4 Look closely at Source 6.36.  
a Brainstorm the ecosystem services provided by an intact rainforest. Refer to Source 6.2 for a list of ecosystem services.  
b Highlight those services that will be lost if the rainforest is cleared and underline those services that will be changed but not lost.  
**Investigate and create**  
5 Imagine that the Brazilian Government decided to ban forest clearing and instead encourage people to replant the forest.  
a How would this decision affect ecosystem services and the Brazilian economy?  
b Is this likely to happen? Give some reasons for your answer.

**225 CHANGING AND MANAGING THE ENVIRONMENT**

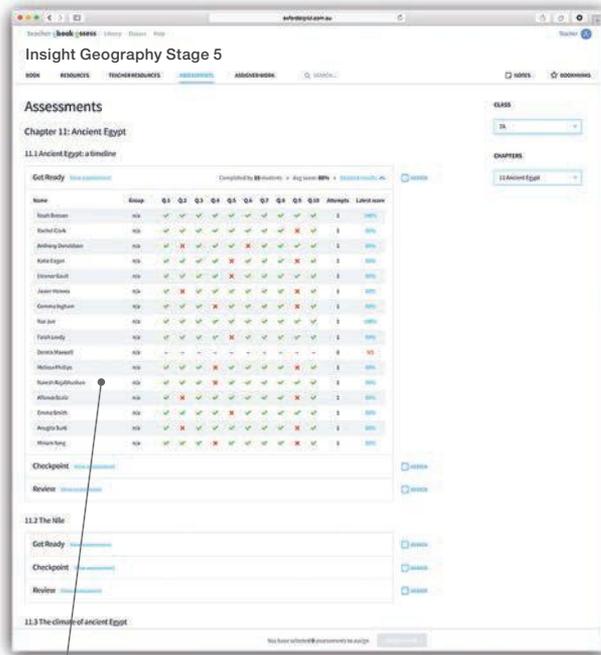
## PERSONALISE TEACHING AND LEARNING

The new syllabus demands contemporary online learning for all students in NSW. *Oxford Insight Geography* delivers new opportunities for teachers and students to personalise teaching and learning through obook and assess:

- » obook provides an electronic version of the Student book with note-taking, highlighting and bookmarking. The obook includes videos, interactive learning modules, weblinks and worksheets, and can be accessed both online and offline. Access your entire cloud-based obook library anywhere on any device with one simple log-in



» assess provides 24/7 online assessment designed to support individual student progression and understanding.



Select from hundreds of auto-marking assessment tasks at various difficulty levels – foundation, standard and advanced.



Monitor student participation and track performance by graphing and comparing individual and group results.

Create your own tests tailored directly to the needs of your students or assign ready-made tests complete with marking guidelines and suggested solutions.

## DELIVER BETTER RESULTS

**Checkpoint** questions appear at the end of every section. They are linked to a content dot point in the NSW Geography syllabus and are designed to help you identify areas of weakness in student understanding. They can be used flexibly – completed orally in class (to support formative assessment) or set as written tests (to support summative assessment).

*Oxford Insight Geography* helps to deliver better results for you and your students by ensuring that student progress on all syllabus outcomes and content can be carefully monitored throughout every chapter. Features contained at the end of every section of every chapter allow you to easily identify gaps in student understanding and target further development in these areas.

**Rich tasks** appear at the end of every section. They are open-ended, inquiry-based tasks designed to engage students to develop their geographical inquiry skills.

Each **Checkpoint** is supported by three separate student worksheets available electronically (via the Teacher book). These worksheets are graded to **support, consolidate** or **extend** students, or differentiate abilities and personalise learning in your class. Like **Checkpoint** questions, student worksheets are linked to content dot points from the syllabus with the goal of providing tailored support to ensure better results.

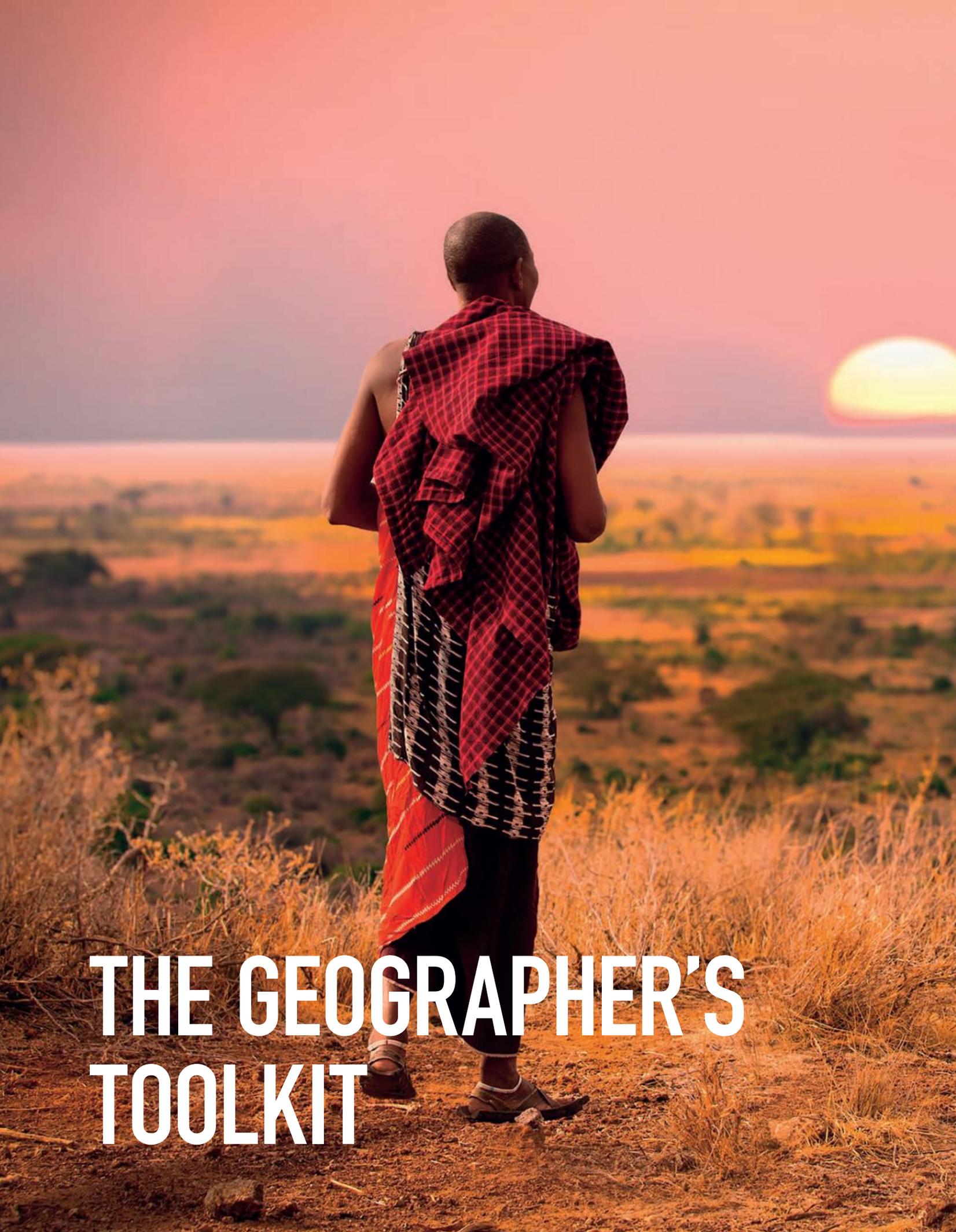
# NSW SYLLABUS FOR THE AUSTRALIAN CURRICULUM: GEOGRAPHY STAGE 5

## – SCOPE AND SEQUENCE

STAGE 5: 100 HOURS TEACHING TIME	
GEOGRAPHICAL CONCEPTS	<p>The following geographical concepts are to be integrated throughout Stage 5:</p> <ul style="list-style-type: none"> <li>• <b>Place:</b> the significance of places and what they are like</li> <li>• <b>Space:</b> the significance of location and spatial distribution, and ways people organise and manage spaces that we live in</li> <li>• <b>Environment:</b> the significance of the environment in human life, and the important interrelationships between humans and the environment</li> <li>• <b>Interconnection:</b> no object of geographical study can be viewed in isolation</li> </ul> <ul style="list-style-type: none"> <li>• <b>Scale:</b> the way that geographical phenomena and problems can be examined at different spatial levels</li> <li>• <b>Sustainability:</b> the capacity of the environment to continue to support our lives and the lives of other living creatures into the future</li> <li>• <b>Change:</b> explaining geographical phenomena by investigating how they have developed over time</li> </ul>
GEOGRAPHICAL INQUIRY SKILLS	<p><b>Acquiring geographical information</b></p> <ul style="list-style-type: none"> <li>• develop geographically significant questions and plan an inquiry that identifies and applies appropriate geographical methodologies and concepts (ACHGS063, ACHGS072)</li> <li>• collect, select, record and organise relevant data and geographical information, using ethical protocols, from a variety of appropriate primary data and secondary information sources (ACHGS064, ACHGS073)</li> </ul> <p><b>Processing geographical information</b></p> <ul style="list-style-type: none"> <li>• evaluate information sources for their reliability, bias and usefulness (ACHGS065, ACHGS074)</li> <li>• represent multi-variable data in a range of appropriate forms, with and without the use of digital and spatial technologies (ACHGS065, ACHGS074)</li> <li>• represent the spatial distribution of geographical phenomena on maps that conform to cartographic conventions, using spatial technologies as appropriate (ACHGS066, ACHGS075)</li> <li>• evaluate multi-variable data and other geographical information using qualitative and quantitative methods and digital and spatial technologies as appropriate to make generalisations and inferences, propose explanations for patterns, trends, relationships and anomalies, and predict outcomes (ACHGS067, ACHGS076)</li> </ul> <ul style="list-style-type: none"> <li>• apply geographical concepts to synthesise information from various sources and draw conclusions based on the analysis of data and information, taking into account alternative perspectives (ACHGS068, ACHGS077)</li> <li>• identify how geographical information systems (GIS) might be used to analyse geographical data and make predictions (ACHGS069, ACHGS078)</li> </ul> <p><b>Communicating geographical information</b></p> <ul style="list-style-type: none"> <li>• present findings, arguments and explanations in a range of appropriate communication forms selected for their effectiveness and to suit audience and purpose, using relevant geographical terminology and digital technologies as appropriate (ACHGS070, ACHGS079)</li> <li>• reflect on and evaluate the findings of an inquiry to propose individual and collective action in response to a contemporary geographical challenge, taking account of environmental, economic and social considerations; and explain the predicted outcomes and consequences of their proposal (ACHGS071, ACHGS080)</li> </ul>
GEOGRAPHICAL TOOLS	<p>The following geographical tools are to be integrated throughout Stage 5:</p> <ul style="list-style-type: none"> <li>• maps</li> <li>• fieldwork</li> </ul> <ul style="list-style-type: none"> <li>• graphs and statistics</li> <li>• spatial technologies</li> <li>• visual representations</li> </ul>
OUTCOMES	<p><b>A student:</b></p> <ul style="list-style-type: none"> <li>› explains the diverse features and characteristics of a range of places and environments <b>GE5-1</b></li> <li>› explains processes and influences that form and transform places and environments <b>GE5-2</b></li> <li>› analyses the effect of interactions and connections between people, places and environments <b>GE5-3</b></li> <li>› accounts for perspectives of people and organisations on a range of geographical issues <b>GE5-4</b></li> <li>› assesses management strategies for places and environments for their sustainability <b>GE5-5</b></li> <li>› analyses differences in human wellbeing and ways to improve human wellbeing <b>GE5-6</b></li> <li>› acquires and processes geographical information by selecting and using appropriate and relevant geographical tools for inquiry <b>GE5-7</b></li> <li>› communicates geographical information to a range of audiences using a variety of strategies <b>GE5-8</b></li> </ul>

	<b>Sustainable biomes</b>	<b>Changing places</b>	<b>Environmental change and management</b>	<b>Human wellbeing</b>
<b>KEY INQUIRY QUESTIONS</b>	<ul style="list-style-type: none"> <li>• What are the main characteristics that differentiate the world's biomes?</li> <li>• How do people use and alter biomes for food production?</li> <li>• Can the world's biomes sustainably feed the world's population?</li> <li>• What strategies can be used to increase global food security?</li> </ul>	<ul style="list-style-type: none"> <li>• Why has the world become more urbanised?</li> <li>• How does migration impact on the concentration of people into urban places?</li> <li>• How does urbanisation change environments and places?</li> <li>• What strategies are used to manage environmental change in urban places to enhance sustainability?</li> </ul>	<ul style="list-style-type: none"> <li>• How do environments function?</li> <li>• How do people's worldviews affect their attitudes to and use of environments?</li> <li>• What are the causes and consequences of change in environments and how can this change be managed?</li> <li>• Why is an understanding of environmental processes and interconnections essential for sustainable management of environments?</li> </ul>	<ul style="list-style-type: none"> <li>• What makes human wellbeing a geographical issue?</li> <li>• How can the spatial variations in human wellbeing and development be measured and explained?</li> <li>• What are the economic, social and environmental impacts of variations in development and human wellbeing?</li> <li>• How do governments, groups and individuals respond to inequalities in development and human wellbeing for a sustainable future?</li> </ul>
<b>CONTENT</b>	<p><b>Biomes</b></p> <ul style="list-style-type: none"> <li>• investigate the distribution and physical characteristics of biomes [ACHGK060]</li> </ul> <p><b>Changing biomes</b></p> <ul style="list-style-type: none"> <li>• investigate the human alteration of biomes to produce food, industrial materials and fibres and the environmental effects of these alterations [ACHGK061]</li> </ul> <p><b>Biomes produce food</b></p> <ul style="list-style-type: none"> <li>• investigate environmental, economic and technological factors that influence agricultural yields in Australia and across the world [ACHGK062]</li> </ul> <p><b>Challenges to food production</b></p> <ul style="list-style-type: none"> <li>• investigate environmental challenges to food production for Australia and other areas of the world [ACHGK063]</li> </ul> <p><b>Food security</b></p> <ul style="list-style-type: none"> <li>• investigate the capacity of the world's biomes to achieve sustainable food security for Australia and the world [ACHGK064]</li> </ul>	<p><b>Causes and consequences of urbanisation</b></p> <ul style="list-style-type: none"> <li>• investigate the causes and consequences of urbanisation with reference to ONE Asian country [ACHGK054]</li> </ul> <p><b>Urban settlement patterns</b></p> <ul style="list-style-type: none"> <li>• investigate differences in urban settlement patterns between Australia and another country [ACHGK055]</li> </ul> <p><b>Internal migration</b></p> <ul style="list-style-type: none"> <li>• investigate reasons for and effects of internal migration in Australia and another country [ACHGK056, ACHGK057]</li> </ul> <p><b>International migration</b></p> <ul style="list-style-type: none"> <li>• investigate the reasons for and effects of international migration to Australia, [ACHGK058]</li> </ul> <p><b>Australia's urban future</b></p> <ul style="list-style-type: none"> <li>• investigate the management and planning of Australia's urban future [ACHGK059]</li> </ul>	<p><b>Environments</b></p> <ul style="list-style-type: none"> <li>• investigate the role and importance of natural environments</li> </ul> <p><b>Environmental change</b></p> <ul style="list-style-type: none"> <li>• investigate human-induced environmental changes across a range of scales [ACHGK070]</li> </ul> <p><b>Environmental management</b></p> <ul style="list-style-type: none"> <li>• investigate environmental management, including different worldviews and the management approaches of Aboriginal and Torres Strait Islander Peoples [ACHGK071, ACHGK072]</li> </ul> <p><b>Investigative study</b></p> <p>Select ONE type of environment in Australia as the context for a comparative study with at least ONE other country.</p> <ul style="list-style-type: none"> <li>• investigate the biophysical processes essential to the functioning of the selected environment</li> <li>• investigate the causes, extent and consequences of the environmental change [ACHGK073]</li> <li>• investigate the management of the environmental change [ACHGK074, ACHGK075]</li> </ul>	<p><b>Human wellbeing and development</b></p> <ul style="list-style-type: none"> <li>• investigate ways of measuring and mapping human wellbeing and development [ACHGK076]</li> </ul> <p><b>Spatial variations in human wellbeing</b></p> <ul style="list-style-type: none"> <li>• investigate causes, issues and consequences of spatial variations in human wellbeing [ACHGK077, ACHGK078, ACHGK079]</li> </ul> <p><b>Human wellbeing in Australia</b></p> <ul style="list-style-type: none"> <li>• investigate the reasons for and consequences of spatial variations in human wellbeing in Australia [ACHGK080]</li> </ul> <p><b>Improving human wellbeing</b></p> <ul style="list-style-type: none"> <li>• investigate initiatives to improve human wellbeing in Australia and other countries [ACHGK081]</li> </ul>

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# THE GEOGRAPHER'S TOOLKIT



GEOGRAPHICAL  
CONCEPTS **GT.1**

GEOGRAPHICAL  
INQUIRY SKILLS **GT.2**

GEOGRAPHICAL  
TOOLS **GT.3**

**Source GT.1** A Masai man wearing traditional clothes overlooks the Serengeti in Tanzania, Africa. The Serengeti is a vast ecosystem and a popular tourist attraction. Each year it hosts the largest migration of animals in the world – over 1.6 million zebra, wildebeest, and other animals migrate from Tanzania to lower Kenya.

# GT.1 GEOGRAPHICAL CONCEPTS

Geographers use seven key concepts to help investigate and understand the world. These concepts will help you to ‘think geographically’ and will help guide you through every geographic inquiry. At times you will use several of these concepts at once, while at other times you may focus on just one. The seven key concepts in geography are:

- place
- space
- environment
- interconnection
- scale
- sustainability
- change.

## PLACE

A place is a part of the Earth’s surface that is identified and given meaning by people. For example, the Serengeti – which is a vast ecosystem in Africa – is a place (see Source GT.1). It is famous for its enormous plains filled with wildlife, animals and birds. Places aren’t defined by size, however. They can be very large, like a whole continent, or small, like your classroom. Your home and school are important places for you because they are places where you live and spend a lot of time.

Places can be natural (i.e. shaped by the environment and largely unchanged by humans) or human (i.e. built or changed by humans).

The life of every person and animal on Earth is influenced by place. Places determine our relationships with one another. Our closest relationships are likely to be with people in places that are physically near. The environmental and social qualities of a place all influence the way we live. Climate, landscapes, types of plants and resources, transport networks, entertainment venues and workplaces all have a major impact on the way we live in our places.

Geographers use the concept of **place** to frame their inquiries. For example, a geographer visiting Namche Bazaar in Nepal (see Source GT.2) would use the concept of place to help understand why people choose to live in this challenging environment and how they overcome these challenges. They would also investigate the ways people have altered this environment, and assess the environmental and social impacts of the effects of these changes.

The geographer would also be interested in the forces that have shaped the mountains. They would look for clues and begin to ask questions, much like

a detective. Why are the sides of the mountains so steep? Why are the highest mountain peaks in a line? Why are there stripes in the mountain peaks? By seeking answers to these questions the geographer is aiming to explain, not just describe, a place.



Source GT.2 The town of Namche Bazaar lies at the base of Mount Everest.

# SPACE

To most people, space means the empty universe but to a geographer it has a different meaning. Geographers use the key concept of space when investigating the way that things are arranged on the Earth's surface. They also investigate the ways people use and change the spaces in which they live.

Geographers look for patterns in the way features and structures are arranged, and the concept of **space** helps them to do this. It has three main elements:

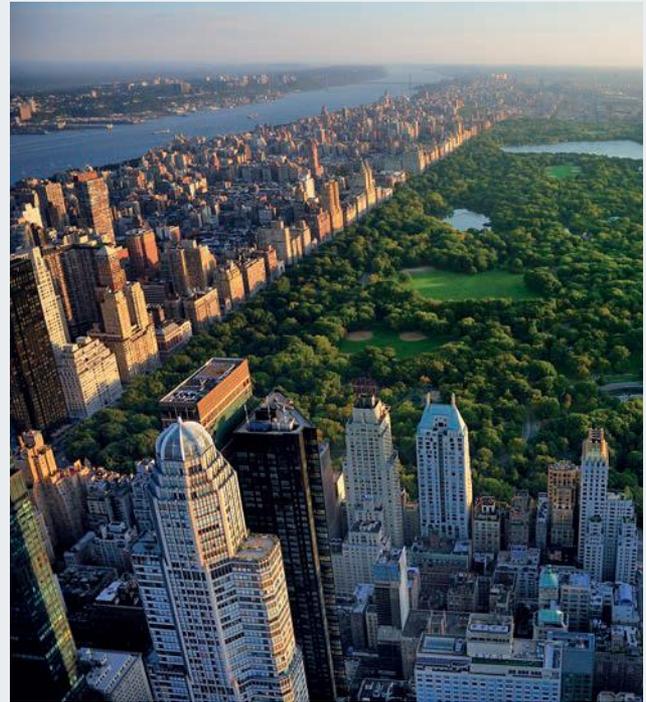
- location – where things are located on the Earth's surface
- organisation – how and why things are arranged and managed on the Earth's surface by people
- spatial distribution – the shapes and patterns in which things are arranged on the Earth's surface.

At first, you may find you confuse the concepts of place and space, as people often use the words interchangeably. To a geographer, however, the concepts of place and space are quite separate. It may help you to remember that places can be divided and organised into spaces. Spaces also are assigned with different purposes.

For example, a place like your school is organised into different spaces, each with its own purpose. There are spaces for learning, spaces for sports and spaces to eat. Larger places, such as your **suburb**, town or city, are also organised into different spaces. There are spaces for housing, spaces for businesses, and spaces for sports and entertainment – all with their own function.

Understanding the location, patterns and planning of spaces helps geographers to make sense of our world. A geographer would look at a photograph, like this one of New York City (see Source GT.3), and might examine it by using the key concept of space in the following terms:

- location – they would observe that Manhattan Island is located in the mouth of the Hudson River and that land is limited. Clearly, there is an open space in the centre of the city. A geographer might identify that it has been designated as a space for recreation and enjoying nature. They may ask questions like: How big is the park? When was it established?
- organisation – they would conclude that there are many tall buildings in a confined area. Were the



Source GT.3 Manhattan Island in New York is one of the most densely populated places on Earth.

buildings constructed around a set perimeter, after the park was established? Are the buildings mainly used for business or housing purposes?

- spatial distribution – the geographer may investigate how many buildings there are per square kilometre, how sparsely or densely they are situated from each other, and how sparsely or densely they are populated.

Further investigation would reveal that there is a complex network of bridges, ferries, subways and walkways that link the island to surrounding areas. In fact, Manhattan Island in New York is one of the most densely populated places on Earth, with more than 26 000 people living in every square kilometre! New Yorkers would perceive and use the space around them in quite a different way from someone living on a huge block in an outer suburban area.

Geographers also investigate the ways that people use and change the space in which they live. They recognise that different groups of people use space in different ways and that this changes over time. By examining, researching and describing how spaces are used, geographers can further our understanding of the world and help manage it into the future.

# ENVIRONMENT

You will have heard people talk about ‘the environment’ and probably studied aspects of the environment before. In geographical terms, the key concept of **environment** means the living and non-living components and elements that make up an area, and the ways they are organised into a system.

Geographers are interested in investigating and describing the relationships between people and the environment. In particular, they examine:

- the ways in which different groups of people perceive and use the natural environment and why these perceptions differ
- the ways in which people change the environment and how these changes can be managed
- the impact of environmental hazards on people and how the impacts of these hazards can be reduced.

The world in which we live is made up of many different environments. Some environments are natural (or physical) such as deserts, **grasslands**, mountains, coral reefs, forests, oceans and ice caps. The natural environment provides us with basic resources for living such as food, water and clean air. Natural processes such as **tectonic activity**, **erosion** and **weathering** have formed these environments over millions of years. In order for an environment to be considered natural its soils, rocks, climate, plants and animals must remain largely untouched by humans. Today there are very few natural environments left on Earth. The Australian World-Heritage-listed Heard and McDonald Islands are

outstanding examples of pristine natural environments with no introduced animals or plant species and no human impact.

Other environments have been so changed by humans – largely for settlement and economic activity – that very few natural features remain. These are known as human (or built) environments and include large cities, towns, suburbs and areas of farmland. For example, mountainous land in the Philippines has been transformed into terraced pond fields for rice farming by skilfully following the natural contours of the land.

Researching an environment also allows geographers to evaluate how people can best interconnect with that environment, and identify potential risks for people interacting with that environment. For example, examining the landscape, height, as well as the ascent of Mt Kilimanjaro (see Source GT.4) in Africa allows prospective travellers to know that, unlike with Mt Everest, they don’t need to bring additional oxygen for their climb, but they do need to follow one of six official routes.

The study of different environments helps geographers to better understand and appreciate natural processes, such as how weather works, how mountains are formed and how rainforests and coral reefs grow. The concept helps geographers to analyse the changes humans make to natural environments and better appreciate their impact so that they can be managed more wisely.



Source GT.4 Mt Kilimanjaro in Africa is a popular place for climbers to interact with the natural environment.

# INTERCONNECTION



Source GT.5 A container ship prepares to berth at Port of Sydney.

Nothing on Earth exists in isolation – all environments and every living and non-living thing are connected. Geographers use this concept of **interconnection** to better understand the links between places and people, and how these interconnections affect the environment and the way we live. These connections can be on a local level or a global level.

Natural processes link places and people. For example, the water cycle links the water in the oceans with the land. When it brings rain to inland areas, water flows across the land and into rivers and streams. Farmers rely on this natural link to provide the water they need to grow food.

Links between places and people can affect the way people live. In turn, the way people live can affect places. A relatively small change in one area can have a great impact on another it is interconnected with. The melting of ice from a glacier at the top

of a mountain, for example, will affect the land at the bottom of the mountain. The extra water could potentially damage crops that are being grown there, or conversely the changed conditions may benefit farmers.

Human activities such as the movement of people, the production and trade of goods, and the flow of money within and between different countries also link places and people. Interconnection through electronic means such as mobile phones and the internet is now a part of everyday life for many of us. Being consumers in a global market place also means we are connected to many places via international trade. The Port of Sydney handles over \$60 billion in international and domestic trade each year and processes almost one-third of Australia's containerised cargo each year (see Source GT.5). These ships and the goods they carry link dozens of countries around the world.

# SCALE

The concept of **scale** is used to guide geographical inquiries. Geographers study things that take place on many different spatial levels – meaning from small areas (such as a local park) to very large areas (such as the use of oil and gas all over the world). They use the concept of scale to look for explanations and outcomes at different levels. For example, a geographical inquiry on climate change may be carried out at a range of scales (from smallest to largest) (see Source GT.6):

- local – such as an inquiry into increased electricity use (for air conditioning) in your neighbourhood due to higher-than-average temperatures. Increased energy consumption may result in power outages.
- regional – such as inquiry into coral bleaching on the Great Barrier Reef (see Source GT.7). Warming ocean temperatures can trigger coral bleaching often resulting in coral death.
- national – such as an inquiry into changing weather patterns and increased frequency of extreme weather events in Australia. This impacts on government allocation of resources across many sectors (water security, agriculture, emergency services, coastal communities and **infrastructure**).
- international – such as inquiry into drought in Africa. Rains have become less reliable in many places as the climate has changed and many African nations have been hit by a series of devastating droughts that have brought widespread hunger and starvation.
- global – such as an inquiry into the reduction in Arctic sea ice due to global warming. This reduction in white ice means that less of the Sun’s energy is reflected back into space and more is absorbed into the earth and sea resulting in further increases in temperatures globally.



**Source GT.7** The Great Barrier Reef, off the coast of Queensland, is the world’s largest coral reef system. A geographical inquiry of the reef could be undertaken at a range of scales.

Some geographical studies investigate a large area. For example, something that affects a whole country, such as a severe drought, would involve a study at the national scale. If an event or phenomenon affects the whole world, such as climate change and rising sea levels, it would be examined at the global scale.

It may be necessary to use different scales when studying the same thing. For example, as mentioned above, climate change is occurring globally and should be examined at the global scale.

However, it can be examined at other scales too.

**Source GT.6** Geographical inquiries can be carried out on a number of different scale levels.

Scale	Example of climate change inquiry
Local scale	Electricity consumption in your neighbourhood (increased use of air conditioning)
Regional scale	Coral bleaching on the Great Barrier Reef
National scale	Frequency of extreme weather events across Australia
Global scale	Reduction in Arctic sea ice; rising temperatures throughout the world

# SUSTAINABILITY

The concept of **sustainability** relates to the ongoing capacity of the Earth to maintain all life. This means developing ways to ensure the Earth's resources are used and managed responsibly so they can be maintained for future generations.

Sustainable patterns of living meet the needs of the current generations without compromising the ability of future generations to meet their own needs. Many of the world's resources (such as oil, coal and natural gas) are non-renewable. This means that if we continue to use them they will one day run out. Other resources (such as wind, forests, solar and water) are renewable. This means that they replace themselves naturally, or can be replaced to meet the needs of society. Sustainability encourages us to think more closely about these different types of resources – the ways in which they are formed and the speed at which they are being used. It also encourages us to look more closely at renewable options and take greater care of the Earth. Actions to improve sustainability can operate at a number of levels:

- local – recycling of paper by individuals, schools and households reduces the number of trees that need to be cut down
- national – in Australia, the government has begun to encourage sustainable use of energy by offering

incentives to promote the use of solar panels

- international – organisations such as the Marine Stewardship Council (MSC) are working with fisheries and retailers to promote responsible and environmentally viable fishing practices around the world.

There can be debate surrounding the sustainability of an environment, as people or organisations with different interests may put forward different points of view. A tree-logging company may protest that their practices are sustainable, as they re-plant as much as they cut down. On the other hand, a conservation group may be equally convinced that a forest cannot sustain cutting down trees. New trees may take decades to grow, in which time wildlife has moved on and the ecosystem has been altered. Many underdeveloped countries, such as Myanmar (Burma) (see Source GT.8), face enormous challenges controlling and monitoring forest clearance.

Sustainability is an important concept for geographers. They use it to investigate how natural and human systems work, and to understand how resources can be managed in such a way that they will be sustained into the future.



**Source GT.8** Logging in Myanmar (Burma) gives local communities a source of income but leaves hillsides bare and easily eroded by heavy rain.

# CHANGE

The Earth is constantly changing. Some changes are very rapid and are easy to observe, while others take place over millions of years and are almost undetectable to us.

The concept of **change** is important in geography because it helps us to understand what is happening around us and to see the world as a dynamic place. Change refers to both time and space, and allows geographers to examine how environments develop, transform or disappear.

Change can be the result of natural forces. For example, the Earth has been shaped and changed by climate, earthquakes, volcanoes and running water over millions of years. It can also be the result of

human activity, such as the building of a new bridge or clearing of forest for farmland.

Changes also take place on many levels, from local through to global. Local changes that happen quickly, such as storm damage in your street, are easy to observe and explain. Regional or national changes resulting from a bushfire or an earthquake can also happen quickly and their effects can be widespread with devastating impacts on places and people.

Changes that take place on a global scale can take much longer to occur. Global warming, for example, is a long-term change that happens slowly. Global warming has widespread effects that are not easily explained.



Source GT.9 The Barangaroo precinct on Sydney Harbour (in the foreground) – before development.

Observing and understanding changes that are natural and have occurred over time or changes that have been made by humans over time are important parts of any geographical inquiry. Geographers need to look at different types of changes, why they have occurred, over what time period they have occurred and what further changes may take place as a result.

Sometimes changes can be positive, such as the regeneration of vegetation, while other changes can have negative consequences, such as the pollution of waterways from industry. Geographers play an important role in ensuring that change is managed in a sustainable way.



**Source GT.10** The new Barangaroo precinct on Sydney Harbour – after development.

## REVIEW GT.1

### Remember and understand

- 1 Is Namche Bazaar (Source GT.2) an example of the natural or human environment?
- 2 List three natural environments and three human environments. Your answers can be drawn from the photographs in this section or you can use your own observations.
- 3 At what scale would a study of Mt Kilimanjaro's glaciers take place?

### Apply and analyse

- 4 Examine Source GT.8 of the hillside in Myanmar (Burma).
  - a What evidence of change can you identify in this picture?
  - b How might this change impact on the natural environment in this place?
  - c How might it impact on the people in the nearby village?
- 5 Examine Sources GT.9 and GT.10 of Barangaroo in Sydney.
  - a Describe the arrangement of the new business, residential and recreational facilities. Using the key concept of sustainability, what factors do you think would have needed to be considered when planning the development of this area?
  - b What examples of interconnection can you identify in these images?
- 6 Examine Source GT.3 of New York City. With a partner, construct four questions you could ask to

investigate why so many people live in such a small space. Share your questions with your classmates.

- 7 A geographer examining the changes that occurred at Barangaroo in Sydney would be interested in assessing the impacts and sustainability of these changes at the local scale. Describe some possible links between:
  - a environment and sustainability
  - b space and interconnection
  - c place and space
  - d scale and environment
  - e environment and interconnection.

### Investigate and create

- 8 Conduct some research online into the renewal and development of Newham, East London, in preparation for the 2012 Olympic Games. Choose three of the geographical concepts discussed in this section that could be used to better understand this project. Jot down two points for each concept.
- 9 Research the host city of the next summer or winter Olympics. What changes are being made to the natural and human environments in and around the city in preparation for the games?
- 10 Choose one of the key geographical concepts outlined in this section. Find a photograph in a magazine or on the internet that illustrates this concept. Explain your choice of photograph and how you think it describes the concept.

# GT.2

## GEOGRAPHICAL INQUIRY SKILLS

Geographers are investigators. They explore the world around them by asking questions about what they see. These questions begin an investigation that requires them to collect and analyse information and to communicate what they have discovered. To complete a full geographical inquiry there are three sets of skills. These are listed in Source GT.11.

For some geographical inquiries, you may only need to use one tool; for others, you may need to use many. As you develop each new skill you will have gained another important tool in explaining the natural processes and human activities that shape our amazing planet.

**Source GT.11** The three categories of skills used in a geographical inquiry

Acquiring geographical information	<ul style="list-style-type: none"><li>• Develop geographical questions</li><li>• Plan your inquiry</li><li>• Collect, select, record and organise primary and secondary geographical data and information</li><li>• Follow ethical protocols</li><li>• Use a variety of appropriate primary data and secondary information sources</li></ul>
Processing geographical information	<ul style="list-style-type: none"><li>• Evaluate information sources for their reliability, bias and usefulness</li><li>• Represent your data in a range of appropriate forms</li><li>• Represent the spatial distribution of geographical phenomena on maps</li><li>• Evaluate your data and information using qualitative and quantitative methods, and digital and spatial technologies</li><li>• Make generalisations and inferences, propose explanations for patterns, trends, relationships and anomalies, and predict outcomes</li><li>• Analyse your information, draw conclusions, take into account alternative perspectives</li><li>• Identify how geographical information systems (GIS) might be used to analyse geographical data and make predictions</li></ul>
Communicating geographical information	<ul style="list-style-type: none"><li>• Present findings, arguments and explanations in a range of appropriate forms</li><li>• Use relevant geographical terminology and digital technologies</li><li>• Reflect on and evaluate the findings of the inquiry</li><li>• Propose action, taking account of environmental, economic and social considerations; and explain the predicted outcomes and consequences of their proposal</li></ul>

## ACQUIRING GEOGRAPHICAL INFORMATION

### Develop geographical questions

Understanding our world begins by observing the processes that are taking place all around us. Geographers look at people, land, air, water, plants and animals and the connections between them to understand what is happening. They also seek to investigate where, why and how natural, managed and constructed environments are formed and changed. These observations often include identifying any problems or issues that need to be investigated and resolved.

One of your greatest assets as a geographer is curiosity. Geographers look at the world around them and ask questions about what they see, experience or have thought about. You may, for example, see a news item about a volcanic eruption or hear a report about

the world's most liveable cities. Or you may visit the centre of a large city on a field trip or a national park on holiday. As you begin to think like a geographer you will begin to ask questions about these events and places and these questions may be the starting point for a geographical inquiry.



**Source GT.12** Zebras grazing on the plains surrounding Mt Kilimanjaro

## SKILL DRILL

### How to develop geographical questions

You can learn to develop geographical questions that will help you to begin an inquiry about a particular topic or place. Start your questions with the words 'what', 'where', 'how', 'why', 'what impact' or 'what should' when thinking about your topic.

Your questions should examine ideas such as:

- Where is it?
- How big is it?
- What pattern or shape is it?
- Why is it like this? Is it like this because something else is at this location?
- How does it interact with other things in this place?
- How is it changing?
- How should people best manage this change?

The very best questions open up an exciting area for you to explore. Examine Source GT.12. A visitor to this place might ask a simple question, such as 'How much snow is there on the mountain?' This is a question with a relatively straightforward answer.

A better geographical question would be to ask 'Does the amount of snow on the mountain change

over time?' This question opens up a whole new area to explore because the answer to that question will lead on to further questions and greater depth of understanding. Some other example questions are:

- Is this a volcano?
- Why is it green on the ground but there is snow on the mountain?
- Are the animals all eating the same things?
- Is there more or less snow than in the past?
- How do people use the mountain?

### Apply the skill

- 1 Why is 'Does the amount of snow on the mountain change over time?' a better geographical question than 'How much snow is there on the mountain?'
- 2 Examine Source GT.8, which shows forest clearing in Myanmar (Burma). Work with a partner to develop a set of geographical questions about this place.
- 3 Where could you begin to find the answers to your questions?

## Plan a geographical inquiry

Asking geographical questions is a good way to open a range of possibilities for further research and investigation. It is usually best to narrow your investigation by selecting one of the geographical questions you have written as the basis for your inquiry. You should select a question in which you are interested and that will better help you to understand the environment you are investigating.

For example, you may choose to investigate the key inquiry question ‘How does this mountain affect the climate?’ The next step is to decide what data is needed to answer the question and how to collect the data.

## Planning an inquiry about Mt Kilimanjaro

Having chosen to investigate the key geographical question ‘How does this mountain affect the climate?’, it is time to consider what information you are going to need to answer this question. You also need to decide where you are going to locate the information you will need to collect. A good way to do this is to use a planning table like the one shown in Source GT.13.

**Source GT.13** Planning is a key stage in conducting a geographical inquiry.

Key inquiry question	Information needed	Possible sources of this information
How does this mountain affect the climate?	Climate data, particularly temperature and rainfall for places at various distances from Kilimanjaro including the summit	Atlas map to locate towns and cities at various distances from Kilimanjaro
		Encyclopaedia entry for the climates of Kenya and Tanzania
		Online search for climate data for selected towns and cities
	Observation of photographs and satellite images of the region	Photographs and satellite images of Kilimanjaro from throughout this chapter
		Google Earth, including historic imagery
	An understanding of the impact of landforms on temperature and rainfall	Printed resources such as geography textbooks, encyclopaedias and Bureau of Meteorology (BOM) books and leaflets
BOM website		

## Collect, select, record and organise primary and secondary geographical data and information

Good planning and preparation will ensure that your geographical inquiry will run smoothly, be relevant and give you the answers you are looking for. Once you have identified the issue, formulate your key inquiry question. You can conduct a sound, useful inquiry by following these steps:

- collect and record the information you think you will need to answer your key inquiry question
- evaluate this information and data to determine that they are accurate and relevant
- represent your findings in an interesting and appropriate way (such as tables, graphs, maps and sketches).

Geographers find answers to their questions in many places. They may collect information themselves by interviewing people, taking photographs, making sketches out in the field or conducting surveys and questionnaires. This kind of information will generally only be relevant to a particular inquiry and is called **primary data**.

Often a geographer collects information that supports his or her inquiry but has not been specifically collected or designed by the geographer for the inquiry. This type of information is

called **secondary data**. Secondary data sources include maps, graphs, statistics and websites that someone else has developed. One of the best secondary sources of information may be photographs from newspapers and magazines and satellite images from Google Earth. It is important to always evaluate any secondary sources for reliability, relevance and bias. This is particularly true for information accessed through the internet. Unlike a printed source such as a book or atlas it can be very difficult to establish who has written and published information online.



Source GT.14 Mt  
Kilimanjaro in Africa

## Ethics in geography

When conducting research and obtaining data for an inquiry, it is important for a geographer to be mindful of issues that are likely to raise ethical concerns. This may include being aware of privacy concerns, ensuring anonymity if required, and obtaining informed consent for research participants. Geographers may also need to outline where and how the information obtained will be used or published, and special attention may need to be given for relational data where geographical references or co-ordinates might disclose a participant's location and/or identity.

If a geographer is undertaking an inquiry that involves consulting with Aboriginal and Torres Strait Islander communities, they should be aware that there are guidelines and protocols that should be followed. While these are not necessarily rules, it is important to know that Aboriginal and Torres Strait Islander people have distinctive regional and cultural identities that require respectful consideration for meaningful consultation. This may involve preferred terminology, cues for cultural communication, and other means for making consultation harmonious and productive. If conducting such an inquiry it is advisable to do further reading, such as the *Aboriginal and Torres Strait Islander Peoples Engagement Toolkit*, which can be found online.

### REVIEW GT.2.1

#### Remember and understand

- 1 What are the three sets of skills in a full geographical inquiry?
- 2 What is the difference between primary sources and secondary sources of information?
- 3 Imagine that while watching the news on television this evening you see an item about a large earthquake in China.
  - a How could this news item be the beginning of a geographical inquiry?
  - b Write a series of geographical questions about this earthquake.

#### Apply and analyse

- 4 For the geographical questions that you have written, develop a planning table similar to the one shown here for Mt Kilimanjaro (see Source GT.13).

#### Investigate and create

- 5 Bring a copy of your local newspaper to class. Search through the newspaper, or think about your local area, and identify examples of stories or issues that could be investigated as part of a geographical inquiry. Examples may include a shopping centre extension, or a proposal for a new set of traffic lights or a pedestrian crossing. Choose one local issue and work with a partner to develop a series of geographical questions about it. Then, complete a planning table for one of your questions.

# PROCESSING GEOGRAPHICAL INFORMATION

## Evaluate data and information for reliability, bias and usefulness

When undertaking an inquiry, geographers need to evaluate the sources they use for reliability and potential bias, as well as usefulness. In the case of collecting data from primary sources, such as interviewing subjects directly on a topic, the information gathered will be reliable, as it is gathered first-hand. It is important for the geographer to keep in mind, then, any potential bias that may be influencing an interviewee's response. An interview that a geographer is conducting on the potential effects of turning local parkland into an industrial park, for instance, would have very different responses from a representative of the industrial developer, compared with a member of a local wildlife conservation group. It is important for a geographer to evaluate this kind of bias and remember to ask questions about the motivation behind it.

When selecting secondary sources, such as maps, graphs, photographs or other data, the geographer also needs to ensure the data is reliable and unbiased. This includes evaluating the creator of the data – is the data from a recognised source like a government body, such as the Bureau of Meteorology or a research agency like the Commonwealth Scientific and Industrial Research Organisation (CSIRO)? Is the data provided without bias? Or is it presented on a website for a company that might have a vested interest in influencing public opinion?

## Represent data and information in a range of appropriate forms

Geographers often present the information they gather during their inquiries in a number of different ways. They make maps, create graphs and tables or even draw diagrams to help them look for patterns in the data they have gathered. These tools help the geographer to analyse and interpret the information they have gathered, and also present the information to other people (the general public, the government, the media) and help them to understand the geographer's findings. You will practise using some of these geographical tools in GT.3 including:

- topographic maps
- digital maps and terrain models
- cartograms
- climate graphs
- compound column graphs
- population pyramids
- scatter plots
- geographical diagrams
- tables
- geographical sketches
- geographic information systems (GIS)
- geographical photos.

## Evaluate data and information gathered, analyse findings and results, draw conclusions

Once you have collected, recorded, evaluated the quality and represented your information using appropriate geographical tools, it is time to make sense of it all and reach some conclusions about the geographical question that began your inquiry. Geographers look for order, diversity, trends, patterns, anomalies and relationships in their information. It can often help to classify information by sorting it into groups.

## Evaluating the reliability of websites

There is an enormous amount of information available online but it is important to keep in mind that not all websites provide reliable information. You must be careful not to naively accept all information published online as being from a reliable source. Websites should be critically evaluated for reliability by following these steps:

- Step 1** Find out how old the information is. When was it first published? This will help you decide whether it is useful for your inquiry or not.
- Step 2** Find out who published the information. Is it possible they have a bias? You can often find out more about the organisation publishing these statistics by going to their 'home' page or 'about us' page.
- Step 3** Look at the extension at the end of the website address as this gives you an important clue about the origin of the information. For example, .com is used by commercial

organisations such as online stores, .org is used by non-commercial organisations such as NGOs and welfare groups, .gov by government departments, .edu refers to schools and universities, .biz by businesses and .mil by military groups.

- Step 4** If you cannot find out when the information was published or who published it, it is probably too unreliable to use in a geographical inquiry. Look for a more reliable source of information.

### Apply the skill

Common websites used for reference information include the CIA Factbook (see Source GT.15), the Australian Bureau of Statistics, National Geographic and the United Nations Development Programme. Use the steps listed above to assess the reliability of the data found on these websites.

**Source GT.15** This web page describes Tanzania. How do you know if it contains reliable information?

The screenshot shows the CIA website's Library section. The header includes the CIA logo and the tagline 'THE WORK OF A NATION. THE CENTER OF INTELLIGENCE.' Below the header is a navigation menu with options like HOME, ABOUT CIA, CAREERS & INTERNSHIPS, OFFICES OF CIA, NEWS & INFORMATION, LIBRARY, and KIDS' ZONE. The main content area is titled 'Library' and features a search bar and a dropdown menu for selecting a country. The selected country is Tanzania, and the page displays a list of categories for Tanzania, including Introduction, Geography, People and Society, Government, Economy, Energy, Communications, Transportation, Military, and Transnational Issues. A map of Tanzania is also visible on the page.

There are a number of methods and models that geographers use to help them during this stage of their inquiries. These include the:

- PQE method
- SHEEPT method.

## Using the PQE method

PQE is a tool used by geographers to describe the data they have gathered (particularly on maps) and to look for patterns in this data. The letters PQE stand for pattern, quantify and exceptions.

### P Pattern

In this step, you need to give a general overview of any patterns you may identify.

When looking at any form of data, look for things that stand out or form patterns. A pattern may be a group of similar features on a diagram, a concentration of a particular colour or feature on a map, or a particular shape that is created by data on a column graph. For example, when looking at a map of Africa (see Source GT.16) you might say, 'The forests seem to be located mainly in Central Africa and Southern Africa'.

### Q Quantify

In this step, you need to add specific and accurate information to define and explain the patterns.

Quantifying involves using statistics, amounts, sizes and locations to give specific details. For example, rather than just saying, 'The most forest is located in the centre of the continent', you would need to quantify this statement. You might say instead, '240.3 million hectares of forest has been recorded in Central Africa, compared with 35.4 million hectares in East Africa'.

### E Exceptions

In this step, you need to identify everything that does not fit your patterns.

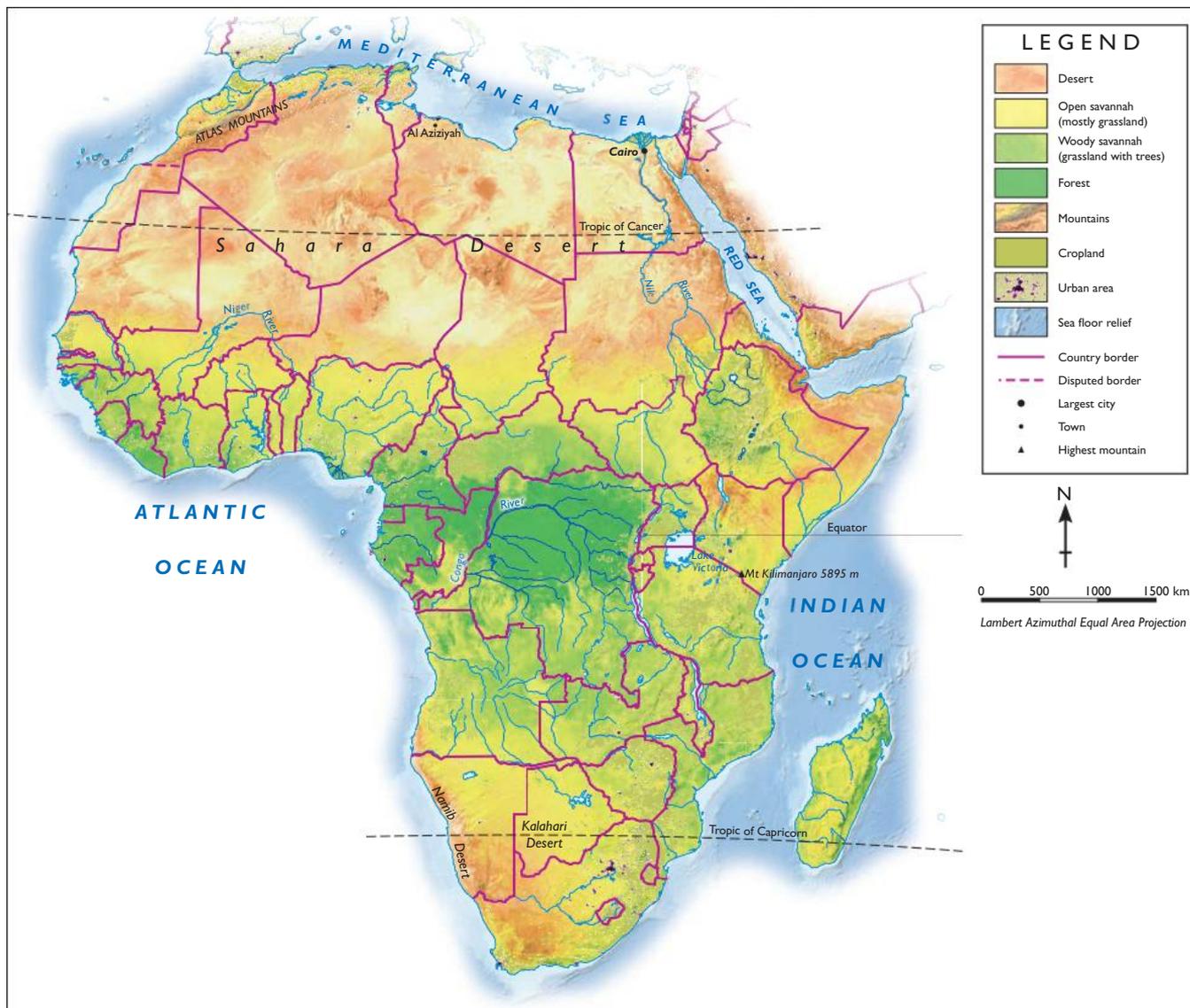
Often, you may find that there are things in your data that do not fit into a pattern you have identified. These are called exceptions. They also need to be identified and quantified. For example, you might say, 'There are also forest regions located in North Africa and West Africa'.

## Using the SHEEPT method

SHEEPT is a tool used by geographers to help them to consider the many factors that may contribute to the patterns identified in their data. When you are examining issues related to your inquiry, it is useful to think about them in terms of these six factors and rank them in order of importance. This will help you to reach your conclusions. The letters SHEEPT stand for:

- social (S) – factors relating to culture and people
- historical (H) – factors relating to past events
- environmental (E) – factors relating to the natural environment (including climate, landforms and vegetation)
- economic (E) – factors relating to the earning or spending of money (including income earned from industry and tourism and the cost of building a dam or highway)
- political (P) – factors relating to governments (including laws, regulations and policies)
- technological (T) – factors relating to the availability and use of different types of technology (including the development of greener technologies, alternative energy sources and **GIS**).

## AFRICA: ENVIRONMENTS



Source GT.16

Source: Oxford University Press

### REVIEW GT.2.2

#### Remember and understand

- 1 What do the letters PQE stand for?
- 2 What do the letters in SHEEPT stand for?
- 3 Why is a website that ends with .edu more reliable than one that ends with .com?

#### Apply and analyse

- 4 Is the CIA Factbook (see Source GT.15) an example of a primary or secondary source?
- 5 Look at Source GT.16. Use the PQE method to think about Africa's deserts.
  - a Can you identify a pattern?
  - b Can you quantify this pattern?
  - c Are there any exceptions in this pattern?

#### Investigate and create

- 6 Conduct your own internet research on the way in which Mt Kilimanjaro is managed and use the SHEEPT method to think more closely about the factors that impact on it.
  - a List at least one point for each of the SHEEPT factors.
  - b What conclusion(s) can you make about the way in which Mt Kilimanjaro is managed?
- 7 Create a colourful and informative pictogram to help you remember what SHEEPT stands for using an image or picture for each of the 'SHEEPT' letters.

# Distinguishing between quantitative and qualitative data

Primary and secondary data provide either **quantitative data** or **qualitative data**.

Quantitative data includes anything that can be recorded as numbers (for example, Mt Kilimanjaro is 5895 metres tall and has an area of 753.5 square kilometres).

Qualitative data, on the other hand, includes anything that can be recorded in words (for example, Mt Kilimanjaro is the tallest mountain on the African continent).

## Quantitative data

The PQE method uses mainly quantitative data.

Examples of quantitative data include:

- climate and temperature statistics
- tourist numbers
- population figures (including birth and death rates)
- types and amounts of food grown
- plant and animal species and wildlife in certain areas
- forest clearance rates
- numbers of people killed in natural disasters
- numbers of volcanic eruptions and earthquakes.

## Qualitative data

The SHEEPT method uses mainly qualitative data.

Examples of qualitative data include:

- opinions
- points of view
- personal stories
- likes and dislikes
- feelings.

Good geographical inquiries will always be based on a combination of primary and secondary data that is both quantitative and qualitative. Even though qualitative data is an important part of any geographical inquiry, quantitative data is considered to be more valuable because it is less open to personal interpretations and can be more accurately represented in graphs and charts.

Before you move to the next stage of your inquiry, it is important to check that you have recorded all your data without errors and that it is balanced and fair. Your data should not reflect your personal opinions, emotions or attitudes; instead it should present the facts in a clear and concise way.

# Using other methods to process geographical data

## Analysing geographical photographs

Landscapes can be photographed from several different angles depending on the position of the camera at the time the photograph was taken (see Sources GT.17–GT.19). Each angle makes some features of the landscape easier to see and interpret than other features, so you need to carefully consider at which angle the photograph has been taken.

## Analysing satellite images

A satellite image is taken from space (see Source GT.20). It allows us to see large areas of the Earth's surface. These images are often used to investigate patterns, such as the streams and rivers that radiate from Mt Kilimanjaro. It is difficult, however, to see smaller features of the environment.

## Analysing false colour images

You may have heard the terms ‘**false colour image**’ or ‘false colour map’ before. The term ‘false colour’ does not mean the colours used in an image are incorrect, it just means different colours have been used to make the image or map easier to interpret. The cartographer or person working on the image has chosen colours that make some aspects easier to see or understand than in a normal ‘natural’ photograph or map.

The colours used in a false colour image can be quite exaggerated and unnatural-looking. This is because the colours of the natural features are too similar to demonstrate a particular point or aspect. If someone is trying to show where a muddy brown river meets a brown-coloured riverbank, where there are brown rocks and some brownish shrubs, they might decide to use false colour to clearly show where the different elements are. In that case, they may decide to make the shrub areas bright green, make the river a neon yellow and the rocks a bright red, leaving just the river bank brown.

You should examine the accompanying legend to interpret the colours used in a false colour map.



**Source GT.17** This is a **ground level photograph** of Mt Kilimanjaro. The camera is being held by someone at the same level as the landscape being photographed. This angle allows you to clearly see the height of any object and the detail in vertical surfaces. However, objects such as the mountain and the tent hide the landscape behind them.



**Source GT.18** In this **oblique aerial photograph** the camera is positioned above the landscape but is angled towards the scene being photographed (oblique means ‘at an angle’). This allows you to see both the foreground and the background of the scene. You can also see both the height of an object and its width or area. Objects in the background, however, seem much smaller than those in the foreground.



**Source GT.19** In a **vertical aerial photograph**, the camera is positioned directly above the landscape. This vertical (or plan) view allows you to see the extent of any feature such as Mt Kilimanjaro’s crater. It is very difficult, however, to judge the steepness of the mountainside or the depth of the crater. Plan views are used for making maps, as the scale is the same over the area shown and similar objects look the same size.



**Source GT.20** This image of Mt Kilimanjaro was taken by a satellite orbiting at 830 km above the Earth’s surface.

### REVIEW GT.2.3

#### Remember and understand

- 1 What is an oblique aerial photograph?
- 2 What are some of the advantages and disadvantages of using a vertical aerial photograph?

#### Apply and analyse

- 3 Which type of photograph would you take on a field trip?
- 4 Some geographers are very interested in the amount of snow and ice on Mt Kilimanjaro, as it has been gradually declining for several decades. Which type of photograph do you think would be most useful to show the decline of the total area of the mountain’s snow and ice?

#### Investigate and create

- 5 The oblique aerial photograph (Source GT.18) was taken in 1991 and the ground level photograph (Source GT.17) was taken in 2009.
  - a How has the mountain top changed in this time?
  - b With a partner, discuss some geographical questions you could ask to investigate why the mountain has changed in this time. Don’t worry about the answers; just concentrate on writing some good questions.
  - c Share your questions with the class. List three questions from the class discussion that you think could be the beginning of a geographical inquiry.
  - d Where could you find information to help you to investigate these questions?

# COMMUNICATING GEOGRAPHICAL INFORMATION

During a geographical inquiry you may discover something new that other people should know about. It is important that you are able to communicate your findings clearly and effectively. There are several ways of doing this and you should select the method that best suits your audience and purpose:

- verbal methods, such as oral reports, discussions and debates
- audio methods, such as radio reports
- graphical methods, such as graphs, annotated photographs, sketches and satellite images
- visual methods, such as annotated visual displays or PowerPoint displays
- maps
- text-based methods, such as essays or paragraphs.

## SKILL DRILL

### Creating and delivering a PowerPoint presentation

Follow these steps to create and deliver a PowerPoint presentation with confidence:

- Step 1** Gather the research for your geographical inquiry. This will include any written research materials, the sources you have used, results of any surveys or interviews, and a range of relevant images, graphs, maps or photographs.
- Step 2** Plan your presentation. Decide what you would like to focus on.
- Step 3** Time yourself. Your teacher will be able to tell you how long your presentation should be, so you should plan your presentation accordingly. For a 10-minute presentation you may need to include 10 slides and talk for about a minute on each one.
- Step 4** Once you have worked out the length of your presentation and the content you would like to include, create your slides. If you aren't too familiar with PowerPoint there are plenty of online guides to help.
- Step 5** Include a couple of bullet points on each slide. You can progress through the points quickly or take a bit more time on some points as you move through your presentation.

- Step 6** Include a question caption with any photo slides. Having a question presented along with a photo helps engage the audience and promotes discussion.
- Step 7** Practise your presentation. Practising will help you with your timing, and get you used to talking through your key points using the slides to support you. Make sure you are confident with the technology before you do your presentation in front of the class.
- Step 8** Deliver your presentation, working through the PowerPoint slides you've prepared.
- Step 9** Invite your audience to ask questions and do your best to answer them. Don't make up answers if you are unsure, just do your best.

#### Apply the skill

Prepare and deliver a PowerPoint presentation on an area of geography that you find interesting. It could be the local issue that you researched in the previous section, or something you have noticed in the news, such as the United Nations Intergovernmental Panel on Climate Change. Ensure you include some interesting visual elements like photographs or graphs, as well as your key points.

## Reflecting

The final steps in completing a geographical inquiry are to reflect on the results of your inquiry and the methods that you used. This is an essential step as it allows you to learn important lessons from any mistakes that you have made and to apply these lessons in your next geographical inquiry. There are several ways to reflect on your geographical inquiry: looking at what you have learned, thinking about how it was learned, and asking critical questions about the way your geographical inquiry was conducted. One of the best methods to help you reflect is to complete a self-evaluation checklist (see Source GT.21).

# Responding

Geographers often use the information gathered and analysed in their inquiry for a specific purpose. This could be to report on an issue and educate people, to raise awareness of a potential problem, or to lobby local, state or federal government about a particular concern. This can be done via various means, from presenting official reports or studies to using social media and starting an online petition. The work you do as a geographer can contribute to your environment, and responding and acting is an important part of this work.

If the results of your geographical inquiry lead you to recommend a plan of action, there are some important things to consider:

- Is it environmentally sustainable? Does the plan impact in a negative way on the natural environment and natural processes?
- Does it bring more economic benefits than it costs? Is it affordable in both the short and the long term?
- Does everyone affected by this plan of action benefit from its outcomes or just a few people?

The title of my geographical inquiry is:

My geographical inquiry set out to investigate:

GENERAL POINTS	My rating	Comments				
	1	2	3	4	5	
I was able to complete all stages of my geographical inquiry	<input type="checkbox"/>	<input type="text"/>				
I was able to answer all my key inquiry questions	<input type="checkbox"/>	<input type="text"/>				
I was able to plan my inquiry effectively	<input type="checkbox"/>	<input type="text"/>				
My maps, graphs, tables and diagrams were clear and accurate	<input type="checkbox"/>	<input type="text"/>				
I was able to analyse my data and reach a conclusion	<input type="checkbox"/>	<input type="text"/>				
I was able to communicate my findings in an interesting and appropriate way	<input type="checkbox"/>	<input type="text"/>				

AREAS OF STRENGTH	Comments
My areas of strength are:	<input type="text"/>
I'm getting much better at:	<input type="text"/>

AREAS NEEDING IMPROVEMENT	Comments
The part I found most difficult was:	<input type="text"/>
I need the most help with:	<input type="text"/>

IMPORTANT ISSUES HIGHLIGHTED BY MY INQUIRY	Comments
The most important thing I learned from my inquiry was:	<input type="text"/>
This issue is important to me because:	<input type="text"/>
This issue is important to my community/country/world because:	<input type="text"/>

Source GT.21 A self-evaluation checklist

A geographical inquiry on the lower slopes of Mt Kilimanjaro found that many schools lacked a reliable supply of clean water for sanitation. Based on this inquiry, the members of several non-government organisations along with the local villagers laid hundreds of metres of new pipes and installed tanks and taps so that school children could wash their hands before preparing food.



## CASE STUDY

### Mt Kilimanjaro

Source GT.22 Children at school near Mt Kilimanjaro using newly installed taps to wash their hands before preparing food

## REVIEW GT.2.4

### Remember and understand

- 1 Why is communicating an important part of a geographical inquiry?
- 2 List three ways you could communicate your findings.
- 3 The self-evaluation checklist is one way to reflect on a geographical inquiry. What are two other ways?
- 4 Why are the findings of a geographical inquiry often useful to the community?

### Apply and analyse

- 5 What do you most enjoy about other students' oral presentations? What do you least enjoy?
- 6 What geographical questions do you think began the inquiry that resulted in the new taps in Source GT.22?

- 7 Why is it important that an action plan for change consider the issue of sustainability?

### Investigate and create

- 8 You are preparing a PowerPoint presentation for your class on the decline of the glaciers on Mt Kilimanjaro. Write a rough plan for your presentation, including answers to the following.
  - What are some of the main points you would raise?
  - What images from this toolkit would you use?
  - What would the focus of your presentation be?
- 9 Create a checklist to assess your map-drawing skills.

# GT.3 GEOGRAPHICAL TOOLS

## MAPS

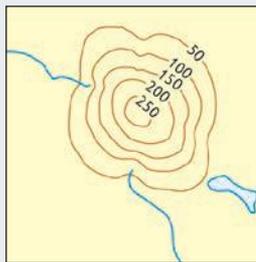
One of the most useful tools that geographers use to process information is a map. A map is a simplified plan of an area. Maps are drawn in the plan view (directly from above) because this ensures the scale will be the same across the entire area. If maps were drawn from an angle, some parts of the mapped area would look distorted and so it would not be an accurate representation of the area. When properly used, maps can reveal a great deal about our planet and the ways in which we use it.

### Topographic maps

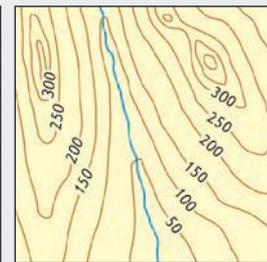
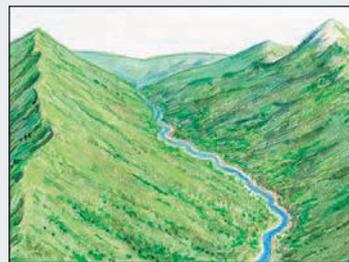
A piece of paper only shows two dimensions: width and length. However, the Earth's surface has a third dimension: height. Cartographers (map drawers) use a variety of methods to show this third dimension.

**Topographic maps** are one of a geographer's most useful tools. Because most topographic maps are drawn of a small region they can show that region in great detail right down to individual buildings and rocks. They also show the height of the land above sea level through the use of **contour lines** that join together all places of an equal height. By learning to interpret the contour patterns made by these lines you can work out the shape and height of the land that has been mapped (see Source GT.23).

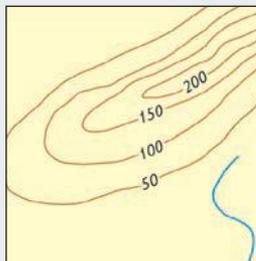
#### ROUND HILL OR VOLCANO



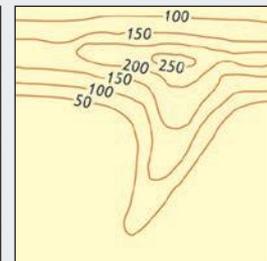
#### VALLEY



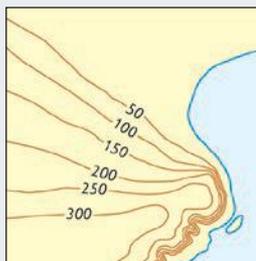
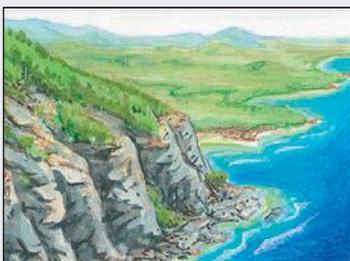
#### RIDGE



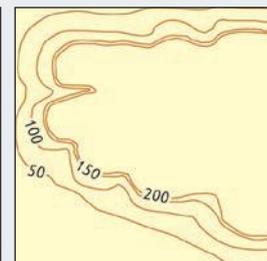
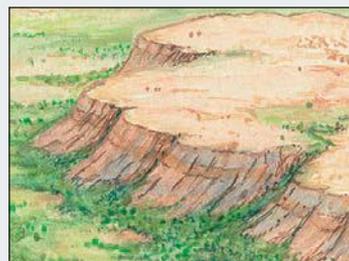
#### SPUR



#### CLIFF



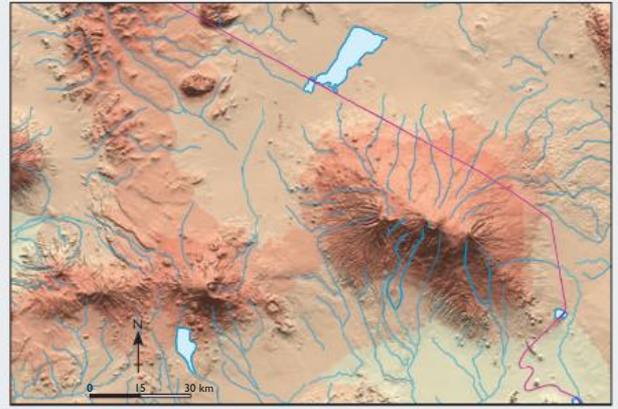
#### PLATEAU



Source GT.23 Common contour patterns

## Digital maps and terrain models

There are about 6000 satellites orbiting the Earth. Many of these collect digital data about the shape and height of the land and transmit it back to computers on the ground. This data is then interpreted and can be used to draw maps. Cartographers can use computer programs to add colours to these digital maps to highlight certain aspects of the environment. In Source GT.24, for example, the land has been shaded according to its height. The data can also be manipulated in other ways. In Source GT.25 it has been used to create a side view of the landform being mapped. This type of illustration is known as a **digital terrain model (DTM)**.



**Source GT.24** In this digital map of the Mt Kilimanjaro region, land has been shaded according to its height above sea level. Shadows have also been added to help map users understand the shape and height of the land.

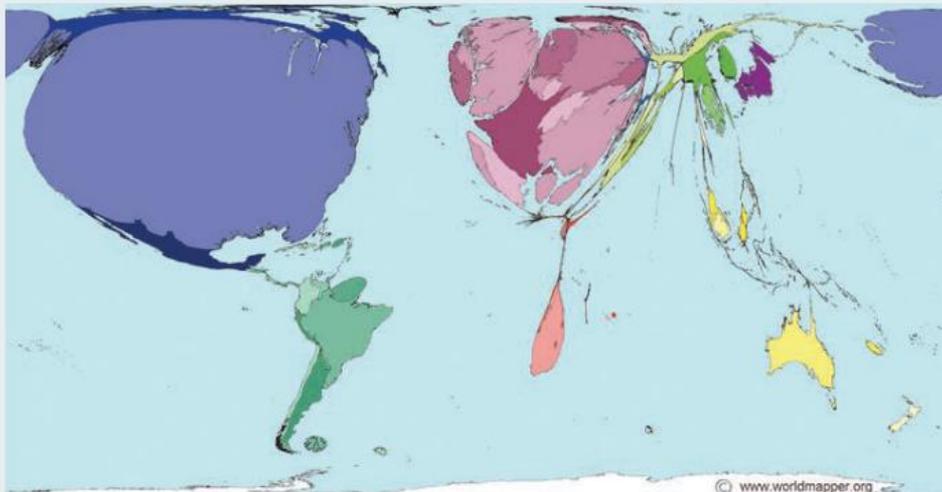


**Source GT.25** This is a digital terrain model of Mt Kilimanjaro and the surrounding area. The data was collected by a NASA space shuttle and an orbiting satellite. Cartographers have exaggerated the height of the landform so that it appears twice as high as it actually is.

## Cartograms

You will have seen **cartograms** already in the course of your geography studies. These are the maps that look distorted and have areas that appear thinner or more enlarged than they would normally be, depending on what they are showing. Cartograms are sometimes called ‘value by area’ maps, which means the spaces on the maps are distorted to show a representation of a value rather than land area.

For example, while Vietnam is a relatively small country in terms of land area, it is the fifth largest rice growing country, so it would be exaggerated to a much greater relative size in a cartogram. The United States, which actually has a much larger land mass than Vietnam, is the 10th largest rice producer, so it would appear much smaller than actual size on a cartogram.



**Source GT.26** This cartogram shows the percentage of the population living on more than US\$200 a day. The distortion shows that the United States has many more people living on this amount than Asia does.

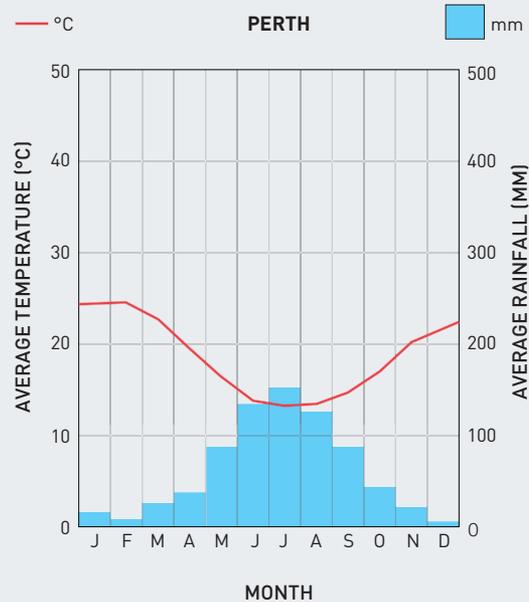
# GRAPHS AND STATISTICS

In Years 7 and 8 you will have learned how to create and interpret simple graphs, such as **bar graphs**, **column graphs** and **pie graphs**. In Years 9 and 10 you will be working with more complex graphs. You won't necessarily be creating these kinds of graphs yourself but you will be learning how to interpret them and make sense of the information they provide. A range of complex graphs are described below.

## Climate graphs

**Climate graphs** show the general climate of a place – what the weather is like over the long-term trend in a certain location, and graphing the average monthly temperature over the course of a year (see Source GT.27). Climate graphs combine line and column graphs. Temperature is recorded as a **line graph** and rainfall is recorded as a bar graph.

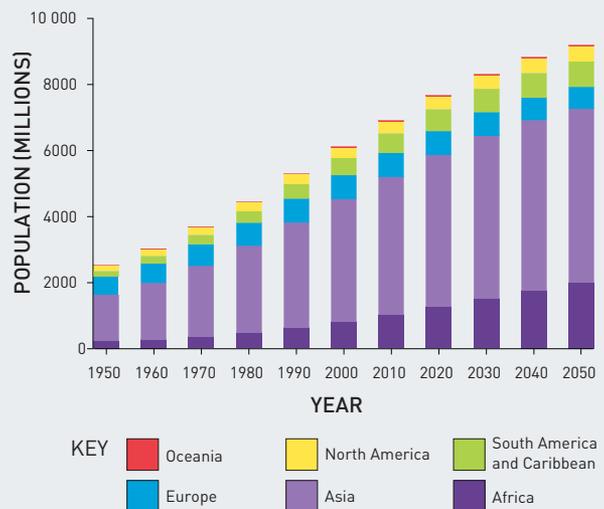
Source GT.27 A climate graph showing the average monthly temperature and rainfall in Perth



## Compound column graphs

A **compound column graph**, sometimes called a stacked column graph or stacked bar graph, is used by geographers to compare the parts of something with the whole. They are a more complex type of column graph in which each column is split into sections. The results are then stacked on top of each other, in different colours or different shades, so that results can be easily compared (see Source GT.28).

Each column in a compound column graph represents a total, and each different coloured segment represents a part that makes up that total. The graph in Source GT.28, for example, shows the total increase in world population from 1950 projected up to 2050. Of the total increase in population, it is immediately clear that Asia, coloured light purple, has experienced and will continue to experience the greatest growth. It is also immediately clear that Oceania, coloured red, has experienced very small population growth in comparison. We can quickly see and compare a number of figures that contribute to a total.

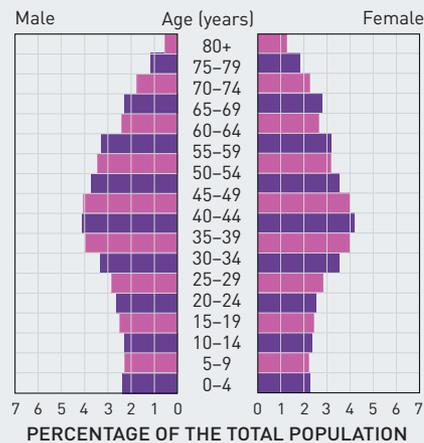
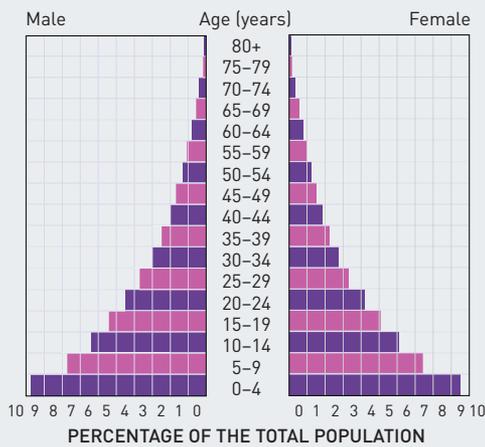


Source GT.28 A compound column graph showing the increase in world population by region, 1950–2050 (columns on the right provide projections)

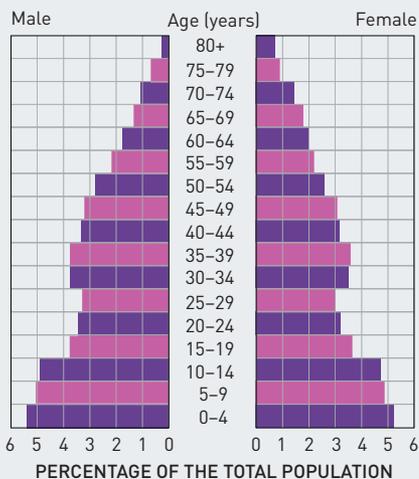
## Population pyramids

**Population pyramids** are horizontal bar graphs that show the proportion of men and women in different age groups in a population. They can be used in a number of ways. Most commonly, they are used to compare the population structures and growth rates of different countries. A triangular-shaped graph shows a population with a high birth rate while a graph that tapers in (is narrower) at the younger ages indicates a population that is contracting or declining (see Source GT.29).

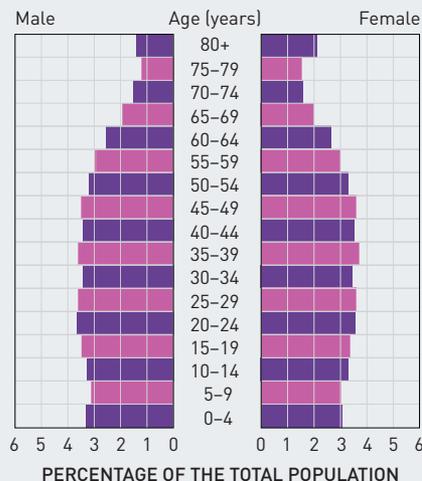
Population pyramids can also help geographers to identify the ways in which the population in a single country is changing over time. In these population pyramids of Australia's population, for example, it is clear that the percentage of Australia's population over the age of 65 increased between 1960 (see Source GT.30) and 2009 (see Source GT.31). Geographers describe this change as the ageing of the population.



Source GT.29 Population pyramids showing growing (left) and contracting (right) populations



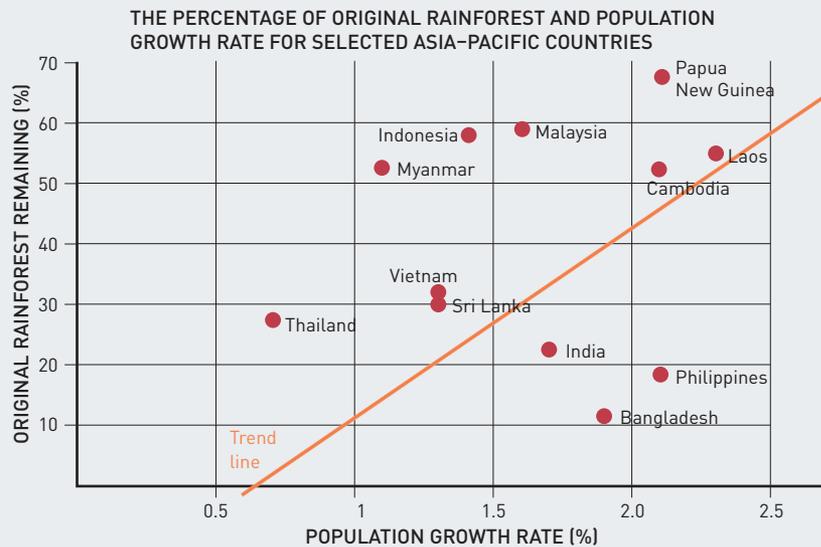
Source GT.30 Population pyramid for Australia, 1960



Source GT.31 Population pyramid for Australia, 2009

## Scatter plots

Maps can be useful to show a pattern but they don't really explain that pattern. A special type of graph called a **scatter plot**, or scatter graph, is a better way of doing this. A scatter plot compares two sets of data in a visual way so that connections between them can be easily seen. They are also called a scattergram. The following scatter plot compares the amount of original forest cover remaining in selected Asian countries with their population growth rate. It is essentially testing the theory that forests are more endangered in countries where the population is growing rapidly (see Source GT.32).



Source GT.32 Scatter plot showing remaining forest and the population growth rate

Because most of the countries lie close to the trend line in this graph, it is possible to say that there is a relationship between the amount of forest in a country and the rate at which its population is growing. Countries with the fastest growing populations have the most rainforest remaining. Those countries that lie apart from the general trend, such as Myanmar, are called outliers. A geographer studying this graph might use it as the beginning of a geographical inquiry into deforestation in Myanmar.

### REVIEW GT.3.1

#### Remember and understand

- 1 Maps drawn from what angle are sometimes called a 'birds eye view'? Why is this so?
- 2 Contour interval is the vertical distance between each contour line. What interval is used in Source GT.23?
- 3 What advantages do scatter plots have over maps?
- 4 What do population pyramids show? Why are they a useful tool for geographers?
- 5 Examine Source GT.32. In which of these countries is the population increasing most rapidly? How much original forest cover remains in this country?

#### Apply and analyse

- 6 Using Source GT.24, describe the terrain of the region surrounding Mt Kilimanjaro. Do you think Source GT.24 is more useful for this task than Source GT.25?
- 7 Describe the differences between the population pyramids in Sources GT.30 and GT.31. What do these differences reveal about the populations at these two times?

#### Investigate and create

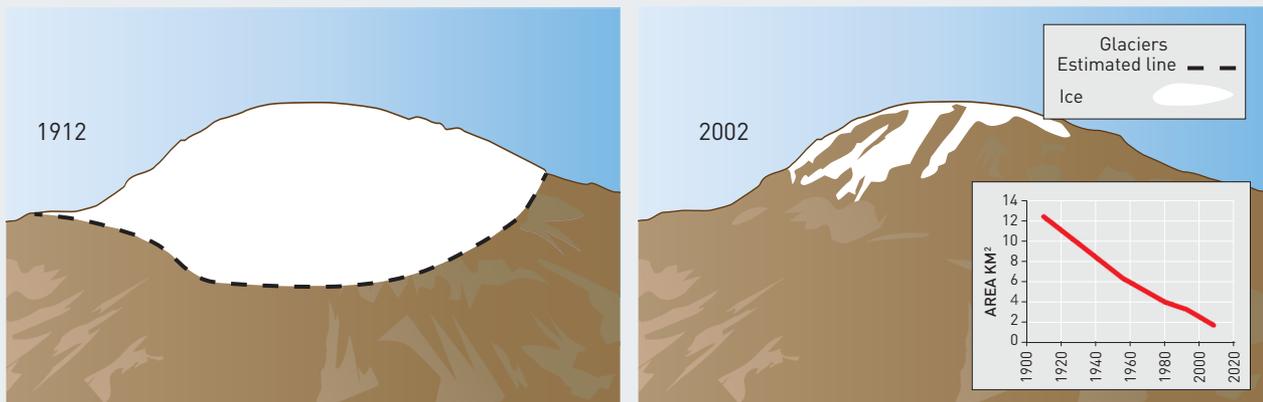
- 8 Examine Source GT.25. Sketch the probable contour pattern of the landscape shown. Use Source GT.23 as a guide to common contour patterns.
- 9 Research the size of the population of a country other than Australia over a 10-year period. Create a graph or graphs to present your findings.

# SPATIAL TECHNOLOGIES AND VISUAL REPRESENTATIONS

In addition to maps and graphs, geographers use a range of other visual representations to communicate information they have collected. These include geographic diagrams, sketches, tables, geographical photographs and geographic information systems (GIS). These ways of presenting information allow geographers to communicate their findings in the most clear and appropriate manner.

## Geographical diagrams

Geographical diagrams are simplified drawings of the real world. They allow geographers to show the features or characteristics of places or things much more directly than describing them in words. Certain interesting or complex processes can also be easily explained and demonstrated in a diagram, and communicated quickly and effectively by simple visual representation (see Source GT.33).



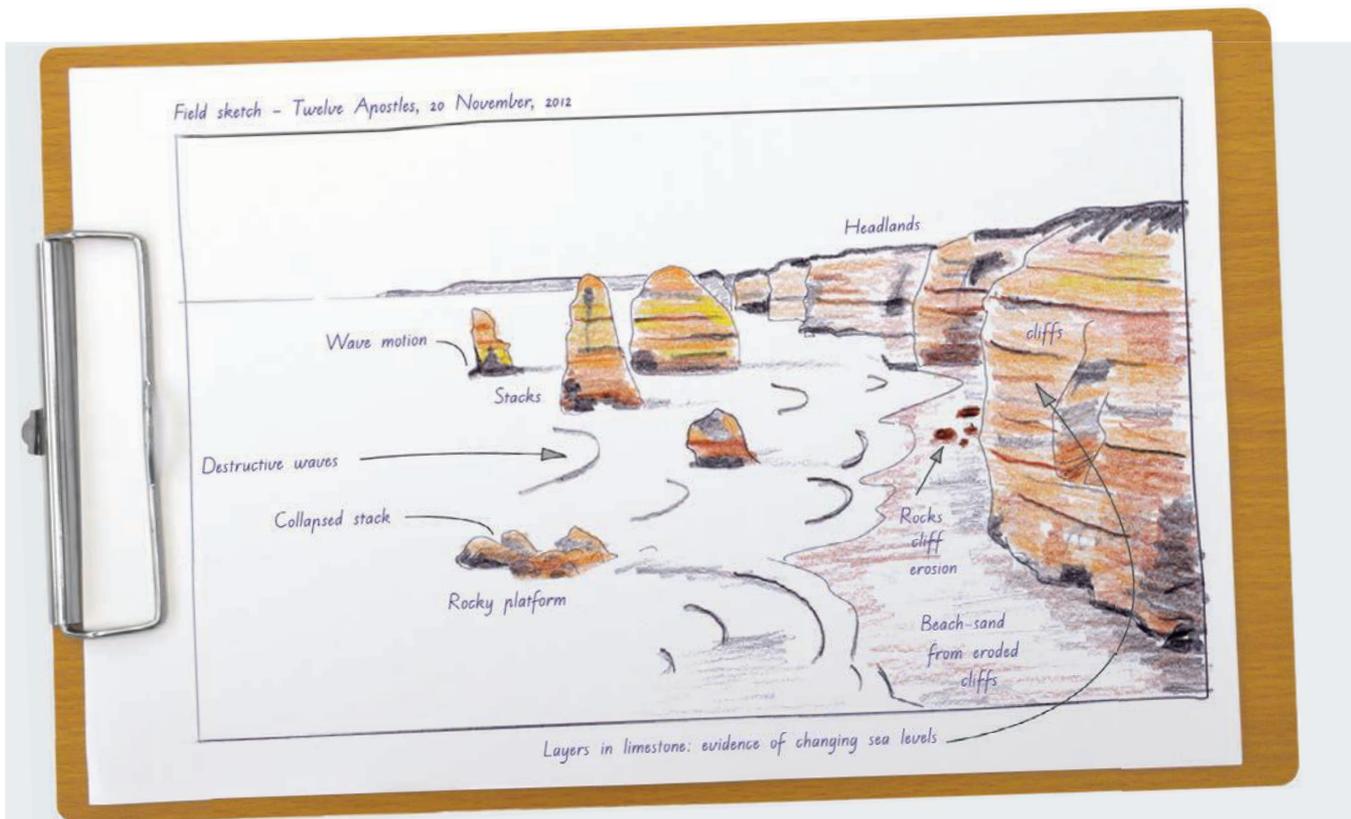
Source GT.33 These diagrams show the dramatic rate at which snows have melted on Mt Kilimanjaro.

## Tables

Tables allow geographers to present and compare data by organising it under different headings. Tables can be useful for presenting information over a range of time periods or locations.

Source GT.34 This table, based on data gathered by geographers in 2006, shows the change in area of seven glaciers (A–G) on Mt Kilimanjaro, 1912–2003.

Areas (10 <sup>3</sup> m <sup>2</sup> )	Glacier Area A	Glacier Area B	Glacier Area C	Glacier Area D	Glacier Area E	Glacier Area F	Glacier Area G	Total
1912	5676	3	27	5011	811	372	158	12058
1953	3829	0	16	2156	493	181	0	6675
1976	2440	0	0	1409	209	113	0	4171
1989	1900	0	0	1168	147	90	0	3305
2003	1304	0	0	1025	132	49	0	2510



Source GT.35 Field sketches are useful for capturing information quickly and directly.

## Geographical sketches

A geographical sketch can be an extremely useful way of collecting information, and presenting it in a straightforward and immediate way. They are often completed in the field (and are known as field sketches) or are sketched from photographs. The aim of a geographical sketch is to focus on those parts of the environment that are relevant to the current geographical inquiry. For example, a geographer studying the role of waves in the erosion of a coastline would sketch the rocks and landforms of a beach (see Source GT.35), while another geographer studying tourism at the coast would sketch the buildings and roads at the same beach. Sketches allow the geographer to simplify information to make it easier to understand.

## Geographic information systems

A geographic information system (GIS) is a way of collecting, storing, presenting and using geographical data. GIS encompasses collecting geospatial data – real-world distance between landmarks, depth of sea level, height and width of buildings, layout of streets and suburbs – and presenting it through digital means. A car's GPS uses GIS data to allow you to navigate through the real world, using data that have been gathered using computer technology. GIS has many different applications and is used for planning, telecommunications, transport and logistics, to name just a few.



Source GT.36 Geographic information systems gather and present real-world geographical data using computer technology.

## Geographical photographs

Geographical photographs differ from other types of photographs in that they are taken to depict and present a place or particular feature of the landscape for the purpose of demonstrating an aspect that you are studying. This is quite different from taking photos of you and your friends for fun, or even from taking an attractive picture of a landscape. Geographical photographs are used as a source of data.



**Source GT.37** A geographical photograph demonstrates a particular aspect of a place or environment, like this one of the Mt Kilimanjaro glacier area.

### SKILL DRILL

## Collecting and evaluating geographical photographs

Geographers take photographs with the purpose of capturing a specific visual reference. This skill in geography is learning to capture a scene on camera that shows exactly what you want it to. You will not necessarily be taking the prettiest picture – you will be taking the picture that is relevant to your inquiry. Then, you can show the key features by adding notes or labels to your photograph. This is known as annotating the photograph. Annotating your photograph will help with your evaluation of the subject, too.

**Step 1** Prepare for your session. Read the manual for your camera and get to know what your camera is capable of doing. Learn about exposure and how to frame your subject – there are plenty of tips online to help you with this. It is important to hold your camera steady, or you can practise using a tripod. This is especially useful when collecting photographs of the same place over a period of time.

**Step 2** Decide on your subject and ensure you are photographing the relevant parts you want to feature. Select the features of the landscape that show important aspects of

your geographical inquiry. Remember your key inquiry question. It could be something like, 'How does tourism impact on this environment?' If so, ensure you include evidence of any impact, such as rubbish left along a shoreline. In the case of the photo shown in Source GT.37, the key inquiry question was, 'Are the glaciers becoming smaller because of natural or human factors?'

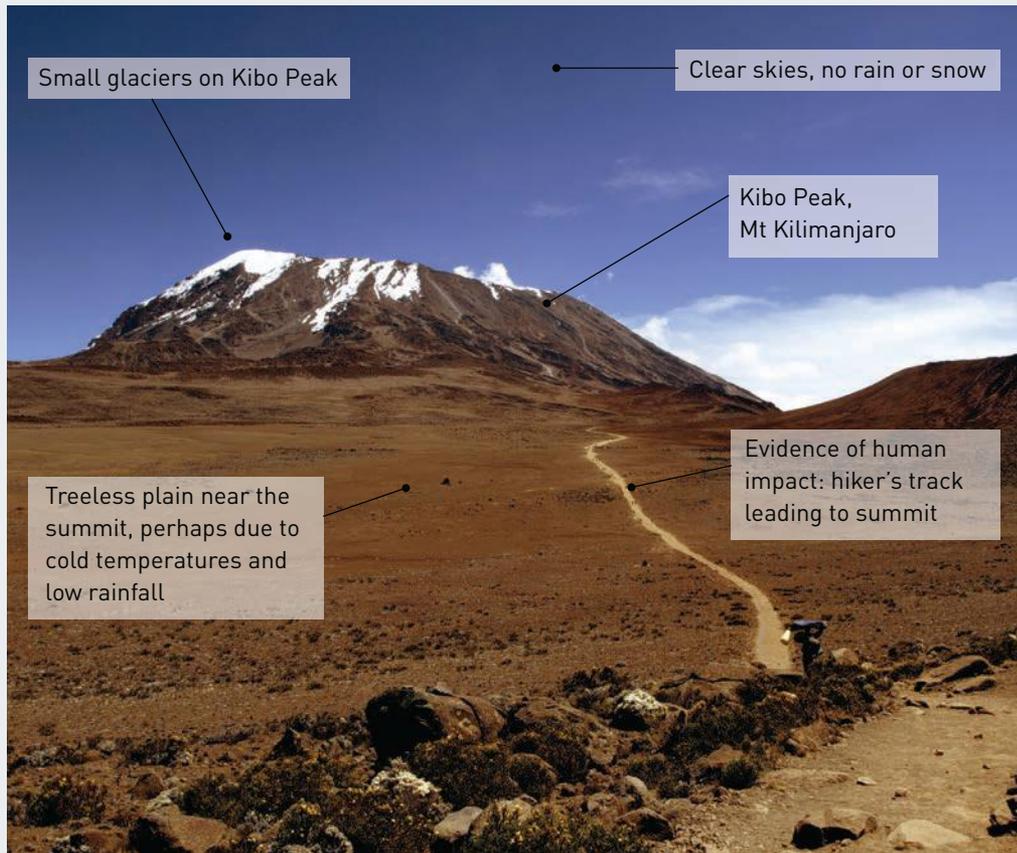
**Step 3** Evaluate photo drafts as you go. Remember that your photograph is part of your geography fieldwork or study, and ensure that your photographs include the aspects you want to show. You might need to try photographing your subject from different angles, or from above or below it, to capture what you are after.

**Step 4** **Annotate** your photographs, remembering to focus on the topic of the inquiry. Write labels that include the key features of the landscape. Keep your labels neat, relatively short and relevant to your inquiry. Note any observations you have and possible causes for changes or damage in the environment.

**Step 5** Place your labels, taking care not to obscure important parts of the photograph. Space the labels around the photograph without making them too cluttered. Avoid having the lines from the labels crossing each other. If you think you have too many labels, go over them again and delete any you think aren't really relevant to your inquiry question.

### Apply the skill

- 1 Prepare for a geographical photo session. Decide on a subject and head out to a natural environment such as a forest, stream or coastline with your camera. Evaluate your photographs as you go to ensure you are collecting the information you are seeking.
- 2 Annotate your photographs following the steps listed above. Choose your best three photos and set up a digital display on the school computer network or print them out and set up a wall in your classroom as a photo gallery.



Source GT.38 An annotated image of Mt Kilimanjaro

### REVIEW GT.3.2

#### Remember and understand

- 1 List some of the types of visual representations mentioned in this section.

#### Apply and analyse

- 2 Why might a sketch be preferred over a photograph?

#### Investigate and create

- 3 Take a photograph of an area of your school grounds and use it to complete the steps of the 'Skill Drill: Collecting and evaluating geographical photographs'.

# FIELDWORK

A historian studying a period in the past will try to find primary sources of information such as letters or diaries to better understand that period. For geographers the field is an essential primary source of data. Books, websites and maps can give you some information about a particular place but they are usually secondary sources of information. To really understand a landscape or issue you need to go and see it for yourself.

A field trip can be a fun and exciting experience as you spend time with your classmates in an interesting place. As well as being fun, field trips are an essential part of your geography course. This is because **fieldwork**:

- helps you to better understand how the world ‘works’ as it builds a bridge between what you learn in a classroom and the world outside that classroom
- teaches you new skills, particularly in collecting information. Many of these skills, such as surveying and digital mapping, are in demand in the workplace.
- allows you to learn about the world in a new and different way. Not everyone learns well by reading books or answering questions in the classroom. Many students learn more by completing practical, hands-on activities such as fieldwork.
- gives you the opportunity to discover how other people feel about their environment and to compare this with your own values and ideas about your world
- requires you to be organised and to work together with other people.

## The skills associated with fieldwork

The aim of all fieldwork is to enable you to develop the skills of observation, information gathering, analysis and interpretation of different forms of data, and communication of your results. The types of fieldwork you conduct will differ according to your chosen topic and the fieldwork site. All fieldwork is activity-based and inquiry-based. You will be:

- identifying different types of environments and the features within them
- describing what you see around you in geographical terms
- recording data from different sources
- sampling things such as water quality and wind speed
- investigating why things are where they are
- comparing different features to see if there is a pattern
- calculating amounts such as water flow, number of different species of plants and animals, and visitor numbers
- analysing different forms of data
- forming a more complete picture of the area you are studying
- communicating your findings.

All of these activities are aimed at developing and improving your geographical skills and understanding.



**Source GT.39** You never know where fieldwork will take you! These geographers are using a drill to examine the age of the glaciers on Mt Kilimanjaro.

## Fieldwork locations and inquiry questions

Fieldwork can take place in many locations and for a wide variety of purposes. The best locations tend to be where change is happening before your eyes. Rivers and coasts are popular fieldwork locations as the constant movement of water in these places changes the natural environment, often resulting in a response from people. Shopping centres, parks and city streets are also popular as the constant movement of people creates patterns, flows and changes.

## Conducting successful fieldwork

Fieldwork is a type of geographical inquiry, so whenever you take part in fieldwork you will need to follow the stages that are outlined in this toolkit, namely:

- 1 acquiring geographical information
- 2 processing geographical information
- 3 communicating geographical information.

The first stage is vital as this gives you a focus for your fieldwork. It also allows you to make a judgment about whether your fieldwork investigation has been successful.

### Stage 1: Acquiring geographical information

Begin by identifying an issue or problem and compile a set of related geographical questions that you would like to investigate. Plan your fieldwork so that you can collect the evidence and data that you will need. For example, take photos, draw sketches, conduct tests, and construct questionnaires and surveys. You will then need to use this data to create graphs and maps for analysis. You may also need to consider members of the public, including Indigenous people and their beliefs and feelings about places in the landscape. If your class is planning a field trip to a natural environment, such as a forest or beach, you will need to ensure that you do not damage the environment by trampling on plants or animals or by dropping litter.

### Stage 2: Processing geographical information

Interpret and analyse the data you have collected and look for patterns or clues that will help you to answer your key inquiry question and come to a conclusion. There are a number of different tools and methods you can use to do this, including PQE and SHEEPT.

### Stage 3: Communicating geographical information

Communicate what you have found to an audience in the form of a report, a presentation or an annotated visual display (AVD). Think about your fieldwork findings and reflect on ways to improve your investigation process. Finally, decide on a course of action, if this is appropriate.

## A fieldwork example: Lowecroft Vegetable Farm

In the following example, the Year 9 Geography class (9GEO) at Gumtree College conducted fieldwork at a vegetable farm in their local area as part of a geographical inquiry into food security in Australia. This site was chosen because it is reasonably close to Gumtree College and the farmer's children attend the school.

### Stage 1: Acquiring geographical information

The students in 9GEO discussed a range of problems and issues that they could investigate and this led to a brainstorm based on the unit of inquiry they were completing in class. They used the ideas generated from this brainstorm to develop a list of possible inquiry questions:



**Source GT.40** Students from Gumtree College speak to the vegetable farmer about the impact of climate on his food production.

- How does food production on this farm impact on the natural environment?
- How does the natural environment impact on food production?
- What technologies does the farmer use to increase his food production?
- How does the food grown on this farm reach the consumers?
- How will food production in this region change in the future?

The students decided that all of these questions could be used for a geographical inquiry, but they decided to focus on the second question about the role of the environment in influencing food production. This linked with their study of ‘the environmental, economic and technological factors that influence crop yields in Australia and across the world’.

While some of the students in the class were from farming families, most were not. They had only limited understanding of the importance of environmental factors such as rainfall, frosts, temperature, seasons, drainage and soil type on food production.

Students planned what information they would need in order to investigate this issue. They decided that some information about rainfall and temperature could be researched using the Bureau of Meteorology (BOM) website. They decided that they would only visit the vegetable farm once and during this time they should speak to the farmer and record the ways in which the natural environment has impacted on his production of food.

To investigate the impact of the natural environment on food production students set out to collect and record a range of geographical information:

- Before their field trip students collected data about temperature and rainfall from the BOM website (‘climate and past weather’). They also used Google Earth and maps of the region to locate the farm in relation to environmental features such as streams and hills. They used these maps to draw a sketch map of the farm.
- Based on this data students wrote a series of questions to ask the vegetable farmer about how factors such as the seasonal pattern of rainfall and temperature highs and lows affected his crops. They also added questions about the type of soil and soil drainage to the local creek. They emailed these questions to the farmer before their visit.
- On the field trip students asked the farmer their questions and recorded his answers in their notes.
- They took photographs of the different crops grown on the farm and added these to their sketch map, along with the location of irrigated paddocks, glasshouses and other buildings.

- They recorded environmental factors during their visit such as wind speed and direction, temperature and rainfall. They sketched a soil profile that could be seen where a track had been cut through a low hill. Students also collected some soil to test the clay and sand content as well as the soil pH in class.



Source GT.41 Students doing fieldwork

## Stage 2: Processing geographical information

Once they had converted their primary data into a range of tables, graphs and maps, the students analysed it much more easily and looked for patterns and trends that would help them answer their key inquiry question: 'How does the natural environment impact on food production?'

They decided to break their inquiry into different environmental factors to simplify their analysis. This also allowed them to conclude that some environmental factors were more important than others. The key conclusions were:

- Rainfall is a key environmental factor that affects this farmer and his ability to grow food. The seasonal pattern of rainfall in this region means that he must purchase water to irrigate his crops during summer. During winter and spring he captures water in large dams and uses this water in drier times of the year.
- The air temperature influences the type of crops he grows and the times of the year in which he grows them. Leeks and parsnips are mainly a winter crop whereas his other main crop, lettuce, grows best in summer.
- The farmer has large areas of hedges that are a habitat to insects and birds. These help to control harmful insect pests. He also plants crops that naturally control some soil diseases.
- This farm is part of a much larger farming region that grows large quantities of food for Australia's cities. Farmers in the region, including the vegetable farmer visited by 9GEO, have flat land with fertile soil. In the past the area often flooded during heavy rains but a system of drainage ditches and levees has reduced this hazard. The farmers and local council maintain these ditches.
- There is little natural vegetation remaining in the region as it has been cleared for farming.

## Stage 3: Communicating geographical information

Students prepared individual field reports based on their inquiry. Most completed this as a display folder containing their sketch map, photographs, climate graph and written conclusions. Several students presented their field reports as an AVD, and two gave an oral presentation to the class. One of these students included a short film that he had made while on the field trip.

This film and several of the written reports were sent to the farmer, along with a letter thanking him for his time and expertise. A group of students wrote a report on the field trip and their conclusions for the school newsletter.

Following the submission of their field report students reflected on their findings and the methods they used to reach their conclusions. They decided that the key inquiry question they had chosen was a good one because it allowed them to explore a range of factors rather than just one or two. Many students felt that visiting a farm on a field trip helped them better understand how farmers use both the natural environment and their own ingenuity to produce the food they eat.

Some of the students felt that they would like to have explored the impact of this farm on the natural environment, particularly the impact of fertilisers on the soil and streams of the region. They suggested that the class who visited this farm next year could explore this in more detail.



**Source GT.42** A student's sketch map of the farm showing the location of crops and other key features

### REVIEW GT.3.3

#### Remember and understand

- 1 Is the information collected by 9GEO students an example of primary or secondary information?
- 2 Why do you think 9GEO students emailed their questions to the farmer before the field trip?

#### Apply and analyse

- 3 Examine Source GT.42. What features of the farm has this student chosen to focus on in her sketch map? Why do you think she has chosen these features?
- 4 Why would investigating the type of soil on Lowecroft Vegetable Farm help to answer the inquiry question?
- 5 What other information could the students have collected on the field trip to help them answer the inquiry question?

#### Investigate and create

- 6 Why is fieldwork sometimes better than investigating an environment through secondary sources such as books and films?
- 7 Students from another Geography class at Gumtree College visited a sheep sale as part of their investigation into food security in Australia.
  - a What inquiry questions could they investigate at a sheep sale?
  - b Work in a small group to describe the steps you would undertake to explore one of these questions using fieldwork.



**Source GT.43** An auctioneer sells a mob of sheep in Jamestown, South Australia. Saleyards such as these can be a great fieldwork destination as you can investigate the ways in which people and places are interconnected as well as where our food comes from.



1

# SUSTAINABLE BIOMES



# INVESTIGATING BIOMES

# 1

CHAPTER

# FOOD SECURITY: FEEDING A HUNGRY WORLD

# 2

CHAPTER

These hillsides in southern China have been terraced, or had flat 'steps' cut into them, to create flat land for growing rice, which is the most important staple food for more than half the world's population. Rice, like wheat and corn, grows in the grasslands regions of the world. Grasslands around the world share similar climate and vegetation features and are therefore known as a single biome.

## CHAPTER

# 1



**Source 1.1** The tundra biome is the coldest of all the biomes. Tundra comes from the Finnish word *tunturia*, meaning 'treeless plain', and covers about 20 per cent of the Earth.

## INVESTIGATING BIOMES

A biome is a region that shares similar and distinctive climates, soils and vegetation. The tundra lands biome, for example (Source 1.1), is characterised by very cold climates, extreme winds and very limited plant and animal diversity. In contrast, the tropical rainforest biome is characterised by a warm and wet climate, highly weathered soils and thick, lush vegetation. Geographers are interested in the diverse physical features of biomes, their spatial distribution and the way that humans use and alter biomes for food, fibre and material production. In this chapter you will explore eight diverse biomes: polar lands, tundra, boreal forest, mountain vegetation, temperate forest, grassland, desert and tropical rainforest.



# 1.1

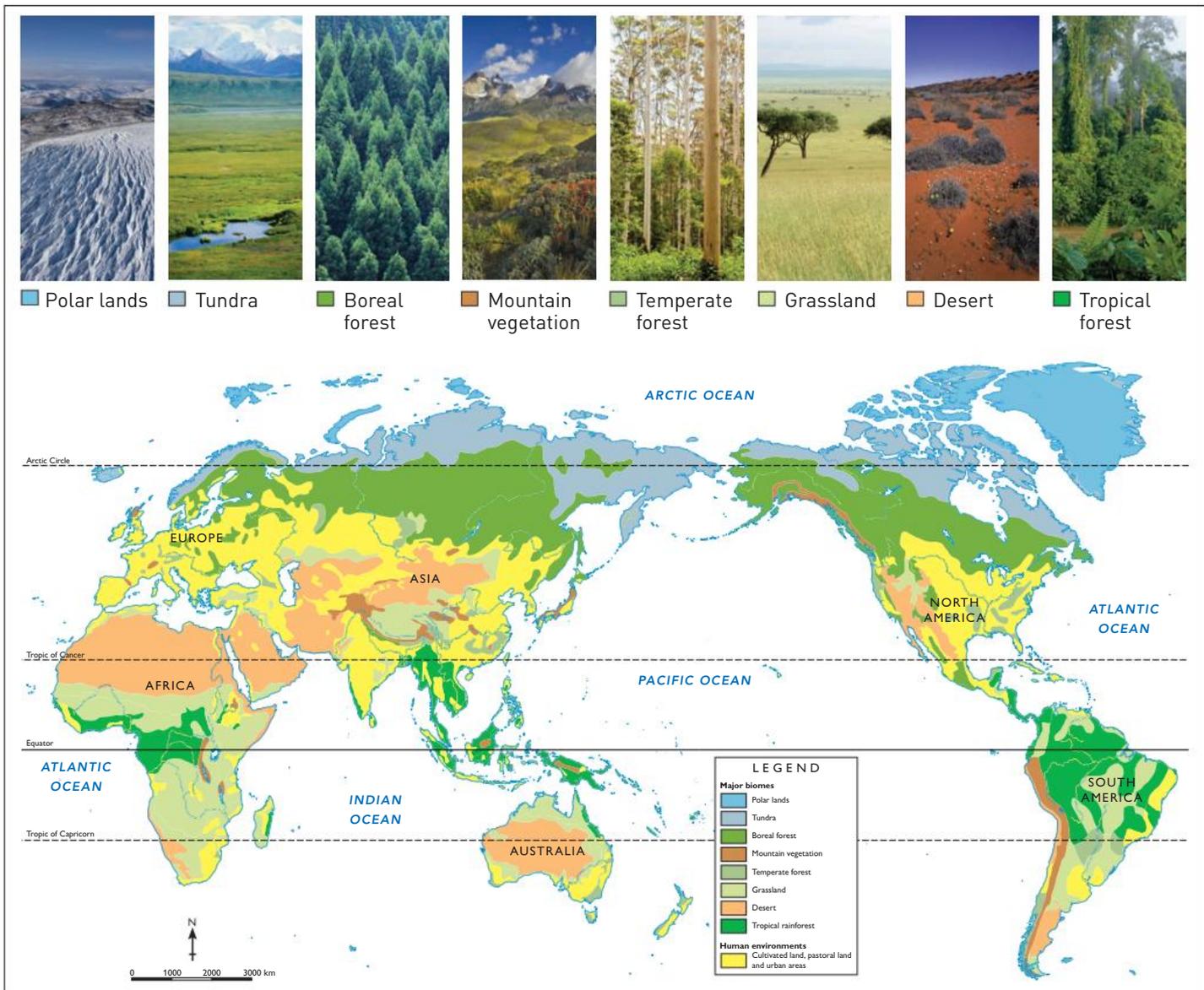
## THE WORLD'S BIOMES

WHAT ARE THE MAIN CHARACTERISTICS THAT DIFFERENTIATE THE WORLD'S BIOMES?

In order to better understand the Earth's natural and human environments, geographers divide the Earth's surface into a number of distinct regions. Each region has particular features that make it different from other regions. One region may be hot and rainy most of the time, for example, and another might be dry and cold. This means the plant and animal life found there functions, adapts and interacts according to the conditions of the region it inhabits. Regions defined by landscapes that share similar climates and types of vegetation in this way are known as **biomes**.

In some biomes, such as **tropical forests** and grasslands, there is an abundance of plants and animals and therefore they are more able to sustain life. This is because the conditions favour a huge variety of species. A recent study of a Colombian rainforest, for example, found 596 bird species, 150 different species of amphibians and more than 200 species of mammals. Scientists estimate that there are more than 100 000 insect species per hectare in

### WORLD: BIOMES



Source 1.2

Source: Oxford University Press

this rainforest and more tree species in a single hectare here than there are in the whole of North America. This explosion of life is due to the year-round high temperatures and rainfall in the region.

At the other end of the scale are the **tundra** and the **polar lands**, which are the coldest biomes. The tundra biome circles the North Pole. Tundra, meaning ‘treeless plain’, has short growing seasons, very little plant diversity and very low temperatures. Antarctica, a polar land, is twice the size of Australia and contains virtually no native land species. Only two flowering species of plants exist on the continent and the largest native land animal is a 1-centimetre-long wingless midge. There are no native mammals, amphibians or trees in Antarctica. It is simply too cold, too dry and too windy for plants and animals to flourish.

In the **mountain vegetation** biome, too, cold conditions determine plant life and the animals that live there. Plants in the mountain vegetation biome tend to be low and hug the ground to preserve warmth. The mountain vegetation biome has a long winter period, and animals that live in these areas need to be able survive the cold and the exposure to UV radiation.

**Aquatic biomes** exist too. The world’s oceans, freshwater lakes, coral reefs and wetlands are all examples of these biomes, which are dominated by water and the plants and animals that call them home.



**Source 1.3** A red-eyed tree frog in the rainforest of Panama in Central America is one of the many species that lives in this rainforest biome.



**Source 1.4** A juvenile mountain gorilla in the tropical mountains of Varunga National Park (Democratic Republic of the Congo). Mountain gorillas today are endangered, numbering fewer than 1000 due to local poaching for their meat.

### STRANGE BUT TRUE

Epiphytes are plants that live happily together on other plants and depend on the air to bring them moisture and nourishment. Parasitic plants take nourishment from their host plants, directly feeding off them.



**Source 1.5** Wildebeest migrate the grasslands of Africa in search of fresh grasses after the monsoonal rains.

### REVIEW 1.1.1

#### Remember and understand

- 1 What is a biome?
- 2 Why is there such an abundance of life in a rainforest?

#### Apply and analyse

- 3 Where are the world’s tropical forests located? Why do you think they are located in these places?
- 4 Describe the distribution of biomes in Australia.

#### Investigate and create

- 5 Design a world tour that includes at least one visit to each type of biome. Research where you

will go using a map that shows the world biomes, and then list the countries you would visit on this tour. Include some of the activities you might do at each place, based on the biome’s climate and geographical conditions.

- 6 Work with a partner to rank the world’s eight major biomes from a habitat of ‘most species’ to ‘least species’. Compare your list with other groups. Were there some rankings you all agreed on? Were there others where there was little agreement?

# BOREAL AND TEMPERATE FORESTS

## Boreal forest biome

The largest biome on land is not the hot **desert** or treeless tundra – it is the **boreal forest** biome. Boreal forest, sometimes called **coniferous forest**, is composed of coniferous, evergreen trees that have needle-like leaves and cones, like pine cones. This biome is characterised by having a low number of species of plants when compared with other forests in more temperate regions or in the tropics.

The boreal forest biome covers vast areas in the Northern Hemisphere, between the Arctic tundra and the north of Europe, Asia and North America. While the climate in these regions is not as harsh as that experienced in the polar lands or on the tundra, it is still cold enough to limit the number of plant and animal species that can survive, and winter is long. In fact, the boreal forest's longest season is winter. Average temperatures fall to about  $-15^{\circ}\text{C}$  and snow is common. In summer, which lasts only one to three months, temperatures climb towards  $20^{\circ}\text{C}$  and humidity is relatively high. The plants and animals that survive in this biome must be able to handle great variations in rainfall and temperature, as well as large areas of permanently frozen ground and poor soils.



**Source 1.6** This Canadian paper mill is situated by a large body of water. Paper is made by pulping woodchips from logs and mixing the pulp with water.

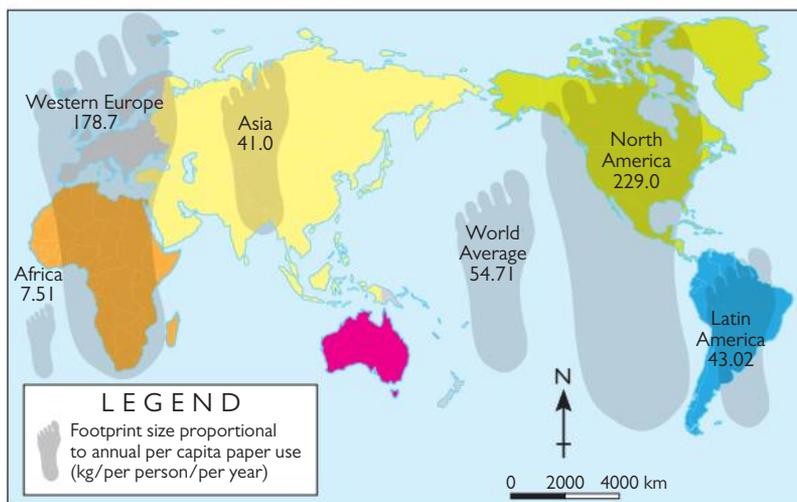
## Threats to the forest

Boreal forests have provided many important resources for people in both the past and the present. Historically, wood for construction, heating and cooking came from boreal forest trees. More recently, boreal forests have supplied the increased global demand for cheap wood and paper spurred by population growth and a change in global markets.

However, many boreal forests are under threat. One of the main threats to the boreal forest biome is the clearing of trees to make way for oil and gas exploration. It is estimated that huge reserves of petroleum products lie under the forests, and the ever-increasing demand for petroleum is pushing exploration into these areas.

In Canada and Russia, forests are logged extensively and many are being attacked by insect plagues and acid rain. Forests are also at risk from bushfires during the summer period. Climate change is causing some forest areas to spread further north. Rising temperatures in the Arctic region have seen the edge of the boreal forest slowly advancing northward, replacing tundra in some places.

## WORLD: AVERAGE PAPER CONSUMPTION



**Source 1.7**

Source: Oxford University Press

## Temperate forest biome

Between the tropics and the cold polar regions is a large zone that is neither excessively hot nor excessively cold. For this reason it is called the temperate zone. The forests that grow in the temperate zone

experience a range of seasonal climate conditions. In winter, temperatures may fall below freezing and in summer they can climb above 40°C. In some temperate forests, rain falls reliably throughout the year. In others, there are more distinct wet and dry seasons.

Most of the world's population lives in the temperate zone and this has had a huge impact on the **temperate forest** biome over time. As the world's population spread and grew, temperate forest biome areas gradually became smaller. Cities were formed on land that was once covered in forest, and trees were cut down to clear land and to provide fuel and building materials. The forests gradually disappeared from these places. This happened in Europe, then in Western Asia and North America. Currently, little temperate forest remains in some of these places.

However, as explorers set out from Europe to colonise new lands, they often carried with them seeds and saplings of the trees with which they were familiar. They planted these in the places they travelled to, such as Australia, New Zealand and South Africa, and in this way temperate forest trees were spread around the world.



**Source 1.8** The spectacular deciduous trees in the town of Orange in NSW are mainly native to Europe half a world away.

## REVIEW 1.1.2

### Remember and understand

- 1 Describe the temperature variations experienced in the boreal forest biome.
- 2 How have trees from temperate forests spread around the world?

### Apply and analyse

- 3 What are some of the differences between boreal and temperate forests? What are some of the similarities?
- 4 Use the map in Source 1.2 to compare the distribution of temperate and boreal forests.

- 5 Why do you think the consumption of paper has increased dramatically in the last 50 years? What influence has this growth in demand had on the world's forests?

### Investigate and create

- 6 Examine Source 1.7, showing the average consumption of paper by person in each continent.
  - a Who are the biggest paper users? Who are the smallest?
  - b Australian consumption is not shown on this graphic. Draw the size you estimate Australia's paper footprint to be compared with one other continent. Explain how you decided on the size of Australia's footprint.

# THE GRASSLANDS BIOME

In places where it is too dry for forests and too wet for deserts lie a biome dominated by shrubs and grasses – the **grasslands** biome. In some places, regions that are part of this biome are also known as prairies, steppes or savannahs. In Africa the grasslands are often referred to as savannahs. In the United States of America they are often called prairies, and in parts of Siberia and south-eastern Asia, they are alternatively known as steppes.

Much of the world's food and fibre comes from plants and animals that live in the world's grasslands. Rice, wheat and corn, all grasses, provide the bulk of the human population's food, and many animals that are farmed to provide meat and milk also live in the grasslands biome.

Much of Australia can be considered grassland and many of our native animals, such as kangaroos, wallabies and wombats, thrive in this biome.

In Africa, too, grasslands dominate, covering more than half the continent. In this landscape the grassland is dotted with individual trees, providing little cover for the wildlife that live there. These grasslands support a variety of plant-eating mammals as well as predators that feed off them. The animals living here have developed an amazing array of physical and behavioural changes to adapt to the challenges of the open environment. The zebra's stripes, for example, make it difficult for a predator to see it clearly. The giraffe, one of the larger kinds of grasslands inhabitants, has evolved in such a way that its long neck allows it to source food at the tops of trees.

Many other animals that live in the grasslands are nocturnal, allowing them to avoid the main heat of the day and venture out at night to hunt and gather food. These animals include the prairie dog, barn owl and grey wolf of the American prairies, which all scout for food at night. Smaller mammals also venture out in the cool of the night, often when the moon is full or near full, to allow them to better spot animals that may be seeking them out as prey.

Many grasslands around the world have changed greatly over time. Some of these changes are the result of human activities, such as introducing grazing animals to a grasslands environment. Grazing animals such as cattle, sheep and goats compete with native species for food and often trample the ground, damaging the roots and soil structure.



Source 1.9 Elephants on the savannah



Source 1.10 An Asian steppe



Source 1.11 A bison on the prairie

## KEY CONCEPT: CHANGE

### The American prairie

The prairies of North America were once dominated by Indigenous American tribes, such as the Cheyenne, Apache and Comanche tribes.

The Comanche lived in the grasslands in the region, which now includes Texas, Oklahoma and Kansas, in the United States. They were typical of many of the Indigenous tribes of North America. Their main food source was bison and they followed the great herds across the plains, as the bison travelled to find the best grazing. When the bison stayed in one location to eat the plentiful grass, the Comanche set up temporary villages. Then they moved with the bison when better grazing lands were needed. The bison provided more than food for the Comanche: their hides were used to make clothing and the distinctive pyramid tents, called tepees.

Some tribes hunted bison by building fences from fallen logs, and then herding the bison into a small area where they were killed with arrows and knives. Herding massive animals such as bison was difficult for tribesmen on foot. With the arrival of European explorers, and their horses, about 400 years ago, however, life for Native Americans changed dramatically.

Many tribes, including the Comanche, quickly realised the potential of using horses in their culture and soon became expert horsemen. As well as being faster and more nimble than bison, horses had one other great advantage for the grasslands tribes. Like bison, horses are grazing animals that eat grass. This meant that the tribes could move easily across the plains following the gradual movement of the bison herds; the grasslands now feeding both bison and horses.

But as European ranchers moved across the prairies through the 16th to 19th centuries, the

numbers of Native Americans and their way of life gradually disappeared. Much of the vast grasslands of the prairie were turned into grazing land and farmland by the European settlers. However, the open plains remain an iconic image of American history and the American pioneering spirit.

For more information on the key concept of change, refer to section GT.1 of 'The geographer's toolkit'.



**Source 1.12** With the arrival of the horse, tribesmen could hunt bison more easily.



**Source 1.13** It is estimated that 30 million bison lived in North America in the 1500s. Within 400 years this had fallen to about 1000. In this photograph, taken in the 1870s, a pile of bison skulls waits to be crushed for fertiliser.

## REVIEW 1.1.3

### Remember and understand

- 1 Why is the grasslands biome important for human populations?
- 2 What changed the grasslands of North America?

### Apply and analyse

- 3 Examine the map in Source 1.2 showing the distribution of the world's biomes.
  - a Describe the distribution of grasslands in each continent.
  - b What relationship do you notice between grasslands and human environments such as cultivated land and urban areas?

- c Why does this relationship occur?
- d Examine the three images of grasslands from different parts of the world (Source 1.9, Source 1.10 and Source 1.11). In which countries do you think each of these photographs was taken? Describe the slight differences in the images and give some reasons for your chosen country.

### Investigate and create

- 4 Compare the images of the grasslands with the pictures of Australia's deserts that appear in Source 1.21 on page 54. What are some of the main differences between the two biomes? Explain why these differences occur.

# THE TROPICAL FOREST BIOME

It is estimated that about half of all the plant, animal and insect species in the world live in tropical forests. Many of these are among the wettest places on Earth and are therefore known as **rainforests**. They can be considered to make up the world's richest biome and the abundance of life can be astounding. In Brazil, for example, researchers found that a single pond contained more fish species than exist in all of Europe's rivers. In Peru, a single tree was found to contain 43 ant species; this is more than the total number in all of the British

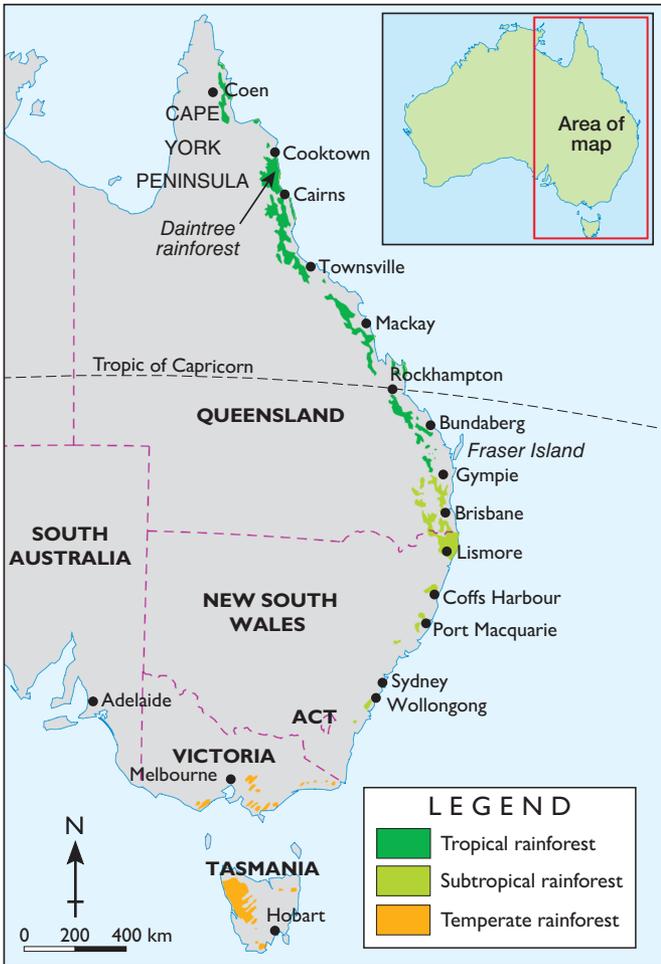
Isles. One hectare of South American rainforest may contain over 750 different types of trees, and one-fifth of all of the world's birds live in the Amazon rainforest. This explosion of life is due to the ideal growing conditions that occur in the tropics.

These places experience the most stable climate conditions on the planet with virtually no seasonal changes in rainfall, temperature or available sunlight throughout the year. Most days are the same in the rainforest: hot and wet. It rains virtually every day, often in torrential downpours. The temperature hovers between about 26°C and 32°C all year round.

## Australia's rainforests

Though much of Australia was once covered in forest, now there are only a few small pockets near the east coast (see Source 1.14). Rainforests now make up only 2.5 per cent of Australia's remaining native forest. This surviving forest, however, is a real Noah's Ark for many plant and animal species, many of which exist nowhere else in the world. There are more than 1000 species of plants in Australian rainforests, of which about 700 exist nowhere else. These plants support thousands of insect species, hundreds of reptile and bird species and nearly 90 different types of mammals. The subtropical rainforests of New South Wales and Queensland are also internationally recognised for their direct links to the world's first flowering plants, which happened about 100 million years ago.

### EASTERN AUSTRALIA: RAINFOREST REGIONS



Source 1.14

Source: Oxford University Press

**Source 1.15** Tropical rainforests cover the slopes of many Queensland mountains and experience Australia's highest rainfall. The Daintree rainforest near Port Douglas is the oldest continuously surviving rainforest in the world.





## Ecosystem services

About 80% of the plants we eat began in the world's tropical rainforests. Potatoes, corn, rice, avocados, oranges, bananas, coffee, chocolate and hundreds of other foods are rainforest plants.

About 25% of the drugs we use to treat illnesses, from leukaemia to headaches, come from rainforest plants.

Rainforest plants take in carbon dioxide and produce oxygen. The Amazon rainforest alone is thought to produce about one-fifth of the world's oxygen.

Rainforests regulate the Earth's temperature and rainfall, and hold much of the world's fresh water.

Rainforests in Africa, Asia, South America and Australia are home to Indigenous peoples.

Products such as toothpaste, golf balls, rubber tyres, paints, cosmetics, steroids and cork are all made from rainforest plants.

**Source 1.16** A scarlet macaw flies over the world's largest rainforest – the Amazon. The Amazon provides many ecosystem services.

## The gifts of the rainforest

Rainforests have provided humans with many resources for thousands of years. These resources are known as **ecosystem services**. Rainforests provide many services, including the ones described in Source 1.16.

### REVIEW 1.1.4

#### Remember and understand

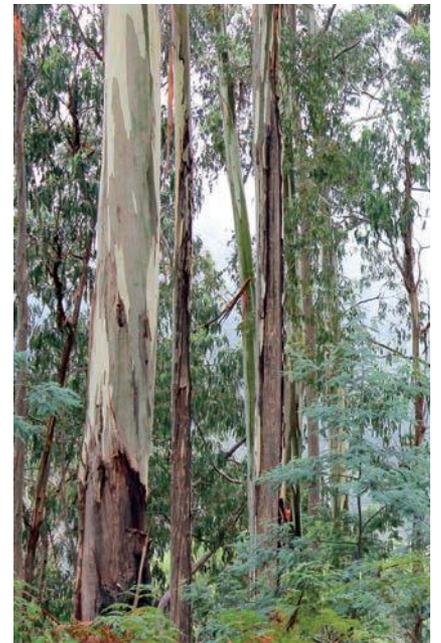
- 1 Use the map showing the world's biomes (Source 1.2) to describe the distribution of the world's tropical forests.
- 2 What are some of the links between the world's climate and rainforests?

#### Apply and analyse

- 3 Describe the distribution of Australia's rainforests. Refer to particular places and states and use compass directions in your answer.
- 4 What are some of the differences between tropical and temperate rainforests?

#### Investigate and create

- 5 Why do you think the amount of rainforest in Australia has decreased so much? Consider both natural processes and human activities.
- 6 What information from these pages would you use to explain the importance of rainforests?
- 7 Clearing of rainforests for farming, mining and urban development makes the tropical forest biome one of the world's most endangered.
  - a How might the clearing of a rainforest impact on people who live in it or nearby?
  - b How might it impact on people living in places that are further away?



**Source 1.17** Temperate rainforests are found in the temperate climate zone. Like tropical rainforests, they receive an abundance of rain and take in high amounts of carbon dioxide. However, they do not have the same levels of biodiversity as the tropical rainforests. The temperate rainforests of Tasmania and Victoria are characterised by ferns covering the ground and tall trees, some of them among the world's tallest.



# GOING WITH THE FLOW IN THE RAINFOREST

A rainforest, like all **ecosystems**, is a very dynamic place. Complex relationships between the climate (including rainfall, temperature, wind, humidity and sunlight), the shape of the land, soils, plants and animals have developed over millions of years and keep the rainforest alive and flourishing. A change to any part of the ecosystem can have devastating consequences for the whole ecosystem. The cross-section in Source 1.18 shows some of the flows of energy (intangible sources of power or nutrition) and matter (tangible sources of power or nutrition) that exist in a rainforest.

## Changes in the rainforest

It might seem logical that rainforests must have a deep rich layer of soil to support the great trees and other plants that flourish there. However, this is not the case. The heavy rain washes the nutrients of the soil deep into the ground where the roots of the plants cannot access them. The rainforest trees are able to survive in these soils because they have developed wide-spreading roots and the warm temperatures in the tropics allow leaf litter – dead plant material that has fallen to the ground – to be quickly recycled into plant nutrients.

When the rainforest plants are cleared to make way for farms, these nutrients are quickly lost and the soil becomes exposed to the heavy rain and tropical sun. Farmers often find, contrary to expectations, that their plants do not thrive in these conditions and the soil provides few of the nutrients the plants need.

### SKILL DRILL

#### Creating a flow diagram

Geographers use **flow diagrams** to show the movement, sequence or stages in a process. Flow diagrams can be created by adding text and arrows to an image, or by creating text boxes from scratch, joined by arrows, to describe the flow of a process.

You can create a flow diagram by following these steps:

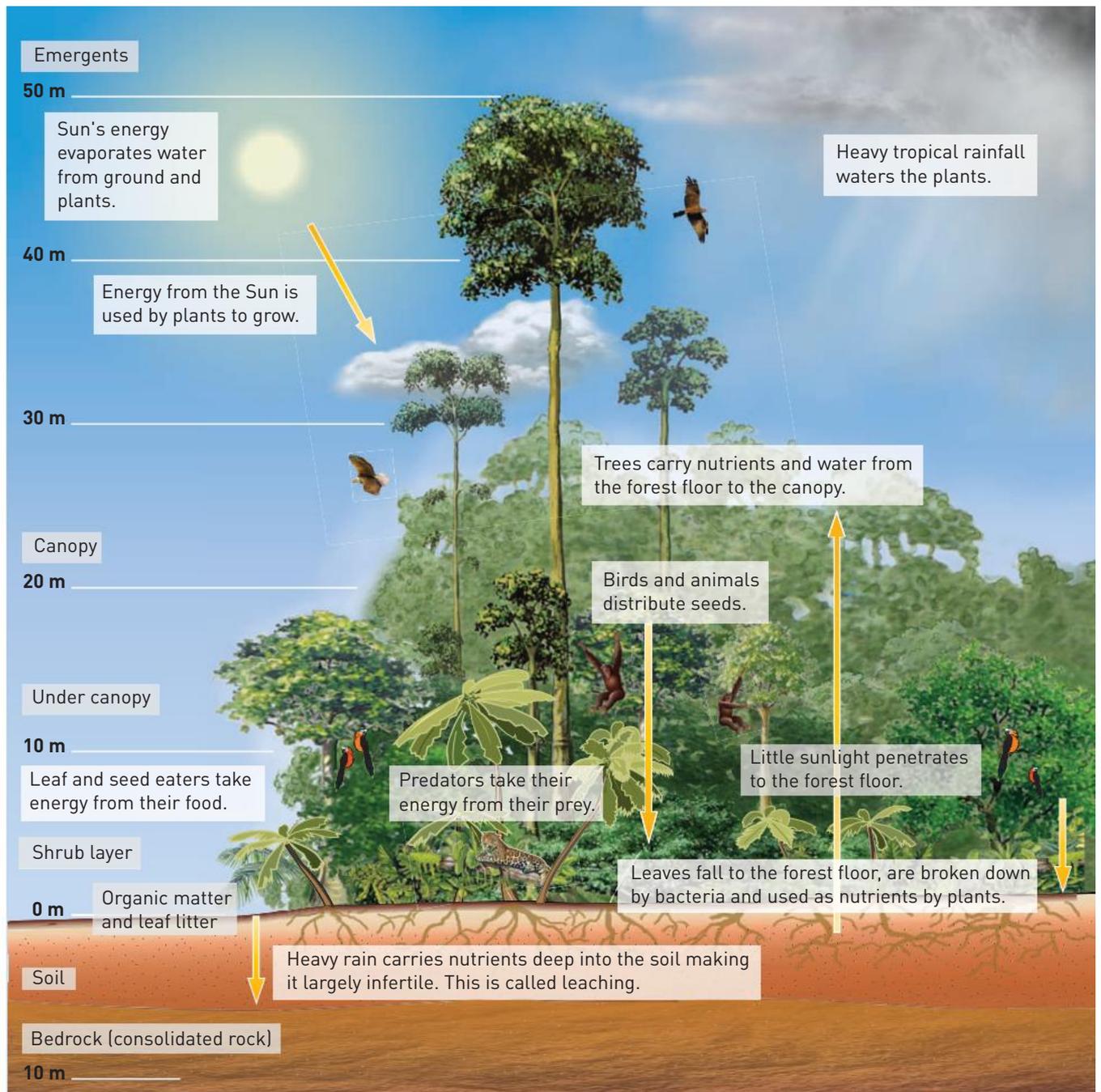
- Step 1** Decide on a process you want to describe. For example, you might want to describe the life of an apple, from seed to compost stage.
- Step 2** Jot down the steps you wish to highlight in the process. Try to keep each step clear and separate.
- Step 3** Create a text box for each step, and write or insert your text in each box.
- Step 4** Link each step with an arrow showing the direction of the process. Read through your diagram to make sure the steps you have included are logical and that you haven't missed any important parts of the process you are aiming to describe.

You can also create a flow diagram by adding your arrows and text to an existing image, following the process described here.

#### Apply the skill

- 1** Use the steps above to construct a flow diagram of your own. Use the picture and labels of the rainforest from Source 1.18 to describe the flow of energy and matter that would occur between the different elements of the rainforest and the plants and animals that inhabit it.





Source 1.18 Cross-section of a tropical rainforest

### REVIEW 1.1.5

#### Remember and understand

- 1 Look at the illustration of the rainforest in Source 1.18 and identify an interaction that takes place between animals and plants.
- 2 What effect do you think there would be on the rainforest ecosystem if this interaction no longer occurred?

#### Apply and analyse

- 3 Why are rainforest soils poor in nutrients?
- 4 How have rainforest trees adapted to the poor soils in the rainforest?
- 5 Describe how water is moved through the rainforest.

#### Investigate and create

- 6 What changes of movement in energy and matter would result if the trees and vegetation in Source 1.18 were cleared to make way for farming land? Consider the living and non-living inhabitants of the ecosystem.

# THE KOKODA TRAIL

Papua New Guinea is a country with vast areas of rainforest. The forest covers the slopes of rugged mountain ranges such as the Owen Stanley Range. The Kokoda Trail crosses this range and was the location of fierce battles between the Australian and Japanese armies in the Second World War. The area is notable for steep mountainsides, dense rainforests and heavy rainfall. This turns the trail into a sea of mud and makes progress along it very difficult. Many Australians attempt to walk the trail every year to achieve personal goals, which perhaps include gaining an appreciation of the difficulties faced by the soldiers during the war.

## Estimating gradient and aspect on topographic maps

Estimating gradient (angle of the slope) and aspect (direction of the slope) is an important skill for geographers to master. These factors also play a major role in determining the types of plants and animals that may live in a given area. Conditions may differ greatly across a small area if one part is almost always in shade (aspect) or exposed on steep slopes (gradient).

### Estimating gradient

Using a topographic map, it is possible to estimate the gradient between two points, by following these steps:

- Step 1** Determine the height of the two points. For example, examining Source 1.20, Owens Corner (186, 530) is at 600 metres and The Gap (241, 588) is at 2190 metres.
- Step 2** Estimate the difference in height between these two points (known as the rise):  $2190 - 600 = 1590$ .
- Step 3** Estimate the straight line distance (the run) between these two points using the line scale. This is 40 km or 40 000 metres in this example.
- Step 4** Divide the rise by the run and multiply this by 100:  $(2190/40\ 000) \times 100 = 5.5\%$  slope.

### Estimating aspect

The aspect refers to the compass direction that the slope is facing. This is also simple to work out by following these steps:

- Step 1** Using the information we found out when estimating the gradient we can tell that the terrain slopes down from The Gap (at 2190 m) to Owens Corner (at 600 m).
- Step 2** Imagine an arrow from The Gap to Owens Corner and estimate the direction of this arrow using the north arrow. This arrow would be pointing south-west. The aspect, along this entire section, is therefore south-west. Aspect can also be calculated at a particular point. To do this draw 'your arrow' perpendicular to the contour lines, pointing downhill. You've worked out the aspect standing at that specific location.

### Apply the skill

- 1 **a** Estimate the aspect and gradient of the slope between The Gap and Kokoda (241, 638).
  - b** Is this slope less steep or steeper than the slope between Owens Corner and The Gap?
- 2 Estimate the gradient and aspect for the slope between The Gap and Mt Kenevi (266, 584).
- 3 Estimate the aspect for the slope at (247, 615).
- 4 Provide three pieces of evidence that this landscape is very rugged and mountainous.
- 5 Estimate the total length of the Kokoda Trail from Owens Corner to Kokoda.

## REVIEW 1.1.6

### Investigate and create

Conduct some further research on the Kokoda campaign and then complete the following tasks.

- 1 Which of the world's major biomes are shown on this map of the Kokoda Trail area (Source 1.20)?
- 2 What is the relationship between forest and terrain in this environment?
- 3 Explain why you think this relationship occurs.
- 4 Research the Kokoda campaign that took place between July 1942 and January 1943. Focus on the

ways in which the natural environment (landforms, forest and rainfall) influenced the soldiers and the campaign.

**Source 1.19** The rugged terrain of the Owen Stanley Range, Papua New Guinea



# PAPUA NEW GUINEA: KOKODA TRAIL



Source 1.20

Source: Oxford University Press

# 1.1

## CHECKPOINT

### WHAT ARE THE MAIN CHARACTERISTICS THAT DIFFERENTIATE THE WORLD'S BIOMES?

- Investigate the distribution and physical characteristics of biomes.

- 1 Considering the variety of biomes that exist across the world, why is it that Australia also has a wide variety of biomes? (Hint: Refer to Sources 1.21 to 1.23.) [5 marks]
- 2 Explain why latitude, but not longitude, plays a major role in the types of biomes that exist. [5 marks]
- 3 Outline why there are limitations to describing places according to just their dominant biome. [5 marks]
- 4 What is the dominant natural biome where you live? [5 marks]
- 5 Describe some of the ways in which this biome has been altered by human activities. [5 marks]

TOTAL MARKS [ /25]

### RICH TASK

#### Australia's biomes

Many of Australia's original biomes have been changed by human activities. More than half of Australia's total land area is now used for food production, particularly sheep and cattle farming, covering 430 million hectares of land. This has resulted in significant changes to vegetation, land and water. Source 1.22 shows Australia's original biomes before they were changed by human activities..

#### Australia's deserts

Australia is the second driest continent in the world, after Antarctica. The combined area of the 10 biggest Australian deserts makes up about 18 per cent of the total land area of our 'wide brown land'. We can describe Australia as **arid** or **semi-arid** because 70 per cent of the continent receives fewer than 500 millimetres of rainfall each year. Low rainfall has resulted in large desert areas across Australia.

Many people think of deserts as being entirely composed of large sand dunes, with the occasional date palm or cactus as the only sign of life. This image may come from movies or pictures they have seen of deserts around the world.

However, while the Sahara Desert in Africa does have date palms and sand dunes and most North American deserts have cactuses, there are variations within the desert biome. Some desert areas in Australia have large areas of red dunes, for example, while others are covered in vast areas of stones, called gibber plains.

In most of Australia's desert areas, grasses and low shrubs dominate the landscape (see Source 1.23). In the tropical deserts north of the Tropic of Capricorn, spinifex and tough Mitchell grass cover much of the ground. South of the tropics, woodland deserts are more common, with hardy acacia trees, such as the mulga and witchetty bush, in evidence.

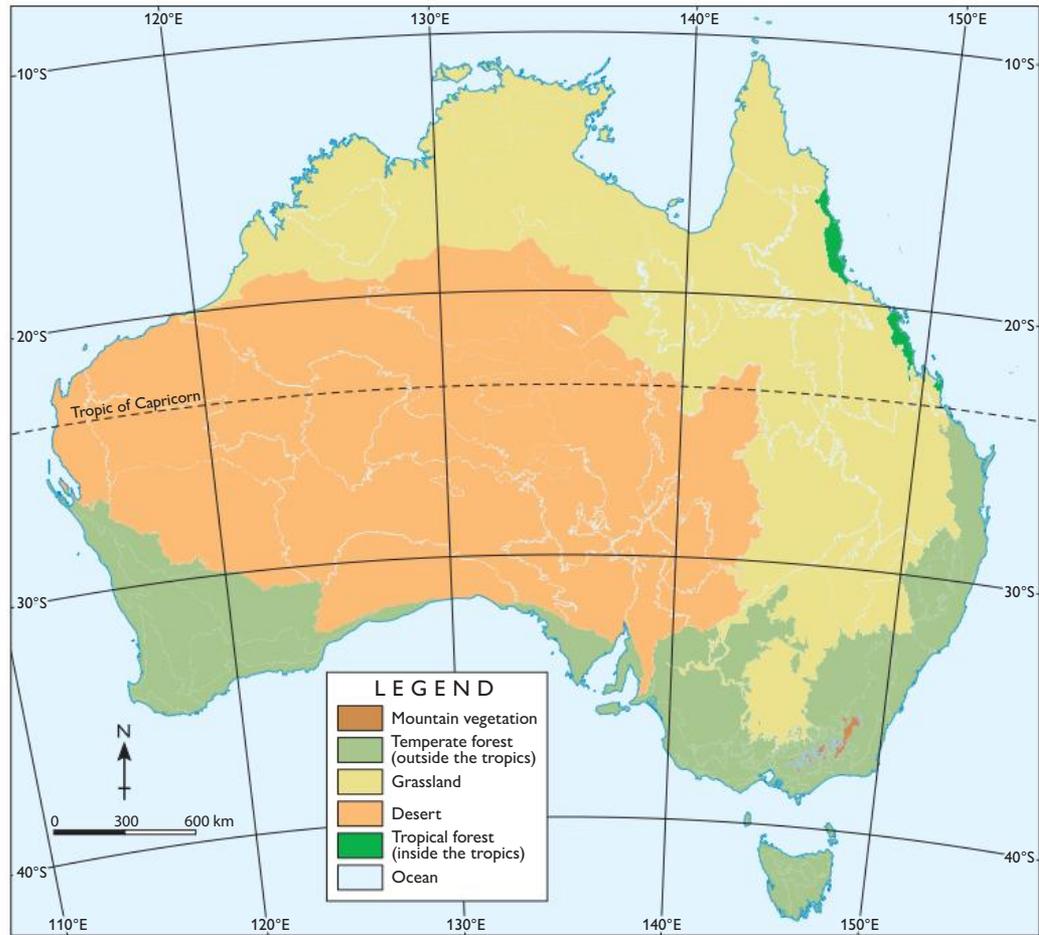
#### Acquiring geographical information

- 1 Compare Australia's biomes in Source 1.22 with the world's biomes in Source 1.2 and answer the following questions.



Source 1.21 Different Australian desert landscapes: spinifex grass in the Great Sandy Desert (top); acacia trees in the Great Victoria Desert (middle); stony plains in the Simpson Desert (bottom)

## AUSTRALIA: BIOMES



Source 1.22

Source: Oxford University Press

- a Which biomes do not exist in Australia?
- b Give a reason for each of these biomes being 'missing' in Australia.

### Processing geographical information

- 2 The world biomes map (Source 1.2) shows large areas of desert, while the three images in Source 1.21 show us that there are significant variations in landscape within the desert biome.

- a Why do you think there are such variations within the desert biome?
- b Research one of the other biomes to find out if such variations exist in that biome's regions too.

### Communicating geographical information

- 3 Construct a collage or create a PowerPoint/Prezi display of Australia's major biomes. Include at least one image of each biome.



Source 1.23 About one-third of Australia's total land area is used for cattle farming.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Space, Environment, Interconnection, Scale, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Maps, Fieldwork, Visual representations

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

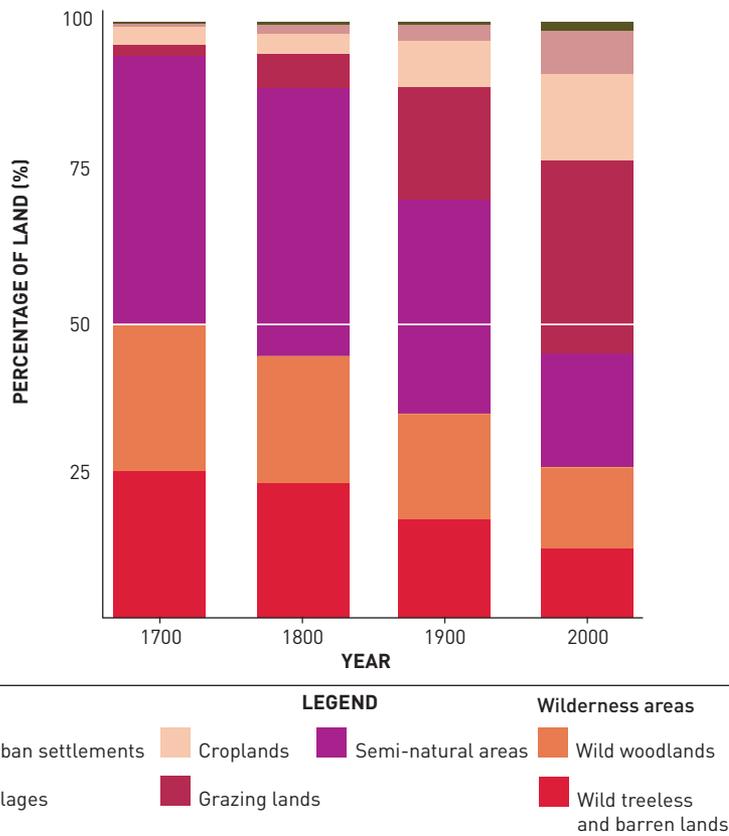
# 1.2

## CHANGES TO THE NATURAL ENVIRONMENT

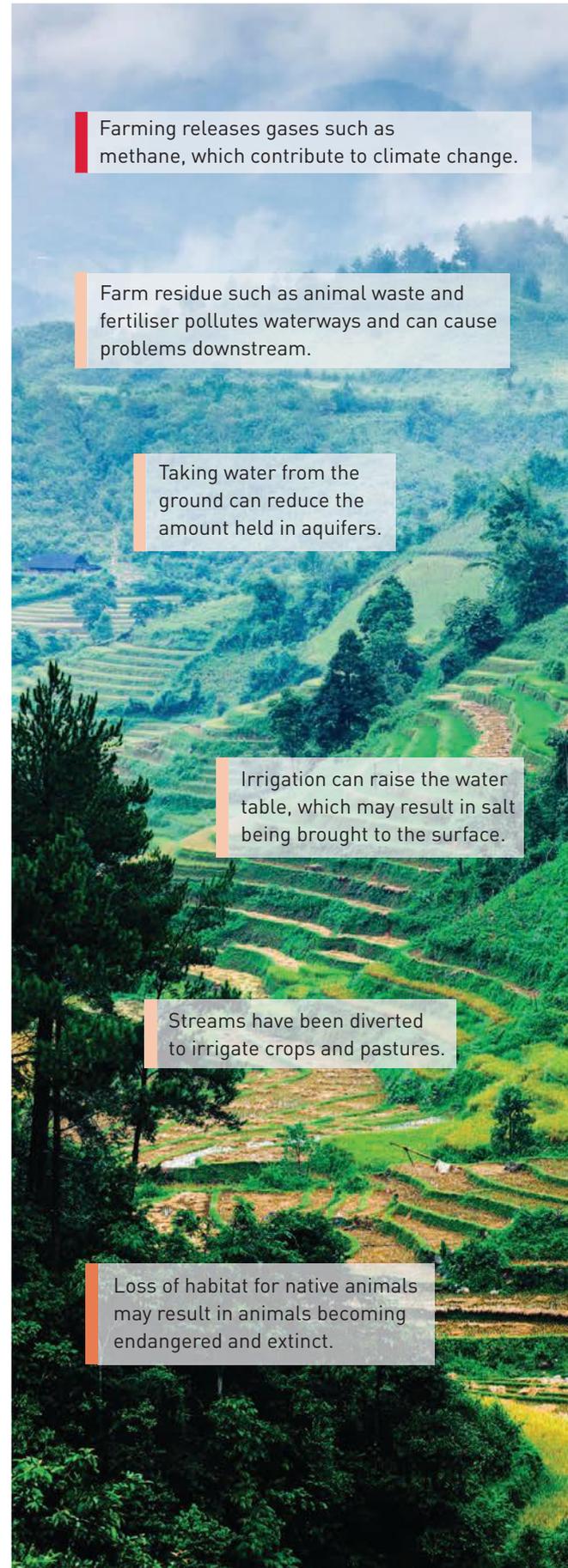
HOW DO PEOPLE USE AND ALTER BIOMES FOR FOOD PRODUCTION?

The last 300 years have seen more extensive change to the Earth's biomes than in any other period in the Earth's history. Over half of the world's land area that is considered habitable has now been converted into farmland or housing to provide food, fibre, shelter and fuel to the world's people – and this area is expanding.

All around the world the natural biomes of forests, grasslands, tundra and even deserts are being converted into farms. In some places, large corporations are converting the land but in most places it is the work of small-scale farmers, each motivated by the need to provide food for their own families. Source 1.24 shows the extent of biome change around the world since 1700.



Source 1.24 Changing land-use patterns worldwide between 1700 and 2000.



Farming releases gases such as methane, which contribute to climate change.

Farm residue such as animal waste and fertiliser pollutes waterways and can cause problems downstream.

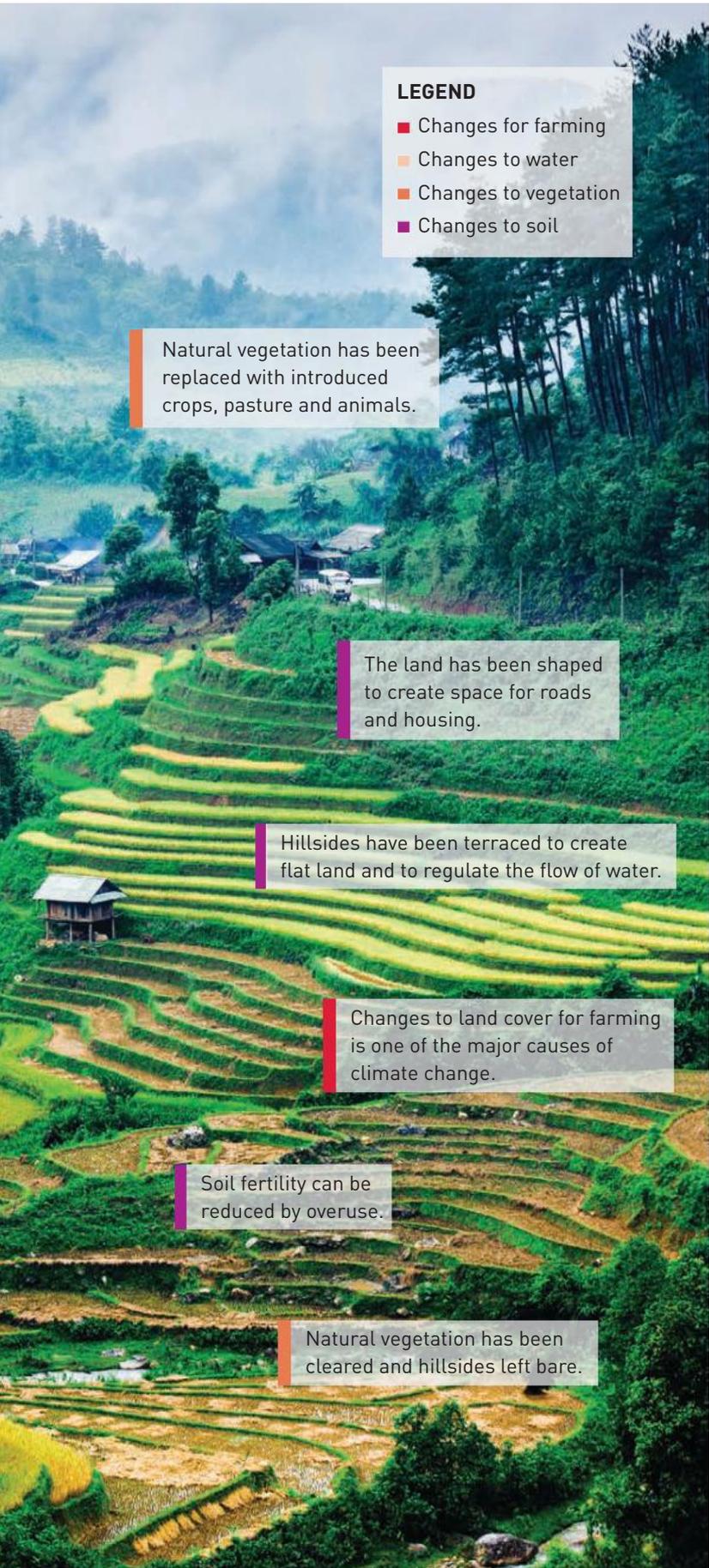
Taking water from the ground can reduce the amount held in aquifers.

Irrigation can raise the water table, which may result in salt being brought to the surface.

Streams have been diverted to irrigate crops and pastures.

Loss of habitat for native animals may result in animals becoming endangered and extinct.

Source 1.25 Some of the changes made to a landscape in China that is being used for farming.



#### LEGEND

- Changes for farming
- Changes to water
- Changes to vegetation
- Changes to soil

Natural vegetation has been replaced with introduced crops, pasture and animals.

The land has been shaped to create space for roads and housing.

Hillsides have been terraced to create flat land and to regulate the flow of water.

Changes to land cover for farming is one of the major causes of climate change.

Soil fertility can be reduced by overuse.

Natural vegetation has been cleared and hillsides left bare.

## REVIEW 1.2.1

### Remember and understand

- 1 How much of the world's habitable land area has been converted into farms?
- 2 Name three potentially negative impacts that farming can have on the environment.
- 3 List two changes made on the Chinese farm in Source 1.25 that involve altering irrigation practices.

### Apply and analyse

- 4 Examine Source 1.24 and then complete the following.
  - a Describe the change to the amount of wilderness areas from 1700 to 2000.
  - b Use the world biomes map (Source 1.2) to classify the wilderness areas remaining today.
  - c Which type of land use has increased the most? Why do you think this is the case?
  - d The labels for Source 1.25 are in four different colours. Suggest a title for each colour.

### Investigate and create

Conduct some further research on the internet to complete these tasks.

- 5 Examine the image of a Chinese farming landscape as shown in Source 1.25. Describe the landscape as you think it would have been before people arrived in this valley.
- 6 The labels on this image focus on the ways in which people have changed the landscape. What are the underlying causes of these changes?
- 7 Work together as a class to plan and conduct an informal debate about changes to the natural environment. The debate topic should be: 'A small-scale farmer should have unlimited capacity to farm their own land for the purpose of providing food for their family and community'. Students should be allocated to a team. One chairperson should be selected to moderate the debate. All arguments should be logical and well thought out and presented in appropriate language.



# CHANGING VEGETATION AND WATER



Source 1.26 A woman in Madagascar plants a food crop on a burnt hillside.

Farmers make many changes to the natural environment in order to grow crops and raise farm animals. The greatest changes are made to the natural vegetation. Forests are cut down, burnt and replaced with a single plant species, wetlands and swamps are drained and vast areas of native grasses are replaced with crops such as wheat and rice.

## Changes to forests

Around the world about 5 million hectares of forest is converted for agricultural use every year: an area about two-thirds the size of Tasmania. Most of this change takes place in tropical forests, particularly in South America and Africa. Few forests in regions such as North America and Australia have been converted into farmland in recent years, largely because most of the forest has already disappeared. In Australia, for example, around 50 million hectares of forests and woodland have been cleared for farming or affected by logging since European settlement.

In the developing world, there is a strong link between **deforestation** and poverty (see Source 1.27). Millions of people who live below the poverty line and struggle to meet their daily food requirements are becoming small-scale slash-and-burn farmers. They use a machete to slash the undergrowth in forests and then set it alight to clear the land. Seeds are thrown into the warm ashes and in this way a forest has been converted into a farm. The types of farm animals that small-scale farmers raise, such as goats and dogs, push deeper into nearby forest areas to forage for food. Over time, as soil fertility declines, the farmers and their animals move into a new patch of forest and begin the process again. In Madagascar, for example, where 80 per cent of the population lives in poverty, only 10 per cent of the natural forest remains.

## MADAGASCAR: DEFORESTATION AND POVERTY LEVELS



Source 1.27

Source: Oxford University Press

## KEY CONCEPT: SUSTAINABILITY

### Greening the desert

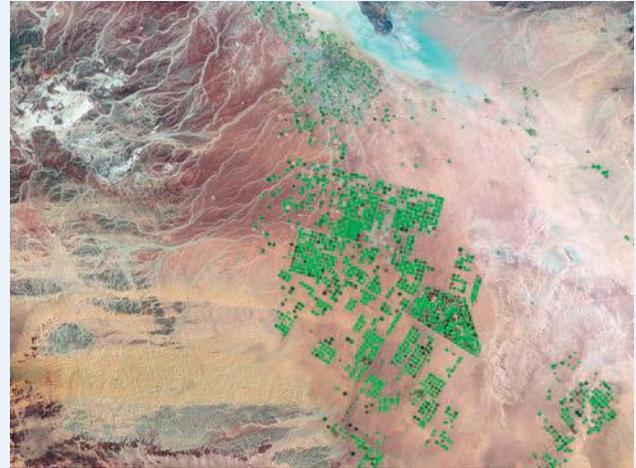
The types of changes being made to tropical rainforests and grasslands in South America and Africa for agricultural use are also being made to biomes in other parts of the world. In Saudi Arabia, for example, sections of the desert have been transformed into farmland for the purpose of growing crops.

Only a few centimetres of rainfall naturally in the Saudi Arabian desert each year, but crops can still be grown there thanks to large **aquifers** deep beneath the Earth's surface. These aquifers contain water that was trapped between layers of rock during the last Ice Age. They also store water that has fallen as rain over hundreds of thousands of years.

In Saudi Arabia, water is extracted from the aquifers by drilling deep into the ground under the desert floor and pumping it to the surface. Once on the surface, the water is pumped through a circular sprinkler system. This is known as centre-pivot irrigation. Sources 1.28 and 1.29 show the dramatic increase in centre-pivot irrigation in Saudi Arabia from 2000 to 2012. These satellite images show healthy vegetation in bright green, dry vegetation in orange and barren soil in pink. Each circular field shown in green is approximately 1 kilometre wide.

Because of the increasing rate at which water is being used, geographers and environmental scientists now believe that this type of farming has become unsustainable – both environmentally and economically. In time, supplies of water in the aquifer will become totally depleted as they are being used far more quickly than they can be replenished. The high cost associated with accessing water from the aquifers also means that crops grown in this way will soon become too expensive to buy.

For more information on the key concept of sustainability refer to section GT.1 in 'The geographer's toolkit'.



Source 1.28 Satellite image of the Saudi Arabian desert in 2000



Source 1.29 Satellite image of the Saudi Arabian desert in 2012

## Changes to grasslands

Because the world's most important food crops – rice, wheat and corn – are grasses, they grow best in the world's grasslands biome. However, clearing of native grasses to plant these crops can have devastating effects on the natural environment. Across much of Australia, North and South America, Asia and Africa, native grasses have been cleared and replaced by these three crops to provide food.

Source 1.30 Fields of wheat have replaced native grasslands across much of central America.



This farming then has a further impact on the biome. Because the rice, wheat and corn crops are harvested for human consumption, none of the nutrients from the plant material is returned to the soil. As a result, the soil fertility falls. This means farmers need to add chemical fertilisers to the soil, which further changes its composition. This can impact on the ability of the soil to hold water and can pollute waterways and coasts. Pesticides used to control weeds and insects also pollute the air, soil and water and may kill native plants and animals. Exposed soil becomes vulnerable to erosion by wind and rain and is washed away. Clearing of native grasses to make way for farming has many flow-on effects.

**Source 1.31** Conversion of the world's natural grasslands

Case study regions	Existing grasslands (% of natural cover)	Estimated conversion of natural grasslands (%)		
		Crops	Cities	Other
North American prairie	9.4	71.2	18.7	0.7
South American savannah	21	71	5	3
Asian steppe	71.7	19.9	1.5	6.9
Sub-Saharan African grasslands	73.3	19.1	0.4	7.2
South-west Australian grasslands	56.7	37.2	1.8	4.3

## Changes to water

Water is one of our most important resources, and agriculture is by far the greatest consumer of water around the world. About 70 per cent of the available water supply is used for agriculture, mostly for irrigation. Once water has been used to grow crops and given to animals to drink, it is, of course, returned to the environment. However, the farming process can change the quality of the water significantly, making it unsuitable for other uses and for the natural environment.

### Water pollution from farming

The water that is used on farms eventually flows through soil and rocks into nearby streams and rivers. Bare soil that is not protected by plants and held together by their roots can be washed away in the process, causing streams to become so cloudy that sunlight cannot reach the stream bed. This often kills many aquatic plants and animals.

Fertilisers such as nitrogen, phosphorus and animal manure can also end up in lakes and rivers, causing algae to grow out of control. This starves the water of oxygen and creates 'dead zones' in the water. Upon entering water sources, pesticides used in farming to control insects and weeds can poison fish and native animals, as well as kill the plants that create their habitats.



**Source 1.32** This Filipino farmer is spraying his rice crop with a pesticide to control insect pests. His fields drain into Laguna Bay, which is one of the world's most polluted water bodies and also home to a large freshwater fishing industry.

## Changing natural water flows

In many places, rivers are dammed to create a large reservoir of water that can be used for irrigation. In the last 50 years the amount of water held in dams has quadrupled and the volume of water taken from rivers and lakes has doubled. Most of this water is used for farming. The reduced volume of water in the rivers creates major problems for the natural environment and downstream users. In the lakes near the mouth of Australia's Murray River, for example, the water can be five times saltier than the sea partly because so much has been extracted for farming that the river cannot flush out the naturally occurring salt.

### REVIEW 1.2.2

#### Remember and understand

- 1 Describe the link between poverty and deforestation in your own words.
- 2 Is the scene in Source 1.30 a natural or human environment? Give evidence from the source for your answer.
- 3 How might the farmer shown in Source 1.32 affect the quality of fresh water?
- 4 How can fertilisers that are used on a farm eventually reach and kill fish?

#### Apply and analyse

- 5 Carefully examine Source 1.26.
  - a List the changes that you can see to the soil, vegetation and water that have taken place in this environment.
  - b Add changes that are likely to have occurred that you cannot see.
  - c Why has this farmer made these changes to the landscape? What are her likely motivations? Compare these with the likely motivations of the farmer who has changed the grasslands environment shown in Source 1.30.
  - d Examine Source 1.27. Describe the variations in forest cover between regions of low poverty and regions of high poverty.
- 6 Examine Source 1.31.
  - a What is the most common land use that replaces grasslands around the world?
  - b Which region has converted the most grassland? Suggest a reason for this.
- 7 Examine Sources 1.28 and 1.29.
  - a Each of the agricultural fields in these images is about 800 metres squared in area. Estimate the change in area covered in 2000 and in 2012.
  - b What impact will this change have over time on the volume of underground water in this region?
  - c Can you think of the environmental impacts that would result from irrigating using water that has been extracted from under the ground?

#### Investigate and create

- 8 Use an ICT chart tool such as Microsoft Excel, or a protractor, to construct pie graphs for the conversion of grasslands in Australia, North America and Sub-Saharan Africa (Source 1.31). Describe the differences between these three regions as shown in your completed pie graphs.
- 9 Draw a sketch of a river flowing through a farming region. On your sketch, show five different ways in which the farms affect the quality or quantity of water in the river.
- 10 Discuss some ways in which the impacts shown on your sketch could be reduced.

# WEARING OUT THE SOIL



**Source 1.33** The most highly erosion-prone soil in the world is said to be found at China's Loess Plateau.



**Source 1.34** Soil salinity near Renmark, South Australia

In many places around the world, soils are being degraded to such an extent that the amount of food that can be grown is in decline. It is estimated that about 2 billion hectares of land have been affected in this way, an area that is home to about one-fifth of the world's population. **Soil degradation** occurs because human activities affect the soil's ability to support plants and animals. These activities include clearing forests to make way for farms and towns, increasing the numbers and density of farm animals, poor irrigation practices and overfarming by growing so many crops that the natural nutrients of the soil are removed and not replaced.

Soil degradation takes many forms. At its worst, the soil is broken down and washed away (see Source 1.33). It is estimated that 75 billion tonnes of fertile soil is lost this way each year. This is largely as a result of forest clearing that allows fragile soils, particularly on sloping land, to be attacked directly by heavy rain. Without the roots of forest plants that help bind the soil together, soil is washed away. In other places, nutrients in the soil such as nitrogen and potassium have become so depleted that the soil lies barren, unable to support plant life.

In Australia, soil degradation often takes the form of **salinity**. Salinity is a condition where the amount of salt causes problems in the soil and affects the environment. There are two types of soil salinity:

- primary salinity – a natural condition that develops in the landscape over time
- secondary salinity – caused by human impact.

Human impact is related to the irrigation of soil to grow crops. Salts in the irrigation water are left in the soil, and eventually the soil becomes too salty for plant life to survive. Secondary salinity also occurs when trees that have deep roots are removed by humans to make way for crops with short roots. Termed 'dryland' salinity, salt held in the **water table** is then able to move up to the soil's surface, killing virtually all plant life. Approximately 2 million hectares of Australian farming land is degraded in this way (see Source 1.34).

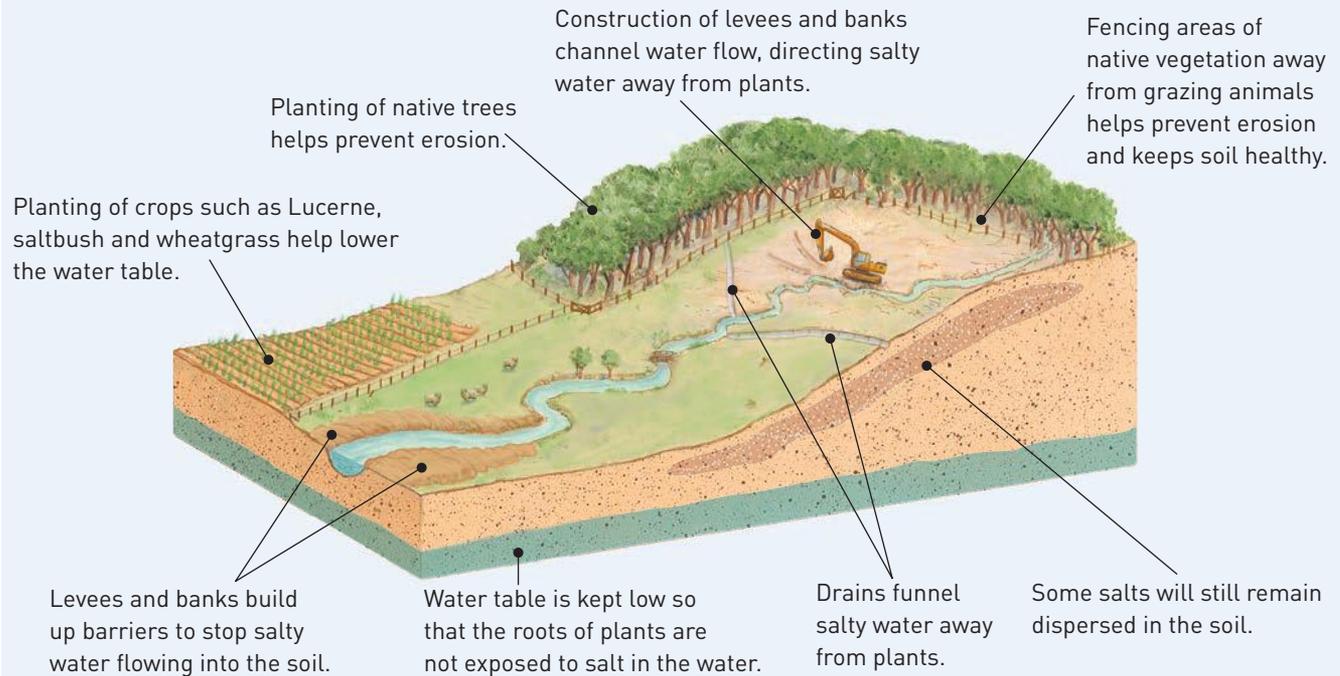
## KEY CONCEPT: SUSTAINABILITY

### Managing salinity

Many Australian farmers, particularly in Western Australia, have responded to the threat of soil salinity by changing the ways in which they farm the land. Some of these changes have been more successful than others, but all are designed to use the soil in a more sustainable way. Source 1.35 shows some of the strategies used by farmers to

combat soil salinity. The most successful strategy used so far appears to be lowering the level of the water table, which keeps salt in the water away from plants.

For more information on the key concept of sustainability, refer to section GT.1 of 'The geographer's toolkit'.



Source 1.35 A range of responses and strategies can be used to tackle salinity.

### REVIEW 1.2.3

#### Remember and understand

- 1 What is salinity? Why is it considered to be a cause of soil degradation?
- 2 How does forest clearing lead to soil degradation?

#### Apply and analyse

- 3 How has the farmer in Source 1.35 managed salinity on the farm?
- 4 Select one of the farmer's strategies and comment on its potential effectiveness.
- 5 Examine Source 1.33 showing soil erosion in northern China.
  - a What evidence is there that this is a farming area?

- b How has farming changed the soils in this place?
- c Compare this image with the image of rice terraces seen on the unit opener. Both these areas have been farmed in the same way, but one has experienced soil erosion while one has not. Brainstorm the possible reasons for these differing outcomes.

#### Investigate and create

- 6 The eroded soil in Source 1.33 was once some of the most fertile soil in the world. Describe and sketch a system that would help to slow or reverse soil erosion in this place.

# SPREADING DESERTS

The **food security** of people who live in the world's dryland areas is under threat from a process known as **desertification**. As a result of desertification, once-productive land has become too infertile, too salty or too heavily eroded to continue to support the way of life previously experienced in those areas. According to research by the United Nations Desertification Convention released in 2013, there are currently 168 countries at risk from desertification.

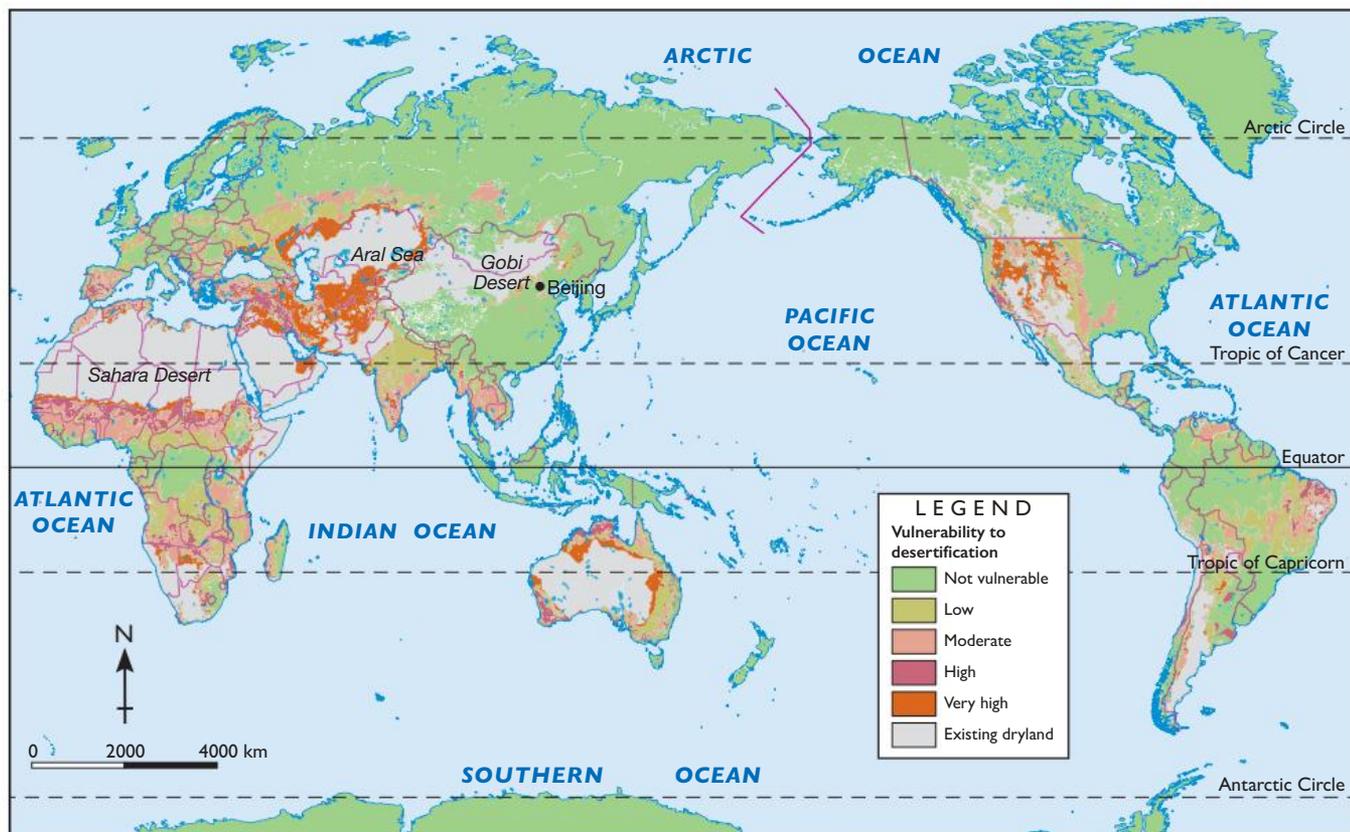
## STRANGE BUT TRUE

Oxfam rates a country's ability to provide sufficient safe food for its population to live a fit and healthy life. Many European nations, along with Australia, are all 'food secure' on their index, with most of Africa and Asia rating the worst.

There are many human activities that can lead to desertification but they are all related to the overuse of the land and water in vulnerable regions. This includes overgrazing by animals such as cattle and goats, the removal of forest cover, the use of trees and shrubs for firewood, extracting water from the ground, poor irrigation practices and growing crops on marginal farming land (land that is difficult to cultivate). Natural factors including drought can also contribute to desertification.

The United Nations currently estimates that the food security of about 250 million people around the world is directly affected by desertification. They believe that the food security of a further one billion is also threatened. There are many effects of desertification: sandstorms, crop losses, famine, environmental refugees and conflict are all direct or indirect results of desertification. About 12 million hectares of land are lost every year to desertification, which is about twice the size of Tasmania. It is estimated that this results in an annual loss of 20 million tonnes of grain. Most of this occurs in developing regions in Central Asia and Sub-Saharan Africa, further contributing to **food insecurity** in those regions.

## WORLD: DESERTIFICATION VULNERABILITY



Source 1.36

Source: Oxford University Press

## KEY CONCEPT: ENVIRONMENT

### The Green Wall of China

Over the next few decades, the Chinese Government has plans to plant over one billion trees in an attempt to halt the advance of the Gobi Desert over productive farmland across vast areas of China. Nicknamed the Green Wall of China, this line of trees is expected to extend for 4480 kilometres and cover 4 million square kilometres on the desert margins.

Despite some local success stories, not all experts are convinced the wall will halt desertification. In

fact, some geographers argue that it may even add to desertification over the longer term as the trees require large amounts of water to help them grow.

For more information on the key concept of environment, refer to section GT.1 of 'The geographer's toolkit'.



**Source 1.37** A line of trees on the edge of the Gobi Desert in China helps to protect crops from being covered in sand.

### REVIEW 1.2.4

#### Remember and understand

- 1 What is desertification? What are some of the direct and indirect results of desertification?
- 2 Name three human activities that can lead to desertification.
- 3 How does desertification lead to food insecurity?

#### Apply and analyse

- 4 Using Source 1.36, describe the global pattern of desertification. Ensure you name specific countries, regions and continents in your description.
- 5 What is the spatial association between existing dry lands and areas vulnerable to desertification? Explain why this spatial association exists.

- 6 How do you think desertification may lead to wars between countries or civil conflicts within countries?

#### Investigate and create

- 7 In what ways might climate change be a leading cause of desertification in some regions of the world?
- 8
  - a Examine Source 1.37. How effective do you believe the line of trees will be in stopping the advancing sand dunes of the Gobi Desert? Give some reasons for your answer.
  - a Design a better solution for the issue. It may be stopping the sand in another way, moving it, or changing the human activity in the area. Be prepared to justify your solution.

# 1.2

## CHECKPOINT

### HOW DO PEOPLE USE AND ALTER BIOMES FOR FOOD PRODUCTION?

- Investigate the human alteration of biomes to produce food, industrial materials and fibres and the environmental effects of these alterations.

- Which biome(s) do you believe have been altered the most by humans? [5 marks]
- Making reference to your answer above, explain why some biomes are more easily altered than others. [10 marks]
- Why is it that many areas of the world have been changed by humans to produce food but it is those areas in less developed or poorer nations that show the most environmental impact? [15 marks]

TOTAL MARKS [ /30]

### RICH TASK

#### The environmental impact of changing diets

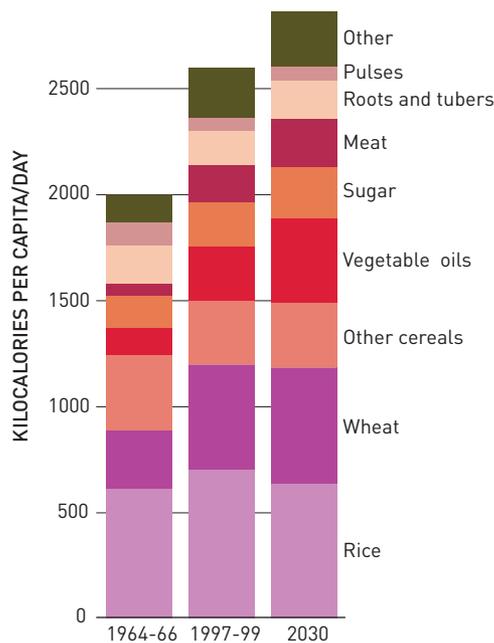
The diets of many people around the world are changing and this is having significant impacts on the environment. As the wealth and wellbeing of people in countries such as China and India increases, the diets of people in those countries are gradually changing. With greater wealth, many people are moving from a diet based almost entirely on grains and plants to a diet with more protein from meat and dairy products. Food production industries are also changing to meet this growing demand.

#### Processing geographical information

- Use the information presented here to suggest ways in which people in developed countries such as Australia could reduce the environmental impacts of their diets.

#### Communicating geographical information

- Design an advertising campaign to communicate your findings to the Australian public.



**Source 1.38** A compound column graph showing observed and predicted changes in the human diet between 1964 and 2030

Source: [http://www.unep.org/pdf/foodcrisis\\_lores.pdf](http://www.unep.org/pdf/foodcrisis_lores.pdf)

Beef	15 500	16	7.9	6	2470
Chicken	3900	4.6	6.4	1.8	1650
Eggs	3333	5.5	6.7	*	1430
Milk	1000	10.6	9.8	*	610
Wheat	1300	0.8	1.5	*	3400
Rice	3400	*	*	*	1300
1kg	Water footprint (L) <sup>1</sup>	Emissions (kg CO <sub>2</sub> ) <sup>2</sup>	Land use (m <sup>2</sup> ) <sup>3</sup>	Grain for feed (kg)	Calories (Kcal)

**Source 1.39** The ecological footprint of different food types

Source: <http://ccafs.cgiar.org/bigfacts/dietary-change/>

Here are some facts you might consider:

- Currently 33%, 50% by 2050, of cereal grown feeds animals for human consumption (UN report, 2011).
- Meat consumption is expected to increase from 39 kg/person/year in 2009 to over 49 kg/person/year by 2050 (FAO, 2012).
- The production of animal protein must be more than tripled if the projected global population of nine billion people in 2050 were to consume meat and dairy at current North American and European levels (Consultative Group on International Agricultural Research report, 2012).
- With rising incomes in the developing world, demand for animal products will continue to surge; 74% for meat, 58% for dairy products and 500% for eggs. Meeting increasing demand is a major sustainability challenge (Food and Agriculture Organisation of the UN, 2012).
- Today, the number of urban residents is growing by nearly 60 million every year. By 2050, the urban population will almost double to 6.4 billion people. Almost all urban population growth in the next 30 years will be in cities of developing countries (World Health Organization, 2013).

## Analysing secondary geographical data and drawing conclusions

Geographers often use secondary data sources such as graphs and statistics to draw conclusions about what they have found. Geographers need to be able to correctly interpret data that has been collected and represented by other people. By following the steps below you will learn to interpret a range of secondary data sources (e.g. graphs, tables, reports) to reach conclusions about your investigation.

- Step 1** Gather a range of secondary data sources and write down two or three key facts that are presented.
- Step 2** Identify any patterns or exceptions that you notice.
- Step 3** Pay particular attention to the title, date of the data and its source. Is the information already dated, is it still relevant, or is it commenting on a situation or place at a particular point in time?
- Step 4** Check the information on graphs carefully. Pay particular attention to ranges of figures and make sure that you understand the classifications. Are things being measured in kilograms or tonnes, for example? You may need to convert the figures to the same units of measurement in order to understand and compare them.

**Step 5** Remember to think about bias – ask why the author has written the piece of information. Are they trying to influence opinion on an issue? Are you getting the complete picture? Try to find a range of sources on the same subject to ensure you have the most complete data available.

**Step 6** Compare the facts and figures you have summarised. It may be helpful to use the PQE method to do this and your notes to reach your conclusion. Support your conclusion with information from the data.

**Step 7** Present your conclusion to an audience. This may be done verbally, graphically or in a written form. Make sure you use the evidence you have gathered to support your conclusion.

### Apply the skill

- 1 Examine the information in Sources 1.38 and 1.39. Follow the steps to draw a conclusion about the environmental impact of changing diets.
- 2 Which information best supports your conclusion, what other information would you need to further support your conclusion and where could you find this information?

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Space, Environment, Interconnection, Sustainability, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Graphs and statistics, Spatial technologies; Visual representations

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'

# CHECKPOINT

## CHAPTER

# 2



**Source 2.1** These people are victims of the famine in the Horn of Africa. Drought, conflict and restrictions on delivery of food aid caused the famine in 2011–12 – one of the world's biggest humanitarian emergencies.

## FOOD SECURITY: FEEDING A HUNGRY WORLD

Compared with people living in many countries around the world, most Australians have very reliable access to a wide variety of different foods. Relatively high wages and a strong economy mean that most Australians can afford to purchase and prepare the food they need and rarely worry about where their next meal is coming from.

Unlike people in Australia, these Somali women are waiting in line to receive food from a local aid organisation in their country's capital city, Mogadishu. They are victims of a food shortage that affected 10 million people in African nations in 2011–12. A widespread shortage of food such as this is known as a famine and can be caused by many factors including drought and war. Food experts are warning that famines are likely to become more severe and widespread as the Earth's climate changes and the human population continues to grow. Some argue that food security is the greatest single issue facing the world today.



# 2.1

## BIOMES PRODUCE FOOD

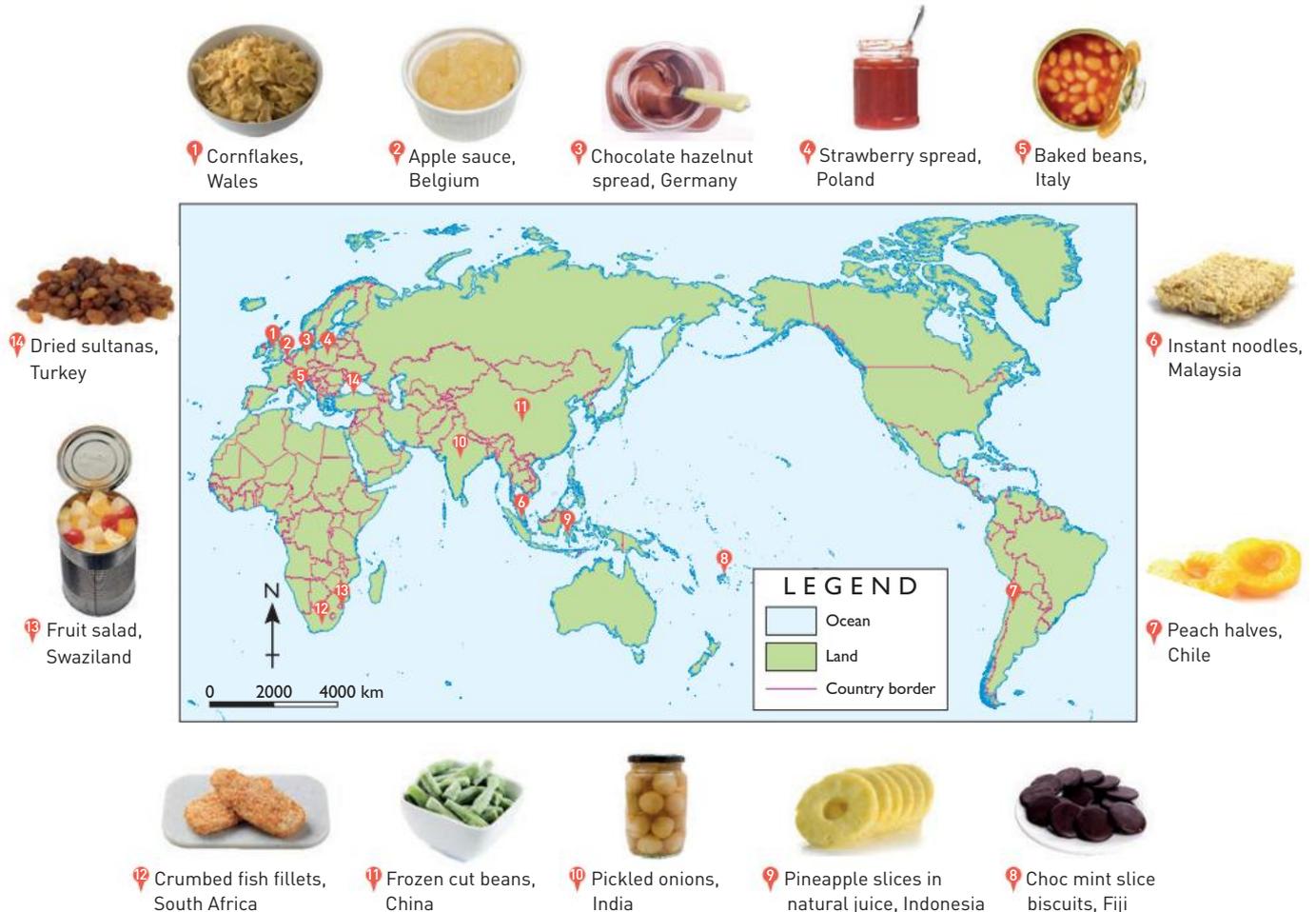
CAN THE WORLD'S BIOMES SUSTAINABLY FEED THE WORLD'S POPULATION?

For many people in the world, the question of where their food comes from is easy to answer. Throughout the developing world, the majority of food comes from what people grow or gather. People in these places spend much of their time planting, growing and harvesting crops or looking after animals, such as sheep, goats or cows. These activities provide virtually all of their food requirements, from milk and meat to grains such as rice, wheat or corn. The crops they grow and the animals they raise are influenced by a wide range of factors but mainly by the climate in which they live.

In developed countries like Australia, the question of where food comes from is much more difficult to answer. In fact, very few people across the developed world would be able to tell you. This is because most people in these countries spend little or no time growing food. They rely on people in other places to grow food for them. Many Australians, for example, buy their food at a supermarket. But where does the supermarket get this food from? Labels on food give some indication but these can be misleading at times.

In a recent study, the origin of the home brand and market leading products sold in large supermarkets was studied in detail. The researchers found that about 41 per cent of Coles' products, 31 per cent of Woolworths' and 13 per cent of Aldi products were grown in Australia with the rest coming from overseas.

### WORLD: ORIGIN OF SOME COMMON SUPERMARKET FOODSTUFFS



Source 2.2

## KEY CONCEPT: SPACE

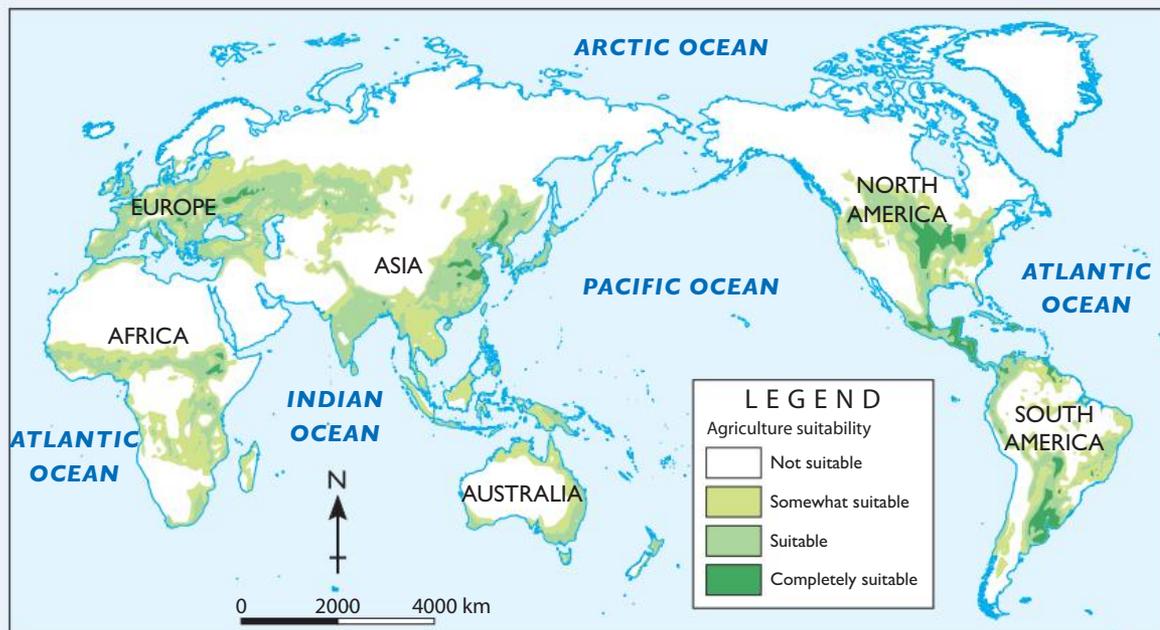
### Agricultural suitability

Limitations of climate such as extremes in temperatures or low rainfall mean that many regions cannot support farming. Other areas may have low soil fertility, be covered in rainforest, be too mountainous or covered in ice caps. This means that the world's farms are concentrated in certain areas where the soil, climate and availability of water make farming possible. Source 2.3 ranks regions of the

world in terms of their suitability for agriculture (i.e. completely suitable for agriculture to not suitable at all). Geographers use the key concept of space to better understand the patterns formed by agricultural use to make recommendations for the future.

For more information on the key concept of space, refer to section GT.1 of 'The geographer's toolkit'.

### WORLD: AGRICULTURAL SUITABILITY



Source 2.3

Source: Oxford University Press

## REVIEW 2.1.1

### Remember and understand

- 1 Why is it difficult for people in developed countries to know where their food comes from?
- 2 Using the scale provided, work out which supermarket item shown in Source 2.2 has travelled the furthest distance to be sold in your town or city.

### Apply and analyse

- 3 Examine Source 2.3 carefully.
  - a Explain why each of the white areas in the following regions and countries may be unsuitable for agriculture: Australia, South America, North Africa, Central Asia.
  - b Compare the map showing areas of the world suitable for agriculture with the world biomes

map in Chapter 1 (Source 1.2). Make some general statements about which biomes are most suitable for agriculture. Explain why you think this is the case.

### Investigate and create

- 4 What factors would be considered when making a map like Source 2.3 that shows areas that are most or least suitable for farming?
- 5 Conduct a classroom survey on the food you have eaten today or last night. List the origins of where the food has come from and compare your results with those of your classmates.
- 6 Conduct research online to work out why Australian supermarkets source a large proportion of their products from overseas. Is there a changing trend? Why/why not?

# MAKING DECISIONS ON A FARM

Every year, farmers in different countries around the world make decisions about what crops they will grow and what animals they will raise on their properties. Before they make any decisions, they must consider a number of competing factors. They need to consider their own level of experience as a farmer, their heritage or background, the types of machinery and help they have available, the cost of grain, the amount of rain forecast, the quality of the soil, the estimated price they will be paid for the crops they produce and how they will transport them to market. Broadly speaking, all of these competing factors can be divided into four main categories:

- environmental factors
- technological factors
- economic factors
- historical or cultural factors.

Examples from each of these categories are provided in Sources 2.4 and 2.5.



**Sunshine:** Places nearer to the Equator receive more direct sunlight than places closer to the poles. This will influence the length of the growing season as all plants need sunlight.

**Wind:** Strong winds can dry out the soil, and damage or even destroy crops.

**Humidity or rainfall.** Some plants like warm and moist conditions, some need dry conditions to grow well. All plants need water but some need large quantities spread throughout the year while others thrive in drier conditions. Farmers carefully assess factors such as the total rainfall in a year and the times of the year when it falls in deciding on the best crops to grow and when to plant them.

**Temperature:** Different plants have different tolerances to temperature. Some grow best in warm temperatures, others when it is cold. Frosts and very warm temperatures can damage some plants so farmers carefully monitor air and soil temperatures so they know when to plant or harvest their crops.

**Soil structure and texture:** Soils are a combination of clay, sand and silt in varying proportions. Soils with high clay content can make it difficult for plant roots to penetrate and may become waterlogged whereas sandy soils may not hold water. The best soils are called loams and combine all three parts in equal proportions.

**Slope of the land:** Flat areas are generally easier to farm than hillsides as machinery such as tractors and harvesters can work more easily on flat land. Flat areas, however, may be prone to flooding. The direction that a slope faces (the aspect) may be important as it may determine the amount of sunlight plants receive.

**Soil fertility:** Plants need certain minerals and trace elements to grow and they take these from the soil. Some soils have more of these and are therefore more fertile. Farmers may need to add minerals in the form of fertiliser to infertile soils.

**Water:** A nearby river or aquifer can provide water to irrigate crops or to give animals such as cows and sheep water to drink.

Source 2.4 A range of environmental factors that need to be taken into account when making decisions on a farm

**Markets:** Farmers who grow food for profit have to be able to sell it. The proximity of a large city will provide a demand for many products and many farmers also export their produce to other countries. The prices for farm produce change over time and this may influence which crops a farmer grows in a particular year.

**Technology:** New technologies such as irrigation systems and breeds of crops may allow some farming types to spread into new areas. On the other hand, many farmers in developing countries may have access to only simple technologies such as a horse-drawn plough or hand sowing of seeds.

**Expertise:** Farmers often specialise in growing a certain crop or raising a certain breed of animal. This may have been the case for many previous generations. As a result, they may have built up a great deal of expertise in this type of farming.

**Financial resources:** Many farmers in the developing world have few financial resources to buy machinery and hire labour and so they rely on their own physical labour and are able to grow only enough food to feed their own families.

**Source 2.5** A range of technological factors that need to be taken into account when making decisions on a farm

## REVIEW 2.1.2

### Remember and understand

- 1 How does the climate in a particular place influence farming practices there?
- 2 Name three soil properties that might influence successful crop growth.

### Apply and analyse

- 3 Most farmers continue to practise the same type of farming year after year. Which of the four main factors would this reason come under and why do you think this is the case?
- 4 Select one of the environmental factors discussed in Source 2.4 and explain how an individual farmer may improve or adapt to this factor on his or her farm.

### Investigate and create

- 5 Consider all of the environmental, technical and economic factors discussed in Sources 2.4 and 2.5. Rank the factors a farmer needs to take into consideration from most to least important. Give a reason for each of your three top-ranked factors.



# THE IMPORTANCE OF CLIMATE



More than any other factor, climate (especially rainfall and temperature) determines the type of farming that is practised in a given location. Some crops, such as rice and sugar cane, require warm temperatures and a reliable water supply. Other types of farming, such as sheep and camel farming, can tolerate a wider range of temperatures and water supply (see Source 2.6). Farmers who share a similar climate tend to practise the same type of farming. This leads to large regions of the Earth's surface being farmed in the same way.

In some places, farmers are able to use technology to overcome some of the limitations of climate. Many Australian farmers, for example, use water from rivers and dams to **irrigate** their crops rather than rely on natural rainfall. Others pump water from natural underground water storages called **aquifers**. Others use greenhouses so they can control the temperature and humidity, allowing crops such as flowers and vegetables to grow throughout the year.

**Source 2.6** A nomadic farmer herds his camels in Ethiopia.

## SKILL DRILL

### Comparing patterns on maps

One of the most common ways that geographers analyse and explain the world around them is by looking for patterns in geographical data. For example, by comparing patterns on maps they can examine the relationship between climate and farming.

To compare patterns on two maps, follow these steps:

- Step 1** Look carefully at the first map, particularly the title and legend, so that you understand exactly what it shows.
- Step 2** Repeat this for the second map.
- Step 3** Look at each map carefully and note regions where there seems to be a correlation (relationship). For example, in Sources 2.7 and 2.8 one correlation would be: 'little or limited agricultural use' on the agricultural regions map

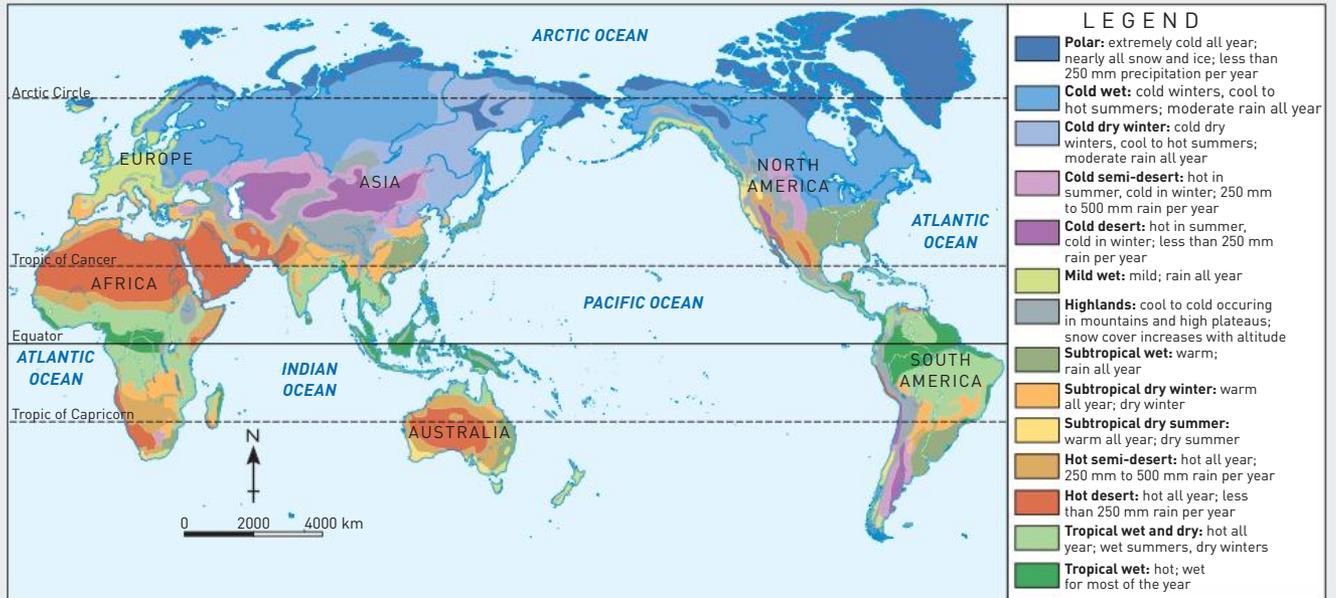
(Source 2.8) relates to hot desert on the climate zones map (Source 2.7).

- Step 4** Use an atlas map to find out the names of the places where this association occurs.
- Step 5** Make a statement that sums up your associations. For example, 'Rice farming is dominant in places with a subtropical climate such as north-east India and southern China where it is warm all year and has a dry winter'.

### Apply the skill

- 1** Use Sources 2.7 and 2.8 to account for the distribution of:
  - a** dairy farming
  - b** commercial – extensive livestock farming
  - c** the pattern of agriculture in South America.

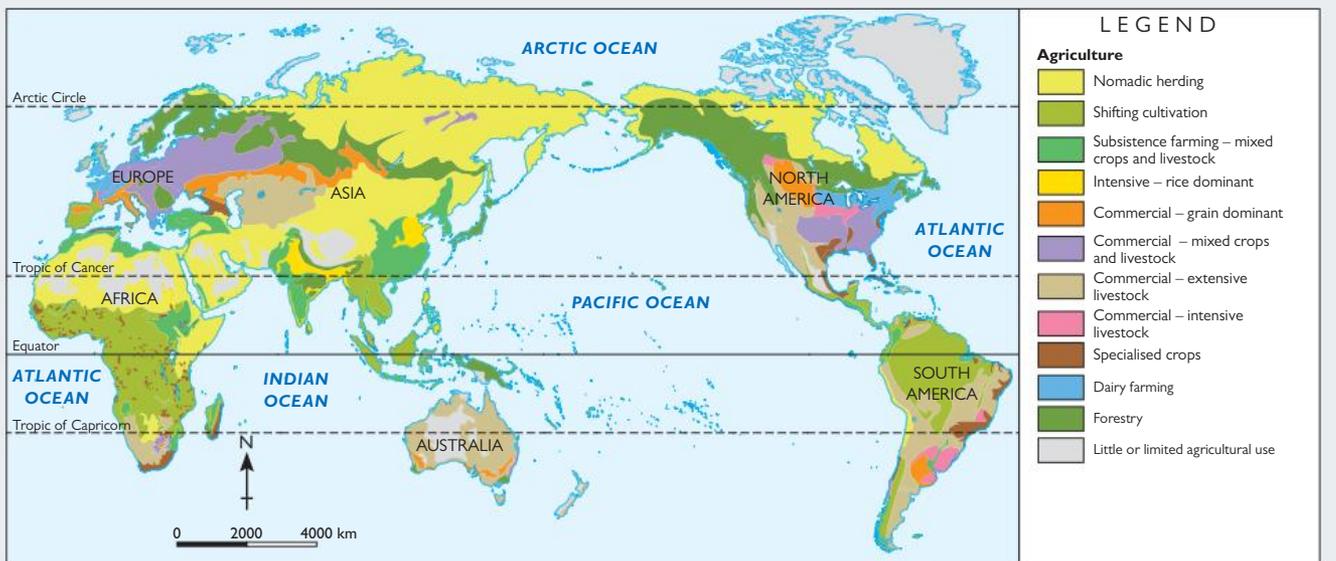
## WORLD: CLIMATE ZONES



Source 2.7

Source: Oxford University Press

## WORLD: AGRICULTURAL REGIONS



Source 2.8

Source: Oxford University Press

### REVIEW 2.1.3

#### Remember and understand

- 1 How does the climate of particular places influence the type of farming practised there?
- 2 How do some farmers overcome the limitations of climate?

#### Apply and analyse

- 3 How might a farmer overcome the limitations of frost?

- 4 Describe the distribution of nomadic herding in the world. Account for this distribution using Source 2.7.

#### Investigate and create

- 5 Consider that most of the world's population live across Africa and Asia; compare and analyse why the climate and agricultural practices (Sources 2.7 and 2.8) combine to be some of the harshest places to grow food for the masses.

# SOIL – MORE THAN JUST DIRT



**Source 2.9** Like all rocks, Uluru is under attack from physical and chemical weathering. The desert soil in the foreground would be partly made up from weathered rock particles. Only shrubs and grasses are able to grow in this soil due to its low nutrient levels and harsh climate.

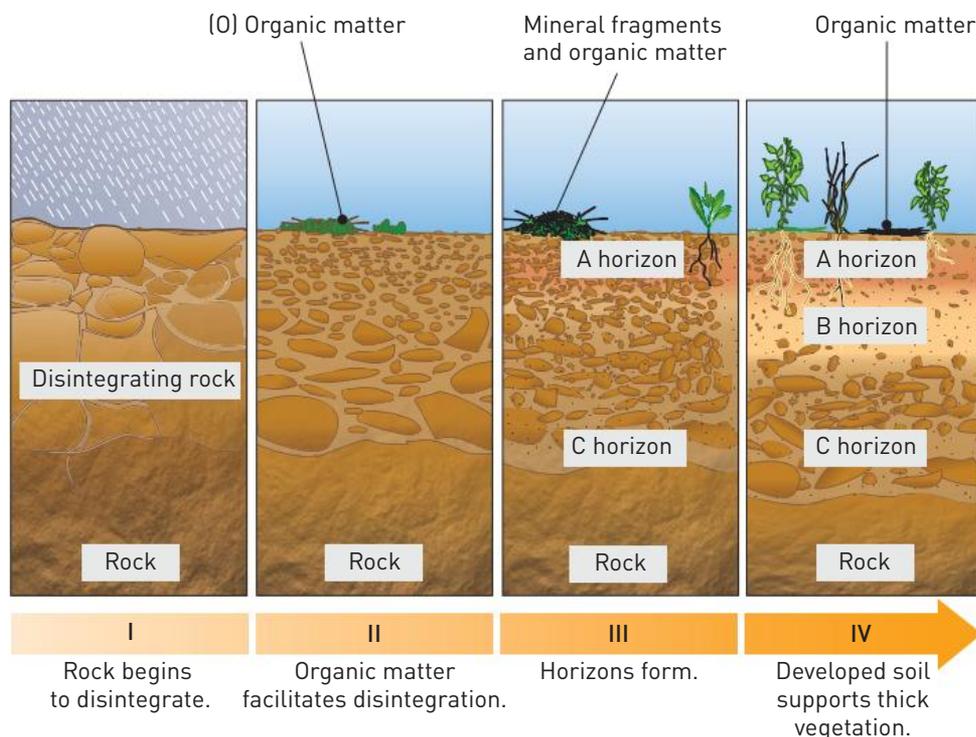
Many parts of the Earth’s surface are covered in a thin, fragile layer of soil. Plants grow in this soil that feed every animal on Earth, including you. But what is soil and how are plants able to use it to grow?

Soil is a mixture of air, water, broken-down rock and organic material such as tiny animals and plants. Soil is a non-renewable resource – it takes thousands, even millions of years to form. The first step is the gradual breaking down or weathering of rock. Rock weathers because it is subjected to physical forces and processes such as freezing and thawing, the expansion of roots, or because the rocks rub against each other in a stream or river. Movement of ice in a glacier, the flow of water in a river or ocean, or the force of wind can all cause rocks to weather.

Rocks are also weathered by chemical changes that occur. Water can dissolve minerals found in rocks, reacting and forming new minerals, which may then break down the rock itself. Oxygen also combines with some minerals to wear away rocks and the slightly acidic nature of rain can also help to dissolve rocks (see Source 2.9).

As rocks break down into finer and finer particles the minerals within them become available to plants. Seeds carried onto weathered rock by wind, water, animals and birds are able to germinate and send roots down into the new soil. As plants die and leaves fall onto the soil they decompose and add to the fertility of the soil. This allows other plants to flourish in the soil.

Over time, soils form layers known as **horizons**. These can be seen where a road has been cut through a hillside. By examining the horizons, soil scientists and farmers are able to determine how best to farm different areas. The horizons are labelled using letters so they can be easily identified and compared. From top to bottom, the horizons are O (organic matter), A, B, C and Rock (see Source 2.10). Some soils may have all the horizons, while others may have only one or two horizons. By identifying which of the horizons are missing



**Source 2.10** The development of soil horizons over time

in the soil, the farmer will know how and when to treat it. For example, if the soil is lacking organic matter, **mulch** can be added to increase mineral content and prevent water loss through evaporation.

## Australia's soils

Australian farmers have to overcome the many challenges of a variable climate, with its extremes of droughts and floods. Perhaps the greatest challenge faced by Australian farmers is the condition of the soil. As one of the world's oldest continents we also have some of the oldest soils on Earth. The constant weathering over millions of years has washed away many of the important nutrients and minerals and our soils are among the world's poorest.

As well as being much less fertile than other soils around the world, many of our soils are also much saltier than in other places. This is because much of the continent was once covered by ocean, and though the water has receded, the salt remains. Much of our soil is also composed of clay either at the surface or just below the surface. This restricts water drainage into the soil and makes it difficult for the roots of plants to penetrate.

Australian soils therefore are generally low in nutrients, thin and easily eroded. Australian farmers have developed many ways of dealing with these limitations. The most obvious of these is adding nutrients and chemicals to the soil that are missing (see Source 2.11). Farmers regularly test their soil and will add fertiliser containing those chemicals that their plants need. As crops grow, the plants draw these nutrients from the soil and so farmers must continue to replace them, often applying fertiliser annually.



**Source 2.11** Fertiliser containing nutrients such as nitrogen and phosphorus is usually spread using a tractor or truck.

### REVIEW 2.1.4

#### Remember and understand

- 1 Why are Australia's soils generally low in nutrients?
- 2 Why is soil an important natural resource?
- 3 Why do many farmers need to replenish the nutrients in the soil with fertiliser annually?

#### Apply and analyse

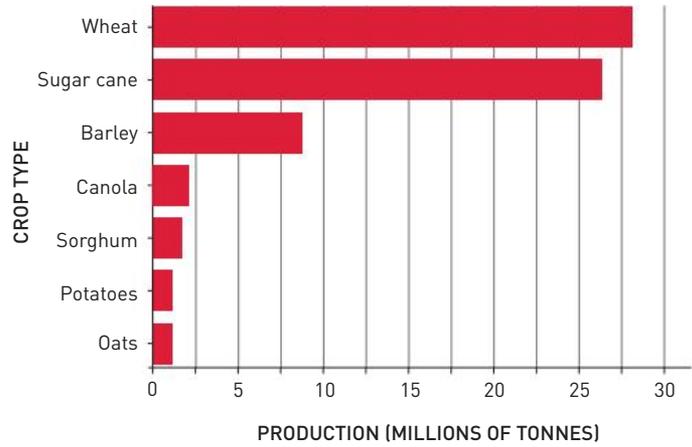
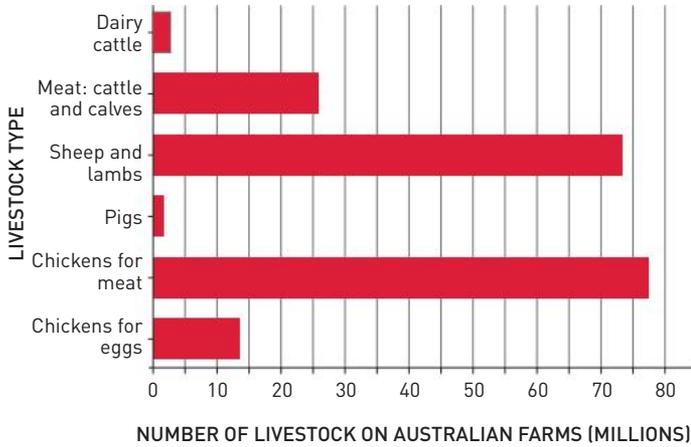
- 4 Look at Source 2.9. What physical forces do you think are weathering Uluru?
- 5 Is soil a renewable or non-renewable resource? Give some reasons for your answer.

#### Investigate and create

- 6 Construct a flow diagram with boxes and arrows describing how soil is formed.
- 7 Explore the soil profile in your local area. Look for a place where a stream has cut down into the soil or a cutting has been made for a road or railway. Sketch the soil profile and see how many of the horizons you can identify. Compare your profile with stage IV in Source 2.10. What are the similarities and differences?

# FOOD PRODUCTION IN AUSTRALIA

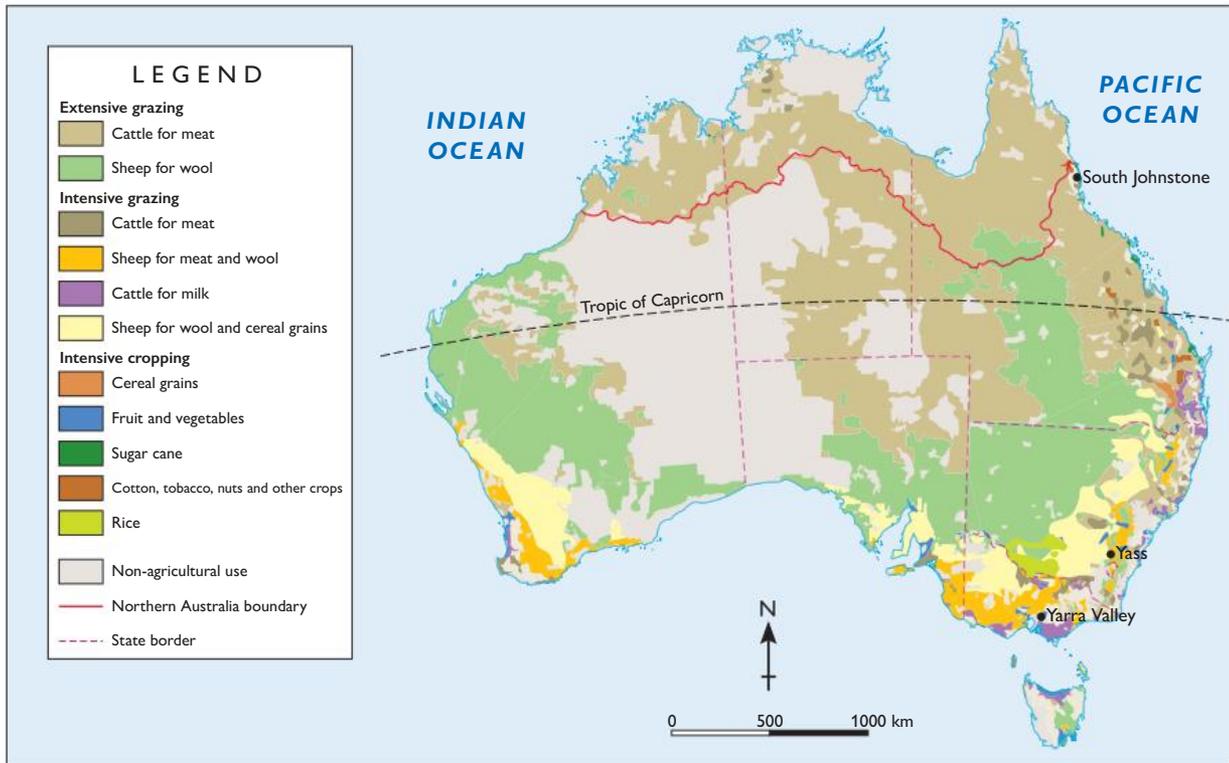
There are more than 135 000 farms in Australia. They can be classified in many different ways; for example, those that grow crops and those that raise livestock. Another way a farm can be classified is by how large it is in relation to the amount of food or fibre it produces. Farms that require large areas of land – to provide pasture for sheep or cattle, for example – fall under the classification of **extensive farming**. On the other hand, farms such as poultry farms or those that grow vegetables can produce large volumes of food or fibre in a small area and are classified as **intensive farming**.



**Source 2.12** This graph shows the number of livestock on Australian farms by type.

**Source 2.13** This graph shows the crops grown on Australian farms by type each year.

## AUSTRALIA: LAND USAGE



**Source 2.14**

Source: Oxford University Press

## Should we grow more food in northern Australia?

Farming in northern Australia, like farming everywhere, is determined by environmental factors, particularly temperature, soil fertility and water. The soils are among the world's oldest and have been subject to monsoonal downpours for millions of years. This has **leached** many important minerals out of the soils making them relatively infertile. Many of the soils of the north are arid or semi-arid and the rain that does fall tends to be seasonal rather than all-year round. These factors make intensive farming difficult. Cattle farming therefore dominates, covering 90 per cent of the land area and accounting for 30 per cent of the nation's total cattle.

Several government task forces have identified the water that lies in rock layers (known as aquifers) beneath northern Australia as the key to expanding intensive agriculture. They have suggested that small-scale intensive farming using groundwater has the potential to triple the amount of cropland in the north from the current 20 000 hectares. An example of this type of farming (known as mosaic agriculture) is shown in Source 2.17.



**Source 2.15** Cropping of sugar cane is carried out near South Johnstone in north Queensland.



**Source 2.16** NSW's tablelands and adjacent slopes are where the highest densities of sheep grazing occurs; for example, Yass is a significant sheep grazing area.



**Source 2.17** These circular fields in northern Australia are an example of the result of pivot-circle irrigation using groundwater from aquifers.

### REVIEW 2.1.5

#### Remember and understand

- 1 Describe the main differences between intensive and extensive farming.
- 2 What are some of the limiting factors for further intensive farming in northern Australia?

#### Apply and analyse

- 3 Examine Sources 2.16 and 2.17. Classify each of these farming types as either intensive or extensive.
- 4 Select one farming type in Source 2.14.
  - a Describe its distribution in Australia.
  - b Brainstorm the environmental factors that help to explain this distribution.

- 5 Using Source 2.14, explain why you think fruit and vegetables are often grown near large cities.

#### Investigate and create

- 6 Describe the current distribution of farming types in northern Australia.
- 7 Explain the significance of the Northern Australia Boundary (Source 2.14).
- 8 Using the information provided, together with additional research, classify each of the livestock types in Source 2.12 and crop types in Source 2.13 according to whether they are examples of extensive or intensive farming.

# HIGH-TECH FARMING

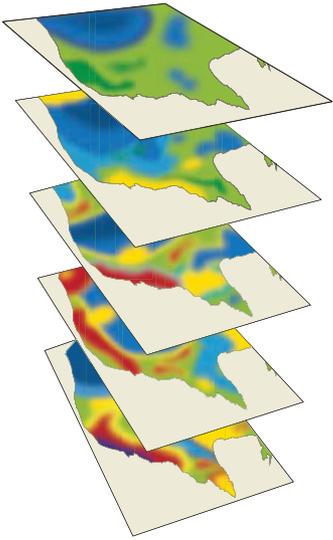
Modern technologies have changed farming methods and made many farms in Australia and around the world more efficient and more productive. The use of technologies such as computers, satellites, remote sensors, geographic information systems (GIS) and global positioning systems (GPS) has allowed some farms to go 'high tech'. Some Australian farmers are using pilotless planes (known as drones) to keep watch on their soils, plants and water troughs, while others are tracking their sheep and cattle with sensors implanted in the animals' ears or in electronic collars. Technology continues to advance farming operations, increasing the fruitfulness and longevity of crops and improving the breeding conditions of cattle.

## Precision farming

On every farm there are wide variations in natural features such as slope, soil fertility, soil moisture and drainage. There may also be different soil conditions in different spots on the farm – past farming practices may have taken minerals from some parts of the farm but not others. Each farm and each field is therefore a patchwork of different soil and water features. Often, however, all parts of the field or farm are treated in the same way, despite being a 'patchwork' of different conditions and levels. This means that some parts of each farm are less productive than other parts.

A new farming system known as **precision farming** is beginning to change this old method to bring about better economic and environmental outcomes. Sensors mounted on satellites, planes and helicopters collect large amounts of data on many aspects of the environment including rates of plant growth, minerals in the soil and soil moisture. Using GPS, this data is then converted to detailed maps of each farm showing, for example, areas of high crop yield and areas with a lower yield (see Source 2.18).

This information is then available to the farmer to make decisions about better and more precise irrigation and fertilisers and the choice of crops and the times to plant and harvest them. Using precision farming tools such as layered maps and GPS, farmers can determine precisely the best places to plant. They can identify where the soil is richer in minerals, so they can grow better crops. Rows of soil used in previous years where minerals have been depleted can be avoided.



**Source 2.18** With the help of layered maps using GPS data, alongside GIS and precision tools, farmers can now determine the different elements they need to consider, such as soil type, soil water levels, slope, aspect and even when to plant or harvest.



**Source 2.19** Drones are increasingly being used to conduct aerial surveys on all types of farms, reducing human needs and increasing efficiency.

## Robots on the farm

Gala dairy farm near Coleraine in Tasmania may look like most other dairy farms in Australia – cows contentedly munch on green grass for most of the day and then head to the shed to be milked. But this farm is like no other dairy farm in the world because these cows milk themselves, with help from a robot or two. Once the cow arrives in the dairy, overhead cameras and a Wi-Fi linked sensor guide robotic arms to clean the cow's teats and attach suction cups. An electronic collar identifies each cow and allows their milk production to be monitored and recorded.

The cows stand on a rotating circular platform while being milked and are rewarded for coming to the dairy with a small feed of grain and access to a paddock of fresh grass. Because cows can choose when and how often they wish to be milked, milk production on the farm is up 20 per cent from the traditional method of milking cows twice a day.



Source 2.20 Milking time at Gala dairy farm in Coleraine, Tasmania, and not a farmer in sight!

## REVIEW 2.1.6

**Remember and understand**

- 1 What is precision farming?
- 2 Why are the cows in Source 2.20 wearing collars?

**Apply and analyse**

- 3 Is Gala farm an example of precision farming? Give some reasons for your answer.
- 4 Why is GPS an essential part of precision farming?
- 5 What are some of the advantages of robotic milking for the farmer and what are some of the disadvantages?

- 6 Explain why precision farming can help to make farming more sustainable.

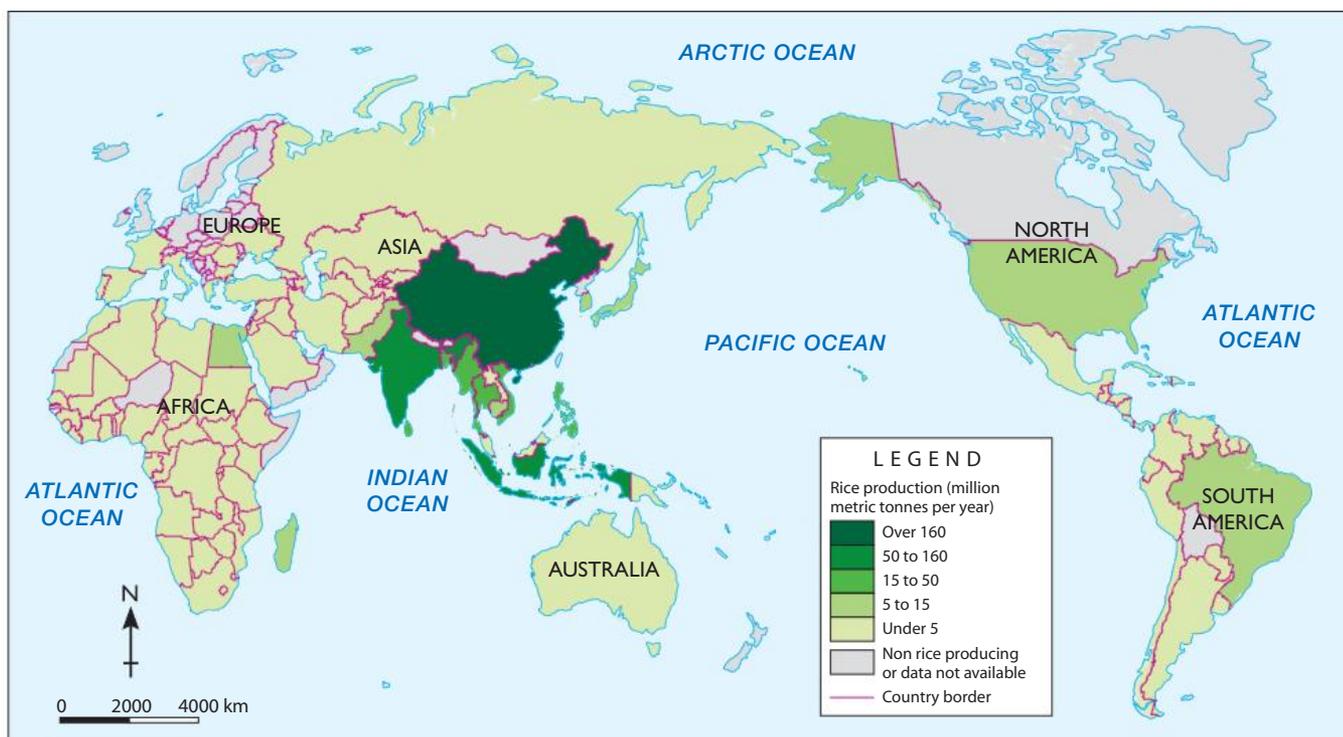
**Investigate and create**

- 7 Using ideas from Source 2.20 and online research, invent a machine that shears sheep. Remember that each sheep is slightly different from every other sheep so your machine needs to take this into account. Draw a labelled sketch of your shearing machine.

# RICE – THE GRAIN OF LIFE

Rice is one of the world's most important crops. It supplies about one-fifth of all **calories** consumed by humans and is the main food eaten in more than 30 countries. About 700 million tonnes of rice are produced around the world every year. Around 90 per cent of this is grown in Asia. China's production of rice alone accounts for almost one-third of the world's total annual rice production.

## WORLD: RICE PRODUCTION



Source 2.21

Source: Oxford University Press

### SKILL DRILL

#### Describing patterns on choropleth maps

The map in Source 2.21 is a **choropleth map**. Geographers use choropleth maps to give a quick impression of a spatial pattern by using dark and light shades of the same or similar colours. Darker shades usually show 'the most' and lighter shades show 'the least'. You can describe the pattern on choropleth maps by following the PQE (Pattern–Quantify–Exceptions) method. For more information on the PQE method, refer to section GT.2 of 'The geographer's toolkit'.

- Step 1** Read the title and examine the legend carefully so that you understand what the map is showing.
- Step 2** Describe the general pattern that is apparent on your map. Use the names of continents and large regions.

- Step 3** Quantify your description of the pattern by giving the names of specific countries and the mapped data related to these countries.
- Step 4** Point out any exceptions to the general pattern that you have described. For example, this may be a country that produces a lot of rice despite being far away from any other major rice-producing countries.

#### Apply the skill

Describe the pattern of global rice production using Source 2.21 and the PQE method.

## Rice-growing methods

Rice is grown in many different environments – from the sides of the world’s highest mountains to coastal river deltas. Rice is grown in areas that flood every year and in other places where rain is far from reliable. Because of these variations in climate and environments, it is possible to identify four main systems of growing rice.

- Irrigated rice:** Irrigated ecosystems account for about three-quarters of global rice production. Irrigated rice is grown in fields, called rice paddies, where series of embankments and terraces are built to control the flow of water across the fields. This system is most common in East Asia, particularly Indonesia, Vietnam, the Philippines and Thailand.
- Rainfed rice:** Many farmers in low-lying areas in countries such as Bangladesh, Myanmar (Burma) and Thailand rely on natural rainfall rather than irrigation to water their rice crops. Annual monsoonal rains may cover their fields with 50 centimetres of water into which they plant their crops. This is known as the rainfed lowland system of rice growing. These farmers face many challenges to produce a reliable crop, notably poor soil quality and unreliable rain.
- Upland rice:** In West Africa, Central and South America, and highland regions of Asia, upland rice growing dominates. Usually grown beside other crops, productivity is generally low as soils are often poor and little or no fertiliser is used. Rainfall may be unreliable and erosion of the hillsides may be a problem in some areas, as the rice fields do not usually have embankments to control the flow of water.
- Flood-prone rice:** In some flood-prone zones in Cambodia, Vietnam and Myanmar (Burma) a rice crop may be grown in areas characterised by periods of flood and drought. The rice grown here is tolerant to being covered by water but yields tend to be low and unreliable.



**Source 2.22** In upland areas many farmers first clear the land, often by slashing and burning.



**Source 2.23** Rice paddies near Longsheng, China

**Source 2.24** A comparison of the productivity of four different rice-growing systems

System	Yield (tonnes/hectare)	Crops (per year)	Productivity (tonnes/hectare/year)
Irrigated rice – rice grown using irrigation systems for water	5.0	2.5	12.5
Rainfed rice – rice-growing system that relies on rainfall for water	2.5	1	2.5
Upland rice – rice grown in rainfed lowland fields that is prepared and seeded when dry	1.0	1	0.12
Flood-prone rice – rice grown in areas prone to extreme flooding and drought, typically low-yield	1.0	1	1.0

### REVIEW 2.1.7

#### Remember and understand

- 1 What type of rice-growing system is being used in Source 2.23?
- 2 How would the farmers in these fields control the flow of water to their crops?

#### Apply and analyse

- 3 Which is the most productive system of rice growing? Why do you think this is the case?

- 4 Why do you think upland rice growing is not as productive as the other systems?

#### Investigate and create

- 5 In small groups, discuss the environmental impacts of growing rice. Present a report of your conclusions, using headings such as ‘Impacts on water, soil, landforms and natural vegetation’. Which of the four rice-growing systems do you believe affects the natural environment the most?

# RICE GROWING IN JAVA

The Indonesian island of Java is one of the world's most populated islands and one of the most densely populated places on Earth. It is home to almost 150 million people. The Javanese people have developed a way of life that uses the island's natural resources to provide them with ample food. Java is a volcanic island with abundant rainfall, and eruptions over millions of years have produced fertile soil for the growing of crops such as rice.

In fact, Java is home to some of the world's most productive rice fields. Over three-quarters of Javanese farmers grow rice, mostly in small family-owned fields of less than one hectare (0.01 km<sup>2</sup>). Farmers tend to live in villages and towns and walk every morning to their rice fields. Everyday tasks are determined by the season. Most rice farmers in Java are able to grow two crops throughout the year but on more fertile ground some farmers are able to grow three. Fertiliser is usually added to the soil to complement its natural fertility.



Source 2.25 Rice production, imports and consumption in Indonesia between 2004 and 2015

## JAVA: RICE-GROWING AREAS



Source 2.26

Source: Oxford University Press

In recent years, Java's population has grown faster than increases in rice production and this has meant that the island has had to import rice from other Asian countries. As Java's population continues to grow there is greater pressure on the rice farmers to become more productive. There is also an increased competition for land. Agricultural scientists are working hard to find solutions to Java's stalled increases in crop yields but they face serious issues:

- Farmers tend to be poorly educated and have little money to invest in new technologies.
- Farm sizes are declining because land is divided between family members after the death of a farmer.
- 100 000 hectares (1000 km<sup>2</sup>) of rice paddies have been lost; they have been used to grow other crops such as palm oil, or to build houses and factories.
- Little government money is spent on improving and repairing irrigation systems.
- There are few qualified experts to advise farmers on how to increase crop yields through the introduction of new varieties of rice and pest control.



Source 2.27 Mount Merapi is one of Java's 45 volcanoes.

## SKILL DRILL

### Constructing an annotated field sketch

Geographers use field sketches as a way of capturing impressions immediately and directly. While on a field trip to examine an environment in detail you may be asked to complete a field sketch. It is often a good idea to practise field sketching from a photograph before the field trip. The method for drawing a field sketch is the same as sketching from a photograph. Follow these steps:

- Step 1** Draw a border of the correct shape.
- Step 2** Using a pencil, lightly sketch the main landscape lines. If there is a horizon in the scene put this about one-third from the top of the frame.

- Step 3** Add detail to your sketch. Annotate or label those parts of the scene that you consider most important.
- Step 4** Add some shading and colour. Don't try to copy every subtle colour of nature, just give a hint of the right colour.
- Step 5** Label your sketch with a title, the location and the date.

#### Apply the skill

- 1** Follow the steps provided to complete a field sketch of Source 2.27. On your sketch, label key natural and managed features of the environment.

## REVIEW 2.1.8

### Remember and understand

- 1** How is the island of Java able to support so many people?

### Apply and analyse

- 2** Examine Source 2.25.
- Describe the pattern in Indonesia's rice production between 2004–5 and 2014–15.
  - Describe the pattern in consumption over the same period.
  - Explain why Indonesia has become a rice importer in recent years.
  - What relationships are there between the natural

environment and the growing of rice in Java?

- 3** The farmer in Source 2.27 is using water buffalo rather than a tractor to plough his fields. What would be the advantages of using buffalo? What would be the disadvantages? How might his method of farming change if he were given a tractor?

### Investigate and create

- 4** Imagine that the Australian Government has decided to give aid to Indonesia to increase its annual rice yield. Write a letter to the foreign minister outlining how you think this money should be spent.

# 2.1

## CHECKPOINT

### CAN THE WORLD'S BIOMES SUSTAINABLY FEED THE WORLD'S POPULATION?

- Investigate environmental, economic and technological factors that influence agricultural yields in Australia and across the world.
- 1 List the eight biomes in order of those that have the most potential for food production to the least. [5 marks]
  - 2 Using the list you have just created, explain the reasons behind your top THREE and bottom TWO. [10 marks]
  - 3 Evaluate why the decision-making process behind 'farming can be difficult for some farmers'. [5 marks]
  - 5 Why has rice been termed the 'grain of life' – can you think of another food product that may also be put in this category? [5 marks]

TOTAL MARKS [ /25]

### RICH TASK

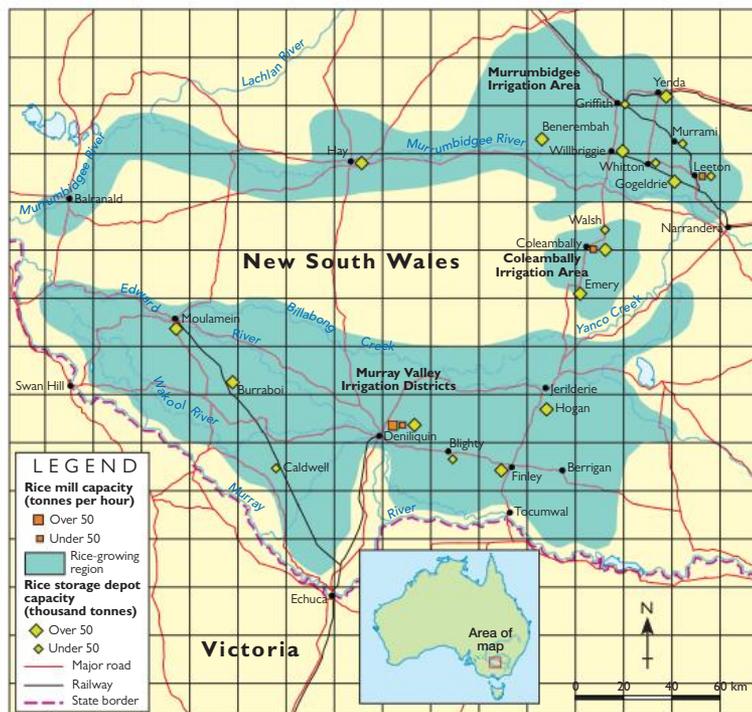
#### Growing rice on the world's driest inhabited continent

There are about 1600 rice farms in Australia and virtually all of them are in southern New South Wales and northern Victoria (Source 2.29). This region is suitable for the growing of rice because of several key environmental factors. The most important of these is the availability of water. Rice farmers in the region irrigate their crops with water from nearby rivers – the Murrumbidgee and the Murray. The soil is also



Source 2.28 Rice fields and the main irrigation canal near Leeton, NSW

#### NEW SOUTH WALES: RICE-GROWING REGIONS



Source 2.29

Source: Oxford University Press

ideal for rice growing as the heavy clay that is present stops water from seeping away. Year-round warm temperatures help the rice to grow and the flat land makes flood irrigation possible.

Although Australian rice growers are the most productive in the world, rice is a controversial crop in this country. Some people feel that growing rice is not a sustainable use of Australia's river water. They argue that the natural environment is suffering because water is being taken from the rivers. Supporters of the rice industry believe that rice is a valuable export crop and that Australian rice farmers are becoming better at using less water to grow more rice.

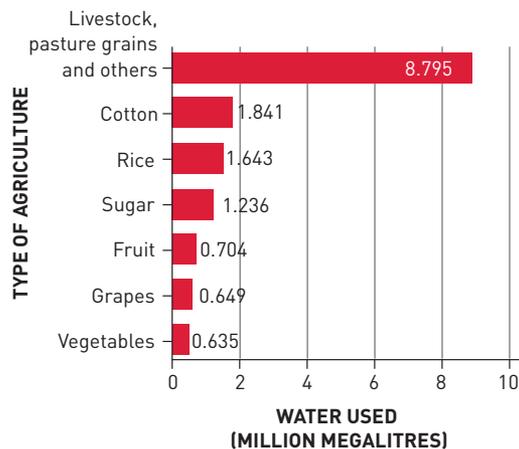
Conduct some further research on rice growing in Australia and then complete the following tasks.

### Acquiring geographical information

- 1 Describe and account for the relationship between rivers and rice-growing regions.

### Processing geographical information

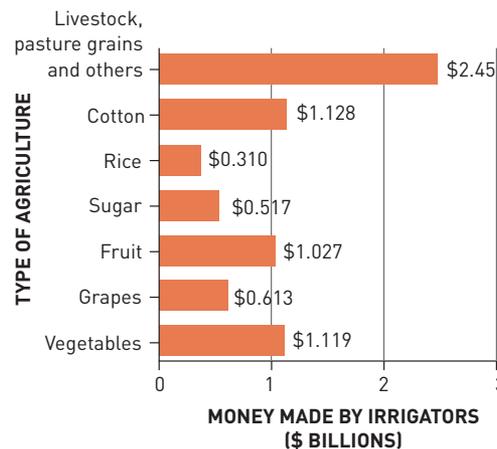
- 2 Compare the photograph of the rice-growing area in Java (Source 2.27) with the rice-growing region of Australia (Source 2.28). List all of the differences that you can find. Discuss with a partner



why these differences occur. Consider both natural and human factors.

### Communicating geographical information

- 3 Examine Source 2.30. What do these two graphs tell you about the relationship between rice crop profitability and water usage? What questions could you ask to assess if Australian rice growers are using water sustainably? Write a few paragraphs exploring the link between rice growing and water usage.



**Source 2.30** Graphs showing the amount of water used for agriculture in Australia (left); and the money made from these types of agriculture (right)

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Space, Environment, Change.
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Maps, Statistics, Visual representations.

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

## SKILL DRILL

### Estimating the size of features on a map

Estimating the size of features on a map is an important skill. You can use the scale of maps to estimate the area covered by certain features. If a regular shape (a triangle, circle or rectangle), use the skills and formulas you have learned in mathematics.

If the shape of the feature is irregular, a grid can be used to estimate its size. For example, on Source 2.29, a grid with squares representing 20 km × 20 km has been drawn. If your map does not have a grid like this already, you can draw your own.

**Step 1** Count the number of grid squares in which the mapped feature you want to estimate fills the entire square.

**Step 2** Count the number of grid squares that contain some, but not all, of the mapped feature. Take this number and divide it by two.

**Step 3** Add these numbers (Step 1 and Step 2) together.

**Step 4** Multiply this number by the area of each square (e.g. 20 km × 20 km, or an area of 400 km<sup>2</sup>).

**Source 2.31** These formulas can be used to estimate different shapes.

Shape of feature	Formula
Triangle	The base × the height, divided by 2
Circle	$\pi$ (approximately 3.14) × radius squared
Square and rectangle	Width × length

### Apply the skill

Follow the steps provided to estimate the areas of the three main rice-growing regions shown in the map in Source 2.29.

# 2.2 CHALLENGES TO FOOD PRODUCTION

WHAT ARE THE ENVIRONMENTAL CHALLENGES TO FOOD PRODUCTION?

There are six main threats to food security. These are outlined here and will be explored in more depth throughout this section of the chapter. The main factors that come into play and put food security at risk are: water scarcity; climate change; threats from non-native plants, animals and insects; competition for land; the use of land for fuel instead of food; and armed conflict.

## Water scarcity

Water scarcity is the lack of access to enough safe water. The supply of clean, safe water is important not only for people to drink but also for the safe growing of crops for food. As the world's population continues to grow, water becomes an even more important resource, and its management becomes more crucial. Water is needed for people to drink, wash and cook with on a household level; however, massive amounts of water are also needed for agriculture, industry, manufacturing and leisure activities. This competition for water can lead to shortages, and when there is not adequate water, food security is put at risk.

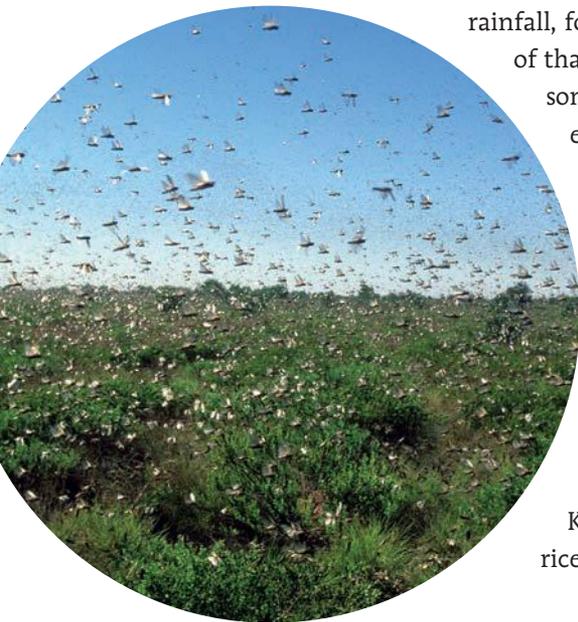
**Source 2.32** The melting of glaciers and icebergs is a well-known example of climate change. Another effect of climate change is the threat to food security in many parts of the world.



**Source 2.33** Swarms of locusts, which will eat any plant material in their path, are another pest that can quickly destroy crops, resulting in food insecurity.

## Climate change

The term 'climate change' refers to long-term changes in weather events and patterns worldwide. The effects of climate change include rising global temperatures and changes in levels of rainfall. Such changes impact on the environment and the sustainability of agricultural production. Places that are able to grow certain crops because of the reliable rainfall, for example, may find that increases or decreases in rainfall affect the viability of that crop. Climate change may also cause more frequent droughts or floods in some regions, both disastrous to crops. The effect on crop growing is just one example of the way climate change can directly affect food security.



## Threats from non-native plants, animals and insects

The introduction of non-native plants, animals or insects into an area can have devastating effects on the natural environment. This, in turn, can develop into a situation where food security is put at risk. Pests such as the Khapra beetle that live and breed in stores of grain can destroy up to 70 per cent of a store and make it inedible. A native of South Asia, the Khapra beetle is now one of the top invasive species globally. In countries where rice is a food staple, the damage caused by this beetle puts food security at risk.

## Competition for land

In many places around the world, agriculture is being threatened by competition for land. Food security may come under threat by people or corporations who want to use land for purposes other than growing food crops. Land that was once productive farmland is being converted into housing, mines, golf courses, shopping complexes and factories (see Source 2.34). This competition for land, partly to service and house growing populations, means that there is less land available to grow food.



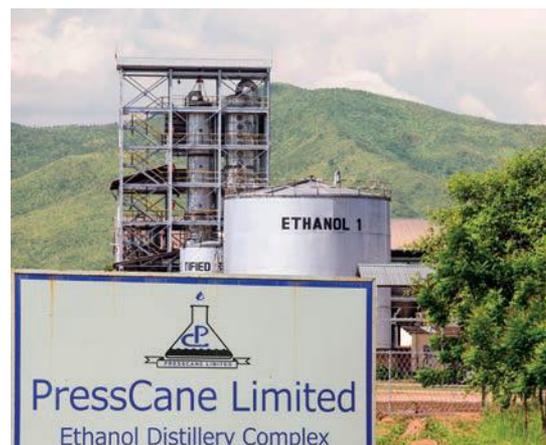
## The use of land for fuel instead of food

One of the biggest emerging threats to food security in recent years has come from the growth in the amount of land being used to produce crops used to feed cars, not people. These crops are used in biofuels – fuels that are produced, or partly produced, by some types of plants. Researchers, trying to reduce carbon emission caused by traditional fuels, developed biofuels. This has meant that land previously used to grow food crops has been taken over in order to supply the produce for biofuel (see Source 2.35).

**Source 2.34** Increasing competition for land to use for purposes other than growing food poses a threat to food security in some regions of the world.

## Armed conflict

Armed conflict is another complex and severe threat to food security. Armed conflicts have the potential to affect the food security of entire regions and may even result in famine. In cases of armed conflict, the food security of a population can be affected in various ways. Food may be stolen from the local people by armed forces, land used for growing food crops may be destroyed, or the young men – even children – who would normally tend fields may instead go off to fight. The effect of armed conflict on food security, and how to deal with it, is a major global concern to organisations such as the United Nations and UNICEF.



**Source 2.35** The practice of using land to grow crops for fuel, not food, puts food security at risk for many people.

### REVIEW 2.2.1

#### Remember and understand

- 1 Why is there growing competition for water and land resources?
- 2 Name some of the competing uses for land around the world.

#### Apply and analyse

- 3 The use of biofuels can help reduce the carbon emissions that cause climate change but growing crops for fuel can also increase food insecurity.
  - a In this instance, do you think it is more important to provide enough food for people or to help stop climate change?

- b How would you suggest balancing the potential risks of climate change against people's need for food?

#### Investigate and create

- 4 Complete a star diagram of the six factors that contribute to the challenges to food production. Before investigating them further in this chapter, propose possible solutions to each of these threats.

# WATER SCARCITY

Agriculture uses about 70 per cent of all fresh water taken from rivers every year. From the rice terraces of China to the orchards of Australia's Murray–Darling Basin, river water is used to irrigate farms and feed billions of people around the world.

River systems and the water they capture, store and distribute are among the most threatened natural environments on Earth. The level of threat to the ongoing supply of fresh water available for agriculture varies from place to place but an increasing demand for water is by far the most common threat to food security around the globe. In many places, population growth – particularly in cities – is putting increased demand on nearby rivers and lakes. This increased demand and usage then threatens the water supplies that farmers rely on.



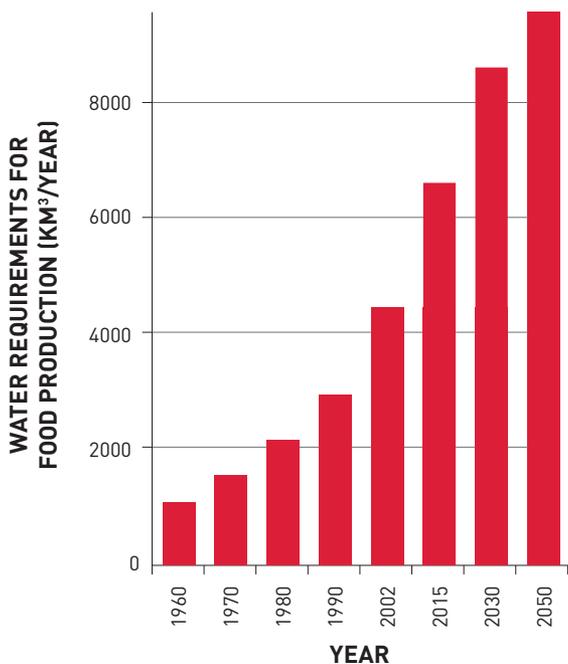
**Source 2.36** A farmer searches for water in the Mekong River Basin.

## Economic factors

Greater prosperity and socioeconomic development also places greater demands on water supplies. Industrial development and an increase in the number of individual households mean increased water consumption. At current usage rates water, needed for industry around the world is predicted to at least double by 2025.

Rapid economic growth and Westernisation in countries such as China and India is also affecting water usage. According to environmentalists and academics, water scarcity and quality are the most pressing environmental issues facing China today. Currently, water is being used at an unsustainable rate. Changing tastes in places like China are also increasing the demand for

certain foods, such as meat, which require more water to produce than traditional rainfed crops. This is putting an added strain on water resources.



**Source 2.37** The historic and projected changes in water consumption needed for agriculture, 1960–2050

## Environmental factors

Environmental factors also affect the amounts of water used for growing food (see Source 2.37). Changing rainfall patterns and warmer temperatures as a result of climate change are seriously affecting water supply in some regions of the world. The rapid melting of glaciers in places such as South America and Central Asia is of particular concern.

Glaciers have historically acted as reservoirs. As the glaciers have slowly melted, water has flowed down the mountains into the rivers, providing water to millions of people. This water has been used to grow a significant amount of the food to meet the requirements of 2.5 billion people in Asia and 53 million people in Peru, Bolivia and Ecuador. As the glaciers shrink, however, this water flow is declining. A lack of water to grow crucial crops is predicted to have a severe impact on food security for people in these regions.

## CASE STUDY

### The Mekong River Basin

The Mekong River begins on the northern slopes of the Himalayas and crosses six countries before reaching the South China Sea. On its journey it is dammed for electricity and diverted for irrigation, providing water to meet the needs of more than 60 million people. Forty-eight million people rely directly on the Mekong River Basin for their food supply (see Source 2.38).

#### THE MEKONG RIVER BASIN: LAND USE



Source 2.38

Source: Oxford University Press

#### REVIEW 2.2.2

##### Remember and understand

- 1 List the ways in which the supply of river water for farming is threatened. Highlight those that apply to rivers in Australia.
- 2 Explain how water scarcity and food security are linked.

##### Apply and analyse

- 3 Use an atlas and Source 2.38 to describe the route taken by the Mekong River from its source to the mouth. Explain how changes near the source could bring about food insecurity for communities near the mouth.

- 4 Estimate the area of rice paddy cultivation in the region shown in Source 2.38. Describe the spatial association between the river and the rice paddies.
- 5 Describe the changes in the amount of water used, and projected to be used, for food production from 1960 to 2050.

##### Investigate and create

- 6 The Mekong River crosses six countries. How might this cause problems and conflicts between countries who rely on it? In particular, how might downstream users, such as the rice farmers of Vietnam, be affected?

# CLIMATE CHANGE

Much debate surrounds the subject of climate change but there is now considerable evidence and consensus that the main cause of global warming is the rising carbon dioxide levels in our atmosphere from burning **fossil fuels**. Gases produced by human activities are being added to the atmosphere at such a rate that they are changing the Earth's climate. The most obvious change is a rise in global temperatures but there are other changes too. Some places are becoming wetter, while others are becoming drier. Glaciers and ice caps are melting, causing sea levels to rise. Extreme weather events such as droughts, floods and cyclones are becoming more serious and frequent. These and other changes are already affecting food production, and climate scientists warn that these impacts will become more severe in the future depending on global temperature increases (see Source 2.39).

Changes in the atmosphere affect water and land that is used for growing crops. Droughts mean there is not enough water for successful crop growing, while a drastic increase in the amount of rain falling on a region means crops may be flooded and destroyed. These changes in climate pose a significant threat to food security.

**Source 2.39** Climate change is projected to impact significantly on food, water and ecosystems.

Global temperature increase	Projected effect
0°–1°	<ul style="list-style-type: none"> <li>• Small mountain glaciers disappearing, affecting water supplies</li> <li>• Extensive bleaching and damage to coral reefs leading to widespread death of coral and attached species</li> <li>• Risk to some ecosystems</li> <li>• Increase in extreme weather events – increased damage from floods and storms</li> </ul>
1°–2°	<ul style="list-style-type: none"> <li>• Up to 30% of species at increasing risk of extinction</li> <li>• Failing crop yields in many areas, particularly developing regions</li> <li>• Cereal-growing productivity to decrease in some regions</li> <li>• Risk to some ecosystems increases</li> </ul>
2°–4°	<ul style="list-style-type: none"> <li>• Significant decrease in water availability in many areas, including the Mediterranean and southern Africa</li> <li>• Increasing level of extreme weather events – increased number of human deaths due to floods, heatwaves, droughts, etc.</li> <li>• Many ecosystems now at risk</li> <li>• About 30% of global coastal wetlands to be lost</li> </ul>
4°+	<ul style="list-style-type: none"> <li>• Very high risk of irreversible environmental damage</li> <li>• Very high risk of abrupt changes to global environments</li> <li>• Sea level rise threatens major cities</li> <li>• Falling crop yields in many developed regions</li> <li>• Significant number of extinct species around the globe</li> <li>• Increasing levels of malnutrition, diarrhoea and infectious disease</li> </ul>

## Impacts on Sub-Saharan Africa and Asia

The impacts of climate change on food production are likely to be greatest in Sub-Saharan Africa and Asia. Many farming areas in Africa are expected to become drier. As the soil dries, causing plants such as trees and shrubs to die, the possibility of Africa's deserts spreading into areas currently being farmed is expected to increase. Infestations from plants and animal pests such as locusts are also expected to become more severe, as are droughts.

Asia's river deltas, such as the Mekong, Ganges, Indus and Yangtze, are sometimes referred to as the world's rice bowl. Due to farming improvements introduced during the **Green Revolution**, these river deltas now help provide food security to over one billion people. This food security, however, is under threat from climate change. Changes in rainfall patterns are damaging crops and affecting food security. Thailand, for example, suffered a severe drought in 2010 that damaged crops across the country. A year later, devastating floods swept through Thailand leaving behind a \$40 billion damage bill.

It is the impact of rising sea levels, however, that has the greatest potential to damage food security in these river delta regions. Rice is grown in the fertile soil of low-lying river deltas. As sea levels rise, ground and river water become saltier, killing the rice crops.

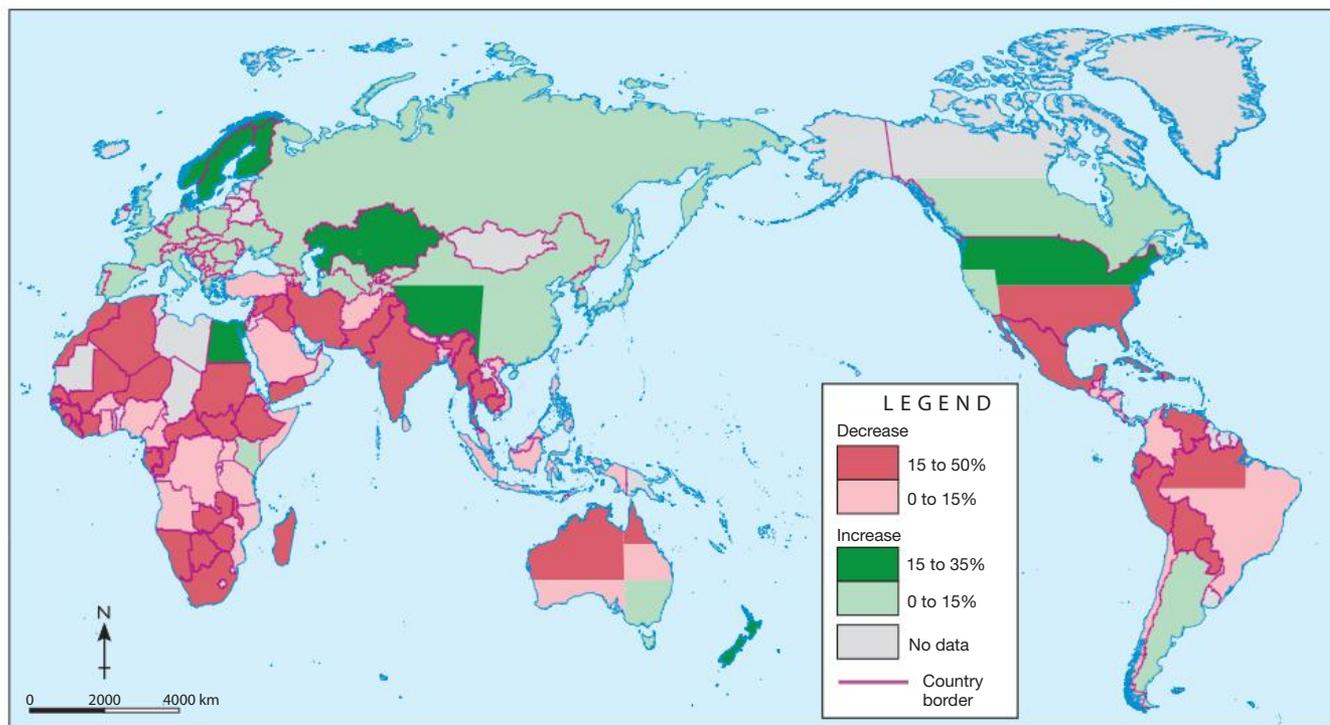


**Source 2.40** This rice field sits on a low island near the mouth of the Ganges River in Bangladesh. A sea level rise of a few centimetres would cover the crop in salty water, destroying it.

## Predicted changes in food production

The effects of climate change on food production will vary across the world. Some regions may even be able to increase food production with the changes in climate. However, for most parts of the world, and most significantly, for the most populated parts of the world, climate change will cause a decrease in potential food production (see Source 2.41).

### WORLD: PREDICTED CHANGES IN FOOD PRODUCTION BY 2080



**Source 2.41**

Source: Oxford University Press

### REVIEW 2.2.3

#### Remember and understand

- 1 Why are many rice paddies in river delta regions at risk from climate change?
- 2 Explain the link between human activities and climate change.

#### Apply and analyse

- 3 Examine Source 2.39. Select five of the effects listed. Describe how they may threaten food security.

- 4 Examine Source 2.41. Which regions of the world are predicted to lose between 15 per cent and 50 per cent of their food production by 2080?

#### Investigate and create

- 5 Compare Australia and New Zealand in Source 2.41. Which impact of climate change will most affect their food security in the future? Give reasons for your answer and propose possible solutions.

# THREATS FROM NON-NATIVE PLANTS, ANIMALS AND INSECTS



One of the greatest threats to natural ecosystems and to food security is the arrival or introduction of non-native plants, animals or insects into an area. Known as **invasive alien species (IAS)**, they cause billions of dollars of crop loss and damage throughout the world every year. Vast sums of money are spent trying to control and contain these invaders.

Virtually all farming communities are under threat from invasion. In Australia, for example, it is estimated that about 15 per cent of all plants growing throughout the country are weeds. Weeds affect food security as they compete with crops for water, sunlight and soil nutrients. The number of invading plant species in Australia is also growing by about 10 new species per year. These new species are spreading faster than they can be controlled.

Invading plants and animals are mainly spread through human activities. In some cases, the spread is accidental. The most successful invader in the world, for example, is the black rat. Native to north-east China and India, rats were carried around the world as stowaways on ships. Most modern invaders, however, now hitch rides on planes rather than ships. Seeds carried accidentally on shoes or insects in clothing can now travel from place to place across the world in a matter of days, even hours.

In other cases, alien invaders are introduced to native environments deliberately. Humans have, at different times, purposely brought non-native species into an environment, usually to tackle an existing problem with another species. Unfortunately, in the past there has been a failure to predict the level of negative consequences that the introduction might have on the local ecosystem as a whole. The cane toad and Indian Myna bird were both introduced to Australia to control pests. They have, however, now caused massive destruction to the natural ecosystem, native species and the food chain.

## CASE STUDY

### The larger grain borer

Two of the most important food crops in Sub-Saharan Africa are maize (a type of corn) and cassava (a root plant). **Subsistence farmers** – those who grow only enough for their household needs – grow small fields of maize and cassava and pick and store them during harvest time, providing some food security throughout the year. However, their stored crops are under attack from an unwelcome invader, the larger grain borer.



Accidentally introduced into Tanzania from its native Central America in the late 1970s, the larger grain borer has now spread throughout West and East Africa. Feeding on the stored maize and cassava, it can quickly reduce stores to piles of dust unfit for human consumption. Farming families are then forced to try and buy food from other farmers. In many cases, however, all the stored crops in a region have been destroyed.

**Source 2.42** Maize is the staple food of millions of people. An invasive alien species such as the larger grain borer can pose a very serious threat to the food security of people who rely on a maize crop for food every day.

Desert locusts are usually solitary insects causing no great harm to farmers' crops. When conditions are right for them, however, they become one of the world's most destructive pests, bringing widespread food insecurity to communities in Africa, Asia and the Middle East.

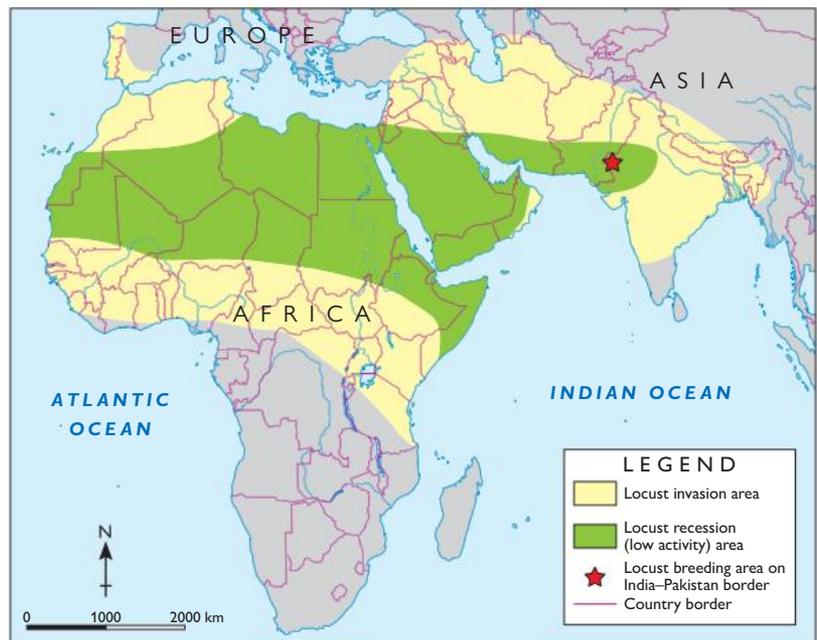
Drought conditions in their usual recession area (the area where they normally withdraw and are not active) combined with good rains in their breeding area cause the locusts to form vast swarms that invade surrounding areas (see Source 2.43). A swarm may cover 1000 square kilometres, with up to 80 million locusts per square kilometre. Travelling up to 100 kilometres per day, they devour entire crops in minutes. One swarm in Ethiopia, for example, is believed to have consumed enough grain to feed a million people for a year.

## Desert locusts

### AFRICA AND SURROUNDS: LOCUST AREAS



**Source 2.43** A swarm of locusts can devour a vast area of crops in a stunningly short period of time.



**Source 2.44**

Source: Oxford University Press

## REVIEW 2.2.4

### Remember and understand

- 1 How do weeds affect food security?
- 2 How are invasive alien species spread?

### Apply and analyse

- 3 Examine Source 2.44. Describe the spread of desert locusts from recession areas into invasion areas. Use the names of regions, countries and compass directions in your description.
- 4 Why are desert locusts a threat to food security?

### Investigate and create

- 5 Here is a list of countries where the larger grain borer has been found with the year of its detection: Kenya (1983); Togo, Benin and Burundi (1984);

Guinea (1987); Ghana (1989); Burkina Faso (1991); Malawi and Nigeria (1992); Rwanda and Zambia (1993); Niger (1994); Namibia (1998); Mozambique (1999).

- a Using the list of the countries, map the spread of the larger grain borer from its discovery in Tanzania on an outline map of Africa. Use labelled arrows to show the progression of the spread.
- b Describe the movement of the borer as shown on your map.
- c Which countries do you believe are most at risk from the future spread of this invader? Why do you think this would be the case?

# COMPETITION FOR LAND

## STRANGE BUT TRUE

If women farmers had the same access to resources as men, the number of hungry people in the world could be reduced by up to 150 million.

In addition to environmental factors, food security can also be threatened by individuals or corporations taking over productive land and using it for purposes other than growing food. In many places around the world, land that was once farmland is being converted for housing, mines, golf courses, factories and other uses. This competition for land is being driven partly by the increase in the world's population and partly by the desire to make more money from the land.



**Source 2.45** New suburbs sprawl into existing farmland north of Asmara, the capital of Eritrea, in Africa.

## Land for housing

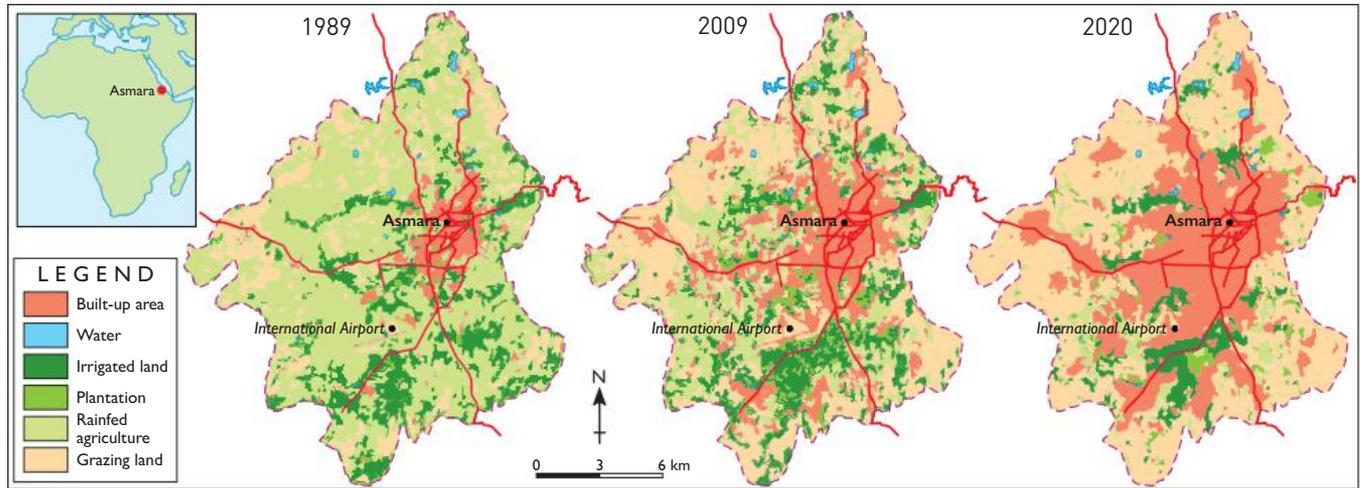
The development of rural areas for housing is one example of competition for land use. Urban areas cover only about 2 per cent of the world's total land area. They are often built, however, on the best land – flat, fertile and well-watered. Farming areas on the edges of cities provide food to the city dwellers. As cities grow in population, however, they also grow in size, and farmland and rural spaces are taken over and developed into new suburbs for the growing population. The spread of a city outwards is known as **urban sprawl**. In this process, farmland is taken over for housing, and farmers are pushed further out onto land that may not be as suitable for growing crops. Their ability to produce food may fall, putting at risk the food security of the people in the city.

The city of Asmara in Eritrea, for example, has tripled in size in the last 20 years and now sprawls across land that was previously prime farmland. Source 2.46 maps the rapid growth of Asmara. This growth is expected to continue at its current rate, and may even accelerate in the next few decades, absorbing more productive farmland. This same process has been experienced by many places around the world, including in Australia, where urban sprawl has seen productive farmland converted to suburban living spaces.

## Land for tourism and recreation

In some places, productive farmland is also being converted into tourism and recreation facilities. Many developing countries, for example, recognise that attracting tourists provides them with a reliable source of income. These tourists, most of them from developed countries such as Australia and the United States, are drawn to these countries for a range of factors including climate, stunning scenery and unique cultures. But tourists often also want a high standard of accommodation and recreation facilities like hotels, pools and golf courses (see Source 2.47).

## ASMARA: URBAN GROWTH 1989–2020



Source 2.46

Source: Oxford University Press

A study of the impact of golf course development in Thailand found that 250 courses in the country together consume about 200 square kilometres of land. About three-quarters of these courses were built on existing farmland, the rest on land that was previously forested. This area represents a loss of about 89 000 tonnes of rice every year. Furthermore, golf courses put great pressure on the freshwater resources of the local area. Each Thai golf course consumes the same amount of water as 60 000 Thai villagers would.

This trend is not confined to Thailand. In other Asian countries, such as Indonesia, Cambodia and Vietnam, as well as in island nations throughout the Caribbean, productive farmland and scarce freshwater resources are being consumed by golf courses and other recreation facilities.



Source 2.47 A rice field has been converted into a golf course to attract tourists, an increasingly common use of agricultural land in many places in Asia. This poses a significant threat to food security – not only is the land for crop growth taken away but golf courses consume massive amounts of water.

### REVIEW 2.2.5

#### Remember and understand

- 1 What is urban sprawl and why is it a threat to food security?
- 2 How does the growth in global tourism affect food security?

#### Apply and analyse

- 3 Use Source 2.46 to describe the growth of Asmara from 1989 to 2009. Which type of farming was most affected by this growth? What is predicted to happen by 2020?
- 4 If golf courses threaten food security, why do many countries around the world build them on

productive farmland? Explain the underlying causes of this problem.

- 5 The golf course shown in Source 2.47 has caused the loss of productive farmland and created other problems. It has also brought some benefits. Brainstorm the potential costs and benefits of this golf course to the local region and community.

#### Investigate and create

- 6 Research the growth of a large Australian city. Find out if its development has resulted in urban sprawl and the loss of productive farmland. If so, explain what the impacts of this have been for food production in the region.

# THE USE OF LAND FOR FUEL INSTEAD OF FOOD

Brazil has increased the use of land for growing fuel rather than food. Despite offering many advantages, this could put food security in Brazil at future risk.

## CASE STUDY

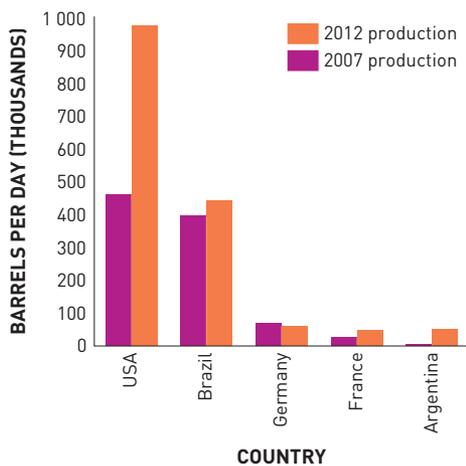
### Brazil's biofuel industry

Biofuels are made from organic rather than fossil matter. They are often from biomass (i.e. plant materials high in sugar, starch or oil) such as sugar cane, corn or soya beans.

Brazil has gradually developed a booming biofuel industry. Biofuels such as ethanol and biodiesel are an example of 'home-grown' renewable energy sectors. The biofuel industry has been part of wider long-term initiatives to change the way Brazilians produce and use energy, including adopting integrated food-energy systems (IFES). Other measures include:

- the introduction of new 'flex-fuel' vehicles that run on any blend of petrol and ethanol
- new land zoning laws that identify suitable areas for biofuel production (avoiding using land with high biodiversity, such as rainforests)
- efficiency improvements to increase the productivity of biofuels
- social and environmental safeguards to address any concerns.

Around 15 per cent of Brazil's domestic energy supply is from biofuels from sugar cane.



Source 2.48 The top five biofuel producers in the world, 2007 and 2012

## Biofuels as a threat to food security

Although waste products of food crops such as corn and sugar cane can be used to provide some of the raw material for the production of biofuels, greater production of biofuels needs bigger crops. In some places, fuel crops are replacing food crops and this has raised concerns about food security in these countries.

While the amount of biofuel produced and used has grown rapidly in recent years, it still provides only 3 per cent of the total energy used to power vehicles worldwide. Despite this, biofuel production threatens the food security of many communities, particularly in the South American countries of Brazil, Argentina and Colombia, which are boosting their biofuel production.

Biofuel production poses a threat to food security in two main ways. First, marginal farming land (land that is situated on edges of arable land) is the land most likely to be converted for growing biofuel crops. This is often the land that poorer farmers use to grow the food needed to feed their families. Second, growing crops for fuel rather than for food pushes up the price of food, making it less accessible.



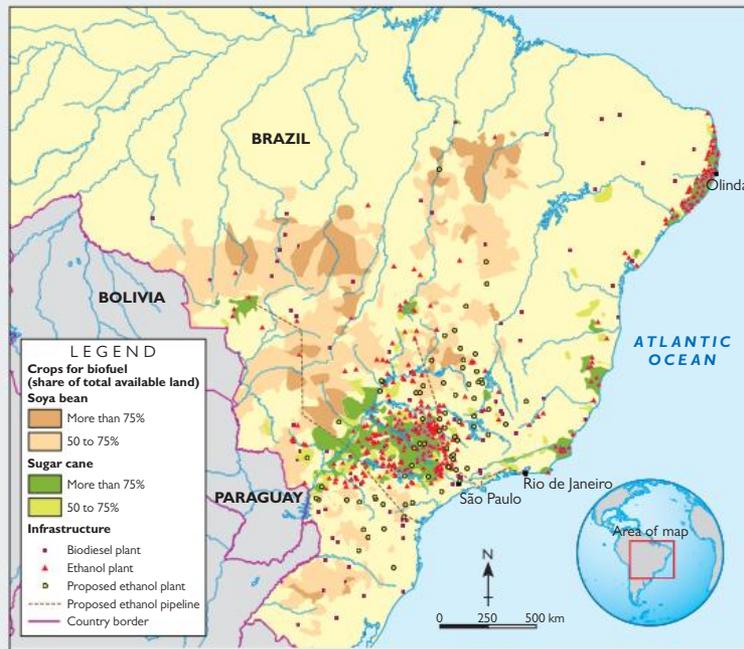
Source 2.49 Political cartoonists often rely on simple images to convey a complex message – this cartoon comments on the competition between using land for food and using land for fuel.

## Analysing complex maps

**Complex maps** contain more than one set of information. Geographers use complex maps to analyse different features, reveal patterns and explain links between features in a given area. You can analyse a complex map by following these steps:

- Step 1** Look carefully at the map and its title to make sure you understand its content.
- Step 2** Examine the map's legend. Complex maps can have more than one part to a legend, and these parts will be represented on the map in different ways. For example, in Source 2.50 areas of colour are used. Different-coloured symbols are also used.
- Step 3** Train your eyes to look for one set of information. For example, look at solid blocks of colour and work out what they tell you.
- Step 4** Move to a different set of information by selecting another symbol or block of colour from the legend.
- Step 5** Look for concentrations of the same symbol in areas to see if patterns exist.
- Step 6** Note any patterns you can find on the map between different features and locations.
- Step 7** Describe how patterns are connected.
- Step 8** Try to suggest reasons for the connection between the two patterns.

## BRAZIL: BIOFUEL INFRASTRUCTURE



Source 2.50

Source: Oxford University Press

### Apply the skill

Look at Source 2.50.

- 1 Find the symbols for ethanol and biodiesel plants; locate these. Describe their concentration.
- 2 What relationship is there between the concentration of ethanol plants and the location of sugarcane crops?
- 3 What does the location of ethanol pipelines tell you about production and consumption of biofuels?

## REVIEW 2.2.6

### Remember and understand

- 1 What are biofuels? What are they produced from?

### Apply and analyse

- 2 Examine Source 2.49.
  - a What point is the cartoonist making?
  - b How effective is the cartoon?
- 3 Examine Source 2.50.
  - a Compare Source 2.50 with Source 1.2 ('World biomes'). Which biomes are most threatened by the expansion of Brazil's biofuels industry?
  - b Some new ethanol plants are planned for construction across Brazil (shown as 'Proposed ethanol plant'). Describe the distribution of these

new plants. How might these lead to land-use changes in the future?

- 4 Who benefits from the growth in biofuel production? Who loses?

### Investigate and create

- 5 Use the data in Source 2.48 to construct a proportional circles map.
- 6 One type of plant being used for biofuel production is jatropha. Jatropha is a flowering plant with seeds high in oil. In India, there are more than 1 million hectares of jatropha plantations. Research this plant and list the advantages and disadvantages of using it as a biofuel.

# ARMED CONFLICT



**Source 2.51** Western armed forces distributing food aid in Somalia

Armed conflict – war between different countries, or civil war between groups within a single country – also has the potential to affect the food security of millions of people. It can result in widespread food shortages, and even long-lasting famines. While armed conflict results in deaths from battle, in some conflicts many people also die from a lack of access to food. Food insecurity caused by an armed conflict can kill more people than are killed by the fighting itself. Most at risk are people in developing countries, where many people rely on their own small farms to provide their family's food.

Several countries in Africa have experienced the devastating effects that armed conflict can have on the food security of the population. In an area where food security is already a serious concern – currently 75 per cent of the continent's countries are at high or extreme risk of food insecurity – armed conflict brings an extra threat. Many African countries, including Somalia, have endured decades of armed conflict and a resulting decrease in food security.

## International aid

While international aid agencies such as the Red Cross and United Nations work hard to address the lack of food security in these war-torn areas, the environment can be very dangerous. In Somalia alone, 14 employees of the United Nations World Food Program were killed while distributing aid between 2008 and 2011. Corruption, theft and a lack of law enforcement all contributed to this terrible situation.

Transporting food and farming supplies by road in these countries is risky, with aid often being seized by fighters for their own use. In Somalia, sacks of grain, peanut butter and other foodstuffs meant for starving Somali people were often stolen. With local food supply markets disrupted, food aid that has been stolen is often sold on in markets, taking relief efforts away from the starving and needy (see Source 2.52).

Distributing food aid is also often complicated by difficulties in reaching war-torn areas and in remote areas. In such situations, hunger can be used as a weapon. The government can deliberately keep food away from opposition fighters and the local people who support them.



**Source 2.52** Food supply is affected as local markets are targeted. In Mogadishu, the capital of Somalia, relief aid was commonly looted at the distribution points and then sold at the markets.



**Source 2.53** Somali children waiting in line for food aid

## Impact on local farmers

During times of war, such as those experienced by Somalia, food shortages are common. Some food shortages are caused by the disruption of food markets and food aid. Landmines are planted, causing lasting danger. Some shortages are caused by the fact that apart from the conflict that is happening, there are ongoing harsh climate conditions to deal with.

Crops cannot be planted, weeded or harvested. Farmers cannot plant new crops, which extends food insecurity even when the conflict is finished. Irrigation systems are destroyed and other water resources, such as wells, are sometimes poisoned as an act of war.

Animals are killed and taken for food by armies and rebel fighters. As well as a food supply, farmers lose manure for their crops and animal power to work their fields. Crop stores are often raided as well.

Young men are often forced to fight. This reduces the available hands to work on farms. The amount of food and income for the family is diminished.

Farms may be destroyed by the armed forces. Native scrub is burnt, and wild sources of food, such as wild fruits and honey, are destroyed. Many farmers abandon their farms.

In the Democratic Republic of the Congo in Africa, at least 400 000 people were displaced from their fields during the harvest period. This affected not only their short-term food security but their long-term food security as well.



**Source 2.54** In war-torn areas, water is a precious resource. These women wait at a water distribution area for their empty containers to be filled.



**Source 2.55** Amnesty International reported that in Somalia, children as young as eight years old were recruited to take up weapons and fight in the conflict.



**Source 2.56** Due to landmines, land previously used to grow food becomes inaccessible for years. Harvests are destroyed and fields cannot be cultivated.

### REVIEW 2.2.7

#### Remember and understand

- 1 Why is there a shortage of farm labour during war?
- 2 How can hunger be used as a weapon of war?

#### Apply and analyse

- 3 Why are subsistence farmers – farmers who grow just enough to feed their own family – most at risk of food insecurity during armed conflict?
- 4 Describe three ways in which food security for local people would improve if peace was reached in an area that had been experiencing armed conflict.

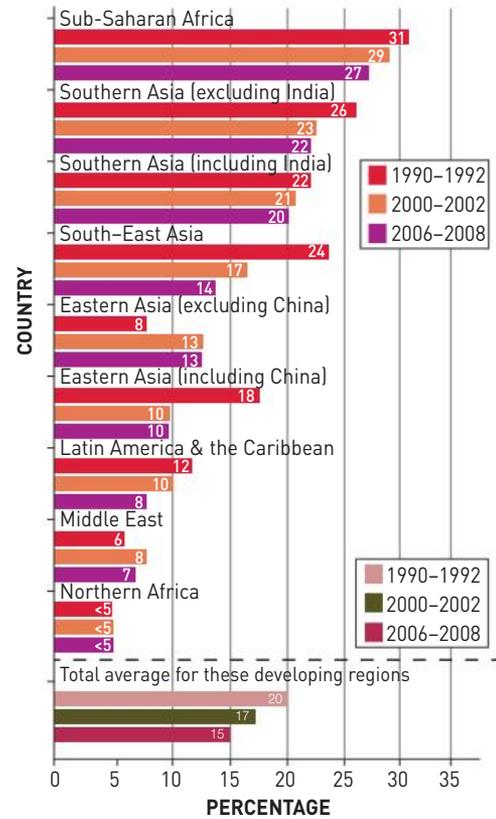
#### Investigate and create

- 5 List the effects of armed conflict mentioned here. Rank them in order from the one that you think will have the most severe lasting impact on food security to the one you think will have the least. Explain the reasons for your choice.
- 6 How would the conflict in Somalia affect the food security of people in other areas of the country or in neighbouring countries? Discuss this with a partner and then with your class.

CASE STUDY

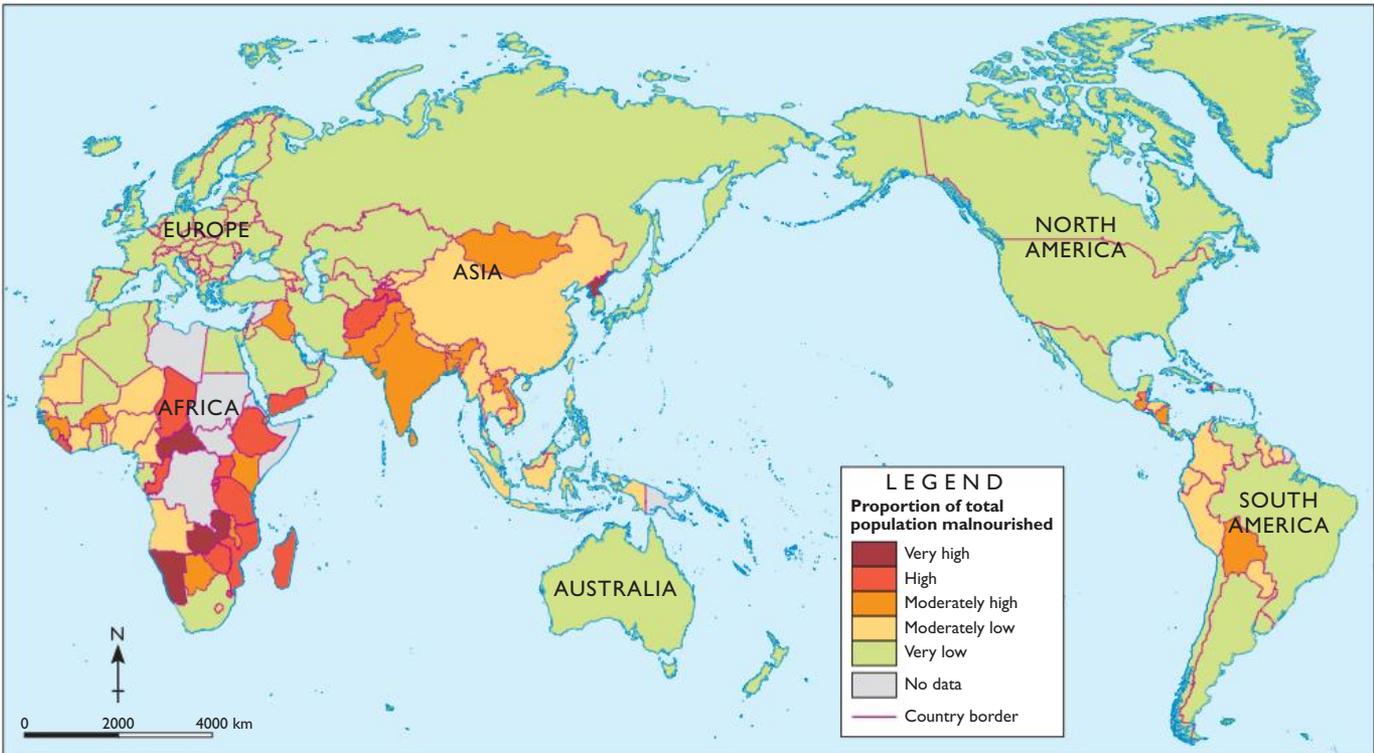
# HALVING HUNGER

At a meeting of the United Nations in 2000, representatives of 189 member countries agreed on a set of goals designed to improve the living conditions of people in developing countries. Eight goals, known as the Millennium Development Goals (MDGs), were developed. One of these goals was to eradicate extreme hunger and poverty, with the specific target of halving the proportion of people who suffer from hunger by 2015. Some of the 2015 targets have been reached and many have shown progress (see Source 9.21). However, the target of halving world hunger by 2015 was not met. When the MDG's era came to an end in 2015, the UN set new goals for the future. These are 17 Sustainable Development Goals with targets for 2030 (see Chapter 9).



Source 2.57 Proportion of undernourished people 1992-2008

## WORLD: HUNGER LEVELS 2015



Source 2.58

Source: wfp.org

## Presenting an oral report to an audience

Geographers often present their findings to an audience by giving an oral presentation.

You may find giving an oral presentation a little daunting at first but if you follow these steps you will be able to confidently deliver a successful report:

- Step 1** Decide on a topic that will interest both you and your audience. Consider your audience and think about what they already know about the topic. What would you like them to understand by listening to your presentation?
- Step 2** Research your topic. Geographers start with inquiry questions and then seek to answer them. Collect information from a wide variety of sources and keep a bibliography of these sources. Try to find images, visual material and audio that may add variety to your presentation.
- Step 3** Organise your findings into a draft outline of your report. It should have a clear introduction and conclusion. In your introduction it is often a good idea to use something to 'hook' your audience. It may be a question, a personal story or a challenging image. After your introduction, develop your report in a series of clearly defined sections. Your conclusion summarises your key points. If your report is going to be assessed, make sure you have fulfilled the criteria for assessment.
- Step 4** Support your verbal report with clear visual material. This may be a set of graphs, maps or images. Do not overdo your visual material but think of it as supporting what you are saying. It gives your audience something to focus on and allows you to refer to features such as places on a map.
- Step 5** Practise your presentation. Make sure that you do not exceed the time limit and that you know your information well enough to avoid having to read it. It may be a good idea to have some memory cards with key words or ideas written on them. Avoid holding a single piece of paper if you are prone to nerves – memory cards are sturdier and won't tremble. Practice will help. Are you nervous because you are not properly prepared?



**Source 2.59** Practise with your memory cards before your presentation.

Have you practised? Do your visuals work to support your report?

- Step 6** Deliver your presentation. Make sure that you speak clearly and vary pitch and tone. Stand up straight, keep your hands out of your pockets and don't lean on a desk. If you become nervous while presenting, take a few deep breaths to calm yourself.
- Step 7** Invite your audience to ask questions and do your best to answer them. If you are unsure of an answer don't make something up, research later and return with the answer next lesson.

### Apply the skill

- Prepare and deliver a verbal report on an aspect of the Millennium Development Goal target to halve hunger by 2015, which was *not* achieved. Your report must be supported by visual material and include responses to questions asked by the audience. Here are some possible topics to choose from, or you may like to develop your own:
  - There will always be hungry people in the world.
  - It is possible to halve hunger in some places but not others.
  - The solution to halving hunger is to ...
  - If we address the causes of poverty we will meet the goal of halving hunger.
  - The proportion of hungry people in the world is more likely to rise than to fall.
  - Where to next – Sustainable Development Goal targets...?

## REVIEW 2.2.8

### Apply and analyse

Do some further reading on the Sustainable Development Goals before answering the following questions.

- Describe the distribution of hunger on a global scale.

- Which regions of the world made least progress towards the 2015 goal and beyond to the 2030 goals? Which made the most progress? Why do you think these differences exist between world regions?

# 2.2

## WHAT ARE THE ENVIRONMENTAL CHALLENGES TO FOOD PRODUCTION?

### CHECKPOINT

- Investigate environmental challenges to food production for Australia and other areas of the world.
- 1 Identify and describe the areas of the world where food production is hard work. [5 marks]
  - 2 Using Source 2.41, which parts of the world are expected to be hit hardest by climate change and its impact on crop production? [5 marks]
  - 3 Give reasons why it is that farmers of more developed nations such as Australia can sometimes cope better with variable environmental conditions than those of less developed nations such as Ethiopia? [5 marks]
  - 4 Summarise all of the threats to food production. [10 marks]

TOTAL MARKS [ /25]

## RICH TASK

### How challenging is the Murray–Darling Basin?

#### Acquiring geographical information

#### Fast facts about the Murray–Darling Basin

The Murray–Darling Basin (Source 2.60) is one of Australia's most important resources. Here are some of the reasons why:

- The basin is 1 000 000 km<sup>2</sup> (larger than Spain and France put together).
- It covers four states and one territory.
- It is home to Australia's three longest rivers.

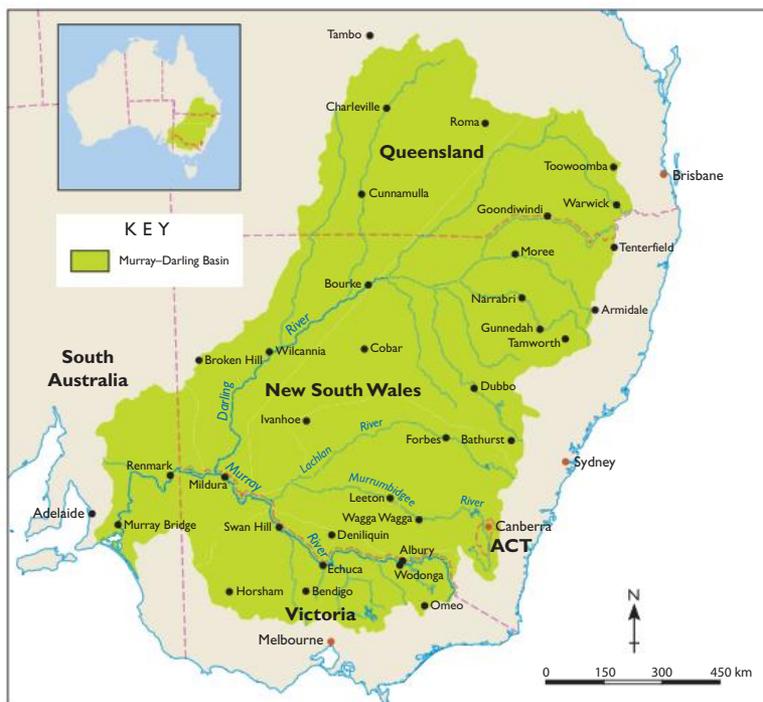
- A third of Australia's food is grown here.
- Half of Australia's irrigated produce comes from the basin.
- Two million people and 40 Aboriginal nations live in the basin.
- The basin provides water to three million people.
- Basin water is really important to environments. It is home to 30 000 wetlands, 57 native fish species, 35 endangered bird species and 16 endangered mammals.
- The basin is important to the economy with \$18.6 billion in agricultural worth.

#### Processing geographical information

#### Modelling the Murray–Darling

- 1 As a class, brainstorm a list of different uses of Murray–Darling water. You should be able to come up with at least 10 uses. Investigate further by exploring the Murray–Darling Basin Authority website ([www.mdba.gov.au](http://www.mdba.gov.au)).
- 2 Break into pairs. Now, with 15 or more plastic cups (one given to each pair of students), draw a symbol on each cup to represent ONE use of Murray–Darling water. For example, one pair might draw a rain drop to represent drinking water; another group might draw a tractor for farming, grass for playing fields, or fish for wetland. Some uses will be drawn more than once (this represents the same water use being replicated at different points along the river).
- 3 Now, stand in a line with your classmates to represent the river. The student at the

## MURRAY–DARLING BASIN



Source 2.60

Source: Oxford University Press

start of the line (the head of the river) starts with an almost full cup of water. Each student then passes some water downstream (the river flow) to the subsequent students in the line, keeping enough water for their own 'use'. How much water will get to the mouth of the Murray (Goolwa, South Australia)?

- Now imagine a year in drought! Start with half as much water and repeat.

### Mind mapping

You may think that a mind map looks like a spider/star diagram with all the ideas coming out from a central point or topic. However, these are very different tools. You might use a star diagram to collect key points while watching a video or during a brainstorming activity. Mind maps are very different and are individualised. They use branches to connect ideas and establish pathways that YOUR brain makes connections with as a *visualisation*. This may be via words, symbols, colour, shapes or pictures. The advantage of this is that your brain maps the ideas and makes the mind map a valuable revision tool.



Source 2.61 How to Mind Map Example

- Use a page big enough for your topic and have your coloured pencils ready.

Centre point	Key idea 1	Key idea 2	Key idea 3
Biomes produce food	Each of the eight biomes and why they produce more or less food for humans	Factors such as climate change, soils, technology and decision-making	Each of the six challenges to food production

### Communicating geographical information

- Imagine that you are the manager of the Murray–Darling Basin Authority. You are in charge of looking after the basin and all the people, activities and livelihoods that depend on it – a tough job! Write up your findings of this experiment and submit a list of recommendations for its management and protection to the federal Minister for Environment, Climate Change and Water.

**Step 2** Put the topic in the middle and around this have the major or key ideas (3–5 works best).

**Step 3** Each of the connections or branches is unique. Use your own colours, symbols, pictures, arrows, etc. This will help your mind remember the ideas in a *visual* way rather than in the note-taking format you may have originally written them in.

**Step 4** Off each of the key areas then comes the lesser connected ideas, and so on, like branches of a tree. Remember that each connection must make sense to you. Not just added wherever, but related.

**Step 5** The best mind maps are hand-drawn but there are also many computer-based programs that will help you to achieve a similar mind map. The example in Source 2.61 will also help you to create your own mind map.

#### Apply the skill

- Produce a mind map from section 2.2 of this chapter. The table below provides a chapter breakdown. BUT remember your ideas, you make the connections!

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Space, Environment, Sustainability, Scale.
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Maps, Graphs, Visual representations.

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'

# 2.3 FOOD SECURITY

WHAT STRATEGIES CAN BE USED TO INCREASE GLOBAL FOOD SECURITY?

**Food security** is a state where all people at all times have access to enough safe, nutritious food to sustain a healthy life. For a person, community or country to have a secure food supply they must have three things:

- **food availability**
- **food accessibility**
- the ability and resources to use the food appropriately.

People who do not have food security suffer from hunger and illnesses related to lack of food, such as malnutrition. About 870 million people around the world do not have food security – the majority of them live in developing countries.

## Food availability

Food availability means people have enough food of appropriate quality available on a consistent basis. This may include production, storage, distribution and exchange of foodstuffs, provided reliably and regularly. People whose food availability relies solely on the production of a single crop, for example, may find themselves at great risk of food insecurity if that crop fails.

Many countries have strategies in place, such as growing a variety of crops, to maximise their food availability and ensure food security. Management of fishing and fishing industries is also used by some communities to ensure a constant supply of fish is available to sustain them. Food availability alone, however, does not guarantee food security.

### STRANGE BUT TRUE

Roughly one-third of the food produced in the world for human consumption every year – approximately 1.3 billion tonnes – gets wasted!



**Source 2.62** In many coastal communities in Arnhem Land, the ocean provides food security. Local knowledge ensures the catch will be prepared in a safe and appropriate way.

## Food accessibility

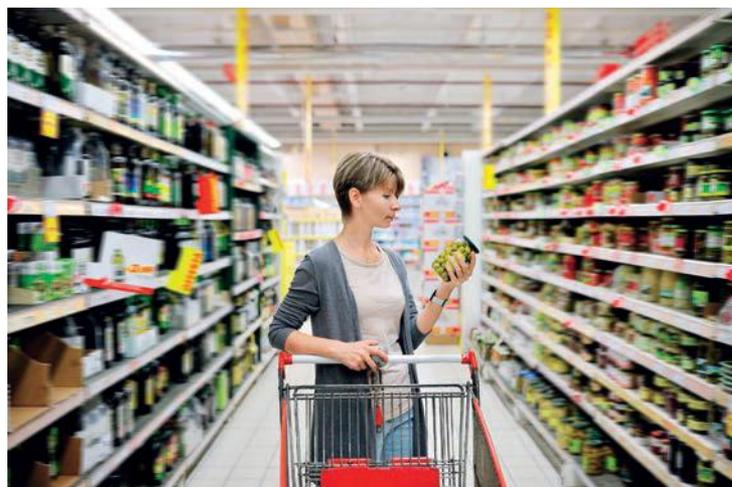
Food accessibility means physical and economic access to food. That is, there needs to be enough food available and it must be in reach of those who need it. Many food researchers believe that the world's farmers produce more than enough food to meet the needs of every person on Earth. However, the food is not distributed evenly. **Developed countries** have

more food than they need and high levels of wastage, while many people in **developing countries** struggle to access enough food to meet their daily needs. The reasons for this uneven distribution are many and complex. They include social, political and economic factors, such as rising prices, trade agreements and quotas set up between countries.

## Using food appropriately

Appropriate use of food means using food safely and applying knowledge about nutrition, clean water and sanitation when preparing food.

What is appropriate use of food varies between different places and cultures. What is appropriate and usual to eat in one part of the world might be viewed as unusual somewhere else. In many Asian countries, for example, insects and other invertebrates such as scorpions and spiders are regularly eaten as part of a balanced diet (see Source 2.64). Local cultural knowledge means these insects are prepared properly, making them safe to eat and nutritious. This is an example of the appropriate use of food. Knowing how to use such foods appropriately could potentially stave off the incidence of food insecurity. In fact, the United Nations has identified insects as the ‘forgotten food crop’ as they could help alleviate food insecurity, particularly in developing countries.



**Source 2.63** Australia is a country that has a high level of food accessibility – many people enjoy good access to a wide variety of food.



**Source 2.64** Deep-fried scorpions ready for sale at a Beijing street market

### REVIEW 2.3.1

#### Remember and understand

- 1 What are the three factors that contribute to food security?
- 2 Describe and explain food security in Australia with reference to these three factors.

#### Apply and analyse

- 3 Where does most of your food come from? How would your answer differ if you lived in another country, for example, Vietnam? Explain the reasons for your answer.
- 4 Quentin, the boy in Source 2.62, shows that he has food availability and food accessibility. To have food security he now has to use the food appropriately and prepare it ready for eating. Do you know how to

prepare his food? Do you think that he does? What does this tell you about food security?

#### Investigate and create

- 5 Find images of foods from around the world and display them on your classroom wall. Use your examples to explain why food preferences and food security differ between places and cultures.
- 6 It is estimated that about 870 million people suffer from hunger due to poor food security. Of the three factors that contribute to food security, which do you believe is most important? Discuss your thoughts with a partner and then share your thoughts with the class.

# LEVELS OF FOOD SECURITY IN DIFFERENT PLACES

People living in different parts of the world experience different levels of food security. People in developed countries including North America, Western Europe and Australia, for example, generally have very high levels of food security. Food is available, accessible and appropriate to a high proportion of the population in these places. At the other end of the scale, many people in developing countries, particularly throughout Asia and Sub-Saharan Africa, do not have food security.



**Source 2.65** The people of Zimbabwe in Southern Africa have one of the lowest levels of food security. This girl is scavenging for food in a rubbish dump near the capital, Harare.

## STRANGE BUT TRUE

Every year consumers in rich countries waste almost as much food (222 million tonnes) as the entire net food production of Sub-Saharan Africa (230 million tonnes).

## Forces affecting food security

Poverty and food insecurity are closely linked. Individuals who suffer from poverty struggle to meet their basic daily food needs and spend a greater percentage of their income on food than those who are wealthier. This makes them highly vulnerable to forces that change the availability and accessibility of food. If the price of food suddenly increases, for example, food that they could previously afford becomes unaffordable. This also applies on a country level, with poorer (developing) countries having less food security than wealthier (developed) countries.

Those without food security are much more vulnerable to change that is caused by outside forces. Developing countries can have their food security severely affected by natural disasters, such as drought or flood. Many people in poor areas rely on local agriculture for food, so food sources can be left damaged or destroyed following natural disasters. Human activities can also severely affect food security in these places. Armed conflicts may interrupt usual markets and food supply lines, or land used for growing crops may be repurposed for other uses, affecting local food supplies.



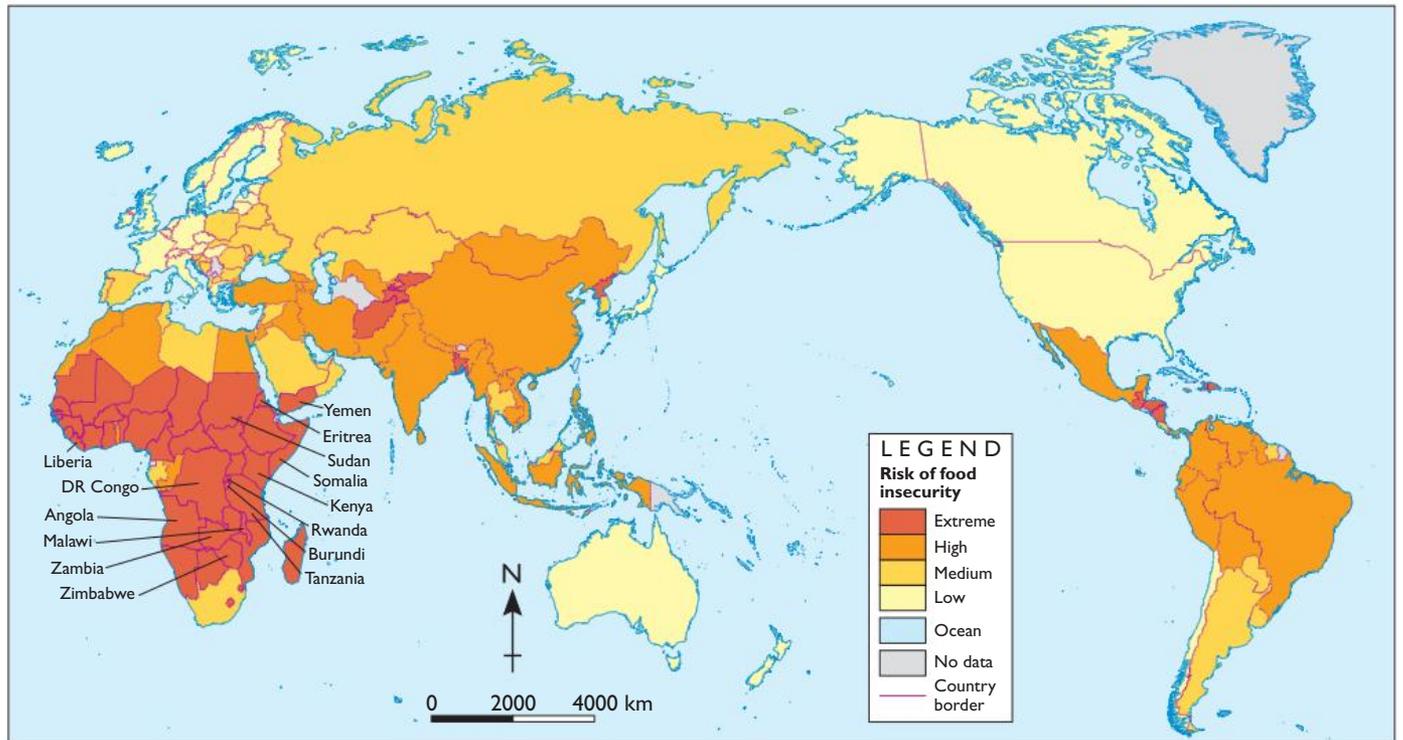
**Source 2.66** One of the most food-secure nations in the world is the United States, where the majority of people have access to a reliable, safe and nutritious food supply.

## Global patterns of food security

Source 2.67 shows the global pattern of food security and insecurity. Scores for each country were calculated using 18 different indicators, including the nutrition and health status of the population, the availability of food staples such as rice, wheat and corn, and access to these foods. Countries were then grouped into four categories according to their risk of experiencing widespread food insecurity.

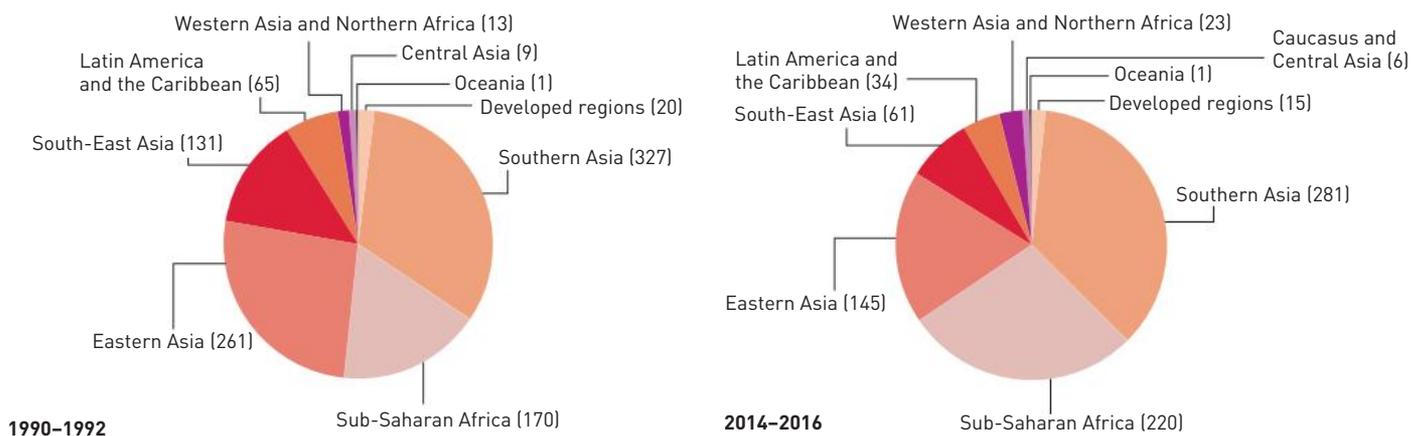
The global distribution of food security is not static. The number of **undernourished** people in the world, for example, has fallen by more than 130 million in the last 20 years, despite the world's population growing by more than 1.5 billion in the same period. The distribution of undernourished people in the world has also changed (see Source 2.68).

## WORLD: FOOD INSECURITY LEVELS



Source 2.67

Source: Oxford University Press



Source 2.68 The distribution of hunger in the world is changing. These charts show the number of undernourished by region, 1990-92 and 2014-16, in millions.

### REVIEW 2.3.2

#### Remember and understand

- 1 How are poverty and food insecurity linked?
- 2 Compare the food availability and accessibility of the two individuals in Sources 2.65 and 2.66.

#### Apply and analyse

- 3 Examine Source 2.68.
  - a What has happened to the overall number of undernourished people over 20 years?
  - b Which regions have seen an overall increase of undernourished people?

c Is this change reflected in Source 2.67?

- 4 Describe the distribution of global food insecurity using the PQE method (refer to section GT.2 in 'The geographer's toolkit').
- 5 Discuss the factors responsible for this pattern.

#### Investigate and create

- 6 Australia has a low risk of experiencing food insecurity. Why do you think this is the case? Support your view with facts and statistics.

# FOOD SECURITY INTO THE FUTURE

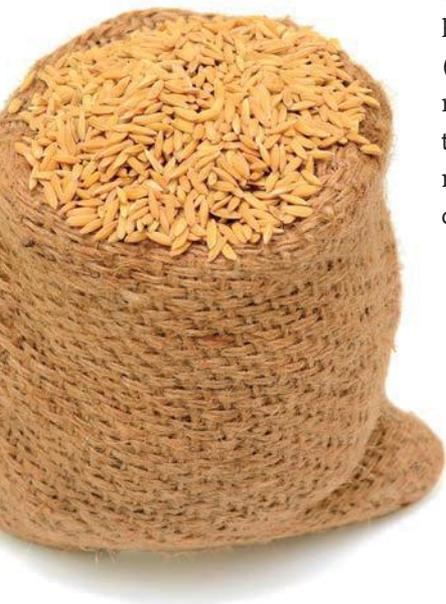
The world's population increases by about 200 000 people per day. At this rate, food will need to be grown to feed an extra 2.5 billion people by 2050. Virtually all of this population growth will be in developing countries (see Source 2.70) where much of the population already struggles to meet their daily food requirements. Asia's population will increase by more than 1 billion by 2050 and Africa's population is projected to increase by 1.3 billion. Food experts estimate that global food production will need to increase by about 70 per cent by 2050 to meet the food requirements of the growing population.

There are two schools of thought regarding the impacts of population growth on food security:

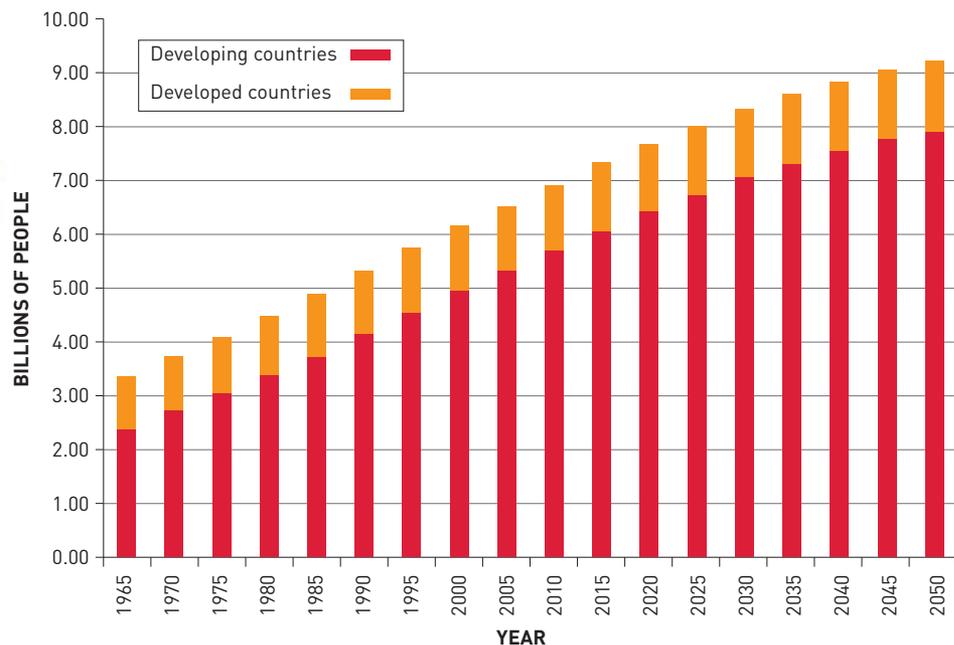
- 1 Some researchers believe that the world's population is growing faster than the world's farmers are able to feed it. The result will be widespread food insecurity, starvation and famine. Those who support this scenario point to the degradation of existing agricultural resources such as fresh water and soil. They also point out that most of the population growth is in areas already at risk of food insecurity, such as parts of Africa.
- 2 Other researchers are more optimistic. They point out that food production over the last few centuries has largely kept pace with (and even exceeded) population growth. This has been largely due to the use of new technologies, referred to as the Green Revolution (see Source 2.71). They also focus on the slight slowing of the world's population growth rate in the last few years and the ability of humans to adapt to changing situations through research and innovation. Many believe that new developments in the genetic modification of plants, for example, hold the key to increasing farming productivity and crop yields in the future.



**Source 2.69** Will the world's growing population mean there will be less food security in the future?



**Source 2.70** Population growth in developing and developed countries, 1965–2050



## KEY CONCEPT: ENVIRONMENT

### The Green Revolution

The Green Revolution refers to sweeping and widespread changes that occurred in farming regions across the world over the period 1950–1979. Beginning in Mexico and spreading through North America and much of Asia, these changes brought food security to hundreds of millions of people. The key changes were:

- the development and planting of new and improved varieties of grains, including wheat and rice, that produced much higher yields
- the widespread use of fertilisers and pesticides to increase farm productivity
- the adoption of mechanical vehicles and systems, such as tractors, pumps, sprays and irrigation systems.

As these and other related changes swept through countries such as India and China, many farming practices changed from small, subsistence farms to larger, more efficient farms. Although the Green Revolution has its critics, it is important to note that many of the African countries most at risk of food insecurity have yet to adopt many aspects of the revolution.

For more information on the key concept of environment refer to section GT.1 of 'The geographer's toolkit'.



**Source 2.71** Farm workers in the Punjab region of India use a tractor to pull a load of grain. Part of the Green Revolution in India has been the introduction of high-yielding seed varieties, such as wheat, to encourage self-sufficient farming.

### REVIEW 2.3.3

#### Remember and understand

- 1 What was the Green Revolution? What were the key changes it introduced?
- 2 How could the Green Revolution help to increase food security in Africa?
- 3 By what number is the world's population increasing each day?
- 4 By the year 2050, by how much do food experts estimate food production will need to increase to feed the world's population?

#### Apply and analyse

- 5 Examine Source 2.70 and answer these questions.
  - a What evidence is there that the greatest population growth is in developing countries?
  - b Why is this important when considering global food security in the future?
- 6 List the arguments for and against the theory that there will be increasing food insecurity due to

population growth. Which arguments and evidence do you believe have the most solid basis? Give some reasons for your response.

#### Investigate and create

- 7 While there are many supporters of the Green Revolution there are also many critics. As a class, brainstorm what these criticisms might be. Use this brainstorming session to develop some inquiry questions and use these to research this issue further.
- 8 Conduct research on the internet into the genetic modification of plants.
  - a In your own words, explain what is meant by genetic modification.
  - b Outline three main arguments in favour of the genetic modification of foods.
  - c Outline three main arguments against the use of genetically modified foods.

# FOOD INSECURITY IN THE HORN OF AFRICA

The Horn of Africa refers to the countries in the north-east of the African continent. Ethiopia, Eritrea, Somalia and Djibouti are the four countries that officially make up the Horn, but Kenya, South Sudan, Sudan, Uganda and even Tanzania are sometimes considered to be part of the Horn of Africa. It covers an area of approximately 2 million km<sup>2</sup> and is home to around 100 million people.

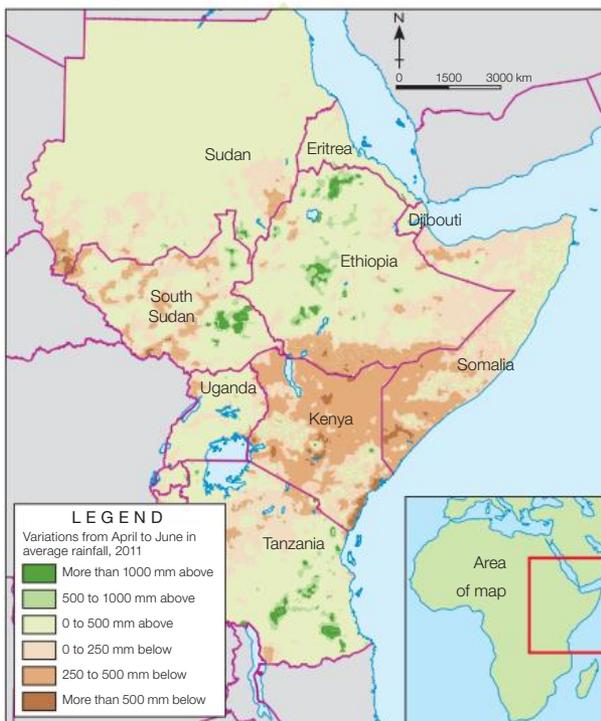
People who live in countries on and around the Horn of Africa often experience food insecurity. This is mainly due to a combination of natural processes and human activities. In 2011–12, the area experienced the worst drought in decades. It caused the widespread devastation of millions of hectares of vital food crops and led to the deaths of hundreds of thousands of people by starvation and malnutrition. The United Nations declared the area to be in the grip of a famine, the first announcement of its type in nearly 30 years.

At its most severe, the drought and subsequent famine brought food insecurity to more than 13 million people in the Horn of Africa as well as in neighbouring countries, including Kenya, Uganda and South Sudan. The situation was worsened by an ongoing conflict in southern Somalia that made it difficult for aid agencies to deliver food to the communities in need. As many as one million people fled the affected areas causing a further humanitarian crisis as refugee camps struggled to accommodate the flood of new arrivals.

**Local people in need of assistance as at 5 September 2011**

Ethiopia	4.6 million
Djibouti	146 600
Somalia	4 million
Kenya	3.8 million

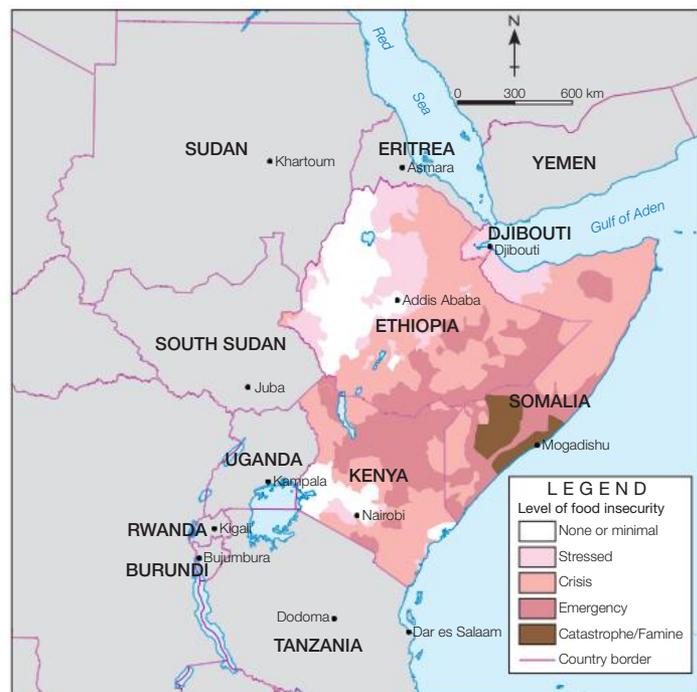
THE HORN OF AFRICA: VARIATIONS FROM AVERAGE RAINFALL, 2011



Source 2.72

Source: Oxford University Press

THE HORN OF AFRICA: FOOD INSECURITY SNAPSHOT, 2011–12



Source 2.73

Source: Oxford University Press

## Developing geographical questions (questionnaires and surveys)

It is important that geographers ask lots of questions. These questions can be simple or complex, and can guide an understanding of places, events and the causes and effects factors have on an environment.

For example, in the case of an event such as a famine, a geographer may start the process of understanding the situation by asking a simple question such as, 'How many people died in the famine?' Often a simple question will look at the more quantitative aspects of a situation (i.e. facts that can be expressed in numbers).

Then, to investigate further and deepen understanding, a geographer may ask a more complex question, such as, 'Was there a change in climate that caused food crops to fail?' Often, a complex question will look at the more qualitative aspects of a situation (i.e. things that can be expressed in words not numbers). The best complex questions can open up a whole new area to explore and understanding of the situation.

The following steps will help you to generate a range of simple and complex questions:

- Step 1** Select an event to investigate.
- Step 2** Construct some simple questions to guide your initial investigation. The key words 'who', 'where', 'when' and 'what' will help you.
- Step 3** Investigate the questions you have listed and note down your answers.
- Step 4** Expand your investigation by forming some more complex questions. Words such as 'why', 'what caused', 'who interacts' and 'what impact' will help you to construct these types of questions.
- Step 5** You may also develop some of the questions from Step 2 into more complex ones. For example, you could develop 'What?' into 'What will the effect of ... have in the future?'

### Apply the skill

#### Questionnaires

Use Sources 2.72 and 2.73 together with the information provided to complete the following tasks:

- 1** Develop a set of five simple questions about the famine in the Horn of Africa in 2011–12. Use your

answers to list some main facts.

- 2** Now investigate the famine more deeply by constructing three complex questions that focus on its causes. You may want to develop a complex question that focuses on the political situation in the region and the effects this had.
- 3** Use these same questions and create a questionnaire. Ask people from varied backgrounds. You could ask members of your class, older or younger school friends, your teachers or family and friends. The more people the better so answers are not one sided.
- 4** Prepare a brief report explaining the famine based on your answers. Check that you have included causes as well as effects in your report to give a well-rounded viewpoint. Include the views of others in your report.

### Surveys

Surveys are quite different. They can be better as they allow for a greater amount of people to be 'surveyed' in lesser time but are often not as detailed. Online surveys can reach thousands of people.

- 1** Take the questions from your questionnaire and turn them into a survey by creating:
  - 'closed' questions – these are where a direct answer can be given from a predetermined list rather than a complex answer
  - questions where answers are on a scale (e.g. 'never happens – sometimes – always')
  - questions that require 'yes' or 'no' answers
  - questions where a number is attributed to the answer. Ensure the lowest number (0 or 1) is given to the most negative response and highest number to the most positive. That way when you add them up the highest score relates to the most positive response.
- 2** Ask the same people to now answer your survey.
- 3** Collate all the data from your survey to gauge the opinions of those surveyed. What trends can be seen in the results?
- 4** Compare the results from your questionnaire and your survey. Are the results the same? If not, where do they differ? Why do you think this is?

## REVIEW 2.3.4

### Investigate and create

Conduct some further research and then complete the following tasks:

- 1** How did the ongoing conflict in southern Somalia contribute to the famine?
- 2** Research the ways in which governments (e.g. Australian Aid) and organisations such as Caritas, UNICEF, Mercy Corps, World Vision and Oxfam helped bring food security to this region.
- 3** What means do you think can be adopted to establish long-term food security in a region that experiences famine?

# HOW CAN WE IMPROVE FOOD SECURITY?

Over the course of human history, the world has seen dramatic and far-reaching changes. Humans have adapted to changes in the natural environment as well as building and changing the environment themselves. People have changed from being hunters and gatherers living in small communities to living as farmers and city dwellers. We have also improved our way of life through a series of remarkable revolutions: the **Agricultural Revolution**, the **Industrial Revolution** and the Green Revolution. These revolutions have allowed our populations to grow at an astonishing rate. In the rush to provide enough food and other raw materials to support our way of life, however, we are in danger of causing permanent damage to the very systems that support us – the soil, water and climate.

There are solutions, however, and some of them can be found in unusual places. Some solutions are based on developments at the forefront of technology, such as manipulating the genes of living organisms. Others come from the distant past; techniques used by Indigenous people who worked more closely with the natural systems of the Earth.

## Looking after the soil

Soil is perhaps the farmer's most important resource. Many farming practices, however, such as ploughing, fertilising, clearing natural vegetation, irrigating and draining have degraded soil to such an extent that the soil can no longer support the same growth of crops as it did in the past. Many farmers are now changing their techniques to minimise their impact on the soil structure and nutrients by reducing ploughing, adding protective layers of organic material (mulch) and growing plants that help return nutrients to the soil.



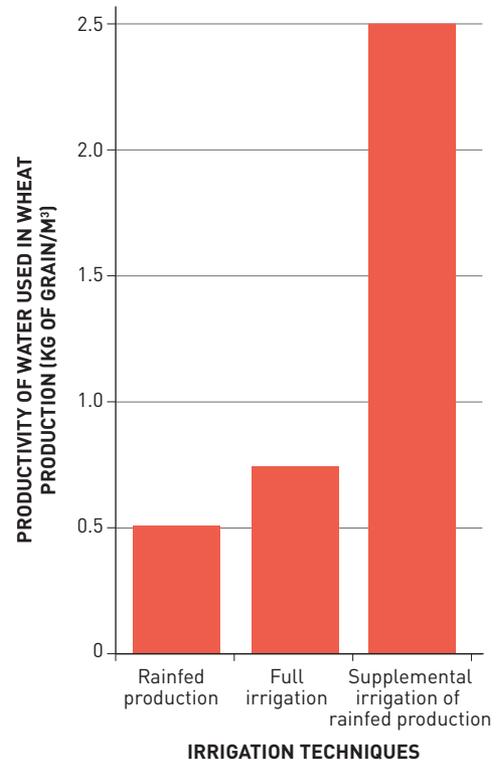
**Source 2.74** Maize crops planted beneath Acacia trees in Africa are three times more productive than others nearby as the shade reduces evaporation and the falling leaves provide a natural fertiliser and mulch.

## Water management

Modern techniques of measuring soil moisture and delivering water to plants and animals are helping to reduce poor water management techniques and improve results in yields. Measuring distribution of water not only conserves the resource, but avoids over-watering, which can lead to salty soils. Storing rainwater in dams and adding it to crops during critical growing times, for example, can triple the amount of wheat grown compared with irrigation systems that water the crops all year round (see Source 2.76).



**Source 2.75** These Cambodian schoolgirls are learning how some insects can be used to control pest species in their rice crops.



**Source 2.76** Productivity of wheat production under various irrigation techniques, including supplemental irrigation

## Pest control

The Green Revolution promoted the use of pesticides such as chemical sprays that helped to increase the amount of food grown in many places. Some of the side effects of using these pesticides, however – such as a build-up of chemicals in the soil, loss of biodiversity and an immunity of some pests to the chemicals – have damaged some of the natural processes on which farmers depend. A range of techniques are now being developed and put into place around the world to reduce reliance on pesticides. Using natural pest controls such as ladybirds to reduce the numbers of aphids on crops, for example, has been highly successful in many places (see Source 2.76).

### REVIEW 2.3.5

#### Remember and understand

- 1 What are the advantages of growing crops in fields where trees are present? What might be some disadvantages?
- 2 List the ways in which using chemical pesticides may be harmful to the environment.

#### Apply and analyse

- 3 In Australia, adding mulch to the soil is a common practice for gardeners and farmers alike. What is mulch and how does it help look after soil and water?

- 4 Using Source 2.76, describe the advantages of adding water to wheat crops at the right time of the year.

#### Investigate and create

- 5 Find an example of an animal species that has been successfully introduced to control another species.
- 6 Australia works to protect our agriculture and prevent new pests from entering. Research Australia's biosecurity measures and find out what sort of produce travellers are expected to declare when they enter Australia. How effective do you think these measures are?

# LESSONS FROM INDIGENOUS FARMERS

In many countries around the world, Indigenous peoples have farmed the land successfully for centuries. They have developed techniques that work with the natural cycles of nature to maintain the soil and water resources of the area. In some of these places, the arrival of mechanised farming and the introduction of chemical fertilisers and pesticides have begun to degrade the soil and make it less productive. Researchers are now learning that the ancient farming practices of Indigenous peoples have valuable lessons to teach modern farmers about working with, rather than against, nature.



## Traditional South American practices

Many South American food crops such as potatoes, tomatoes, peanuts and cocoa are now farmed throughout the world. While these plants started to be grown in countries all around the world, the traditional methods used to farm them were not used. South American farmers are experts at improving and protecting their soil and using water sustainably. The methods they use today are the result of hundreds of years of working with the natural cycles of the area in which they live.



In the Amazon forest, heavy rains leach nutrients from the soil making it almost impossible to farm. The Indigenous people of the region therefore created their own soil by building up layers of charcoal, human waste, river silt, shards of pottery and plant material. They also built garden beds above the flood levels of the region's rivers. Modern-day soil researchers have found that these garden beds are still highly fertile more than 500 years after they were constructed.

Indigenous farmers on the high plains and slopes of the Andes Mountains solved another common problem – variable rainfall. They terraced thousands of hectares of mountain slopes to collect water and provide flat land for growing crops (see Source 2.77). In the high plains, areas that were dry for half the year and covered in water for the other half were successfully farmed by building raised platforms and constructing irrigation and drainage canals, as well as human-made islands. The Aztecs farmed floating platforms on the lake that covered much of what is now Mexico City.

**Source 2.77** These terraces were built on the steepest hillsides by the Indigenous Inca people of Peru to grow and supply food to the people of Machu Picchu.

## Traditional African practices

In many communities in Sub-Saharan Africa, food insecurity and hunger are constant problems. Many people see modern techniques such as adding chemical fertilisers and pesticides as the best way to improve food security in the region. However, some Kenyan experts believe that an important clue to solving food supply problems lies in the past. They are promoting the growing and harvesting of indigenous plants such as sorghum, millet and bambara nuts, as they are better able to cope with the natural soil infertility and cycles of flood and drought than introduced plants such as maize and wheat (see Source 2.78).

As Kenya's population is growing at around one million people per year and there is limited arable land for growing food crops, exploring options for agriculture, including traditional methods, is crucial for Kenya's food security.



**Source 2.78** Kenyan farmers are now planting fields of indigenous bambara nuts – once considered a food of last resort during famine, now a potential wonder crop.

### REVIEW 2.3.6

#### Remember and understand

- 1 How did farmers in the Amazon forest overcome the problem of soil infertility?
- 2 Why did Indigenous farmers in the Andes build terraces?

#### Apply and analyse

- 3 Why do indigenous plants sometimes grow better than introduced plants?
- 4 Why do you think Amazonian farmers added broken pieces of pottery to their soil?

#### Investigate and create

- 5 Conduct research online in order to write a step-by-step guide to building terraces on steep mountainsides such as those shown in Source 2.77. Use sketches to illustrate some of these steps.
- 6 Compare the soil improvement techniques used by Indigenous farmers in the Amazon rainforest with those described earlier in 'Soil – more than just dirt' in section 2.1 of this chapter. What are the differences and similarities? Which techniques are more sustainable?



# GENETICALLY MODIFIED FOOD



Farmers have taken advantage of natural genetic processes in their farming for generations. Dairy farmers, for example, will choose the most productive cows to breed with carefully selected bulls in order to produce offspring that produce the most milk. This is known as selective breeding.

Some farmers, using modern scientific discoveries and techniques, have taken this selection process a step further. All living things are made up of cells containing genes. These genes determine how each organism grows, acts and looks. Scientists are able to change the genes of plants and animals to give them certain desirable qualities known as traits. This is known as **genetic modification (GM)**. In one example of genetic modification, scientists developed a cotton plant that produced a natural insecticide. This has resulted in a 90 per cent decrease in the amount of chemicals used to control insect pests on many Australian cotton farms since 1996.

**Source 2.79** Some canola crops in Australia are genetically modified to produce larger yields and require fewer sprayings of herbicide. Canola is present in many foods such as margarine, bread, mayonnaise and potato chips.

## The main benefits of GM food production

### Pest resistance

Crops can be modified so that they can resist pests such as insects.



### Disease resistance

GM can help plants resist fungi, viruses and bacteria.



### Nutrition

Minerals lacking in human diets can be introduced into food plants making them more nutritious.



### The main benefits of GM food production

### Cold tolerance

Plants affected by frost can be modified to help them survive the cold.



### Drought resistance

Genes from plants that grow in arid areas can help make other plants survive droughts.



**Source 2.80** The five main benefits of producing genetically modified food

## Opposition to GM foods

Many people are opposed to the genetic modification of food. They are concerned that GM foods are gradually becoming a part of our everyday diet without us knowing very much about the long-term effects. They are also concerned about the possible impacts of GM crops on other organisms such as the animals that eat the crops, which are then used for human consumption.

Environmentalists are worried about the impacts of GM crops on the environment and on the balance of ecosystems. They believe that some characteristics from GM plants, such as a resistance to herbicides (weed killers), may be passed on to other plants within the environment and even the weeds themselves.



**Source 2.81** In Australia, foods with GM ingredients must disclose this on the label.

## GM foods in Australia

In Australia, many foods containing GM plants are already available on our supermarket shelves. You have probably eaten some GM foods today. These foods are checked for their safety and must be labelled as being genetically modified (Source 2.82).

**Source 2.82** GM foods that are available in Australia. The name of the GM crop (see column 1) differs from the way it appears on food labels (listed in column 2).

GM crop	The way it appears on ingredients lists	Examples of foods in which it may be used
Canola	<ul style="list-style-type: none"> <li>Vegetable oil, canola oil</li> </ul>	Cooking oil, margarine-type spreads, mayonnaise, bread, cakes, biscuits, snacks (such as potato chips)
Corn	<ul style="list-style-type: none"> <li>Glucose/glucose syrup/dextrose</li> </ul>	Cakes, biscuits, muffins, muesli bars, breakfast cereals
	<ul style="list-style-type: none"> <li>Fructose</li> </ul>	Cakes, muesli bars
	<ul style="list-style-type: none"> <li>Maltodextrin</li> </ul>	Simmer sauces, cake mixes, snacks, breakfast cereals, peanut butter
Cotton	<ul style="list-style-type: none"> <li>Modified starch/thickener</li> </ul>	Cakes, biscuits, muffins, muesli bars, sauces, breakfast cereals
	<ul style="list-style-type: none"> <li>Vegetable oil/cottonseed oil</li> </ul>	Cooking oil, margarine-type spreads, mayonnaise, snacks (such as potato chips), simmer sauces
Soya bean	<ul style="list-style-type: none"> <li>Soy oil/vegetable oil</li> </ul>	Mayonnaise
	<ul style="list-style-type: none"> <li>Soy protein/vegetable protein</li> </ul>	Breads, cakes, biscuits, snack foods
	<ul style="list-style-type: none"> <li>Soy lecithin/emulsifier [322]</li> </ul>	Breads, cakes, biscuits, chocolate, margarine-type spreads, sauces

### REVIEW 2.3.7

#### Remember and understand

- 1 What are the main benefits of GM foods?
- 2 Examine Source 2.82. Did you know that so many foods in Australia contain GM ingredients? Do you eat any of these foods regularly?

#### Apply and analyse

- 3 Check the food labels of five foods you eat often. How many of them contain GM ingredients? Compare this with your classmates' results and work out a percentage of foods that are partially GM.
- 4 Why is it beneficial for farmers to reduce their use of chemicals such as pesticides and herbicides?

#### Investigate and create

- 5 How do you feel about GM foods? Write a 250–300 word piece explaining your point of view and the reasons behind it.
- 6 Which of the benefits of GM food production do you think has the greatest potential to increase global food production? Give some reasons for your answer and discuss them with the class.
- 7 Research one of these GM crops: Golden rice, Bt cotton, Fortuna potatoes, Flavr Savr tomatoes or GM bananas. How, why and where have these crops been modified?

# 2.3

## CHECKPOINT

### WHAT STRATEGIES CAN BE USED TO INCREASE GLOBAL FOOD SECURITY?

- Investigate the capacity of the world's biomes to achieve sustainable food security for Australia and the world.
- Why is it so important to have an understanding of food availability, food accessibility and resources for its use when learning about food security? [5 marks]
  - Write two paragraphs. The first paragraph should outline areas of the world with problems with food security using Source 2.7. The second paragraph should illustrate ways in which food security can be improved into the future. Make sure you use country examples and statistics to support your ideas. [15 marks]
  - Using Source 2.83 identify the:
    - source and year of the data [5 marks]
    - worldwide change in people undernourished [5 marks]
    - regions that have seen the largest reduction and any areas with an increase. [5 marks]
  - Suggest some possible reasons for your answers to question 3c. [10 marks]

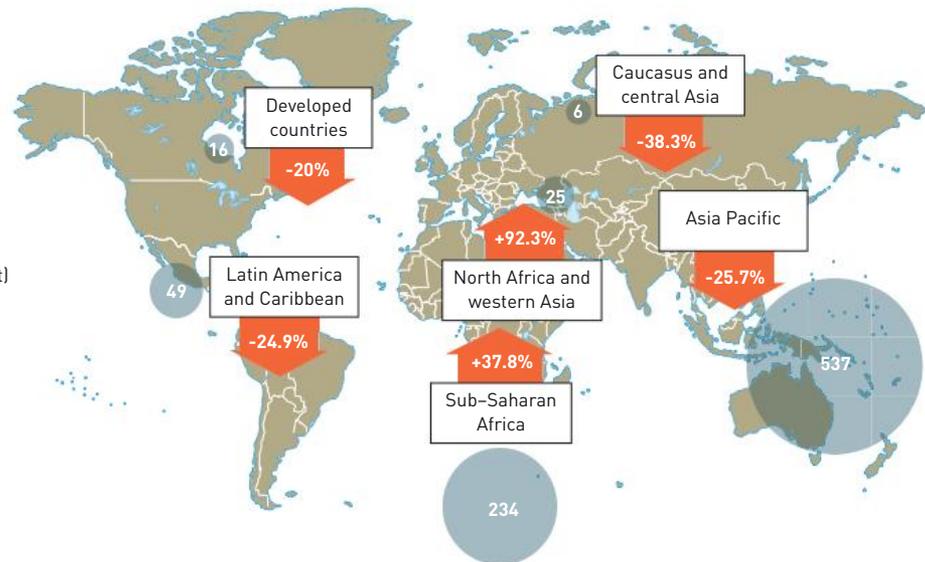
TOTAL MARKS [ /45]

#### Global hunger

868 million people are chronically undernourished worldwide down from 1 billion in 1990–1992 but still 'unacceptably high'.

● Number of chronically undernourished people in 2010–2012 (in millions)

▾ Change since 1990–1992 (in per cent)



#### Source 2.83

Infographic showing the number of undernourished people and the changes over two decades

Source: FAO

### RICH TASK

#### Food loss and waste

It has been estimated that around one-third of all food is lost or wasted around the world every year. **Food loss** refers to the amount of food lost during the growing or production process. In developing countries, most food tends to be lost during production because of problems in harvesting, storing, cooling and packaging. This equates to around 1.3 billion tonnes.

**Food waste** refers to the amount of food thrown away during the consumption process. In developed countries most food waste is carried out by consumers and retailers.

Consumers tend to reject food that is not perfect in appearance and to buy too much food, which spoils or passes its 'best before' date.

#### Acquiring geographical information

- Keep track of your household's food waste for a week, taking note of all edible food that is not eaten, food that is wasted during meal preparation (such as peelings), food served but not eaten, or food spoiled and discarded. This could be placed into a bucket and weighed every day. Multiply the total by 52 to find out the amount wasted per year.

## Communicating geographical information

- 1 One of the main reasons why food is wasted in Australia is linked to consumer demand for fruit and vegetables that are pleasing in shape and appearance. Blemished items such as curved carrots or spotted apples are often taken out

by the food producer, discarded by the retailer or not chosen by the consumer. Design an advertising campaign to reduce this aspect of food waste. Your campaign may use television, newspaper and/or social media.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Place, Space, Environment, Interconnection, Scale, Sustainability, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Maps, Graphs and statistics, Visual representations

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

## SKILL DRILL

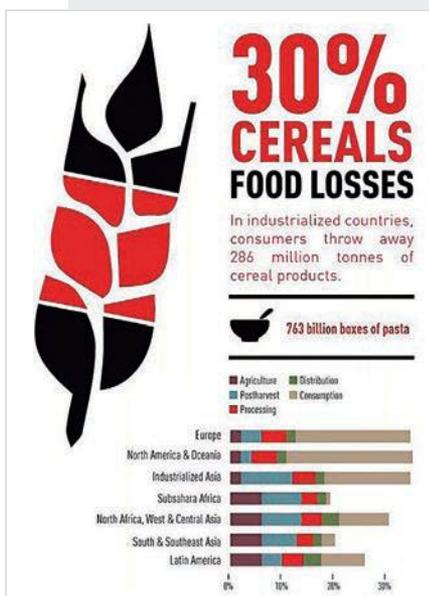
### Preparing an infographic

An increasingly popular way for geographers to present their findings is to prepare an infographic. Infographics use pictures and symbols to represent complex ideas and data so that information is clear and accessible. Follow these steps to produce your own infographic:

- Step 1** Decide on a topic and the message that you want to communicate. Source 2.84, for example, the key message is that people waste a huge quantity of food.
- Step 2** Research your topic and collect data that helps to communicate your key idea. Don't include more than 10 key facts or numbers.
- Step 3** Use a simple picture to communicate each of your key facts.
- Step 4** Lay your graphics out in a logical way that links together the key ideas. Make sure your infographic is not too cluttered. Give your infographic a catchy title that communicates your message.

### Apply the skill

- 1 Design and present an infographic on an aspect of food waste. Here are some facts to help you get started. Many of these come from a UN report, *Global Food Losses and Food Waste*.
  - One-third of all food is wasted/lost.
  - Up to 50 per cent of fruits and vegetables are wasted every year.
  - Total food wasted and lost in North America, Oceania and Europe is 280–300 kg per person per year. The amount of this that is food wasted by consumers is 95–115 kg.
  - In Sub-Saharan Africa 120–170 kg is wasted or lost, about 6 kg of it by consumers.
  - In developing countries more than 40 per cent of food loss occurs in harvesting, transporting and processing. In developed countries more than 40 per cent of losses occur at the retailing and consuming stages.
  - The total amount of food wasted every year in developed countries equals the total amount of food produced in Sub-Saharan Africa, which supports close to 900 million people.
  - One-third of all fish and seafood produced in North America and Oceania is wasted by consumers.
  - The cost of wasted food in Australia is about \$239 per person per year, or \$5.2 billion as a nation.



#### Source 2.84

This infographic shows the percentage of waste worldwide each year for cereals.



2

**CHANGING PLACES**



## URBANISATION: LIFE IN DIFFERENT CITIES

# 3

CHAPTER

## MIGRATION: PEOPLE ON THE MOVE

# 4

CHAPTER

The European settlement of Australia began when a fleet of 11 ships loaded with convicts, soldiers and settlers arrived at Sydney Cove in 1788. As more ships arrived from England, the tiny settlement of Sydney quickly grew into a bustling city. A gold rush in the 1850s and the development of new farming areas west of Sydney attracted more people to the region. By the beginning of the 20th century Sydney was home to nearly a million people. In 2016, Sydney is set to become the first Australian capital city to reach 5 million people and is Australia's largest city. In many ways, current trends in Australian society echo Sydney's history – immigration, population growth, mining booms and life in cities.

## CHAPTER

# 3



**Source 3.1** A view of Sydney's central business district (CBD) taken from the Sydney Harbour Bridge. The Rocks (left foreground) is a historic part of Sydney's city centre and a popular tourist attraction today.

## URBANISATION: LIFE IN DIFFERENT CITIES

Australia's original coastal settlements were established near sources of fresh water and deep harbours. Over time these settlements grew into cities, and Australia is now one of the most urbanised countries in the world, with nine out of 10 Australians living in an urban area. Around the world, cities keep getting bigger. Growing cities put pressure on land resources and require investment in infrastructure such as housing, roads, schools and other services. **Megacities**, many of which are located in Asia, can become swamped with so many people that even the basic supply of housing, clean water and sanitation is difficult.



# 3.1 THE URBAN EXPLOSION

WHY HAS THE WORLD BECOME MORE URBANISED?

On an ordinary day in 2007, something extraordinary happened. For the first time in human history, the number of people living in urban areas (cities) was greater than the number of people living in rural areas. Since that day, the world's cities have continued to grow at a faster rate than rural areas. **Urbanisation** – the increase in the proportion of people living in urban areas – is one of the most significant changes in human population trends ever recorded.

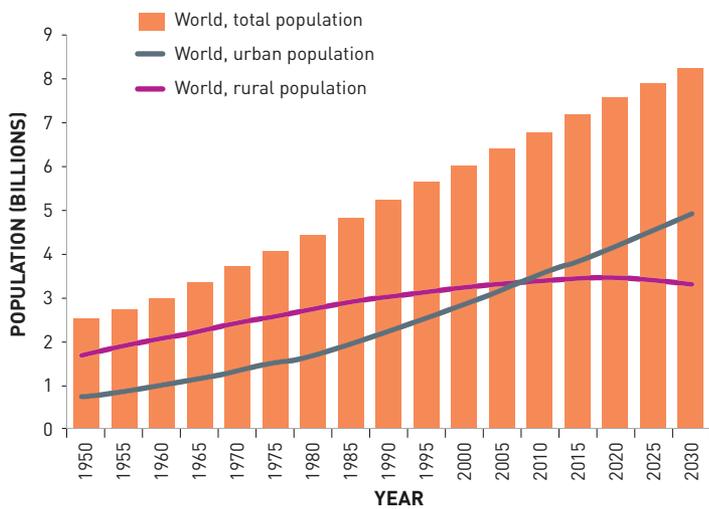
For thousands of years of human history, cities have been the exception rather than the rule. In fact, billions of people have lived and died without ever seeing – let alone living in – a large city.

This all changed about 200 years ago with the arrival of the industrial age. New, improved farming methods and farm machinery meant that fewer people were needed to

produce larger amounts of food. In the cities, new inventions, such as the steam engine and the knitting mill, created new jobs for many people. Less work in rural areas caused people to flood into cities looking for work and new opportunities. This trend quickly changed the economies of many countries, and cities became centres of industry and commerce.

Cities around the world have grown rapidly in the last 70 years. By around 1950, the world's population was 2.5 billion and there were 7 cities with more than 5 million inhabitants. The largest of these cities was New York, with a population of around 12 million. Today, there are more than 7.3 billion people on Earth and 54 per cent of them live in cities. While many of these cities have populations under one million, there has been an explosion in the

number and size of the world's very large cities. These cities, with a population greater than 10 million, have become known as **megacities**. As of 2016, there are 35 megacities around the world. The largest are Tokyo and Jakarta. Chennai is the most recent city to be added to the list. Fourteen of these have populations greater than 20 million. The United Nations predict there will be 41 megacities by 2030. Geographers refer to the rapid growth of the world's cities in the last 20 years and continuing as an urban explosion.



Source 3.2 The urban and rural population of the world, 1950–2030



Source 3.3 1950 – New York was the world's largest city, with a population of just over 12 million people.



Source 3.4 1990 – Tokyo's population reached 25 million, making it easily the world's largest city.



**Source 3.5 2030** – Based on current trends, New Delhi is expected to be the world's largest city by 2030 with a population of over 40 million.

**SKILL DRILL**

### Generating questions for a geographical inquiry

Geographers look carefully at the world around them and ask questions about what they see. The questions they ask often come from natural curiosity and may start a major investigation. When developing questions of your own for a geographical inquiry, follow these steps:

**Step 1** Think about a topic or problem you would like to investigate. Conduct some research online or in the field in order to identify an interesting area to explore.

**Step 2** Think about the types of patterns or exceptions that are linked to the topic you are investigating. Write a series of open-ended questions that help you to explore them. Open-ended questions can have more than one correct answer and cannot simply be answered with 'yes' or 'no', such as 'Why are cities sometimes abandoned?'

For example, when investigating the image of the ancient ruins of the city of Uruk in Iraq (Source 3.6), a geographer would ask why this city was built in such a barren, dry place. This would then lead them onto other questions such as:

- Was this place wetter in the past?



**Source 3.6** Excavations in Iraq have revealed the ruins of the ancient city of Uruk.

- How did the people who lived here grow their food?
- Where did their water come from?

#### Apply the skill

- 1 Examine carefully Source 3.6 showing the ruins of part of one of the world's oldest cities.
  - a What looks out of place in this image?
  - b Generate an open-ended question that may help you investigate why this feature appears in this place.
  - c Generate another open-ended question about the people who once lived in this place.
- 2 Can you think of some more questions to ask about the city of Uruk, based on Source 3.6?

### REVIEW 3.1.1

#### Remember and understand

- 1 Do most people in the world today live in cities or in the countryside?
- 2 What is a megacity? Name three megacities.
- 3 Why has most of the world's population growth occurred in cities rather than in rural areas?
- 4 Study Source 3.2. Describe the growth of the world's population since 1950. Give two reasons for the trends you have described.

#### Apply and analyse

- 5 Why do you think many people in poorer countries move from rural areas to urban areas?

#### Investigate and create

- 6 Compare the photos of New York, Tokyo and New Delhi (Sources 3.3, 3.4 and 3.5). What are some features common to all three cities? In what ways have large cities changed between 1950 and today?
- 7 Use your internet research skills to discover the name and population of each of the world's 15 largest megacities. Indicate these cities on a world map. Describe the spatial distribution of the megacities. Which continents have the greatest number of megacities? Account for this pattern of distribution.

# THE ADVANTAGES OF CITIES

Countries that have a high level of urbanisation can have advantages not only for the people who live in cities but also for the nation as a whole. These advantages can roughly be divided into two categories – **economic** and social.

## Economic advantages

Among the economic advantages offered by cities is access to work, industry, trade and, of course, income. Because cities are home to so many people, they are an obvious location for businesses and large companies to base their offices. Cities also provide companies with huge numbers of customers in a relatively small space, making it easier for them to sell their goods and services there. In addition, cities offer the best access to transport links, such as major highways, ports, railway lines and airports. These services (known as **infrastructure**) are vital for factories and businesses to manufacture and trade efficiently.

Probably the most obvious economic advantage offered by cities is the wide range of jobs available to those who live there. These range from jobs that involve little training and education through to highly skilled jobs requiring years of university study and training. Three-quarters of all jobs in Australia are based in our major cities and the income generated in those cities accounts for around 80 per cent of the total economy.

Cities provide their inhabitants with a range of efficient transport options both within the city and between adjoining cities. The Shanghai Maglev train is one of the fastest trains in the world with a top commercial speed of 431 kilometres per hour (see Source 3.8).

Throughout history, cities have been the birthplace of new ideas and inventions that have changed the world. Some of these (such as skyscrapers, subways, elevators and sewerage systems) were invented in response to the challenges of city living. Other great inventions (including telephones, computers, cameras, the iPod and the internet) all began in cities. Many of history's greatest thinkers, including William Shakespeare and Albert Einstein, lived



**Source 3.7** Cities, such as Hong Kong (shown here), are obvious locations for both small and large companies to base their offices because they offer access to a large number of potential customers.

in cities. Cities continue to be places of innovation and change as they allow individuals and organisations to share ideas and resources effectively.

## Social advantages

There is a range of social advantages to city life, including access to schools, hospitals and other services, and activities such as entertainment, sporting and cultural events.

Cities generally offer more social advantages than rural areas because there is a higher concentration of people in a smaller area. It is usually easier and cheaper to supply services to people who live closer together than to those who live far apart. As a result, city dwellers have access to an enormous range of goods and services. Cities provide their residents with essential services, including water, electricity, supermarkets, public transport, health care, communication services (such as internet access and Wi-Fi), schools and universities. In addition to these services, cities offer access to a range of non-essential products and services, including specialty boutiques, movie theatres, art galleries, casinos and major sporting and entertainment events.

## The pull of cities

One of the main ways in which the populations of cities in developing countries grow, such as Jakarta and New Delhi, is through the arrival of migrants from other parts of the country, from both smaller cities and rural areas. These migrants come in search of employment and education opportunities and a better standard of living.

By contrast, one of the main ways the populations of cities in developed countries, such as Singapore and Australia, grow is through the arrival of people from overseas. Cities are obvious choices for new arrivals because they offer the best opportunities for employment, good access to government and support services (such as translators and community workers), and the best possibility of making links with people from their own cultural and language backgrounds. Immigration results in cultural diversity, which can often be seen in the range of shops, social and cultural organisations, restaurants and religious buildings (such as churches, mosques and temples). These changes help to make our cities dynamic and vibrant places.



**Source 3.8** The latest transport option for people living in Shanghai – the new super-fast Maglev train.



**Source 3.9** Cities, such as Sydney (shown here), offer a wide range of world-class hospitals and healthcare options for the residents there.



**Source 3.10** Constable Amitoj Singh, a member of the Sikh religion, is an example of how cultural and religious diversity can be seen across Australian cities. He is the first member of the Victoria Police to wear an official police-issue turban.

### REVIEW 3.1.2

#### Remember and understand

- 1 Why do city-dwellers usually have access to a wide range of goods and services?
- 2 Why are cities often places of innovation and invention?

#### Apply and analyse

- 3 People in cities usually live longer than people in rural areas, particularly in poorer countries. Why do you think this is the case?
- 4 Examine Sources 3.7 to 3.9. What advantages of city living are shown in each of these images?
- 5 Why do you think young people in country towns often move to a city after they finish their high school education?

#### Investigate and create

- 6 List 10 advantages of life in cities and then rank them from most to least important. How did you decide on your ranking? Did any of your classmates have a list similar to yours? Why/why not?
- 7 Australian inventions include the black box flight recorder, Google Maps, spray-on skin, the bionic ear, Wi-Fi, plastic bank notes and Relenza anti-flu medication. Select one of these (or another Australian invention) and research its inventor and the place where the invention was developed.

# THE DISADVANTAGES OF CITIES

Although there are many advantages to city life, there are also a number of disadvantages. Cities house a large number of people in a relatively small space, and this can create a number of unwanted problems and disadvantages. These disadvantages can roughly be divided into two categories – environmental and social.



## Environmental disadvantages

Cities change the natural environment in many ways. The people, factories, cars and industries based in cities often pollute the air, water and soil. The goods and services needed by the residents of cities include food, water, electricity, petrol and gas, and these often have to be transported long distances, creating even more pollution. As cities grow in size they place an enormous amount of stress on the natural environment around them.

**Source 3.11** Mumbai's Dharavi slum is home to up to one million of Mumbai's most disadvantaged inhabitants. The slum, which is situated on an old swamp, is adjacent to some of the city's most expensive real estate and home to Mumbai's wealthiest inhabitants.

As cities and suburbs grow and spread, forests and grasslands are cleared, lakes and wetlands are drained, and rivers are diverted or dammed. Soft earth is replaced with hard surfaces, such as concrete and roads. This often has disastrous consequences for native animal and bird populations. For example, a recent study found that more than half of Australia's rare or threatened plants, mammals, birds, reptiles and fish live in or near our cities.



**Source 3.12** The squirrel glider, native to eastern Australia, is endangered by the loss of its habitat due to the sprawling city suburbs along the east coast.

## Social disadvantages

The social disadvantages faced by city-dwellers can vary widely between cities and from suburb to suburb within a city, so one person's experience may be very different from another's. Overcrowding and rising house prices might be a disadvantage for those living in the older, established parts of a city, while lack of schools and hospitals might be a disadvantage for those living in new housing estates on the edge of the city.

As the populations of cities grow, land on the edges of cities is often converted from farmland and green spaces into residential areas. This urban sprawl comes at a cost to both the environment and to people.

Regardless of where the residents of a city live, many will experience some form of disadvantage that affects their quality of life. Most of these disadvantages are linked to competition for services and resources. Because cities are home to large numbers of people concentrated in relatively small areas, these services and resources can be



stretched beyond their limits. Some of the problems most commonly experienced by people living in cities include:

- traffic congestion – the result of too many people trying to use the roads at the same time
- rises in the cost of housing, food and utilities – the result of greater numbers of people competing for resources than can be supplied
- waiting times for schools, public transport and medical care – the result of more people trying to access these services than they were originally designed to accommodate
- rates of crime – the result of a complex combination of factors including unemployment, cultural and economic background, age and gender.



**Source 3.13** New suburbs on the city fringes of Perth expanding into areas of native bushland



**Source 3.14** Large cities all suffer traffic congestion on a daily basis. Jakarta, Indonesia's capital city, is no different.

### REVIEW 3.1.3

#### Remember and understand

- 1 Why is traffic congestion a common problem in many cities?
- 2 How are native animals being impacted by the urban sprawl of cities?

#### Apply and analyse

- 3 Describe the changes taking place in Source 3.13. How will these changes affect the people who already live in this place? How will they affect the natural environment?

#### Investigate and create

- 4 With a partner, choose a large city in a developing country, such as Jarkarta (in Indonesia) or Mumbai

(in India), and conduct a brief internet search into the disadvantages of city life for people living there.

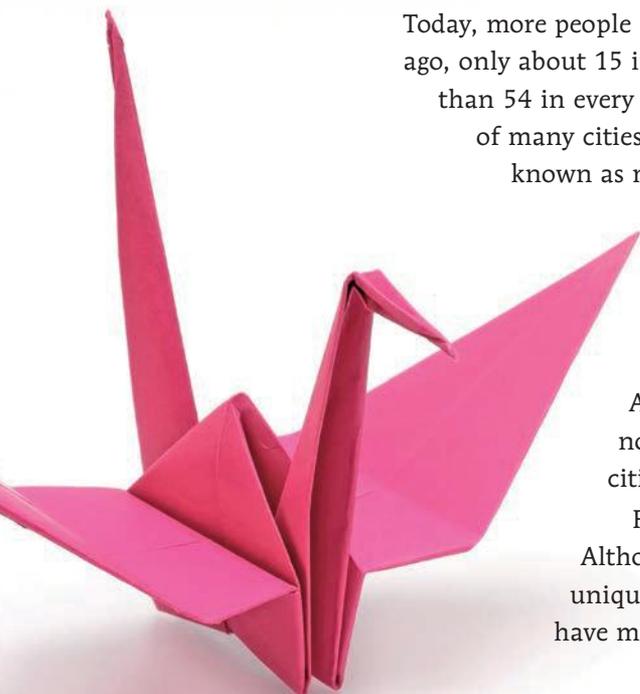
- a How might the problems experienced by people living in your chosen city be different from those experienced by city-dwellers in developed countries such as Australia and the United States?
  - b Make a list of the disadvantages experienced by people living in your chosen city, and another list of disadvantages experienced by people living in a large city close to you.
  - c Which problems are the same and which are different?
- 5 What strategies do you think could be put into place to protect endangered species whose natural habitat is near a city, such as the squirrel glider in Source 3.12?

# THE RISE OF THE ASIAN MEGACITY

Today, more people around the world are living in cities than ever before. A century ago, only about 15 in every 100 people lived in cities. Today, that number is more than 54 in every 100 people. This increase has resulted in the creation and growth of many cities worldwide, and an explosion in the number of very large cities, known as megacities. Megacities are urban areas with populations of more than 10 million people.

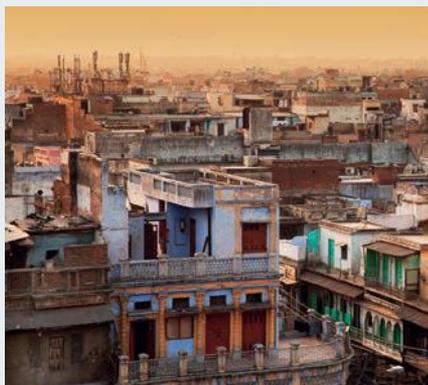
In addition to the increase in the number of megacities over the last century, there has been a change in where these cities are found. No longer do the megacities of Europe and North America dominate – instead, the megacities of Asia, South America and Africa are becoming the world's largest. In fact, Asia now has the most megacities and the biggest concentration of large cities of any region in the world (see Source 3.15).

Four of the world's Asian megacities are explored briefly below. Although they are located in different Asian nations and have many unique characteristics, they also face many of the same challenges and have more in common than you might first think.



## Tokyo: The world's biggest megacity

The Tokyo-Yokohama Metropolitan Area (or Greater Tokyo) is the world's largest megacity and is home to over 37 million inhabitants. The metropolitan area is a **megalopolis** and includes the cities of Yokohama, Kawasaki and Chiba. Tokyo is renowned as a technologically advanced, modern city but it still faces pressures from its population numbers. Tokyo has a problem with pollution and is trying to reduce its greenhouse gases. It has become an **urban heat island (UHI)**, meaning the city is significantly warmer than its surrounding rural areas. Tokyo has a very high population density, crowding many people into a relatively small space. This puts pressure on public services such as water, waste management and public transport. The Tokyo metro system is the world's busiest.



## New Delhi: A fast-growing capital city

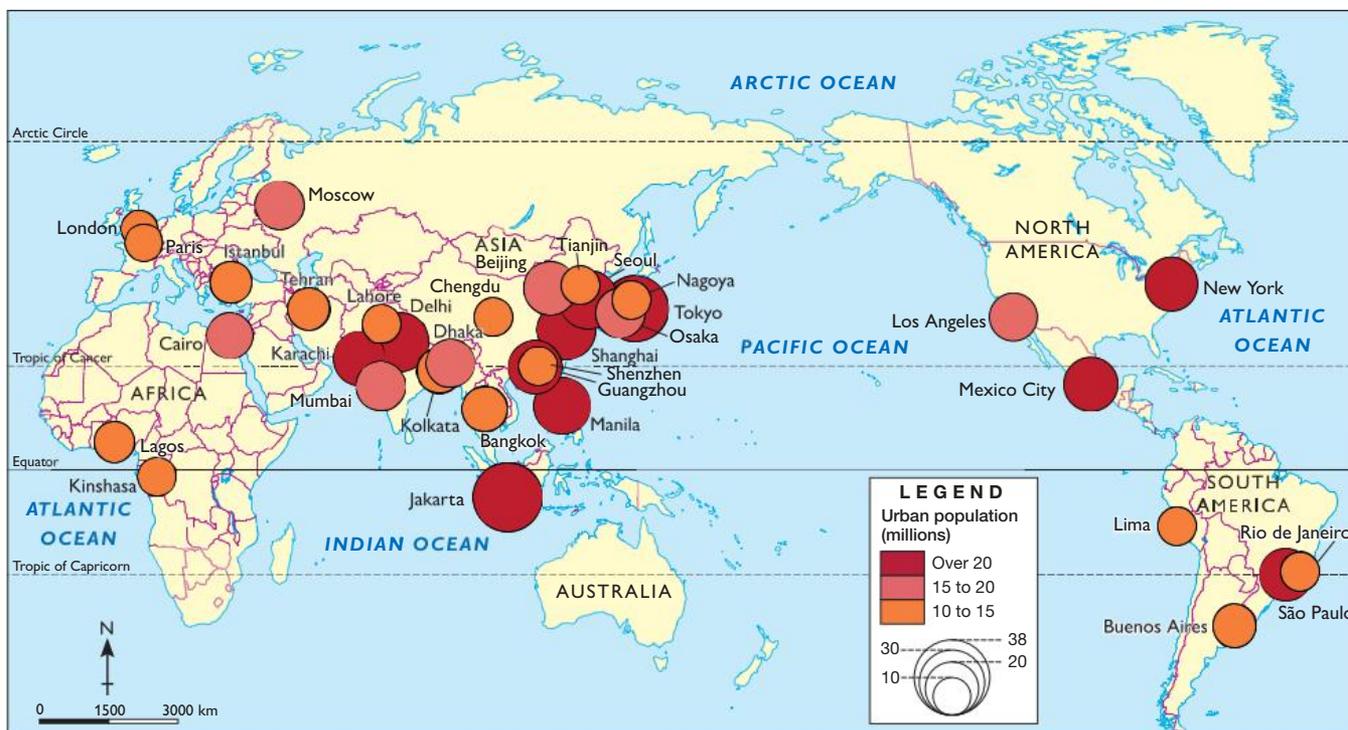
The population of New Delhi, by official census, was just over 18 million people, making it India's second largest city behind Mumbai with a population of 22 million in 2015. The population of New Delhi is expected to increase by 40 per cent by 2020 as people from other parts of India are attracted by a better living standard and greater opportunities than in other regions. But this rapid growth has brought problems. In 2014 the World Health Organization named New Delhi as the most polluted city in the world. Suffering heavily with air pollution from road dust and industry, New Delhi also lacks efficient waste management and raw sewage released into its river, Yamuna, has seriously affected its health.



## Jakarta: Australia's neighbour goes mega

Current estimates put the population of Jakarta at about 30 million people. Up to half the population lives in slums, called kampongs, where temporary homes are built on land considered unsuitable for housing. One of the city's biggest problems is the freshwater supply. Most residents use bores (deep wells) to obtain their fresh water. In North Jakarta so much water has been drawn from the ground that the land has begun to subside (sink) in places, leading to a greater risk of flooding.

## WORLD: MEGACITIES



Source 3.15

Source: Oxford University Press



### Shanghai: China's most populous city

Shanghai is China's most populous city. In 2015 its population exceeded 25 million people. It is both a major financial centre and a global city and sits at the mouth of the Yangtze River in eastern China. The city is mostly flat and is intersected by an extensive system of rivers, canals, lakes and streams, which make it an excellent location for a large population. But Shanghai's rapid population growth has encroached on surrounding farmland, which is being replaced with construction to house the increasing population. Shanghai's new fast train should help with the traffic congestion but air quality is low and Shanghai also shows signs of becoming an urban heat island.

### REVIEW 3.1.4

#### Remember and understand

- 1 What is a megacity?
- 2 How many megacities are there in the world? How many of these megacities could you have named before reading the information given here?
- 3 Which continent is home to the most megacities?
- 4 Do you think the number of megacities will increase or decrease over the next 20 years? Give some possible reasons for your answer.
- 5 What are some of the problems faced by people living in megacities? Which of these problems will become worse as each of these cities grows in size?

#### Apply and analyse

- 6 Examine the location and distribution of the world's megacities in Source 3.15. In what ways are many of their locations similar? What cities do not share all of these similar location features?
- 7 The images of these megacities show that tall buildings are common in many city centres. Why do you think this is the case? Why are there usually very few tall buildings on the edges of cities?

#### Investigate and create

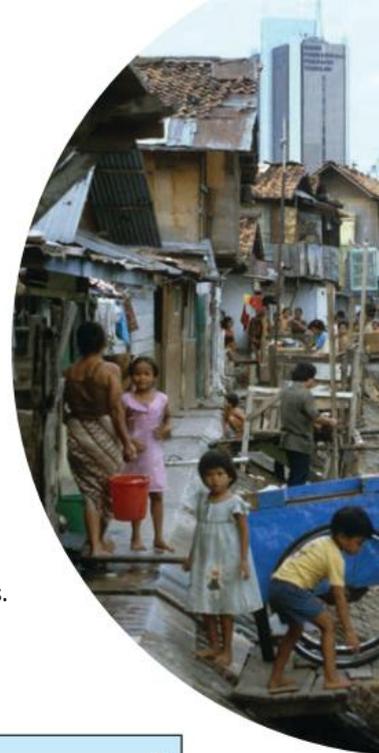
- 8 Select one of the Asian megacities shown on the map (Source 3.15) that is not described in detail. Conduct some internet research on this city. Find out about its location, history and any issues faced by the people who live there. Write a short paragraph about this city, similar to those shown here.

# URBANISATION IN INDONESIA

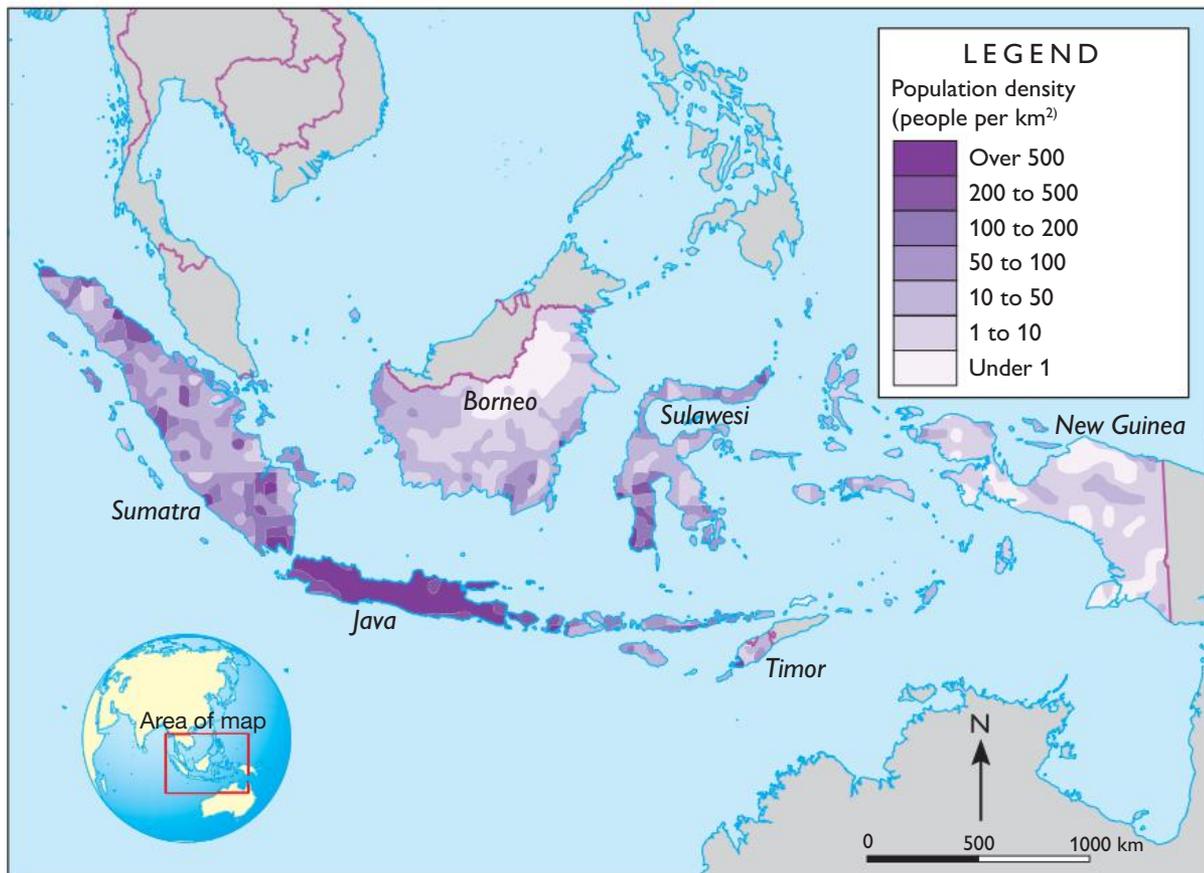
Asia is home to some of the world's largest and fastest-growing cities. Of the 50 cities around the world with a population of over five million, half of them are located in Asia. Many of these cities are growing so quickly that they are unable to meet the demands of new residents, large numbers of whom are escaping rural poverty and looking for opportunities to improve their lives.

## Urban growth in Indonesia

In 1950, Jakarta was the only Indonesian city with a population in excess of one million and only 15 per cent of Indonesia's population lived in urban areas. By 2015 a total of 11 cities had grown to have one million people.



INDONESIA: POPULATION DENSITY



Source 3.16

Source: Oxford University Press

Between 2000 and 2015 Indonesia's population grew from 204 million to 257 million. The proportion of the population living in urban centres also increased significantly during this period, from 42 per cent to 53.7 per cent. About 58 per cent of Indonesia's urban population live on the island of Java, which has 20 cities with a population of 100 000 plus and seven cities with populations of over one million.

The migration of people from rural areas to large cities is a major factor in Indonesia's urban growth. Often, people living in rural areas lack employment and education opportunities



**Source 3.17** A slum located in the metropolitan area of Jakarta, Indonesia

so the younger people move to cities for work, entertainment, education and health services. They leave behind an ageing rural workforce. Of the 140 million farmers in Indonesia, 80 per cent are aged 45 and above.

## Jakarta: Indonesia's megacity

Jakarta, the capital city of Indonesia, is located on the island of Java. In 2015, the population of the official metropolitan area of Jakarta was recorded at 10.2 million, qualifying it as a megacity. In reality, however, the population of greater Jakarta (that is, the suburbs surrounding the metropolitan area) brings the total population closer to 19 million. Jakarta is a very old city, having been settled as a trading settlement over 1500 years ago. Jakarta is located on the north-western coast of Java. A range of volcanoes and hilly slopes south of the city feed a series of rivers that have built up a fertile floodplain leading to the Java Sea. The combination of the flat, low-lying plain and the tropical climate means that flooding is a frequent problem for the residents of Jakarta.

Like many other cities across Asia, Jakarta is a place of contrasts. Slums sit alongside skyscrapers, modern homes and luxury hotels. Half of the population of Jakarta live in these slums. The homes there are often built from temporary materials on land considered unsuitable for regular housing. In the slums, running water, electricity and sanitation are difficult to obtain.

One of the biggest problems in Jakarta is the freshwater supply. The current piped system is largely ineffective, so most residents use **bores** to obtain their fresh water. In North Jakarta so much water has been drawn from the ground that the land has begun to sink in places, leading to a greater risk of flooding. A limited sewerage system due to the lack of running water makes the threat of disease a constant concern.



**Source 3.18** Satellite images of Jakarta taken in 1976, 1989 and 2004. Urban areas appear as blue-green and vegetation appears as orange-red.

### REVIEW 3.1.5

#### Remember and understand

- 1 What percentage of Indonesians live in urban areas? How did this change between 2000 and 2015?
- 2 In Indonesia, why are young people moving from rural areas to the cities?

#### Apply and analyse

- 3 How does Source 3.17 show the contrasting living conditions in Indonesia?
- 4 What health issues do you think the children in Source 3.17 might face?

- 5 Describe how residents in Java have helped to solve their freshwater problem? What additional problem has this caused?

#### Investigate and create

- 6 Trace an outline of the city boundary of Jakarta in 1976 shown in Source 3.18. Mark the coastline and shade in areas of vegetation. Mark in any rivers or lakes that you can see. Now add an overlay sheet showing the city boundary in 2004. Describe the spatial change over time as shown on your overlay map.

# 3.1

## CHECKPOINT

### WHY HAS THE WORLD BECOME MORE URBANISED?

- Investigate the causes and consequences of urbanisation with reference to ONE Asian country.
- 1 Describe what is meant by the term 'urban explosion'. [5 marks]
  - 2 Describe the advantages that urban areas, such as cities, have over rural areas with regard to opportunities for their inhabitants. [10 marks]
  - 3 Describe the factors that have led to the rise in the number of megacities in Asia. [10 marks]
  - 4 Compare and contrast the living conditions of Jakarta to those of your city or town with regard to population growth rate, air pollution, traffic congestion, sanitation, access to clean water and availability and quality of housing. [15 marks]

TOTAL MARKS [ /40]

### RICH TASK

#### Causes and consequences of urbanisation in China

With 1.4 billion people, China has the largest population of any country on Earth. One in every five people live in China.

In 2012, there were two megacities in China – Shanghai and Beijing. By 2025, six new Chinese megacities with populations of 10 million or more people are expected to emerge. By this time, one billion Chinese people will be living in cities.

The beginning of this urban shift can be traced back to the late 1970s and 1980s. At that time, the Chinese government began to

introduce policies and laws that encouraged economic growth. The goal was to turn China from a country of farmers into a country of business people and factory workers. Businesses and factories soon started to pop up in most Chinese cities, and people began to move from the countryside to take advantage of new job opportunities.

One of the fastest-growing cities in China is Shenzhen in Guangdong Province. In 1980, Shenzhen was a small fishing village with a population of about 10 000. Today it is home to almost 10 million people.

#### Processing geographical information

- 1 Compare and contrast Source 3.19 and Source 3.20.
  - a Describe the relationship between population density and population change in China. Identify any areas where the relationship does not exist or is weak.
  - b Provide reasons for the relationship identified above.
- 2 Why are China's cities growing so rapidly?
- 3 As a country, how does China benefit from urbanisation?
- 4 In 1901, both Sydney and Melbourne were home to about half a million people. Within a few years, though, Sydney had outgrown Melbourne, and by the year 2000 Sydney was the only Australian city with a population of over 4 million people. One in five Australians now live in Sydney and it continues to grow by over 35 000 people a year. How is urbanisation in Australia similar to, and how is it different from urbanisation in China?

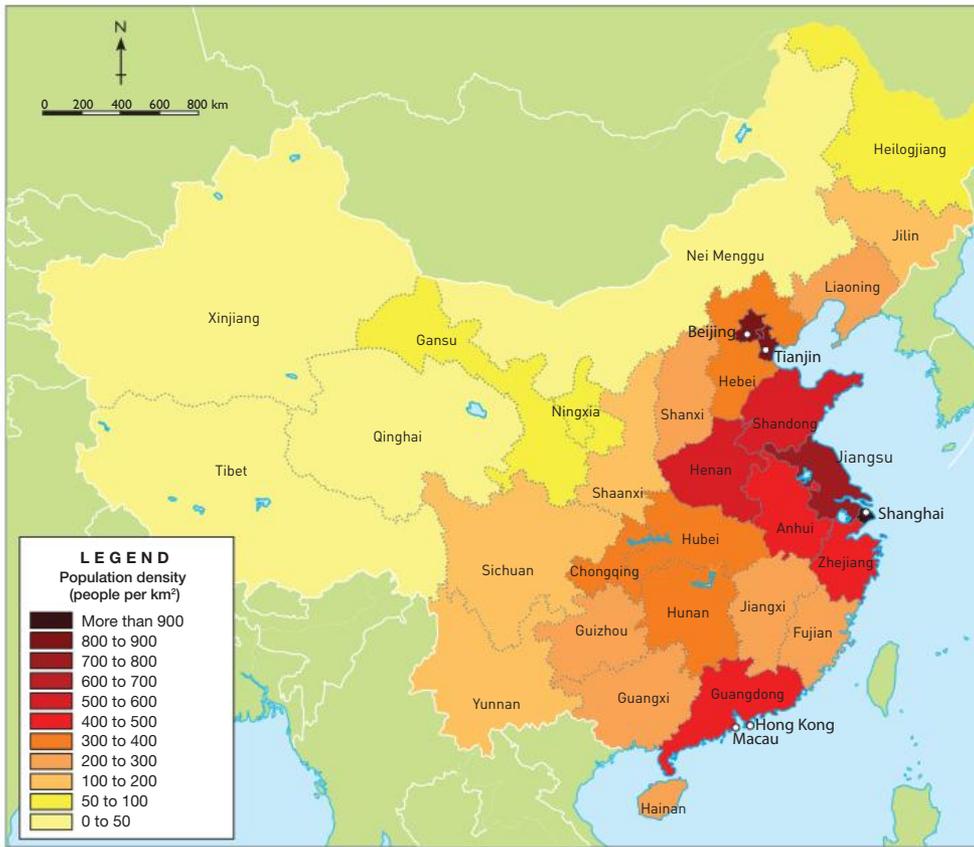
#### CHINA: POPULATION CHANGE



Source 3.19

Source: Oxford University Press

## CHINA: POPULATION DENSITY



Source 3.20

Source: Oxford University Press

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Place, Space, Environment, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Maps, Graphs and statistics

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

### SKILL DRILL

#### Interpreting choropleth maps

Sources 3.19 and 3.20 are known as choropleth maps. These maps give a quick impression of spatial patterns by using dark and light shades of the same or similar colours. Darker shades usually show 'the most' and lighter shades show 'the least'. To interpret a choropleth map, follow these steps:

- Step 1** Read the title so you understand what is being shown on the map.
- Step 2** Look carefully at the legend so that you understand what the various shades and colours represent.
- Step 3** Look for large areas of similar shades and for other patterns (such as lighter colours near the edges of the city and darker colours near the centre of the city).
- Step 4** Look for any exceptions to the general pattern.

#### Apply the skill

- 1** Study Source 3.20. Describe the spatial pattern of population density in China.
- 2** Study Source 3.19. Describe the pattern of China's population movement. Use terms such as 'north', 'south-east', 'north-west' or 'east' to describe the movement patterns you can identify.
- 3** Study Source 3.19.
  - a** Which areas of China have experienced the greatest amount of growth?
  - b** Account for the areas that have experienced the greatest and the least amount of urban growth.
  - c** What services and infrastructure might the government need to offer in areas with large growth?

# 3.2 WHERE AUSTRALIANS LIVE

HOW DOES URBANISATION CHANGE ENVIRONMENTS AND PLACES?

Australia's population is more unevenly spread than virtually any other country on Earth. Of the 23.5 million people who lived in Australia in 2014, nearly 15 million lived in just five cities. All these cities are state capitals and all are located on the coast. Nearly 90 per cent of all Australians live in a town or city, and 85 per cent of us live within 50 kilometres of the coast.



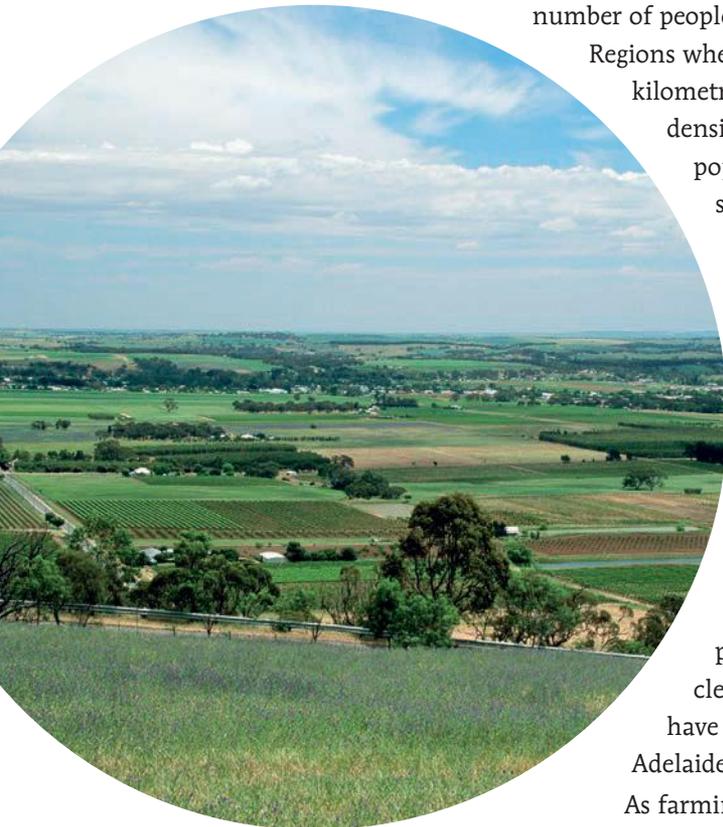
## Where do Australians live?

The best way to show the places where Australians live is to map the distribution of the population and study the **population density**.

This shows not only the locations where people live but also the number of people who live in each square kilometre.

Regions where there are lots of people per square kilometre are said to have a high population density. For example, Sydney's 10 most populated suburbs all have more than 10 000 people living in each square kilometre. Regions where there are very few people per square kilometre are said to have a low population density.

**Source 3.21** Australia has one of the lowest population densities of any country on Earth. Ninety-seven per cent of Western Australia has a population density of less than 0.1 people per square kilometre.



## Australian cities

Cities in Australia are located close to the natural and/or built features that humans need most. These features include fresh water and fertile soil as well as transport links, such as harbours, railways and roads.

Most of Australia's earliest towns were settled on bays, harbours and at river mouths on the coast. These towns were able to trade and communicate with each other. Rivers not only provided clean drinking water but also water for growing food, cleaning, manufacturing and transport. Many of these early towns have grown into our largest cities – Sydney, Melbourne, Brisbane, Adelaide and Perth.

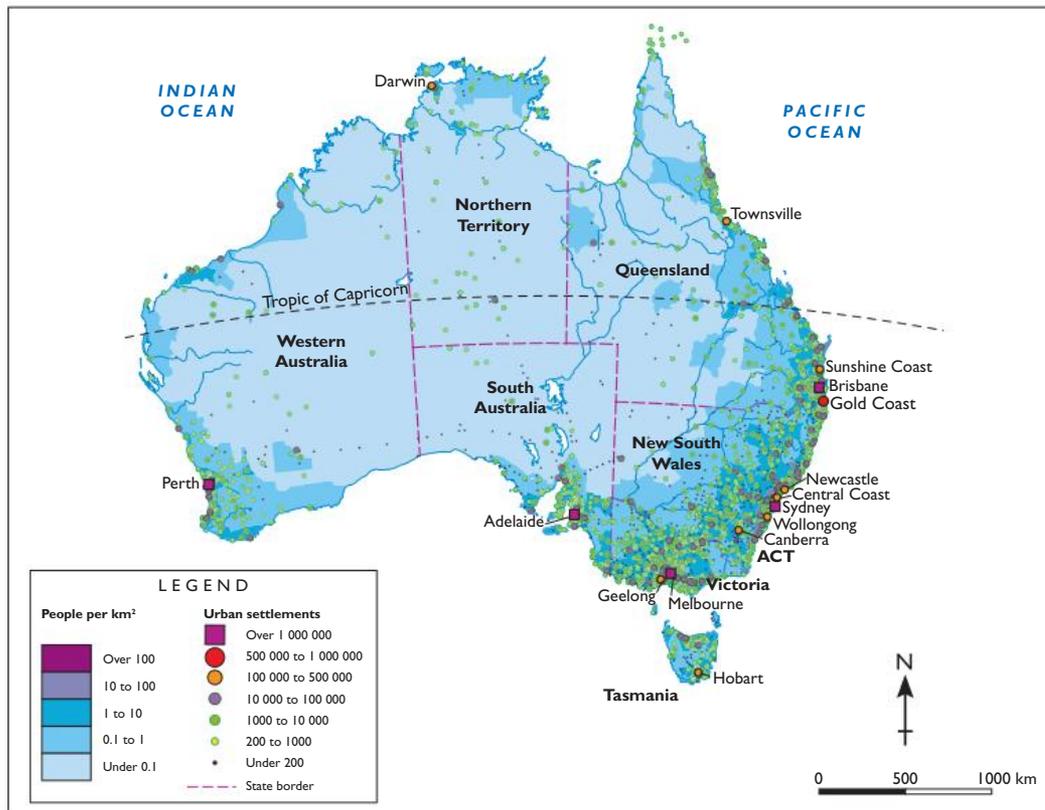
As farming spread and important minerals such as gold were discovered, inland cities such as Bendigo, Bathurst, Castlemaine, Ararat, Kalgoorlie and Rockhampton began to develop. Industrial towns such as Newcastle grew near transport hubs where goods could be sent to markets in Australia and overseas.

**Source 3.22** South Australia's Barossa Valley has a medium population density as it includes a mix of towns and farming regions.



**Source 3.23** The Sydney suburb of Pyrmont-Ultimo is the most densely populated suburb in Australia with approximately 15 000 people per square kilometre in 2015.

## AUSTRALIA: POPULATION DENSITY AND DISTRIBUTION, 2011



**Source 3.24**

Source: Oxford University Press

### REVIEW 3.2.1

#### Remember and understand

- 1 Why are most cities located near a source of fresh water?
- 2 Which parts of Australia are densely populated?
- 3 Which parts of Australia are sparsely populated?
- 4 How many Australian cities have more than one million people? In what ways are their locations all the same? Why do you think this is the case?

#### Apply and analyse

- 5 Study Source 3.21. Why do you think so few people live in parts of Western Australia?

- 6 Compare Pyrmont-Ultimo (Source 3.23) with the Barossa Valley (Source 3.22).
  - a In what ways are they similar and in what ways are they different?
  - b In which of these two places would you prefer to live and why?
- 7 Examine Source 3.24 and describe the distribution of Australia's population using the PQE method. (For more information on the PQE method, see section GT.2 of 'The geographer's toolkit'.)

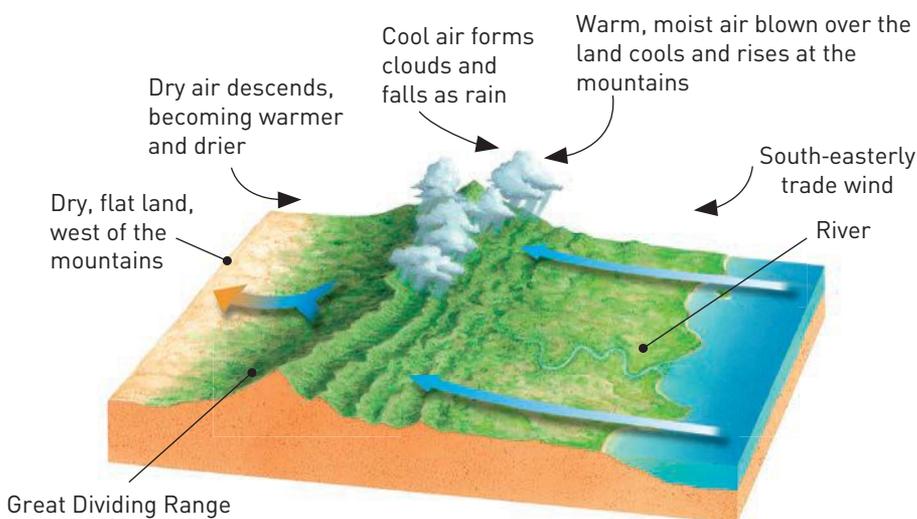
# WHY AUSTRALIANS LIVE WHERE THEY DO

There are many reasons why people live where they do. In Australia, some of the most important factors relate to the natural environment. Much of the continent has low rainfall and poor soil fertility, making it very difficult for people to live and grow crops there. As a result, Australians tend to live in the parts of the country that receive the most rainfall.

## The role of landscapes and climate

Australia's physical environments and different climate zones play a major role in where Australians choose to live. Places that receive the highest and most reliable rainfall are often the most populated. These regions are found in the south-east of the country, to the east of a mountain range known as the Great Dividing Range. This mountain range stretches from Cape York Peninsula in the north of Queensland to the Grampians in western Victoria. The Great Dividing Range has a huge impact on the climate along the east coast of Australia, which in turn influences where people choose to settle (see Source 3.26). It also influences the kinds of vegetation that grow there and the kinds of animals that live there.

Winds from the south-east push warm, moist air over the land. This air is forced to rise over the Great Dividing Range. As the air rises, it cools. Cool air cannot hold as much moisture as warm air, so the moisture condenses into water droplets that fall as rain on the eastern side of the Great Dividing Range (see Source 3.25). The rain fills hundreds of rivers that run eastwards to the coast. These rivers supply fresh water for drinking, food production, hydroelectricity, industry and transport. Most Australians live in coastal towns and cities near the mouths of these rivers. On the western side of the range, most of the land is dry and flat. The once moist air that passes over the range is now dry. As the air descends to the west of the Great Dividing Range it becomes warmer but remains dry, so little rain falls there. As a result, very few people live there.



## The pull of the city

As in other countries around the world, in Australia the economic pull of the large cities is attracting more people to them. Between 2001 and 2015, the population of Australia increased by 4.8 million. The cities of Sydney and Melbourne became home to 38 per cent of these people (around 1.8 million).

The key attractions of living in a large Australian city are the opportunities for jobs and education. Australia's major cities generate 80 per cent of the country's wealth and employ 75 per cent of our workforce. By 2015, 75 per cent of all Australians lived in cities with populations greater than 100 000.

Source 3.25 The influence of the Great Dividing Range on Australia's climate

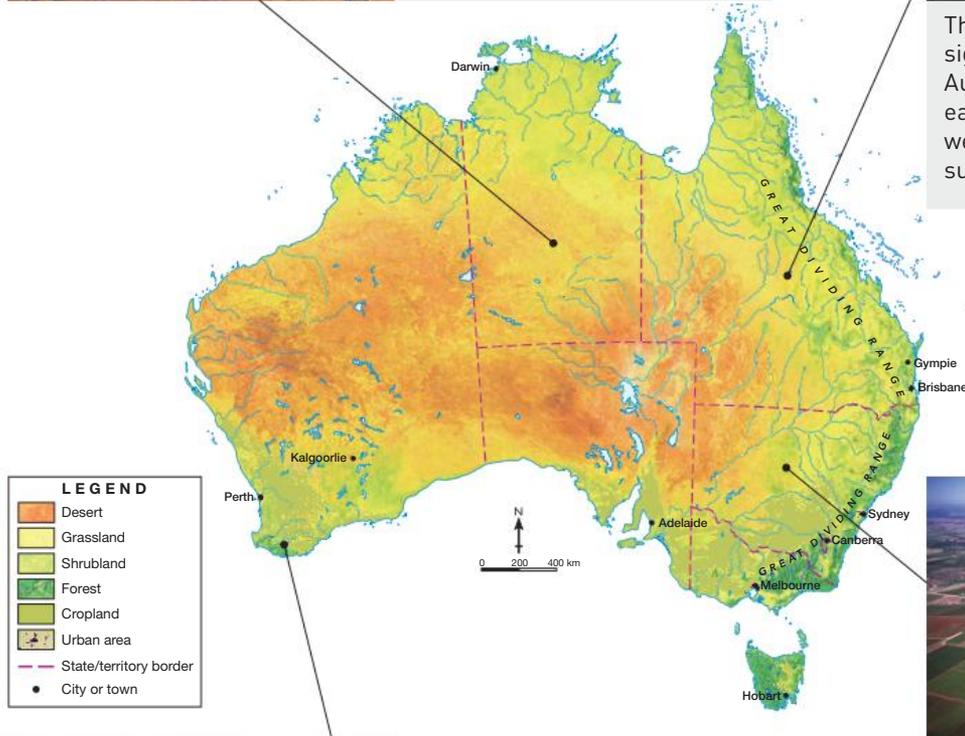
## AUSTRALIA: ENVIRONMENTS



Much of the inland Australia is desert and too dry to support large populations. The soil is generally very poor and cannot be used to grow crops or farm large numbers of grazing animals.



The Great Dividing Range has a significant impact on where Australians live. Areas to its east are the most fertile and the weather is generally able to support large populations.



The south-west of Western Australia receives regular rainfall from passing storms and cold fronts. The region also has a temperate climate and fertile soil, making it an excellent food and wine-producing area.



Two major rivers and fertile soil attracted farmers to the region now known as the Murray-Darling Basin. It has since become Australia's most important agricultural region. One-third of Australia's food supply comes from here.

Source 3.26

Source: Oxford University Press

### REVIEW 3.2.2

#### Remember and understand

- 1 Why do so few people live in inland Australia?
- 2 What is an important economic factor that helps to explain why people live where they do?
- 3 How does the Great Dividing Range influence where people in Australia live?
- 4 List three ways in which water has influenced where people in Australia live.

#### Apply and analyse

- 5 Examine Source 3.26. Which features of the natural environment do you think were important when deciding on the locations of Hobart, Gympie and Kalgoorlie?
- 6 Which factors discussed here apply to where you live?

# WHERE AMERICANS LIVE

The United States is similar to Australia in that the majority of people there live in **urban** areas. In fact, in the north-east of the United States a number of major cities (including New York, Washington and Boston), along with a number of smaller cities, have grown so large in recent years that they have begun to merge into one continuous urban area. The area is now often referred to by the name BosNYWash. Home to about 55 million people, it is classed as a megalopolis.



**Source 3.27** The area known as BosNYWash is often referred to as a megalopolis. It can be seen clearly on the north-east coast of the United States in this satellite image taken at night.



**Source 3.28** This exurb, being developed on the outskirts of Salt Lake City in Utah, is an example of urban sprawl.

## American cities

There are usually three distinct parts to every US city:

- the city centre or central business district (often referred to as ‘downtown’)
- the **suburbs**
- the **exurbs**.

**Source 3.29** Ten largest US cities in 2014

Rank	City	Population
1	New York	8 491 079
2	Los Angeles	3 928 864
3	Chicago	2 722 839
4	Houston	2 239 558
5	Philadelphia	1 560 297
6	Phoenix	1 537 058
7	San Antonio	1 436 697
8	San Diego	1 381 069
9	Dallas	1 291 047
10	San Jose	1 015 785

At the centre of most cities in the United States is an area of tall skyscrapers and high-density residential apartment buildings. Downtown is often the place where the city was first settled and now contains the head offices of large companies and large residential apartment buildings. Land in the city centre is often very expensive, so buildings are tall rather than wide.

Beyond the city centre lies a large area of medium-density residential housing known as the suburbs. In many American cities, the suburbs grew rapidly from the 1950s onwards as people moved out of apartment buildings downtown and built free-standing houses on the city’s edges. The suburbs are home to well over half of those who live in cities.

Separated from the suburbs, but connected to them by a network of roads and rail lines, lies an area known as the exurbs. They are separated from the city by farmland and open spaces, and the people who live there usually commute into the city for work. For this reason, the exurbs are sometimes also called ‘dormitory suburbs’. Over time, as the suburbs and exurbs grow in size, they

## UNITED STATES: POPULATION DENSITY, 2010



Source 3.30

Source: Oxford University Press

may join together, increasing the size of the city. Geographers refer to this expansion as **urban sprawl**. The United States is home to some of the world's most sprawling cities. A key driver of urban sprawl is car ownership. Cars allow those people who live in the suburbs or exurbs to commute to work in the city centre much more safely and easily than they could in the past.

By Australian standards, the sheer number of people living in cities in the United States is staggering. In fact, the total number of residents living in only 10 of the metropolitan areas of the largest American cities is around 26 million (see Source 3.29). This number is more than the total population of Australia.

### REVIEW 3.2.3

#### Remember and understand

- 1 What is the difference between a suburb and an exurb?
- 2 Why do you think the continuous urban area in the north-east of the United States is sometimes referred to as BosNYWash?
- 3 What do geographers call areas such as BosNYWash?

#### Apply and analyse

- 4 Examine closely the map showing population density in the United States [Source 3.30]. Make a list of three patterns that you notice on the map. Share your observations with a classmate and then with your class.

- 5 Compare Source 3.30 with a map showing population density in Australia [Source 3.24]. Make a list of the similarities and the differences between the population densities of these two countries.
- 6 American cities often have three main parts. What are these parts? Do large Australian cities also have these parts?

#### Investigate and create

- 7 Do you think cities in the United States and Australia share similar characteristics? Provide reasons for your answer.
- 8 Which geographical key concepts would you use to help explain the development of the exurb in Source 3.28? Justify your choices.

# WHY AMERICANS LIVE WHERE THEY DO

As you have learned, the American population of 320 million people is not distributed evenly. Some parts of the country are dominated by enormous, crowded cities and large towns that are home to tens of millions of people, while other parts of the country are vast areas of wilderness where virtually no one lives. This is because people tend to live in places that supply their basic needs – food, water and shelter. In the United States, the most densely populated places tend to share the same features:

- a temperate climate (one that is not too cold or too hot)
- reliable rainfall and rivers to supply fresh water
- fertile soils for growing crops
- relatively flat, as opposed to mountainous, landscapes
- closeness to the coast.

## The role of landscapes and climate

As Source 3.31 shows, much of the western United States is mountainous. A vast plain with a few low mountain ranges stretches from the foothills of the Rocky Mountains almost all the way to the east coast. For this reason the east of the country, especially the areas along the coast, is the most densely populated.

The United States is a vast country – the world’s fourth largest. It extends almost from the tropics in the south to the Arctic Circle in the north. This gives the United States a wide range of climates. The climate in the south of the country tends to be much warmer than in the north. In winter, snow can blanket northern cities such as New York and Chicago. In summer, it can be extremely hot and humid in southern cities such as Atlanta and Austin.

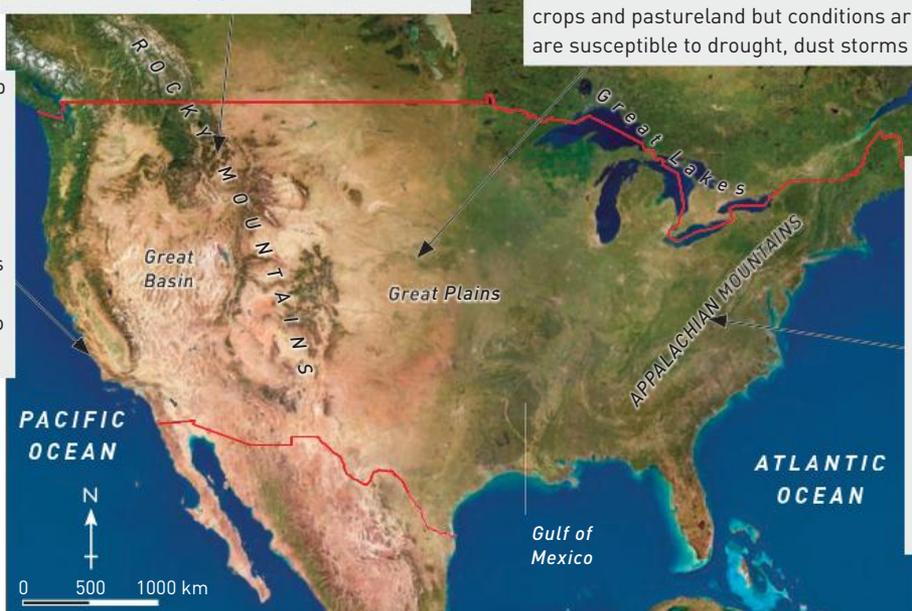
**Source 3.31** A satellite image of the United States highlighting the key topographical features

Much of the western half of North America is mountainous. Mountain ranges such as the Rocky Mountains were formed over millions of years by the collision of the Earth’s tectonic plates. Much of the mountain range is protected by public parks and forest lands, and it is a popular tourist destination.

The interior of the country is a huge, flat plain broken up by a few mountain ranges and mighty rivers, such as the Mississippi River and the Missouri River. The central region of the United States is subject to extremes in temperature with cold, snowy winters and hot summers. The plains have been converted to crops and pastureland but conditions are harsh and the plains are susceptible to drought, dust storms and tornadoes.

A narrow strip of flat, fertile land on the west coast supports several large cities, such as Los Angeles, San Francisco and Seattle.

The north-east region has fewer extremes in temperature and more rainfall than the central plains. This made the region suitable for farming and attractive to early settlers. Large urban centres were also established on the east coast, including New York, Washington and Boston.



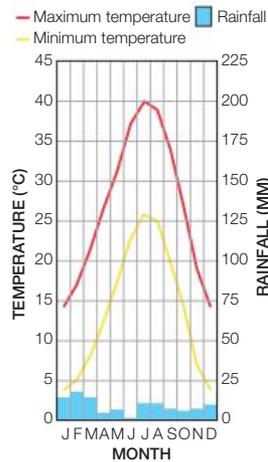
## UNITED STATES: RAINFALL



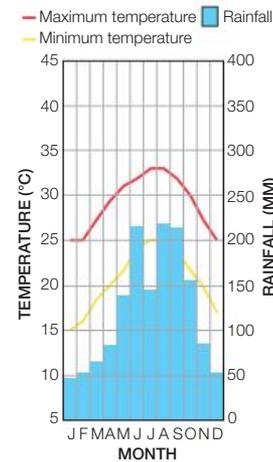
Source 3.32

Source: Oxford University Press

Temperatures tend to vary as you travel from the south up to the north, while the amounts of rainfall tend to vary from the east to the west. Mountainous areas, such as the Rocky Mountains in the west and the Appalachian Mountains in the east, have a big effect on rainfall across the country. They bring large amounts of rain to some places and create **rain shadows** (dry areas) in other places.



Source 3.33 A climate graph for Las Vegas in the state of Nevada, United States



Source 3.34 A climate graph for Miami in the state of Florida, United States

### REVIEW 3.2.4

#### Remember and understand

- 1 Why are the populations of most countries clustered together rather than spread out evenly?
- 2 Why are most large cities located on or near rivers?

#### Apply and analyse

- 3 Compare the climate data for Las Vegas and Miami (Sources 3.33 and 3.34). Identify and describe the similarities and differences between them.

- 4 Why do you think the climates of Miami and Las Vegas are so different?

#### Investigate and create

- 5 Imagine that you are travelling by road from New York on the east coast to San Francisco on the west coast.
  - a Use Source 3.31 to describe the landforms and landscapes that you might see on your journey.
  - b Use Source 3.32 to describe how the rainfall might vary as you travel west.

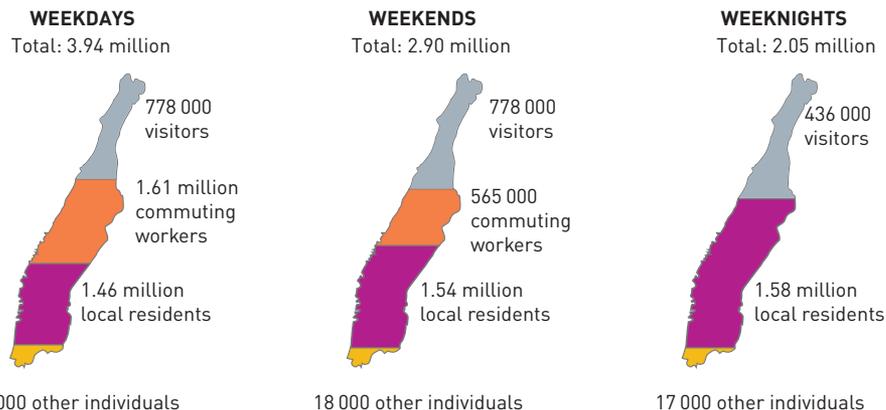
# LIFE IN NEW YORK – A US MEGACITY

New York is the largest city in the United States and is also among the largest cities in the world. New York was the world's first megacity (a city of more than 10 million people). For much of the 20th century it was also the largest city in the world.

New York is made up of five areas known as boroughs. These boroughs are Manhattan, the Bronx, Queens, Brooklyn and Staten Island. In the outer neighbourhoods of Staten Island and Queens many people live in single-storey homes similar to those found in the suburbs of most Australian cities. In the inner neighbourhoods of the other three boroughs almost everyone lives in apartments. Manhattan, in particular, is one of the most densely populated places on Earth. It has a population of more than 1.5 million people in an area of less than 60 square kilometres. This is a population density of about 27 000 people per square kilometre. The overall population density of all five boroughs of New York, however, is around 10 500 people per square kilometre. When you compare this with Sydney – which has a population density of 2000 people per square kilometre – you get an idea of just how many people there are in New York. They literally live on top of one another!



**Source 3.35** This oblique aerial photograph shows part of Manhattan Island in New York. In the foreground are apartment buildings in an area known as Central Park West, in the middle ground is Central Park and in the background is the Upper East Side.



**Source 3.36** A comparison of the population density of the island of Manhattan in New York by day (left), by night (right), and on weekends (centre)



**Source 3.37** Is this the smallest apartment in New York? Felice Cohan pays US\$800 per month to live in this tiny 8-square-metre apartment on the Upper West Side of Manhattan. The living space is so small that she can open the front door while sitting on the toilet!

Apartment buildings dominate the skyline in New York. Each floor of an apartment building is commonly divided into four to six apartments. A typical New York apartment is about 21 square metres in area but this varies widely depending on the apartment blocks and location. About half of New Yorkers own their own apartment and the other half rent. There is often a convenience store at ground level in the building and a subway station nearby. For many New Yorkers, the corner coffee shop is an important meeting place because their apartments are too small for entertaining (see Source 3.37).

A huge number of people flood the island of Manhattan from the surrounding boroughs each day for work and then return home to the outer suburbs each evening. This more than doubles the population of Manhattan each day (see Source 3.36) and is only possible because of a complex and efficient system of tunnels, bridges, rail lines, ferries, bicycle lanes and pedestrian walkways that link the island to the surrounding boroughs and cities. Of the 1.6 million people who travel into Manhattan every day, about half arrive by train. This makes the New York subway the busiest underground train system in North America and the seventh busiest in the world.

**Source 3.38** The top 10 busiest metropolitan train systems in the world measured by passenger rides per year. Australia's busiest train system (in Melbourne) has a total of 200 million passenger rides per year (note: 1 billion = 1000 million).

Rank	City	Passenger rides per year
1	Tokyo, Japan	3.16 billion
2	Seoul, Korea	2.43 billion
3	Moscow, Russia	2.39 billion
4	Beijing, China	2.18 billion
5	Shanghai, China	2.01 billion
6	Guangzhou, China	1.65 billion
7	New York, USA	1.64 billion
8	Paris, France	1.51 billion
9	Hong Kong, China	1.48 billion
10	Mexico City, Mexico	1.41 billion

### REVIEW 3.2.5

#### Remember and understand

- 1 Describe a typical New York apartment building and apartment.
- 2 Where are the world's busiest train systems? Why are they in these places?

#### Apply and analyse

- 3 Compare the population density of New York by day and night (Source 3.36). Why do these two figures vary?
- 4 Compare the population density of New York with that of Australia's largest city, Sydney. How

different are these figures and what impact do you think this difference has on the lives of people living there?

#### Investigate and create

- 5 Use the information provided to describe a day in the life of a typical New York resident.
- 6 Compare the way of life of a typical New Yorker with the life of a typical person where you live. Use a Venn diagram to show features that are unique to each community and features that are shared.

# 3.2

## CHECKPOINT

### HOW DOES URBANISATION CHANGE ENVIRONMENTS AND PLACES?

- Investigate differences in urban settlement patterns between Australia and another country.
- 1 List five environmental factors that influence where the majority of people in Australia live. [5 marks]
  - 2 Large cities are described as having 'pull factors' that attract people from rural areas and other urban areas to them, whereas 'push factors' are those that cause people to move from their previous homes. Create a list of 10 pull factors that attract people to large cities and 5 push factors that drive people from their homes and into cities. [10 marks]
  - 3 Describe the impact that the continued growth of urban areas has on the environment. Support your answer with Australian and overseas examples. [10 marks]
  - 4 Compare and contrast the pattern of settlement in Australia with that of the United States and provide reasons for the similarities and differences. [10 marks]

TOTAL MARKS [ /35]

### RICH TASK

#### The growth of Las Vegas

Cities grow for many different reasons. Some cities grow because they are located on major roads, railway lines or coastal ports. Some cities grow because large numbers of people come in search of work and new opportunities. Other cities grow because they are near reserves of important minerals, metals and natural resources.

Las Vegas, in the US state of Nevada, is an unusual city for a number of reasons. It is located in a desert region with little rainfall, yet it is one of the fastest-growing

cities in the United States. This is due almost entirely to its role as a centre for gambling and entertainment. The state of Nevada has more casinos than any other state in the United States; around 361 in total. The city of Las Vegas alone is currently home to more than 120 casinos and about 200 000 slot machines.

Las Vegas attracts millions of visitors each year. This tourism creates jobs for skilled and unskilled workers who flood into the city. This, in turn, creates jobs for builders, road engineers and many other residents.

#### Processing geographical information

- 1 Study Source 3.40.
  - a Describe the changes in the population of Las Vegas between 1910 and 2010.
  - b Why did the population change over this time?
- 2 Examine the satellite images of Las Vegas taken in 1984 and 2011 (Source 3.42). In these images, urban areas appear green and the surrounding desert is brown. How has the centre of the city changed over time? How have the edges of the city changed?
- 3 Examine Source 3.39. Construct a field sketch of this scene. On your sketch label five ways in which this suburb has changed the natural environment.



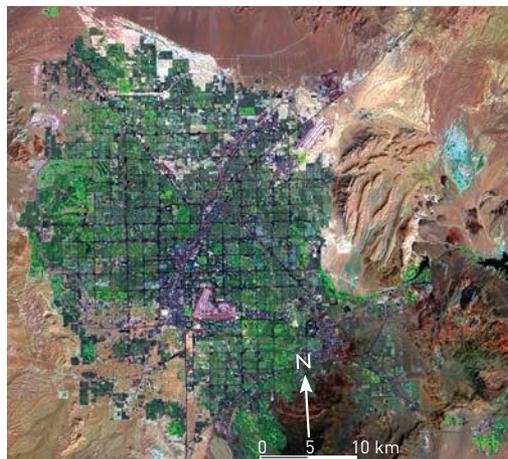
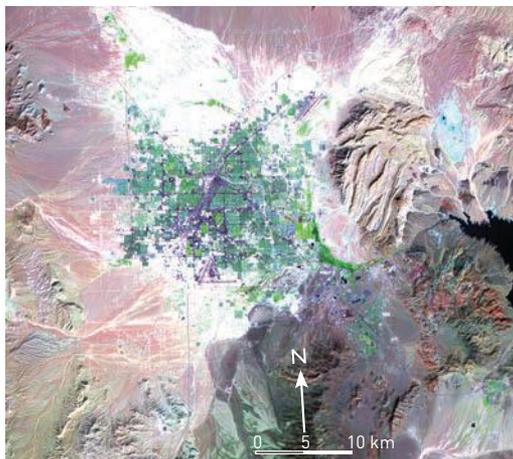
**Source 3.39** A new suburb pushes out into the desert on the edge of Las Vegas.

**Source 3.40** Population of Las Vegas, 1910–2010

Year	Population
1910	3321
1920	4859
1930	8532
1940	16 414
1950	48 289
1960	127 016
1970	273 288
1980	463 087
1990	741 459
2000	1 375 765
2010	1 951 269

**Source 3.41** The US states with the most casinos and the number of casinos in each of these states

State	Number of casinos
Nevada	361
California	184
Florida	150
Montana	146
Washington	125
Oklahoma	115



Source 3.42 Satellite images of Las Vegas, 1984 (left) and 2011 (right)

### Communicating geographical information

- 4 Present your findings as an annotated visual display to the class.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Space, Change.
- » Inquiry skills: Processing geographical information, Communicating geographical information.
- » Tools: Maps, Graphs and statistics, Visual representations.

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

### SKILL DRILL

#### Creating column and line graphs

Graphs are used in geography to display data and make it easier to understand. Raw data often appears as a confusing table of numbers, so turning data into graphs makes it easier to recognise and analyse trends and patterns. Some commonly used graphs in geography are:

- column graphs – used to compare data (for example, to compare the sizes of several cities)
- line graphs – used to show trends over time (for example, the growth of a city's population).

To draw a graph you should follow these steps:

- Step 1** Decide whether a column graph or line graph will best suit your purpose.
- Step 2** Examine the data carefully to decide on the axes and the scale you should use so that all the data fits. It is important that the scale on each axis is an even scale; for example, 1 centimetre equals one million people.

**Step 3** Construct your axes and your scale using a ruler.

**Step 4** Plot the data carefully. Use a straight horizontal line for a column graph. Use a small neat dot for a line graph.

**Step 5** On a column graph, draw a series of columns that extend to the horizontal axis. Lightly shade each column with a coloured pencil. On a line graph join the dots with a smooth freehand line.

**Step 6** Label each axis with a description of the data and give your completed graph a title.

#### Apply the skill

- 1 Using the data provided in Sources 3.40 and 3.41, create two different types of graphs:
  - a a line graph showing the growth of the population of Las Vegas from 1910 to 2010 (see Source 3.40)
  - b a column graph showing the numbers of casinos in selected states (see Source 3.41).

# CHECKPOINT

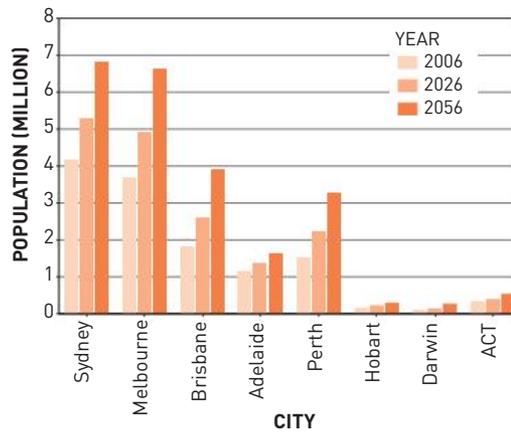
# 3.3 MANAGING THE GROWTH OF OUR CITIES

WHAT STRATEGIES ARE USED TO MANAGE ENVIRONMENTAL CHANGE IN URBAN PLACES TO ENHANCE SUSTAINABILITY?

Around Australia today, about 75 per cent of the total population live in just 18 cities (see Source 3.44). Because this number is so large, it is vital that the growth of these cities be carefully planned and managed – both now and into the future. In June 2015, the population of Australia reached 23 780 000. By 2050 it is estimated that the population will reach 36 million. It is also estimated that around 72 per cent of this growth will take place in our major cities (see Source 3.43).

## Planning for future cities

Growing urban populations place many pressures on governments and councils who need to plan and build new houses and infrastructure, such as schools, hospitals, roads, sewerage systems, power and gas lines, phone and internet cables, public transport links and shopping centres.



Source 3.43 Population projections for Australia's capital cities to the year 2056

By 2050, it has been estimated that Australia will need a further:

- 6.9 million homes (an 82 per cent increase)
- 173 348 kilometres of new roads (a 51 per cent increase)
- 3254 new schools, 1370 new supermarkets and 1370 new cinema screens.

These services take time to build and are extremely expensive, so they need to be budgeted for in advance. There are also serious environmental issues to consider. The construction of new homes and suburbs can damage or pollute the natural environment and have a negative effect on plant and animal populations.

When planning and managing the future growth of Australia's cities, governments and local councils often rely on the following three strategies.

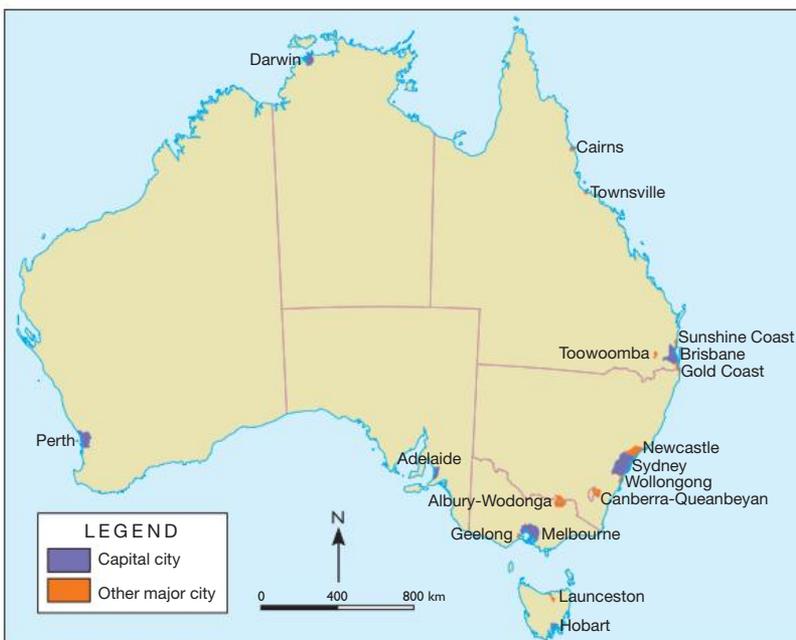
### 1 Suburbanisation

Making more land on the outskirts (fringes) of cities available for new suburbs.

### 2 Urban renewal

Redeveloping existing areas of unused land or buildings within cities to provide housing for new communities.

## AUSTRALIA: MAJOR CITIES WITH POPULATIONS OVER 100 000



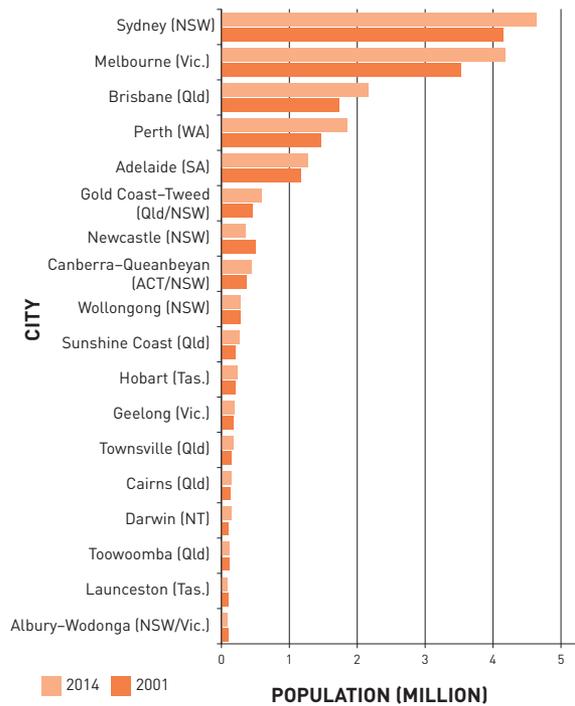
Source 3.44

Source: Oxford University Press

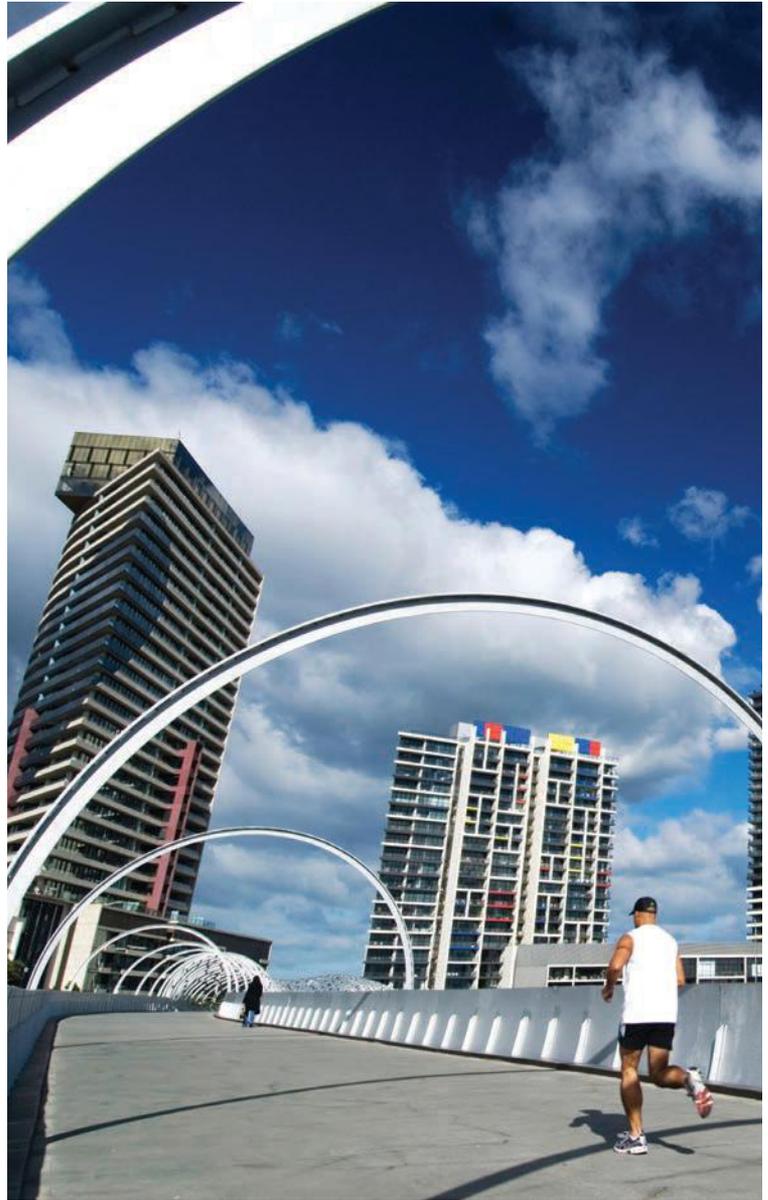
### 3 Decentralisation

Encouraging the growth of regional and suburban areas by moving jobs and businesses there, rather than keeping them concentrated in the central business districts of major cities.

These strategies will be explored in more detail in the remainder of this section.



**Source 3.45** Population growth in Australia's largest cities, 2001–14



**Source 3.46** One of Melbourne's newest suburbs, Docklands is an example of urban renewal. The old docks have been redeveloped with apartments, businesses and restaurants.

**REVIEW 3.3.1**

**Remember and understand**

- How many more people are estimated to be living in Australia by 2050?

**Apply and analyse**

- Examine Source 3.45.
  - Which city added the most people between 2001 and 2014?
  - As a percentage, Perth had the greatest population growth between 2001 and 2014. Approximately how many new residents were added to Perth's population?
- Examine Source 3.43.
  - Which city is estimated to add the most people between 2006 and 2056?
  - What services and infrastructure will this city need to meet the needs of its growing population?
- Name the three management strategies used by governments to plan for future growth in cities. Can you give an example of each of these strategies in a major city near you?

# SUBURBANISATION

**Suburbanisation** is the process of growing cities outwards by building new housing estates away from the central business district. New suburbs are often built on what was once farmland or bushland on the rural–urban fringe. Services are then attracted to these new suburbs to meet the needs of the growing population. Schools, shopping centres, medical centres and sporting facilities are built and the area becomes urbanised. Industries can also be attracted by the cheaper land and rents of the outer suburbs.

## CASE STUDY

### Suburbanisation in Melbourne

Melbourne added more new residents than any other Australian city in the decade between 2001 and 2011. Many of the 650 000 new residents moved to new housing estates on the fringes, contributing to the expansion of Melbourne’s urban boundaries. Melbourne is one of the world’s largest cities by area – stretching 100 kilometres from east to west – and it is still getting larger.

More land on the city’s western, northern and south-eastern fringes is now set to undergo suburbanisation. These growth corridors will provide homes for up to 100 000 new residents. The largest development of 10 500 new homes for 29 500 new residents is in Lockersburg, which is part of the north growth corridor (see Source 3.48). This area will include a train station, a main road, three primary schools, a secondary school, four new sports reserves and a town centre.



**Source 3.47** Melbourne added 650 000 new residents between 2001 and 2011, many ending up in new suburbs on the city’s fringes.

#### Advantages

A major advantage of suburbanisation is that housing estates are relatively quick and inexpensive to establish on already cleared farmland on the fringes of many Australian cities. The housing estates built there also provide an affordable option for new residents and can be designed to meet the needs of modern populations. New housing can also be built to be more energy efficient and sustainable than older housing in established suburbs.

#### Disadvantages

The disadvantages of suburbanisation are that new infrastructure to service housing developments can be very expensive to supply and local services can be slow to arrive, leaving new residents isolated. Residents in new outer suburbs end up relying on the use of motor vehicles because of infrequent or unreliable public transport. This leads to further congestion of major roads to the central business district. For example, by 2031 it is expected that Melbourne roads will have to cope with an additional three million car trips every day.



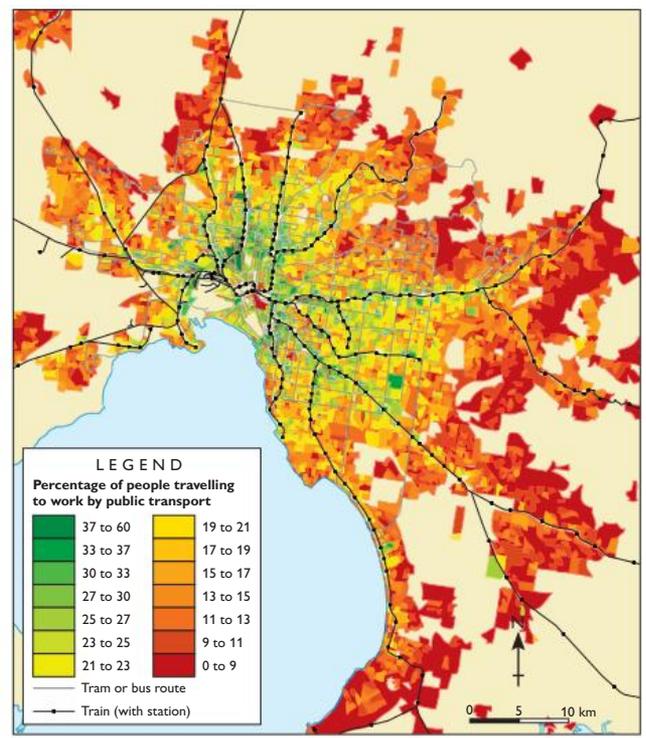
## MELBOURNE: GROWTH CORRIDORS 2013



Source 3.48

Source: Growth Areas Authority

## MELBOURNE: PUBLIC TRANSPORT USE, 2006



Source 3.49

Source: Australian Bureau of Statistics

Urban sprawl also eats into productive farmland and nature areas on the edges of cities, affecting native wildlife. The Southern Brown Bandicoot is an endangered native animal that lives in the area of Melbourne's south-east growth corridor. They are under increasing pressure from the clearance of their native habitat and attacks by foxes, dogs and cats.

To help the Southern Brown Bandicoot survive, habitat corridors linking their fragmented habitats together are a feature of the new development plans in the region. These open spaces will also provide recreation spaces for the new residents.



### CASE STUDY

## The Southern Brown Bandicoot

#### Source 3.50

The Southern Brown Bandicoot is under threat from Melbourne's suburbanisation.

### REVIEW 3.3.2

#### Remember and understand

- 1 What is suburbanisation?
- 2 What infrastructure and services are being built in the new suburb of Lockerbie, north of Melbourne?
- 3 What problems has Melbourne's suburbanisation caused for the Southern Brown Bandicoot?
- 4 What plans are in place to help protect this endangered species?

#### Apply and analyse

- 5 Examine Source 3.48.

- a Which two growth corridors link existing urban areas with Melbourne's metropolitan area?
- b What disadvantages of suburbanisation does Source 3.47 clearly illustrate? Name two examples.
- 6 Examine Source 3.49.
  - a What pattern of public transport use in Melbourne's outer suburbs is created?
  - b What problems might this cause for people in Melbourne?

# URBAN RENEWAL

Urban renewal is the process of taking existing areas no longer in use within a city's boundaries and redeveloping them. Often the areas selected are places that have become rundown or disused over time (referred to as urban decay). For example, old warehouses and docks that are no longer used because the city's port has closed down or been moved are often redeveloped to provide new houses for residents and offices for businesses. Green spaces can also be created for entertainment and leisure.

Urban renewal allows townhouses and apartment blocks to be built in existing urban areas so that more people can be housed within established suburbs rather than needing to build new ones.

## Advantages

Urban renewal can help a city cope with population growth without the need for urban sprawl. By building in established suburbs, developers can make use of the existing infrastructure such as transport routes, energy supply and telecommunications. New residents are able to share in the advantages of inner-city living.

## Disadvantages

Historic areas can have special significance for a city but the preservation and refurbishment of old buildings can be expensive. Developers also need to ensure that any new building blends in with existing buildings, which can also put limits on the use of the site. A sharp increase in population numbers in a small area can put pressure on established services and even decrease the liveability of the area for existing residents. For example, public transport may not be able to meet the increased demand, leading to overcrowding on the routes servicing the areas being redeveloped.

### CASE STUDY

#### Pymont-Ultimo, Sydney

Since 1992, the peninsula of Pymont in Sydney has been part of a large urban renewal project that is expected to see the residential population grow to 20 000 and the number of jobs in the area grow to 26 000 by 2021.

Pymont was once the location of shipyards, wool stores, mills, iron foundries and a coal power station. By the 1950s, the heavy industries had shut down and moved away from the area. In the 1970s, shipyards moved to Port Botany and the facilities at Pymont became obsolete. The area fell into a state of urban decay. Warehouses were empty,



Source 3.51  
Pymont-Ultimo in  
1980

wharves were demolished and the train service ceased. By 1981 the local population had fallen to just 1590 people.

Today, the Pyrmont-Ultimo area has undergone a process of urban renewal. It is now home to a young, wealthy, professional community. More than 13000 residents now live in medium-density housing there. Train services have restarted and over 30 per cent of households do not own cars. Retail shops, cafes and restaurants have opened and the peninsula now has more than 8 hectares of new parks.

Once known for its old industrial buildings and smokestacks, the peninsula is now home to e-commerce and electronic media companies such as Fairfax, Network 10, ABC and Foxtel, radio stations Nova and 2SM, and the technology company Google.



Source 3.52 Pyrmont-Ultimo in 2012



Source 3.53 Pyrmont wharf area with its medium-density housing

### REVIEW 3.3.3

#### Remember and understand

- 1 Give an example of urban decay from your own local area or somewhere you know.
- 2 What is urban renewal?

#### Apply and analyse

- 3 Look carefully at the oblique aerial views of Pyrmont-Ultimo in Sources 3.51 and 3.52.
  - a Which parts of the area have remained the same?
  - b List three changes that have taken place from 1992 to 2012.
- 4 What do you think are the advantages and disadvantages of the medium-density housing shown in Source 3.53?
- 5 People aged 20–29 make up 55 per cent of the population in Pyrmont-Ultimo. Why do you think people in this age group are attracted to the area?
- 6 What percentage of residents in Pyrmont-Ultimo do not own cars? Why do you think this is the case? How does this help urban planners in inner Sydney?

# DECENTRALISATION

Decentralisation is the process of encouraging population growth and job creation in areas outside the central business districts (CBDs) of major cities. Decentralisation is a strategy that governments use to take the pressure off larger capital cities by providing job opportunities in other areas such as:

- smaller towns and cities in regional areas
- newer suburbs on the outskirts of cities.

## Decentralisation to regional cities

One way to decentralise growing capital cities is to encourage people to move to smaller regional cities and towns nearby. Industries and companies are given financial benefits to encourage them to move their operations from capital cities to regional centres. Government departments are also established in regional centres. For example, in 2013, the regional city of Geelong in Victoria was chosen as the headquarters for DisabilityCare Australia – the organisation that will administer the disability insurance scheme. Geelong was chosen over larger cities such as Sydney and Melbourne to encourage the creation of jobs and other opportunities there.

## Decentralisation to suburbs

Another way to decentralise capital cities is to spread the location of multiple business activity centres across the city so that business is not all centralised in the CBD. These smaller business activity centres become hubs for employment and are established in a range of suburbs with good public transport. This form of decentralisation is designed to spread the load so that all workers do not have to travel to the CBD every day but instead can find employment in more accessible locations in the suburbs. In Sydney, the centres of Chatswood, Parramatta, Penrith, Sydney Olympic Park, Campbelltown and Liverpool have all been identified as suitable to become major business centres in addition to the CBD.

## Natural decentralisation

Sometimes population movement trends can operate as a form of natural decentralisation, without government involvement. From 1970 to 2000, for example, many older people moved from Sydney and Melbourne to coastal areas on Queensland's Gold and Sunshine coasts. This was a form of decentralisation driven by retirees attracted by a warm climate and cheaper housing. As housing prices in these regions have increased, however, the number of people migrating north has declined.

## Advantages

Decentralisation of the population can help relieve some of the problems of large cities such as the cost of housing, traffic congestion and damage to the natural environment.

## Disadvantages

It can often be difficult and expensive to get companies and workers to move to regional centres in the numbers necessary to make incentive and development programs a success.



**Source 3.54** Geelong has benefited from regional decentralisation plans.

## Canberra, a decentralised city

Canberra is Australia's largest decentralised city and today has a population of 367 000 people. The inner-city area was originally designed by American architect Walter Burley Griffin. Within the central area of the city, near Lake Burley Griffin, major roads follow a geometric hub-and-spoke pattern rather than a grid. The outer areas of the city, built later, are laid out in a Y shape.

Canberra is organised into a series of seven residential districts:

- Canberra Central – settled from the 1920s onwards and has 25 suburbs
- Woden Valley – first settled in 1964 and has 12 suburbs
- Belconnen – first settled in 1966 and has 25 suburbs (and one not yet developed)
- Weston Creek – settled in 1969 and has eight suburbs
- Tuggeranong – settled in 1974 and has 18 suburbs
- Gungahlin – settled in the early 1990s and has 18 suburbs (and six not yet developed)
- Molonglo Valley – developed in 2010 and has 13 suburbs planned.

Each district contains a mixture of a town centre, group centres, local suburbs and industrial areas. The town centre is the focus for business and social activities. The layout of these districts around a series of central shopping and town centres linked by freeways is designed to make them self-sufficient and prevent the mass-commuting of workers into the CBD every day, as is the case in all of Australia's other major cities.



**Source 3.55** The district of Canberra Central is one of the oldest parts of the city and is divided into divisions (suburbs) such as Barton, City and Dickson.

### REVIEW 3.3.4

#### Remember and understand

- 1 What is decentralisation?
- 2 How do governments try to encourage people to move to regional towns?
- 3 What were the reasons for retirees moving to the Gold and Sunshine coasts between 1970 and 2000?

#### Apply and analyse

- 4 Study Source 3.55.
  - a What are the advantages of having several business activity centres rather than just one CBD?
  - b Do you think a vibrant and bustling CBD is important for a city to have? Why/why not?

# 3.3

## CHECKPOINT

### WHAT STRATEGIES ARE USED TO MANAGE ENVIRONMENTAL CHANGE IN URBAN PLACES TO ENHANCE SUSTAINABILITY?

- Investigate the management and planning of Australia's urban future.

- 1 Describe the spatial distribution of Australian cities with populations over 100 000 people. [5 marks]
- 2 Describe the three strategies that Australian governments have when planning and managing for the future growth of Australian cities. [10 marks]
- 3 Describe the urban renewal development project that has taken place at Pyrmont-Ultimo in Sydney. Evaluate its effectiveness. (Remember that you will first need to come up with the criteria by which to evaluate the project's effectiveness.) [15 marks]

TOTAL MARKS [ /30]

### RICH TASK

#### Barangaroo: Sydney's 'Jewel in the Crown'

Urban renewal is the process of taking existing areas no longer in use within a city's boundary and redeveloping them.



Source 3.56 Barangaroo, Sydney

Often these areas are places that have become rundown or disused over time. An example is the now disused docklands of the Port of Sydney and the urban renewal project of Barangaroo to the west of Sydney's CBD. The project encompasses 22 hectares of a harbour foreshore park, civic and cultural attractions with recreational, residential, retail and commercial uses and premises for many transnational corporations.

#### Processing geographical information

- 1 What types of issues can changing land use and development create for people living in cities?
- 2 The Barangaroo project is expected to be completed by 2021. What evidence is there in Source 3.56 (taken in 2015) that the project is incomplete?

#### SKILL DRILL

#### Comparing vertical aerial images

A range of sources used by geographers – such as maps, plans and photographs – are drawn or captured from directly above. In a **vertical aerial photograph**, the camera is positioned directly above the landscape (often from a satellite or aeroplane). Vertical aerial images can be useful tools for examining a small area of the Earth's surface in detail. This vertical view (often called plan view) allows geographers to see the extent of any features and the patterns they make on the Earth's surface. Most importantly, comparing these sources helps geographers identify any changes that have

taken place over time. This type of analysis allows us to compare changes in various locations over time. These types of comparisons are useful for geographers in a number of ways. When comparing vertical aerial images, follow these steps:

- Step 1** Examine the scale and the legend of both sources, if present. Ideally, these will be the same. If they are not, you will need to be careful when making comparisons that the area on one image corresponds exactly to the same area on the other image.

**Step 2** Look for geographical features such as the outline of coastlines, the location of streets and landmarks such as railway stations. This allows you to compare other features in this landscape.

**Step 3** Locate features that appear on both images that are similar. Take note of these.

**Step 4** Locate features that appear on both images that are different. Take note of these.

**Step 5** Prepare a list or table of these similarities and differences and try to explain the different reasons for them. You may need to conduct more research at this point in order to do this.

#### Apply the skill

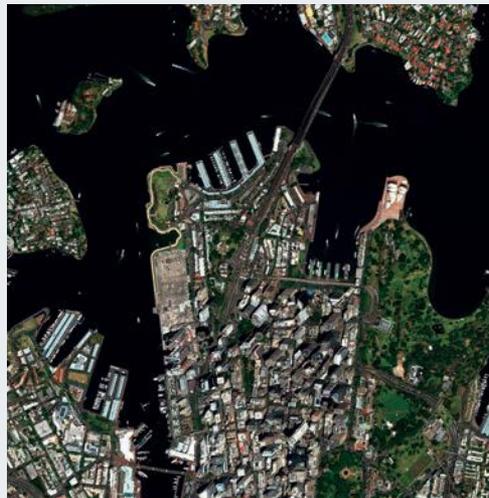
- 1 Look closely at the 1945 vertical aerial photograph of Millers Point, Sydney (Source 3.57).
  - a List the distinctive features and land uses shown in the image.
  - b Describe the primary function of this area in 1945.
- 2 Look closely at the vertical aerial photograph of Millers Point in 2000 (Source 3.58).
  - a Describe the changes evident when comparing the 2000 image with the 1945 image.
  - b Is the area used for the same purpose as it was in 1945? If so, describe the changes that have occurred since 1945.
- 3 Look closely at the vertical aerial image of Millers Point in 2015 (Source 3.59).
  - a Describe the changes evident in the 2000 image.
  - b Is the area used for the same purpose as it was in 2000? What evidence is there to that there have been changes to the function of the Millers Point area?



Source 3.57 Millers Point in 1945



Source 3.58 Millers Point in 2000



Source 3.59 Millers Point in 2015

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

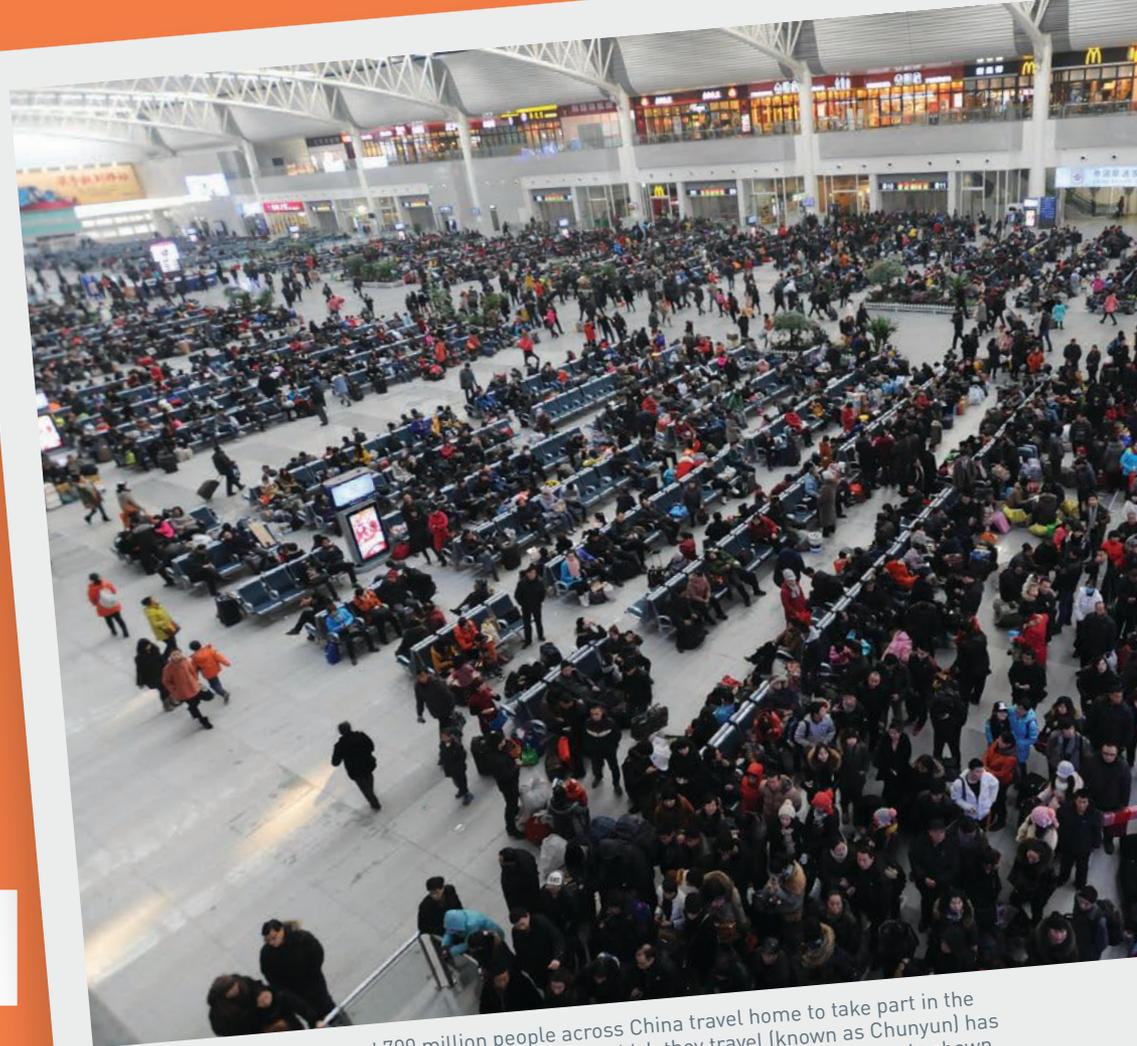
- » Concepts: Place, Space, Environment, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Maps, Spatial technologies

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

## CHAPTER

# 4



**Source 4.1** Every year, around 700 million people across China travel home to take part in the Chinese New Year celebrations. The period of time in which they travel (known as Chunyun) has been described as the largest annual human migration in the world. Many of the people shown here are migrant workers from rural China who are returning home for the holidays.

## MIGRATION: PEOPLE ON THE MOVE

People have always been on the move. Geographers refer to this movement of people as migration. There are many different reasons why we move – for work, for family, for love or for the chance of a better life. There are also different ways in which we move – we move around the block, to the next town, to a different state, or even to the other side of the world. Movements within the same country are known as **internal migration**, while movements between different countries are known as **international migration**.

Some people choose to move – known as **voluntary migration** – while others are forced to move – known as **forced migration**. In Australia, most people are voluntary migrants. Within a five-year period, about one-third of Australians will change their home address at least once. Worldwide, however, the numbers of forced migrants (people fleeing violence, poverty, famine or war) are on the rise.



# 4.1

## VOLUNTARY MIGRATION IN AUSTRALIA

HOW DOES INTERNAL MIGRATION IMPACT ON THE CONCENTRATION OF PEOPLE INTO URBAN PLACES?

People who are free to choose when and where they move are referred to as voluntary migrants. Most people who move within Australia are voluntary migrants.

Australia has a very mobile population. Statistics show that more than 40 per cent of us move home once every five years. Around 15 per cent of us move at least three times in that same period. Source 4.3 shows the main reasons why people move home in Australia, while Source 4.2 demonstrates these trends using an example of an individual and the types of decisions he made during his lifetime.

As you can see, internal migration in Australia is usually a very personal decision and is based on a number of important factors. These may be linked to a person's personal tastes, family life, income or health. In Australia, for example, there has been a movement of people towards the edges of large cities and towards smaller towns on the coast. The first of these moves is largely due to the cheaper land available on the city fringe and the second due to people looking for a change in lifestyle. This movement of people to regional coastal towns is referred to as a 'sea change'.



When my sister was born, my parents bought a big house for us in the Sydney suburb of Epping. I was three years old when we moved in.



I lived at home with my mother, father and sister until I was in my early 20s because I was studying at university and couldn't afford to move out. Our house didn't feel so big anymore!



When I was 29, I got married. My wife and I bought our first house in the suburb of Newtown and moved in together. It had two bedrooms.



By the time I was 38, we had three children. Our family moved interstate to Brisbane because I was offered a job promotion. We bought a large house with five bedrooms in the suburb of Oxley.



By the time my wife and I were in our 50s, all our children had moved out and were starting families of their own. The house seemed too big for just the two of us, so we sold it and bought a two-bedroom apartment in a suburb closer to my office in the city.



When my wife and I retired in our mid-60s, we bought a small apartment in a development on the Sunshine Coast so we could be closer to our grandchildren and enjoy a more relaxed lifestyle.

**Source 4.2** People move for different reasons at different stages of their life.

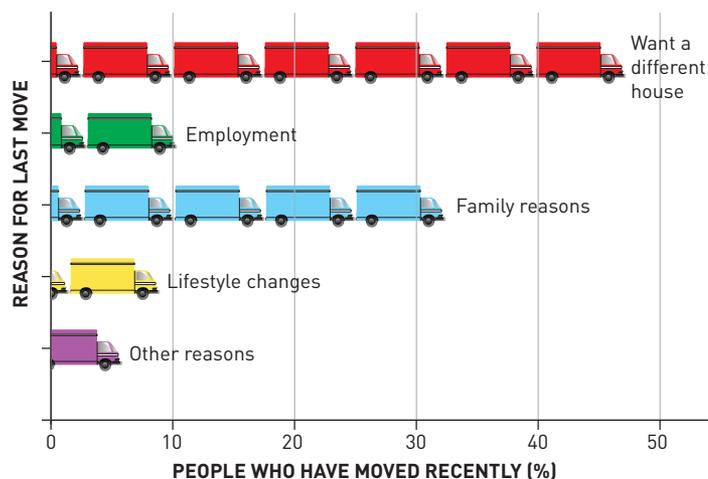
### The effect of sea changes on coastal communities

The popularity of sea changes in Australia, particularly along the south-eastern coast, is presenting many challenges for coastal councils. Population growth in coastal communities has meant an increasing demand for infrastructure and services. Careful planning is needed if these communities are to retain the lifestyle attractions that

brought the increasing numbers of people there in the first place. As well as this, climate change – the impact of extreme weather conditions and increasing coastal erosion – is also causing problems for councils.

Coastal councils are predicting that permanent populations will continue to expand. A large percentage of non-resident property owners are aged between 45 and 64 and many eventually plan to move permanently to their coastal property. The percentage of those planning to make the move in the next two to five years is around 67 per cent.

As populations in coastal areas grow, sleepy coastal towns are expanding into regional centres that require new hospitals, sewerage systems, water resources, roads and other services. In the past, it generally took between 50 and 100 years for a small coastal town to grow into a larger regional centre. Today, the same level of growth is often taking place over five to 10 years. Councils are still working out how to deal with this growth. As well as dealing with the increased needs for infrastructure and housing, coastal communities need to retain their character and historic value if they are to remain attractive to sea changers and tourists in the future.



**Source 4.3** The main reasons why people move home within Australia (proportions may add up to more than 100 per cent as respondents could provide more than one reason for their last move).



**Source 4.4** New homes being built in coastal areas to accommodate more sea changers

### REVIEW 4.1.1

#### Remember and understand

- 1 What is the main reason why people in Australia move home?
- 2 What is a sea change?
- 3 How does a person's stage in life influence whether or not they will move?
- 4 What are the main challenges facing coastal communities because of the popularity of sea changes?

#### Apply and analyse

- 5 When a town's population grows, it can have a major impact on the natural environment. Brainstorm this idea with a partner and make a list of the potential impacts. Share your brainstorm with your classmates.

- 6 Using Source 4.3, categorise the reason for each move made by the person in Source 4.2.

#### Investigate and create

- 7 Conduct a survey on the reasons why people move. Each person in the class should find three (unrelated) people who have moved in the last five years. Ask each person, 'what was the main reason why you moved?' Compare your class findings with the types of reasons given in Source 4.3. What were the differences and the similarities?
- 8 Is your class typical of the Australian population? What percentage of your classmates has moved home in the last five years?

# MOVING TO CITIES



**Source 4.5** The population of a place grows if births and arrivals outnumber deaths and departures. This is happening in many large cities.

The world's population is growing rapidly, with the fastest growth occurring in cities. All across the world, people from rural areas are moving to cities in search of work and better opportunities. Geographers refer to this trend as **urban drift** or rural-urban migration.

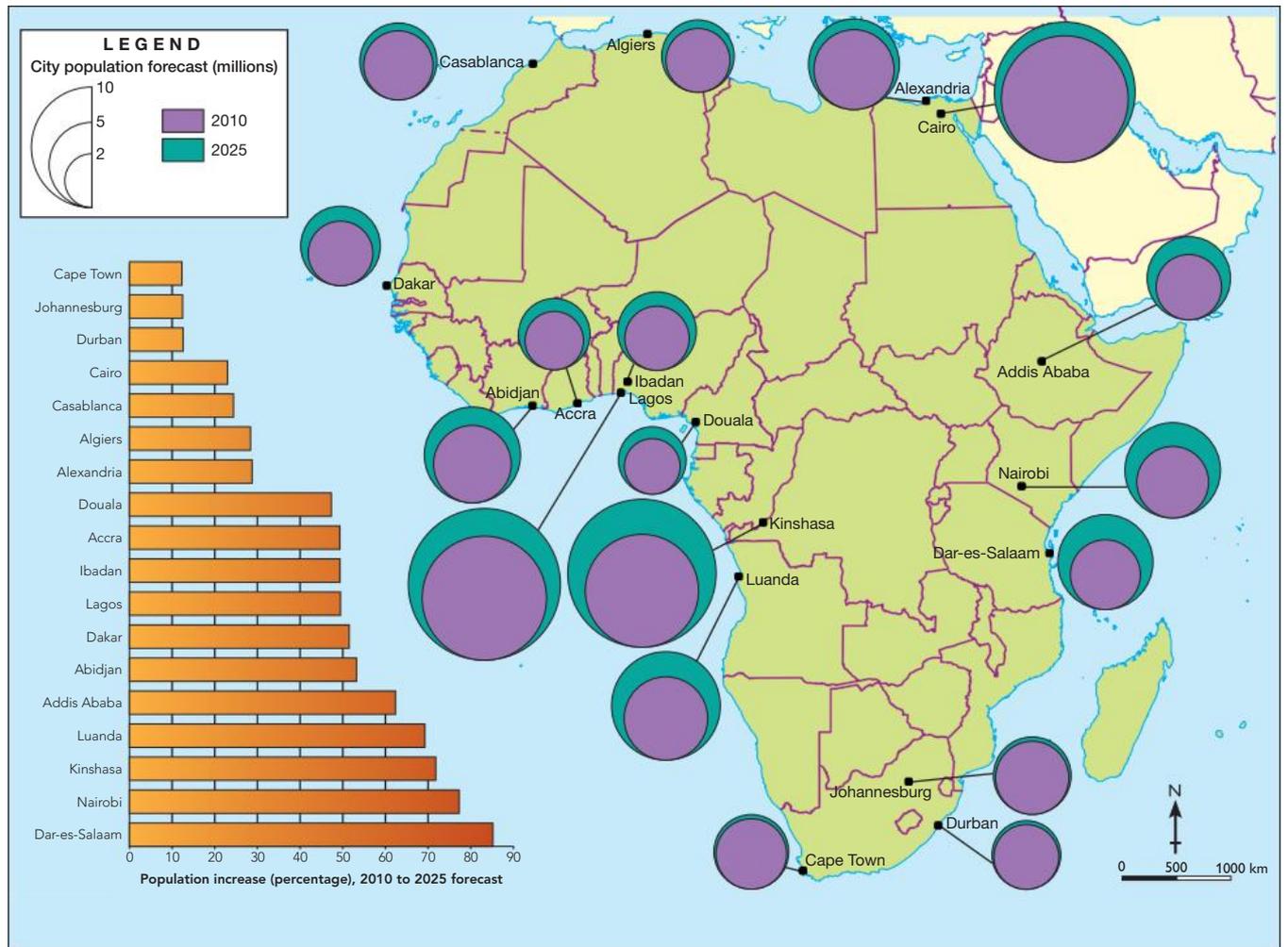
Rural people are drawn to cities by the promise of better jobs, more money and greater access to hospitals, schools and child-care facilities. There is also likely to be better access to services (such as electricity, clean water and sanitation) in most larger cities. Access to a range of entertainment options, such as cinemas and nightclubs, also attracts people. For all these reasons, and many others, people tend to be attracted to urban areas.

Cities across the developing world in places such as Africa, Asia and South America are the fastest-growing in the world today. The city of Lagos in Nigeria, for example, is one of the world's fastest growing cities, increasing by about one million people every three years. In 2015 Lagos was Africa's largest city with an unofficial population of 21 million (the Nigerian Government puts the population at 17.5 million). Much of this growth comes from the movement of people from the countryside to the city. New migrants hope for a job, a house and a future, but the reality is often much worse – life in an urban slum.



**Source 4.6** A row of yellow buses picks up passengers in Oshida market in Lagos, Nigeria.

## GROWTH OF AFRICAN CITIES



Source 4.7

Source: Oxford University Press

### REVIEW 4.1.2

#### Remember and understand

- 1 What is urban drift?
- 2 There are four ways in which populations can change, as shown in Source 4.5. Which of these helps to explain why the population of Lagos has grown so rapidly?

#### Apply and analyse

- 3 Examine carefully Source 4.7.
  - a Estimate the size of the population of Lagos in 2010 and 2025.
  - b How much might the population of Lagos grow between 2010 and 2025?

- c Which city on the west coast of Africa is expected to grow even faster?
- d The biggest percentage growth is expected to occur in two cities on the east coast of Africa. Name these cities.

#### Investigate and create

- 4 Sketch the scene shown in Source 4.6. On your sketch, label the following features: unpaved roads, open drains filled with rubbish, market stalls, evidence of electricity, public transport network and evidence of low rates of car ownership.

# URBAN SLUMS

As people pour into the world's cities they bring about great change. Many cities around the world are struggling to cope with this urban explosion. Providing new arrivals with the basic services they need (such as water, food, housing and sanitation) is becoming difficult in many cities. As a result, many people moving to cities in the developing world find themselves living in slums. Every slum is different, but they share some basic features: poor housing standards and very little assistance from city authorities for the people who live there.

Virtually every city in the developing world has at least one slum. Some have grown to become cities in their own right as people continue to flood into the city. Most of the world's slum dwellers live in Africa and Asia but the world's largest slum, Neza Chalco Itza, at about four million people, is in Mexico City. It is impossible to know exactly how many people live in slums but the United Nations estimates that the figure is more than one billion people; that is one-seventh of all humanity! Even more alarmingly, this number is expected to double to two billion over the next 20 years.

## CASE STUDY

### Life in Dharavi slum, Mumbai, India

One such slum is located in India's largest city, Mumbai. It is known as Dharavi and was the setting for the Oscar-winning 2008 film *Slumdog Millionaire*. For hundreds of years, Dharavi was home to fishermen who fished in the mangrove swamps and rivers surrounding the village. As the population of the nearby city of Mumbai grew, the city expanded outwards. By 1900 it had completely surrounded Dharavi. The swamps on which Dharavi had been built dried out and were filled in. With nowhere to fish, the traditional economy of the area collapsed, but a new economy was about to begin. The newly reclaimed swampland provided space for migrant communities arriving from the countryside. The former fishing village was soon transformed into a bustling suburb, which became home to people such as leather tanners, potters and garment workers.

Attracted by the bright lights of Mumbai with its Bollywood film industry, cinemas, trains, buses, schools and jobs, thousands of rural migrants continue to pour into the city every day. Most of them arrive with no money and few possessions. They take up residence wherever they can, building crude homes from whatever materials they can salvage; no open space in the city is considered off limits.

While many new arrivals find space on the edges of Mumbai, some make their way to Dharavi, near the city centre. More people arrive daily. This tiny area of about 2 square kilometres has one of the world's highest population densities – 500 000 people per square kilometre. This gives each person about 2 square metres of living space. The size of the total population is difficult to gauge but is thought to be more than one million. Most live in cramped, dirty conditions with only one toilet for every 1440 people. Canals and streams are heavily polluted with human waste. Water pipes are installed illegally by tapping into the city water mains that run past the slum. Electricity is connected in the same way.

Toxic black smoke spews from the oil drums that are used as furnaces all day. These furnaces power some of the heavy industries inside Dharavi, such as large-scale recycling, leather tanneries, metalwork and machinery manufacturing.

There is virtually no health care available inside Dharavi. Diseases from drinking contaminated water are particularly common.

Despite all of these problems, there is a less gloomy side to Dharavi. Rather than a slum full of despair, many people consider it to be a slum of hope. While it is one of the world's largest slums, it is also one of the world's most prosperous. There are estimated to be about 15 000 single-room factories in the slum, most of them recycling items from the waste produced by Mumbai's 22 million people.



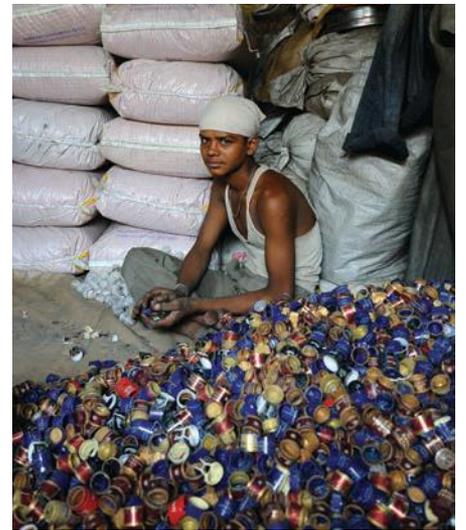


**Source 4.8** Dharavi slum in Mumbai, India

As Mumbai has increased in size and population, this tiny slum with one million residents has become some of the most valuable real estate in the city. Property developers, keen to take advantage of its good location close to the city, are pressuring the government to redevelop the area as housing for India's growing middle class. The current plan is to demolish Dharavi and build new high-rise apartments for the slum dwellers.

However, this plan is viewed with suspicion by many Dharavi residents. They prefer their do-it-yourself suburb to the proposed 'concrete jungle' of high-rise apartments. With India's population increasing by around 16 million a year, the pressures on India's planners and its people, including the slum dwellers of Dharavi, will intensify in the future.

**Source 4.9** This boy is employed to sort through rubbish and separate materials for recycling.



### REVIEW 4.1.3

#### Remember and understand

- 1 What is a slum?
- 2 Why has the number of people living in slums increased in recent years?
- 3 How has the suburb of Dharavi changed over time?
- 4 Why do some people refer to Dharavi as a 'slum of hope'?

#### Investigate and create

- 5 Imagine that you were able to spend one day at Dharavi. Describe the sights, sounds, smells and tastes that you think you would experience.
- 6 Some people feel that slums such as Dharavi should be bulldozed and the residents forced to move into high-rise apartments. How do you feel about this? What points would you use to try to convince a person with the opposite point of view? Join a class discussion about the future of slums, such as Dharavi.

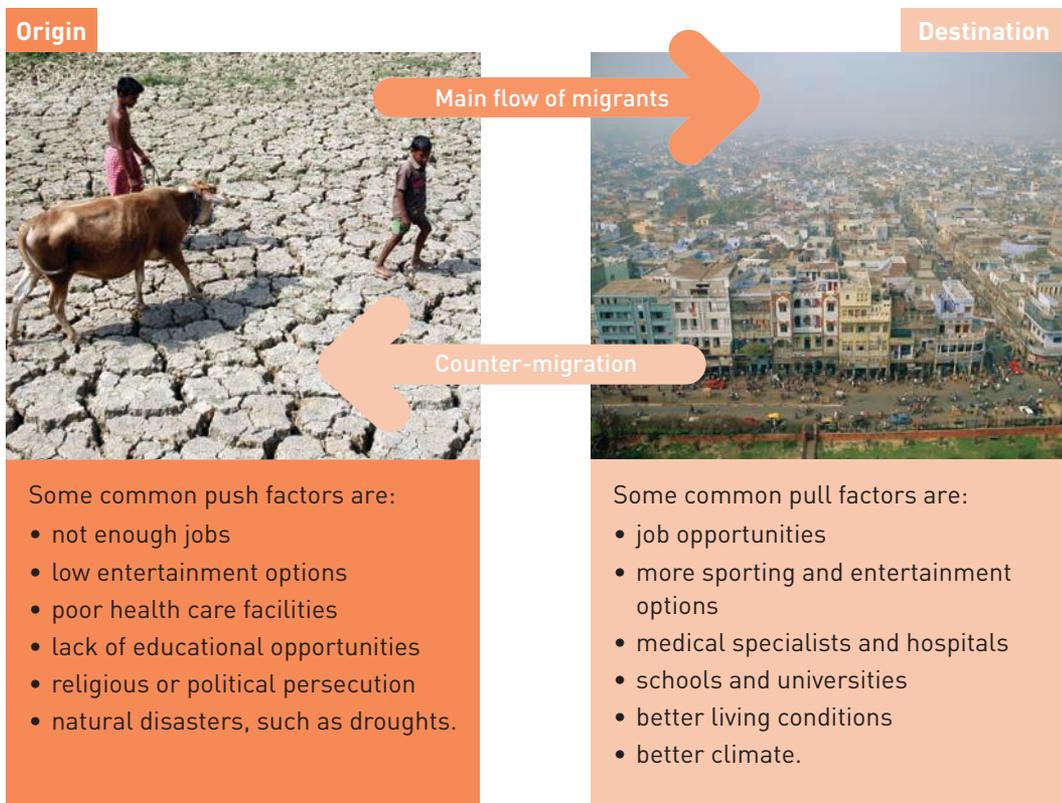
# EXPLAINING POPULATION MOVEMENTS

The world's population is constantly on the move. We move around the block, to the next town, the next state or across the world. As we have seen, one of the largest movements currently underway around the world is the internal migration of people from rural areas to cities.

Geographers attempt to explain these movements. When seeking to explain the reasons behind such population movements, geographers often use models that simplify reality and show general trends.

One such model is known as Lee's migration model, which was developed by American geographer Everett Lee. Lee stated that there are both positive and negative factors of the place each migrant comes from (the origin) and the place each migrant is going to (the destination). The negative factors Lee called **push factors** as they tend to push people away from a certain place. The positive factors he called **pull factors** as they tend to pull people towards a certain place.

All migrants believe that the places they are going to are better than those they are leaving. However, not everyone who believes that better opportunities exist elsewhere will move; they may see certain obstacles to moving, such as family ties and moving costs. Furthermore, some migrants find that the new place does not give them everything they hoped for and so they return to where they came from. This is called counter-migration.



Source 4.10 Lee's migration model

## KEY CONCEPT: INTERCONNECTION

### Population movements in Somalia

The concept of interconnection is used by geographers to show how everything on the Earth, living and non-living, is connected in some way. When population movements happen on a large scale, as they have in Somalia, for example, they can impact on communities around the world.

In Australia, virtually all population movements are voluntary but in other countries people are forced to move. If people are forced to move to another country they are referred to as **refugees**, but if they are forced to move within their own country they are referred to as **internally displaced persons** (IDPs). There are more than 38 million IDPs in the world.

About 1.5 million of these are in Somalia, Africa. An ongoing drought has forced many poor farmers to leave their land and move to camps near the capital Mogadishu, where they hope to find food and water. They join the hundreds of thousands of Somalis who

are fleeing violence and fighting in the city and in other areas of the country. Many of them live in temporary settlements on the sides of the road leading to Mogadishu. The largest IDP settlement, Afgooye, is home to at least half a million people.

As many living in the IDP settlement have little hope of returning to their homes in Somalia, their hopes turn to moving to a new country that holds the promise of a better life. Large numbers of Somalis have been accepted as refugees in countries around the world, including Australia. This has brought new communities to Australia, adding to Australia's cultural mix. In this way, the war and drought in Somalia have resulted in a change in Australia's cultural make-up. International migration will be looked at in more detail in the next section.

For more information on the key concept of interconnection, refer to section GT.1 of 'The geographer's toolkit'.



Source 4.11 An internally displaced man in Somalia passes a group of military vehicles on his way to Afgooye.

### REVIEW 4.1.4

#### Remember and understand

- 1 What are the differences between push factors and pull factors?
- 2 Using Source 4.10, list some of the main reasons why people move to the city.
- 3 What advantages does the city have for people looking for work?
- 4 Why doesn't everyone move?
- 5 What is an internally displaced person?
- 6 What is the main difference between an internally displaced person and a refugee?

#### Apply and analyse

- 7 Why is the population of the Afgooye camp in Somalia growing?
- 8 What are the push and pull factors responsible for the growth of Afgooye?

# POPULATION MOVEMENTS IN AUSTRALIA

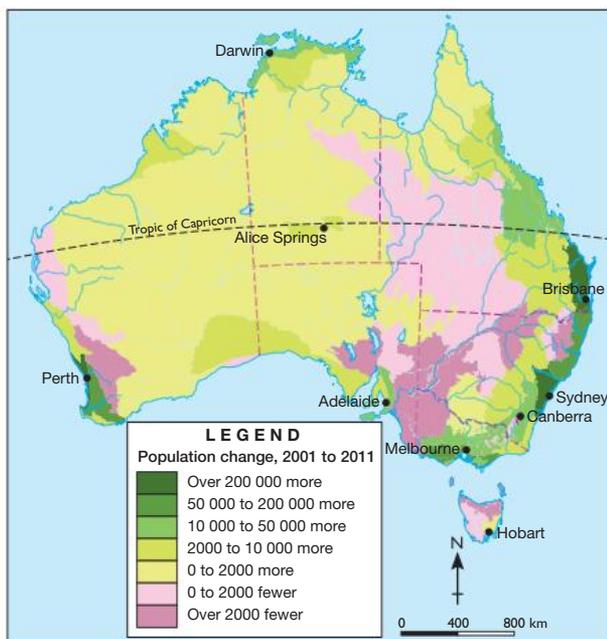
Australians are some of the world's most mobile people. Forty per cent of us move house at least once every five years. People move for a wide variety of reasons, and if enough people move this leads to large-scale changes in the population at local, regional and national scales. For example, young people who live in country towns often must move to one of Australia's capital cities to attend university. This changes the population size and number of young people in both places. Similarly, older people may move from unpleasant climates to milder climates in order to better enjoy their retirement. This means the population of both places will change. Source 4.12 shows the ways in which Australia's population shifted in the 10 years between 2001 and 2011.

The map clearly shows that Australia's four largest cities and the areas surrounding them were growing more rapidly than the rest of Australia. Other significant trends include the following:

- Western Australia overtook Queensland as the fastest-growing state. This was partially due to workers migrating because of job opportunities in the Western Australian mining industry.
- The inner-city areas of our largest cities were some of the fastest-growing areas in the country. Inner-city Perth, for example, was growing at more than 12 per cent per year.
- The large cities were getting larger both in terms of their population and their size. Some of the fastest-growing places in Australia were on the edges of the cities where more land is available for housing estates. The population of Wyndham in outer Melbourne, for example, is increasing by almost 30 people a day.



AUSTRALIA: POPULATION CHANGE, 2001-11



Source 4.12

Source: Oxford University Press



Source 4.13 As with many rural towns in Australia, the population of Trundle in New South Wales is declining. To attract new residents, some empty farm houses are available for rent for only \$1 a week.

## Our fastest-growing suburbs

One of the key population movements in Australia is the movement of people, particularly young families, to the outer suburbs of our major cities. Some of Perth's outer suburbs, for example, are growing at five times the national average. The fastest-growing suburb in Perth is Wanneroo, on the city's northern coastal fringe. More than 6200 people are moving to the suburb every year and new housing estates are being built to house them.



**Source 4.14** The outer suburbs of Perth are some of the fastest-growing urban areas in Australia.

### REVIEW 4.1.5

#### Remember and understand

- 1 Why are the populations of some rural areas in Australia declining? How is Trundle (Source 4.13) trying to reverse this trend?
- 2 Using Source 4.12, list three places in Australia where the population increased. Next to these place names, explain why they increased.

#### Apply and analyse

- 3 Australia's population changes due to factors at a range of scales: global, national and personal. Give an example of a change at each of these scales.
- 4 Analyse Source 4.12. Describe the changes in the distribution of Australia's population between 2001 and 2011. Why did the population change in this way?

#### Investigate and create

- 5 Examine Source 4.14 showing a new housing development in Wanneroo.
  - a How has the natural environment been changed?
  - b Why do you think young families often build houses on the edges of cities, rather than near the centre?
  - c Name some of the advantages of living in this place.
- 6 How do you think Australia's population will change in the next 30 years? Brainstorm these changes and then, with a partner, discuss the impacts of your predicted changes on people and places.

# POPULATION MOVEMENTS IN CHINA

For thousands of years, most Chinese people have lived in small rural villages. Their life was dominated by the daily routine of farming – planting, weeding and harvesting crops, and caring for animals such as pigs and cows. Over the last few decades, however, this situation has begun to change as more and more people move to one of China’s booming cities to find work and a better life.

Although China is still home to more than half a billion farmers, it is also home to some of the world’s largest and fastest-growing cities. The movement of people from rural areas to cities in China is one of the greatest migrations in human history. Lured by the remarkable boom in China’s economy over the last decade, millions of Chinese peasants are leaving their farms and heading for cities along the east coast. This has led to many inequalities between rural and urban areas, with the average income in rural areas being about one-third of that in cities.

## From rural life ...

Xianglan Li lives in a small village in Guangxi Province in southern China. Her day begins at dawn, when she wakes to sweep the concrete floor of the small home she shares with her husband and son. After breakfast she feeds her chickens and pigs, and collects waste from the pig sty to carry to the fields for fertiliser. Using the water from the buckets she has placed beside the house to collect rainwater, she throws some on the road to keep down the dust. Like most rural villagers in China, the family has no car.



Source 4.15 Small villages dot the landscape of Guangxi Province in southern China.

Xianglan’s husband works part-time as a labourer on a building site in a nearby town. Xianglan joins other villagers walking to their fields a few kilometres from the village. The roads are slowly filling with small tractors and bikes, as well as farmers carrying their produce on long poles. There is a buzz of excitement as tomorrow is market day.



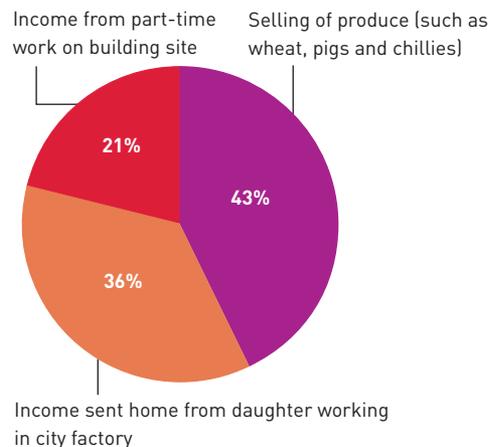
Xianglan spends her morning weeding the wheat and picking chillies for the market. In the afternoon she collects firewood from the nearby forest. Carrying the wood and chillies, she walks through the village to her home. Some farmers are spreading out their wheat crop in the village square to dry it, ready to separate the grain from the stalks. The stalks will become feed for the pigs and fuel for the cooking fire.

Although her home has no running water and no inside toilet, it does have a new colour television that her daughter, Xiu, has sent from Shenzhen. There is only electricity for a few hours in the evening, so after dinner Xianglan and her husband sit on their bed and watch a new soap opera. They go to sleep as the sun sets.

## ... to urban life

Xianglan's daughter, Xiu, lives in Shenzhen, a major city with a population of 10 million people near Hong Kong, hundreds of kilometres from her family's village. Shenzhen is a full day's train ride away. Three years ago, Xiu left her family home to move to the city to find work. She now works in a factory where she assembles mobile phones. Xiu lives in a dormitory owned by the company and shares a room with seven other workers, most of whom are also from Guangxi Province. There is a cafeteria in the dormitory building and the bathrooms have hot and cold running water. There is reliable electricity, which the workers use to watch television in their spare time, wash their clothes and charge their mobile phones. Virtually everyone has a mobile phone; some have two or three.

Xiu works 10 hours a day in the factory. She is pleased to have a job so she can help support her parents and brother, but she finds the work boring and repetitive. She knows that if she quits she will be quickly replaced but she sometimes thinks about moving back to Guangxi. She catches the train home once a year to celebrate Chinese New Year with her family. Next year, she intends to take home a mobile phone for her father.



**Source 4.16** Like many families in rural China, Xianglan's family relies on money sent home from a relative working in the city.



**Source 4.17** Xiu works in an electronics factory in Shenzhen assembling mobile phones for export.

### REVIEW 4.1.6

#### Remember and understand

- 1 Why are young Chinese men and women moving to large cities?
- 2 What does Xiu do for a job? Where do you think she was trained for this job?

#### Apply and analyse

- 3 How has the movement of young Chinese men and women from farms to cities changed both places?
- 4 Why can a worker in the city earn three times as much as a farm worker?
- 5 Study Source 4.16. Use your graphing skills to translate this pie graph into a different type of graph. Don't forget the title, labels and scale.

#### Investigate and create

- 6 In what ways do you consider Xianglan's life to be better than her daughter's? In what ways do you consider it to be worse? Discuss your answers in a small group. Were there some areas that you all agreed on?
- 7 Imagine that Xiu quit her job and returned home. Explain the impact this would have on:
  - a the family's income
  - b the family's food expenditure
  - c the factory in Shenzhen.
- 8 If Xiu's father visited her in Shenzhen, what do you think he would find most surprising about his daughter's way of life? Give some reasons for your answer.

# CHINA'S MANUFACTURING BOOM

The manufacturing boom has resulted in a massive movement of Chinese people from rural areas to booming factory cities. It is estimated that 140 million people have left their rural homes, and that 45 million will leave within the next five years.

## The manufacturing boom's impact on the movement of China's rural population

The growth in China's economy has brought many benefits to the Chinese people but this growth would not have been possible without the mobility of its population. The Chinese Government estimates that the country has a 'floating population' of 215 million people (16 per cent of the total population) who are registered as living in a rural area but who live and work in a city. These migrants receive no benefits and are usually not counted



**Source 4.18** Every year the railway station in the Chinese city of Guangzhou becomes one of the busiest places in the world as migrants from the countryside return home for the Chinese New Year holiday.

### CHINA: MOVEMENT OF PEOPLE



**Source 4.19**

Source: Oxford University Press

as part of the city's population, yet they are improving the economy of their country. In doing so, they are also improving their own standard of living and that of the communities they have left behind when they send money back to their families.

A comparison of living conditions in China between 1995 and 2012 shows some of the ways in which China has changed (Source 4.20). Statistics such as these are often used to show trends as they take into account the whole population and not just a few people.

Perhaps the most amazing statistic is the percentage of the population living below the poverty line or earning less than US\$1.25 a day. In 1981, 85 per cent of the Chinese people were living in poverty. Most of these people were living in rural areas and were only able to grow enough food to feed themselves and their families. By 2005 this figure had fallen to 16 per cent of the population. This means that between

1981 and 2005 over 600 million Chinese moved out of poverty. No other place on Earth has made the same progress at this speed or scale. For many of these people, the way out of poverty involved a move to the booming cities and a job in a factory.

A downside of this economic growth is an increase in the gap between the rural poor and urban rich, with city dwellers earning three times as much as those in rural areas. There has also been a considerable cost to the environment, especially in areas where coal-fired power stations provide the electricity for factories and towns.

**Source 4.20** Selected indicators of the standard of living in China, 1995 and 2012

Indicator	1995	2012
Male/female life expectancy	67/69 years	72/76 years
Infant mortality rate	52/1000 births	16/1000 births
Literacy rate	73%	92.2%
Total exports	US\$58 919 million	US\$1.89 trillion
Electricity consumption	680 400 million kilowatt hours	3.4 trillion kilowatt hours
Carbon dioxide emissions	2 388 613 thousand tonnes	7 706 490 thousand tonnes (2009)
Proportion of population living in cities	33%	47%



**Source 4.21** One of the impacts of China's manufacturing boom is air pollution in many cities.

## REVIEW 4.1.7

### Remember and understand

- 1 How many Chinese people moved out of poverty between 1981 and 2005?
- 2 Which indicator in Source 4.20 do you think best shows the improvement in Chinese living conditions? Give some reasons for your answer.

### Apply and analyse

- 3 Why has the movement of people been an important part of the improvement in Chinese living conditions?
- 4 What are some of the negative outcomes of people moving from rural China to the cities?
- 5 Examine Source 4.19. Where are the wealthiest regions in China? What patterns can you notice in regard to the location of these wealthiest regions?

- 6 Which of these statements best describes the pattern of movement shown in Source 4.19?
  - Most people move from wealthy areas to poorer areas.
  - Most people move from poorer areas to wealthy areas.
  - There is no clear pattern.
 Justify your choice.

### Investigate and create

- 7 Source 4.21 shows an environmental impact of rapid economic growth. With the class, brainstorm other negative impacts on people and places.

# 4.1

## CHECKPOINT

### HOW DOES INTERNAL MIGRATION IMPACT ON THE CONCENTRATION OF PEOPLE INTO URBAN PLACES?

- Investigate the reasons for, and effects of, internal migration in Australia and another country.

- 1 Describe why there has been a large number of people migrating from the rural areas of China to the urban areas in the past two decades. [5 marks]
- 2 Describe the effect on the nature and character of the Chinese rural towns due to the migration of their young population into the major cities for work. [10 marks]
- 3 Outline the possible negative impacts for people who are employed in China's manufacturing sector if there is a downturn in demand for Chinese manufactured goods in the future. [10 marks]

TOTAL MARKS [ /25]

### RICH TASK



Source 4.22 Most Indians live in small, rural villages.

#### Population movements in India

In terms of area, Australia is the sixth biggest country in the world, with a population of around 25 million. The seventh largest country in the world is India, with a population closer to 1.2 billion, more than 50 times greater than Australia's population.

India is the second most populous country on Earth after China. By 2030, India is expected to overtake China as the most populous country.

While many people think of crowded megacities when they think of India, more than half of the population lives in small communities of fewer than 5000 people.

#### Processing geographical information

On an A3 piece of paper, construct a sketch of Lee's migration model as it applies to the cities of India. Use Source 4.10 as a guide to setting this out. Use the information from Source 4.23 to decide on the push and pull factors that attract migrants to India's cities.

#### SKILL DRILL

#### Interpreting graphs

Graphs provide geographers with the ability to more easily identify trends and patterns in data they have gathered. Graphs can be used to compare places and events, to show change over time, to show the relative importance of different things and to show important aspects of a place. When interpreting graphs follow these steps:

- Step 1** Always read the title carefully so that you know exactly what the graph is showing.
- Step 2** Look carefully at each axis on bar and column graphs so that you understand the scale that has been used.

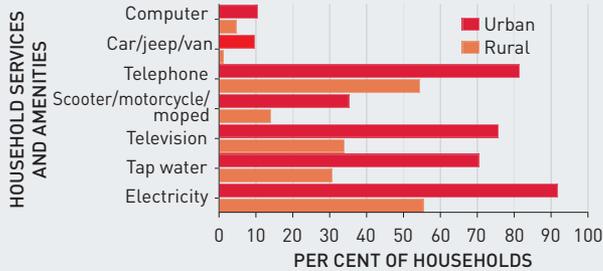
- Step 3** Look for general trends, such as the overall growth of a city, rather than exceptions to trends.

For more information on a range of different graphs, refer to section GT.3 of 'The geographer's toolkit'.

#### Apply the skill

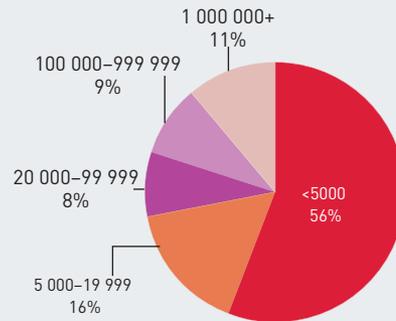
- 1 Study Sources 4.23 to 4.26 and complete the following tasks, giving reasons for your answers.
  - a Which graph best shows why many Indians choose to move to urban areas?
  - b Are conditions better in rural areas or urban areas?

- c Which graph best shows the impact of movement to the cities?
- d Which graph best shows how India's population is changing over time?
- e Which graph best shows where most people in India live?

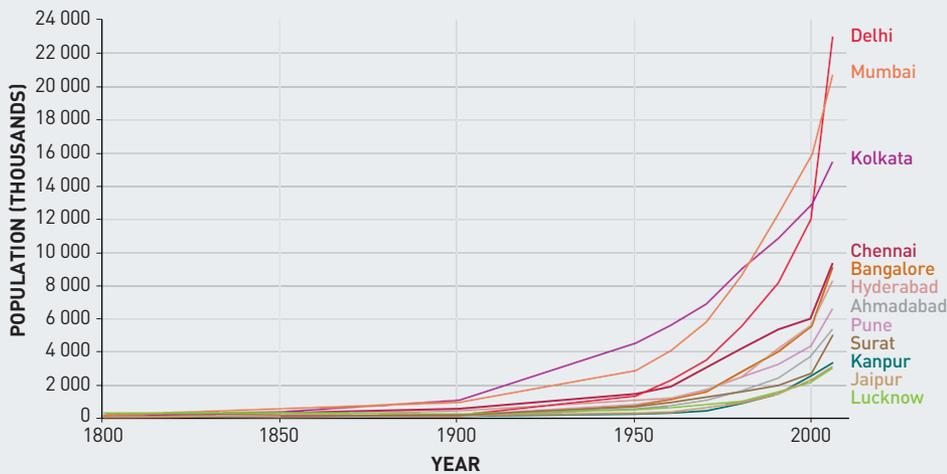


Source 4.23 Household services and amenities of urban and rural Indians

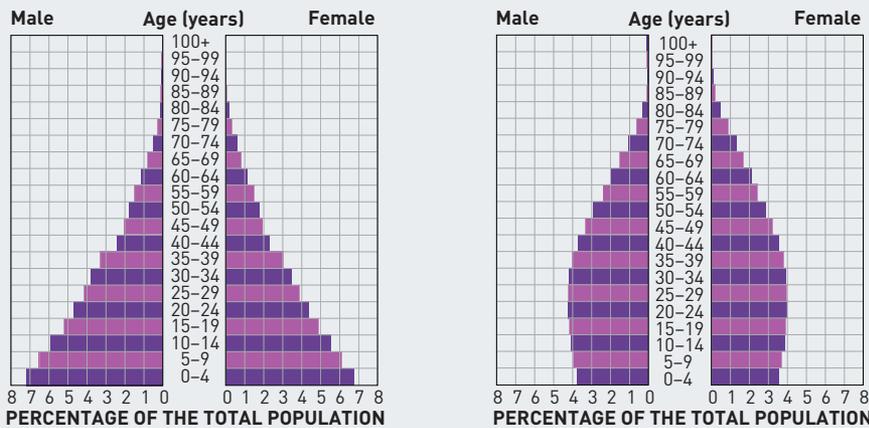
- f The definition of a city varies between countries. One common measure is a place with more than 20 000 inhabitants. By this definition, what percentage of Indians live in cities?



Source 4.24 India's population ranked by the size of the community in which they live



Source 4.25 Growth of India's cities, 1800–2012



Source 4.26 Population pyramids for India, 1990 (left) and 2030 (right)

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Place, Space, Environment, Interconnection, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Graphs and statistics, Visual representations

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

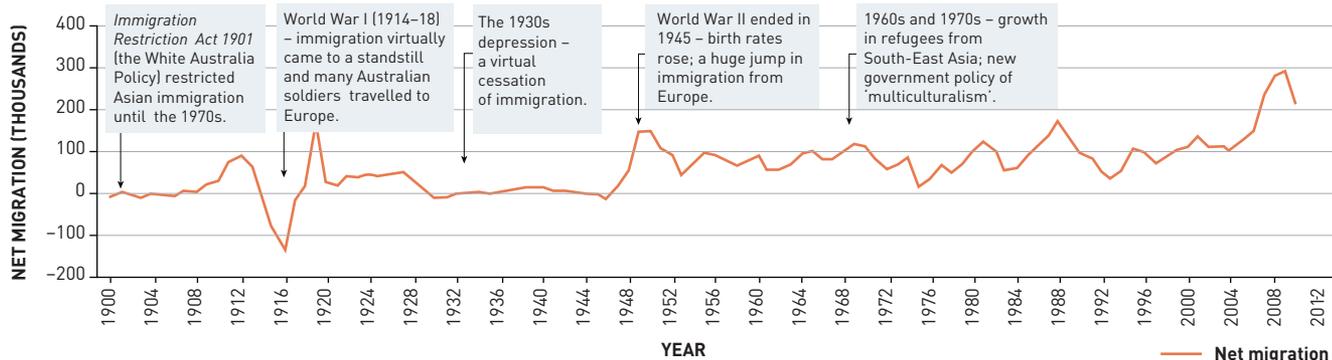
# CHECKPOINT

# 4.2 INTERNATIONAL MIGRATION TO AUSTRALIA

HOW DOES INTERNATIONAL MIGRATION IMPACT ON THE CONCENTRATION OF PEOPLE INTO URBAN PLACES?

Modern Australia has been created and shaped by national and international population movements. From the arrival of the First Fleet in 1788 – loaded with almost 1500 convicts, sailors and soldiers – Australia has been populated by waves of immigrants. First, penal colonies at Sydney, Port Arthur and Fremantle were established. Then large numbers of migrants from Britain and Ireland came to establish towns and farms. By the 1860s more than three-quarters of the population were of Anglo-Celtic origin and this figure remains at about 70 per cent to this day. From the middle of the 19th century, immigrants arrived from across Asia and the Pacific Islands, and continued to flow from Europe. They were attracted by various factors, such as gold, work and the promise of a new life.

During the 1900s, immigrants from Britain continued to dominate. An immigration policy that discriminated against all non-white migrants (known as the White Australia Policy) was enacted in the first days of the new nation in 1901 and remained until the 1970s.



Source 4.27 Net migration (total arrivals less total departures) to Australia during the period 1900–2012.



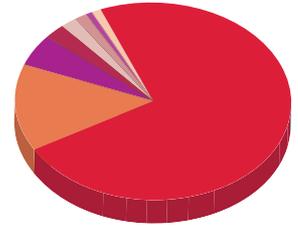
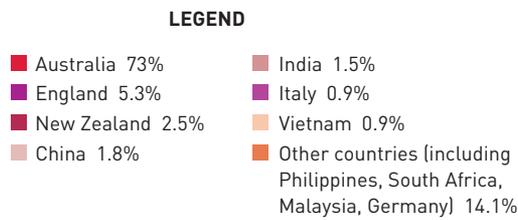
Source 4.28 The discovery of gold in the 1850s brought many immigrants to Australia.

The end of World War II in 1945 saw waves of migrants come to Australia from southern European countries, such as Italy and Greece. As immigration policies were freed up, these waves were followed by others from the Middle East, Asia and South America. Australian society is therefore very different from that in long-established countries in Europe and Asia. Just like the United States, Canada, New Zealand and Argentina, this country is largely a nation of immigrants.

## Multicultural Australia

Today, Australia is considered by many to be a multicultural country. This description acknowledges that the people of Australia come from a wide range of ethnic and cultural backgrounds. In ‘The People of Australia: Australia’s Multicultural Policy’, released in 2011, the Australian Government states that ‘multiculturalism is in Australia’s national interest and speaks to fairness and inclusion. It

enhances respect and support for cultural, religious and linguistic diversity.' On 21 March each year, many Australian schools and communities celebrate Australia's cultural diversity by holding Harmony Day events.



**Source 4.29** Australian citizens by country of birth, 2011. In 2011, more than one-quarter of Australians (around 27 per cent) were born overseas.

## KEY CONCEPT: PLACE

### The birth of multicultural Australia

Some places in Australia have a special significance in the history of certain migrant populations. Such places give these populations a particular connection to the environment and a sense of belonging and identity. This is an important part of the key concept of place.

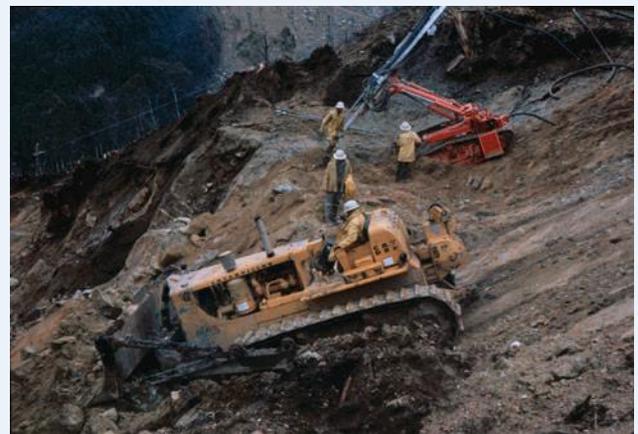
One such connection is the contribution made by many migrants to the Snowy Mountains Hydroelectric Scheme in New South Wales. Begun in 1949, the scheme diverted water from the Snowy River through 160 kilometres of tunnels to create a series of dams and hydroelectric power stations. This was the largest engineering project ever undertaken in Australia at the time.

Over 100 000 people worked on the scheme between 1949 and 1974. About two-thirds of these workers were immigrants from over 40 countries, including Austria, Finland, Jordan, Russia, the United States, Ireland, Scotland, Wales, England, Germany, Norway, Sweden, Cyprus, Czechoslovakia, Hungary, Poland, Switzerland, Turkey, Estonia, France, Portugal, Italy, Greece, Romania and the Ukraine.

Work was difficult to find in Europe after World War II, so many migrants were attracted by the work

and higher wages on offer in Australia. Many of the migrant workers aimed to earn enough money to bring their wives and families to Australia. This is just one example of how Australia began to change from a country mainly populated by English migrants and their descendants to the multicultural society it is today.

For more information on the key concept of place, refer to section GT.1 of 'The geographer's toolkit'.



**Source 4.30** Migrants at work on the Snowy Mountains Hydroelectric Scheme in 1954

## REVIEW 4.2.1

### Remember and understand

- 1 What is multiculturalism?
- 2 Examine Source 4.28 showing miners on the gold fields during the gold rush. How did this event change the environment and the population of Australia?
- 3 The Snowy Mountains Hydroelectric Scheme is thought by many to be the birthplace of multiculturalism in Australia. What do you think this means?

### Apply and analyse

- 4 On a blank outline map of the world, locate and label the countries from which migrants came to Australia to work on the Snowy Mountains Scheme. Describe the pattern on your map using the PQE method. (Refer to the section on the PQE method in GT.2 of 'The geographer's toolkit' for instructions.)

### Investigate and create

- 5 Conduct some research into the impacts of international migration on the original Indigenous Australians. What effect did it have on them?

# MOVING FOR SAFETY

While most people who move are free to do so there are also many forced migrants. The United Nations estimates that in 2014 there were 59.5 million people around the world forced from their homes. Most of these people remain within their home country and are referred to as internally displaced persons (IDPs). Millions of others are forced to cross international borders to escape persecution or to find another home after a natural disaster. These people are referred to as refugees. About half the world's refugees have fled from Iraq, Syria and Afghanistan and are seeking refuge in countries such as Pakistan, Iran and Turkey. Turkey alone had 2.5 million Syrian refugees in December 2015.

## CASE STUDY

### Ahmad Akbar, an Afghan refugee

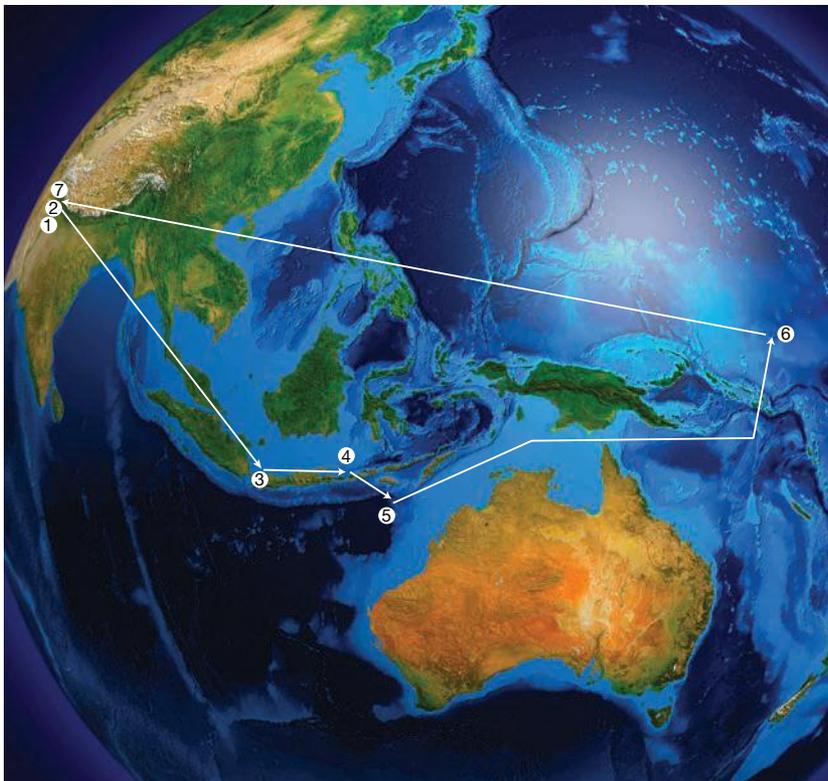
Fierce fighting for control of Afghanistan over decades has resulted in millions of refugees and IDPs. This is the story of one of them.

Ahmad Akbar, the eldest son of Ali, lives in Sarcasma, a small village in Afghanistan. Many people in Sarcasma fought against the Taliban and, in revenge, Taliban forces attacked the village. They rounded up 116 women and children and executed 60 of them in the local bazaar. 'I knew then,' said Ahmad's father, 'I had to get my eldest son out of Afghanistan; it was my duty to save him.' In fear of Ahmad's life, Ali sold his truck to pay a people smuggler US\$14 000 to get Ahmad and two other young men to safety in Australia. Ahmad's long journey had begun – see ① in Source 4.31.

The three men hid in the back of a truck and were driven over the mountains into Pakistan ②. From there they were flown to Jakarta in Indonesia ③ and then travelled to Kupang on the island of Timor ④. The town is well known as a staging post for refugee boats heading to Australia. Ahmad and 438 other refugees were crowded onto a 20-metre-long fishing boat by people smugglers for a 200-kilometre journey from Kupang to Australia.

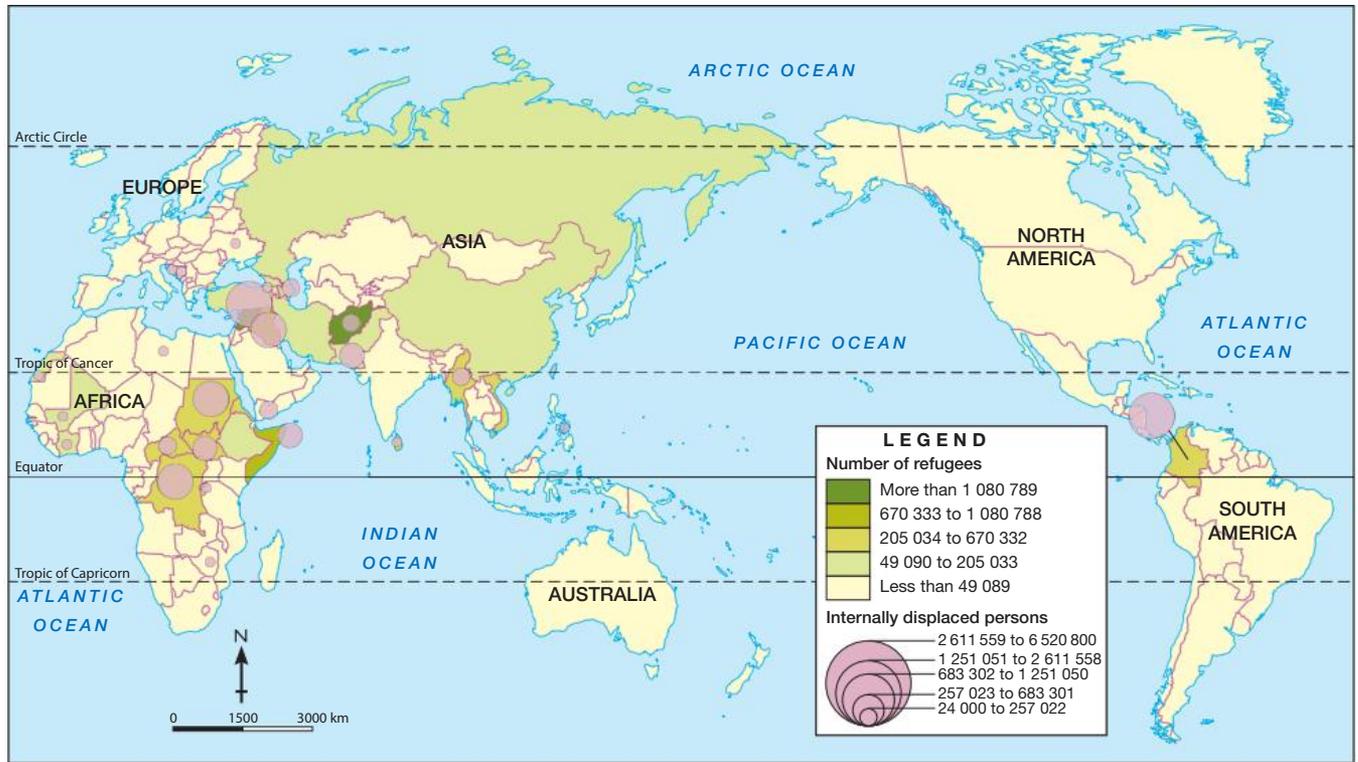
The grossly overloaded boat broke down and began to leak. Fearing for their lives, the refugees were rescued by the Norwegian freighter the *Tampa*, whose captain was responding to a distress call ⑤. Australian authorities refused requests by the ship's captain to bring the refugees to Australia, maintaining that the rescued refugees were the responsibility of Indonesia. So instead of being taken to Australia, Ahmad and the other refugees were moved onto an Australian navy ship, the *HMAS Manoora*, at Christmas Island. They were then taken to the small Pacific island of Nauru ⑥ where Australian authorities had built two detention camps to house refugees while their applications to settle in Australia were processed.

Ahmad was held on Nauru for two years while authorities assessed his claim that he was a genuine refugee. 'I told the interpreter how the Taliban had killed women and children and that my father had organised my escape



Source 4.31 The route taken by Afghan refugee Ahmad Akbar

## WORLD: REFUGEES AND INTERNALLY DISPLACED PERSONS IN MID-2014



Source 4.32

Source: Oxford University Press

to Pakistan and then to Indonesia,' Ahmad said. 'I pointed out my village on a map. But I was not believed.' His application was turned down and he was returned to Afghanistan. Ahmad claims that his application was prejudiced as his interpreter was of a different ethnic group from his.

He believes that he was treated unfairly by the Australian authorities, who did not accept his claim that he was a genuine refugee. In an interview he stated, 'I thought Australians had a love of humanity, but they smashed my dreams.' Back in his village in Afghanistan, Ahmad Akbar sees little hope for the future.

Source 4.33 The *Tampa* alongside the distressed fishing boat



### REVIEW 4.2.2

#### Remember and understand

- 1 What is a refugee?
- 2 What is the difference between a refugee and an internally displaced person?
- 3 Why did Ahmad leave Afghanistan?
- 4 How does he feel about the way he was treated?
- 5 Why do some countries produce many refugees?

- 6 Why do you think Ahmad tried to get to Australia rather than stay in Indonesia or Pakistan?

#### Apply and analyse

- 7 Using Source 4.32 and the world map inside the back cover of this book, list the countries with the greatest number of refugees and IDPs.

# THE CHANGING FACE OF AUSTRALIA

Australia is a multicultural nation – that is, a nation of many **cultures**. Australia’s cultural diversity is due mainly to our history. Our population is made up of our Indigenous peoples, the descendants of our British colonial past and immigrants from the world’s many countries and cultures. Modern Australia is largely a land of immigrants and their children. In 2011, 26 per cent of Australia’s population was born overseas, and a further 20 per cent had at least one overseas-born parent. Today in Australia there are people from more than 200 countries.



Australia’s first female prime minister, Julia Gillard, was born in Wales and migrated to Australia as a child.



Parramatta Eels player Tim Mannah is of Lebanese ancestry.



Comedian Anh Do arrived in Australia as a refugee from Vietnam.



Singer Jessica Mauboy is an Indigenous Australian.

**Source 4.34** The faces of cultural diversity in Australia

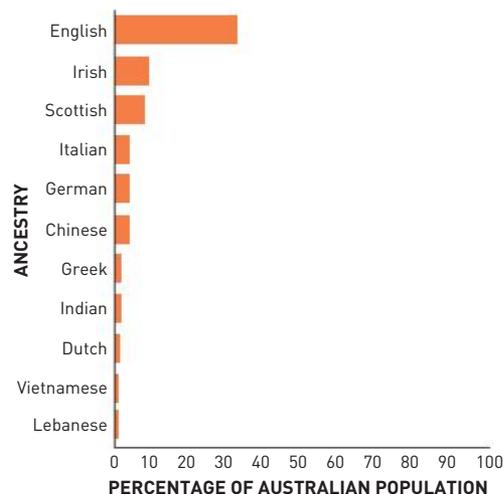
## The ancestry of Australians

The Australian **census**, which is taken every five years, asks every Australian to identify their ancestry. They may identify up to two ancestries in their answer. Source 4.35 shows the top 10 ancestries recorded in the 2011 census.

Some geographers also use the term **ethnicity** to refer to a person’s heritage. Ethnicity combines elements of language, place of origin and culture.

## Language diversity

The number of languages spoken in a particular country is a good indicator of cultural diversity. English is the dominant language in Australia. Fewer than one in 100 Australians cannot speak English. Despite this, more than 200 other languages are spoken in Australian homes every day. The most common include Italian, Greek, Cantonese, Arabic and Mandarin. At the time of European settlement in 1788, it is estimated that more than 250 distinct Indigenous languages were spoken in Australia. Today, this number has fallen to fewer than 150. Of these, fewer than 20 are considered to be strong languages, spoken by all generations.

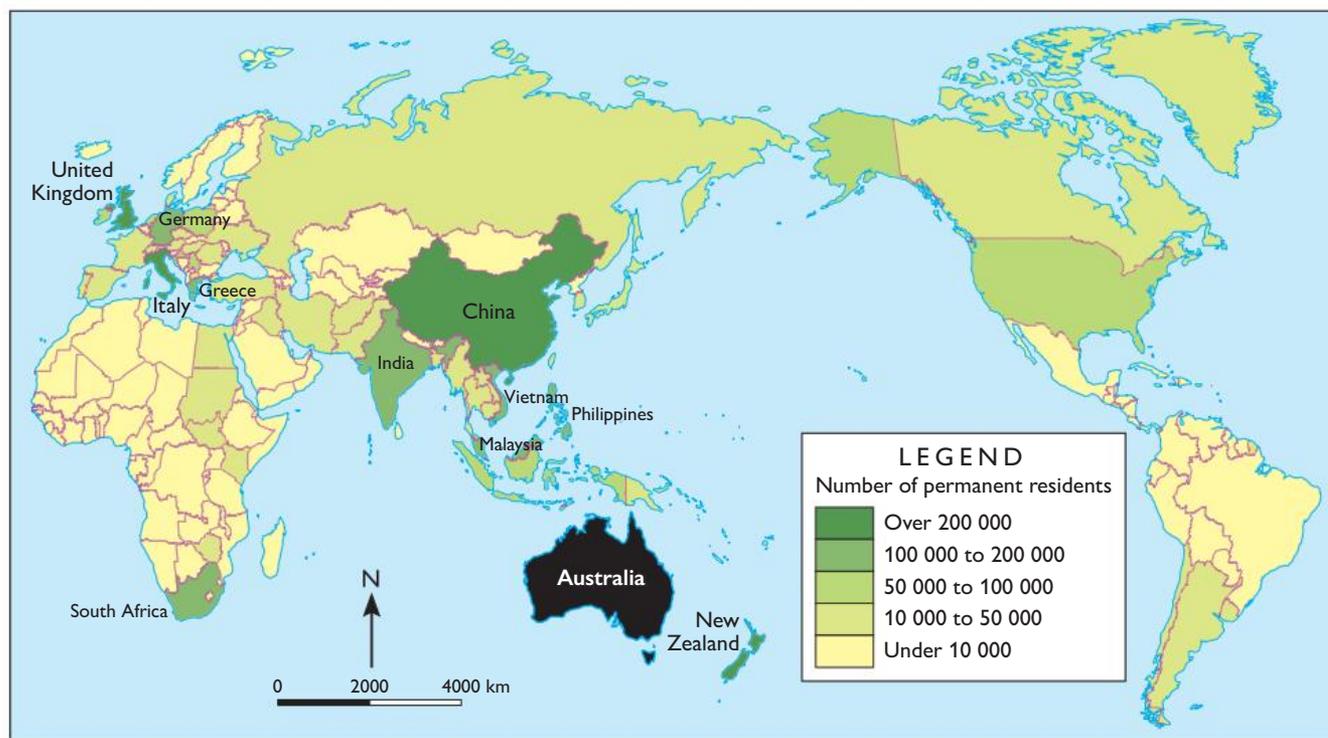


## Patterns of international migration

Patterns of migration to Australia have been shaped by events and policies in Australia and in other parts of the world. For example, at the end of World War II, Australia took in large numbers of migrants from Europe who had been forced from their homes by the war. The proportion of the overseas-born population from Europe was 52 per cent in 2001, but this reduced to 40 per cent in 2011 as the number of migrants from Asia and New Zealand increased.

Source 4.35 Most common ancestries in Australia, 2011

### AUSTRALIA: RESIDENTS IN MID-2014 BY COUNTRY OF BIRTH

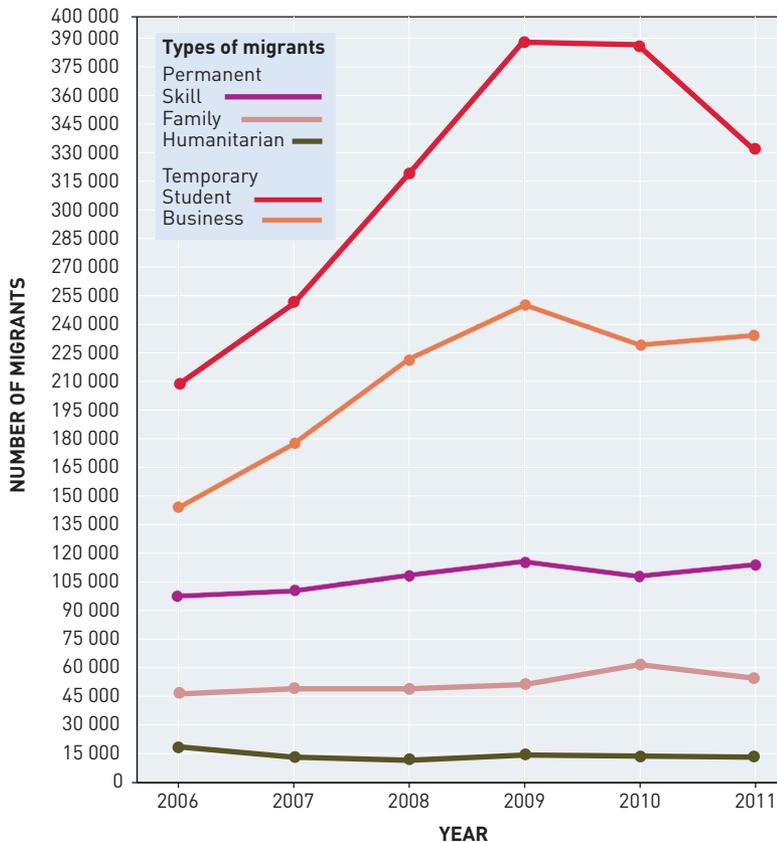


Source 4.36

Source: Oxford University Press

## Australian Government migration policy

Australian governments rely on overseas immigrants to achieve economic goals. In times of strong economic growth there is a higher demand for migrants to work and live in Australia. This migration intake may fall when the economy is weak and unemployment climbs. The



Source 4.37 Migration patterns in Australia, 2006–2011.

federal government is responsible for levels of migration. It sets out categories for migration and sets targets for each group to reflect the economic and political climate in Australia and the world. Australia also provides education services to large numbers of overseas students. The categories of migrants are:

- 1 Permanent migrants
  - Skilled labour – to fill specific shortages in the workforce
  - Family migration – to help families to reunite
  - Humanitarian – to assist people in need, such as refugees
- 2 Temporary migrants
  - Student – individuals coming to Australia to study for a fixed period
  - Business – workers migrating for a short period or on a working holiday
  - Visitor – a short-term visitor for business, family visit or tourism.

## Economic benefits of international migration

As well as social benefits, population movements have the potential to provide many economic benefits. This is most apparent in the contributions that migrants make to the economy of the places they move to. Migrants often fill gaps in the labour market by providing essential skills. The Department of Immigration and Border Protection publishes a list of skilled occupations with shortages of applicants in Australia. Potential immigrants with these skills can then apply for citizenship to the country. Jobs in medicine, construction and education are currently high on this list. Some other sectors of the economy, such as agriculture and hospitality, also rely heavily on migrant labour.



Source 4.38 This worker from Mauritius is harvesting peaches near Swan Hill in Victoria.

The seasonal nature of fruit and vegetable growing, for example, means that growers need a large workforce for a short period of time. Groups of pickers move between different regions of Australia depending on the crop and time of year. Some of these groups are made up of migrants from similar backgrounds, such as Pacific Islanders or Vietnamese, while overseas backpackers are also an important source of this labour. Whether its tomatoes in Bowen between May and October, mangoes in Cairns between November and December, or apples and pears in Shepparton between February and May, there are tens of thousands of workers following the harvest and contributing their skills and money to the local economy.

## Family reunions

Many families can become disconnected through the migration process. This is particularly the case for refugees. Ten-year-old Neema Mukasa was finally reunited with her father at Melbourne Airport in 2006 after being separated for six years. In 2000, at the age of four, she was separated from her family, including her twin sister, while fleeing a civil war in the Democratic Republic of the Congo. Neema's mother was killed in the violence and her father applied to bring his five remaining children to Australia. They were accepted as refugees under the Australian Government's Humanitarian Program and settled in Shepparton in country Victoria. During an interview with the local school principal, Mr Mukasa told the story of his lost daughter.

The principal contacted the Red Cross and through their tracing service they were able to locate Neema who was living in Nairobi with her uncle. He had desperately tried to find the little girl's missing family and had walked through five countries trying to catch up with them. This remarkable journey took them through a series of refugee camps over four years until they eventually reached Nairobi. After contact had been made between Africa and Australia, the family applied to the Department of Immigration for Neema to be able to come to Shepparton and she was reunited with her family.

Although this is just one example of an immigration story, it gives an idea of the types of responses to population movements at various levels. The Shepparton community responds at the local level by providing education and a safe place to live and work for new immigrants. The Department of Immigration operates at the national scale by assessing the refugee claims of thousands of applicants, and the Red Cross operates at the international level in response to disasters and humanitarian crises.



**Source 4.39** Neema with her family and the Shepparton principal who helped them become reunited

### REVIEW 4.2.3

#### Remember and understand

- 1 What does the term 'multicultural' mean?
- 2 What percentage of Australians in 2011 were either born overseas or had a parent born overseas?
- 3 Study Source 4.36. What were the source countries of most Australians born overseas in 2014?
- 4 Why do the numbers of migrants coming to Australia change over time?
- 5 List the different categories of migrants and provide one example for each.

#### Apply and analyse

- 6 See if your class is typical of the Australian population by asking each student to identify their ancestry. They may name one or two ancestries. Compare your results with those described in the 2011 census [Source 4.35].

- 7 Examine the graph in Source 4.37.
  - a Which category provides most migrants to Australia?
  - b When did most skilled migrants enter Australia? Why might the numbers have increased at this time?
  - c How does the number of humanitarian migrants compare with the other groups? What factors do you think might increase or decrease this category of migrant?

#### Investigate and create

- 8 What does the ancestry of modern Australians (Source 4.35) tell you about our past? How do you think this will change over the next 50 years?

# MIGRANT COMMUNITIES IN AUSTRALIAN CITIES

Many people immigrating to Australia choose to start their new lives in areas of a city where people with a similar cultural background have also settled. Over time, these suburbs can develop particular characteristics that reflect the cultures of the people who live there. For example, the Melbourne suburb of Sunshine is home to a large Maltese population, while the Sydney suburb of Marrickville is home to a large Greek population.

New arrivals tend to settle in the same areas for a variety of reasons. The houses there may be affordable, they may have family or friends close by, or there may be a number of community groups and support services nearby. These services might include emergency accommodation, translation services, adult language and education centres, employment agencies and accommodation services (such as Centrelink and Department of Housing). These areas may also provide vital social institutions (such as places of worship), and meeting places and shops selling familiar items (such as food, utensils and clothing).

For people from non-English-speaking backgrounds, an important factor that pulls them to live in certain suburbs is the presence of professionals (such as doctors, lawyers and accountants), shopkeepers and other people who speak their language. This helps them carry out their day-to-day lives.



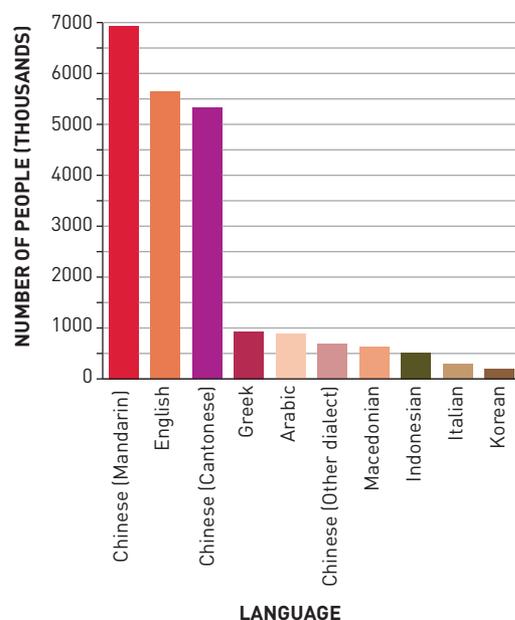
## CASE STUDY

### The Chinese community in Hurstville, Sydney

The suburb of Hurstville in Sydney's south is an example of an area with what geographers call a high ethnic concentration. From a total population of around 26 000 residents in 2011, 68 per cent were born overseas and eight out of 10 speak more than one language. Since European settlement of Australia, Hurstville has seen several waves of immigration. First, it was mainly home to people of British and Irish heritage; then came a wave of southern European migrants, largely from Greece and Italy; followed by people from Bosnia, Macedonia and the former Yugoslavia. Since the 1990s, it has mainly become home to people arriving from Hong Kong and mainland China.



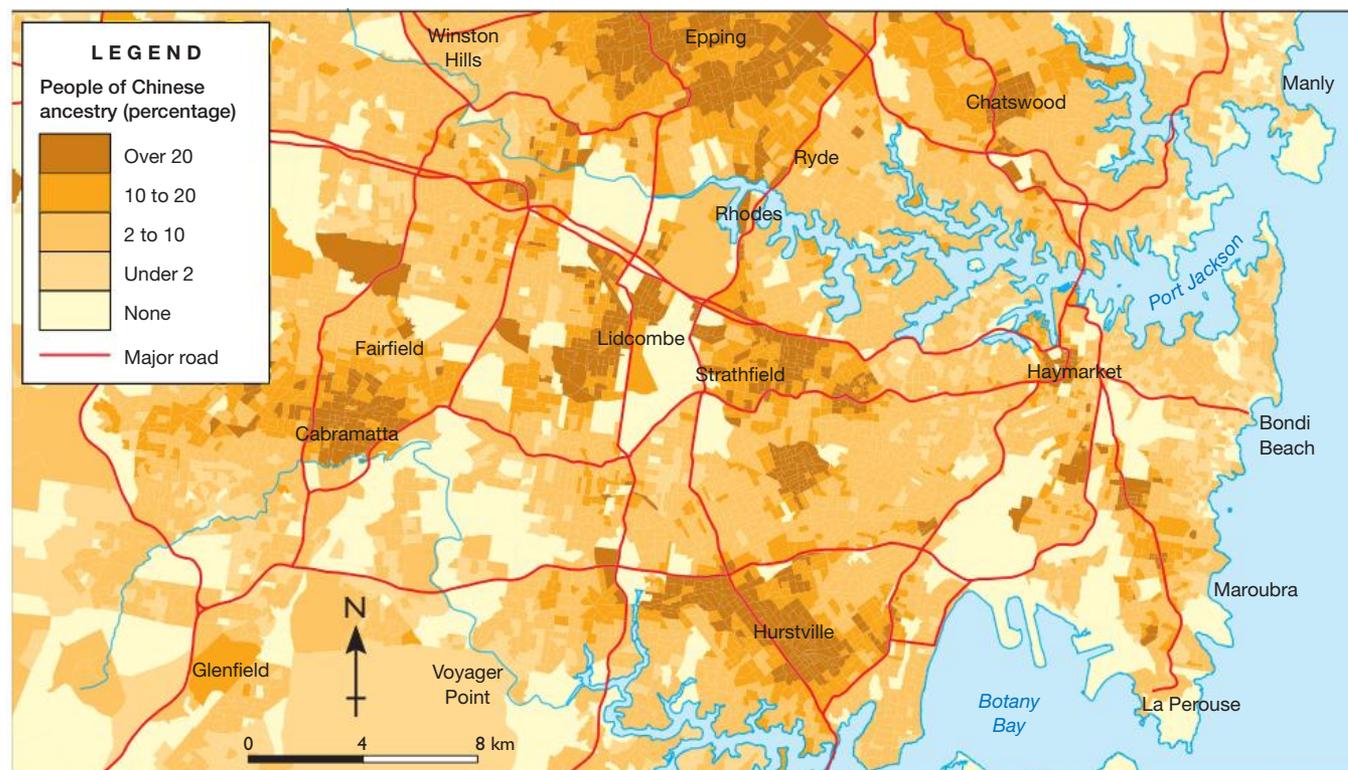
Source 4.40 Chinese businesses in the Sydney suburb of Hurstville



Source 4.41 Top 10 languages spoken at home by Hurstville residents

Chinese immigration to Australia dates back to the 1820s but grew rapidly in response to the gold rushes of the 1850s and 1860s. During the 20th century a series of government policies (including the White Australia Policy) restricted the number of immigrants from Asian countries to Australia, but since these policies were abandoned in the 1970s, there has been a steady increase in the numbers of Chinese people settling in Australia. Today, China is second only to New Zealand in terms of migrant numbers to Australia.

### SYDNEY: CONCENTRATION OF RESIDENTS FROM CHINESE BACKGROUNDS, 2011



Source 4.42

Source: Oxford University Press

### REVIEW 4.2.4

#### Remember and understand

- 1 Why do people from the same language and cultural backgrounds tend to settle in the same areas of a city?
- 2 Studies show that English-speaking migrants arriving in Australia tend not to settle in groups as much as non-English-speaking migrants. Why do you think this is the case?

#### Apply and analyse

- 3 Use the PQE method to describe the distribution of residents from Chinese backgrounds shown in Source 4.42. If necessary, refer to section GT.2 of 'The geographer's toolkit' for instructions on using the PQE method.

- 4 How can the arrival of large numbers of people from similar cultural and language backgrounds change the areas in which they settle?

#### Investigate and create

- 5 Access the community profile for your suburb using the census data available on the Australian Bureau of Statistics website ([www.abs.gov.au](http://www.abs.gov.au)).
  - a Use the country of birth data to construct a bar graph of the top 10 languages spoken at home.
  - b Compare your completed bar graph with the graph for Hurstville shown in Source 4.41. What similarities and differences can you identify?

# 4.2

## CHECKPOINT

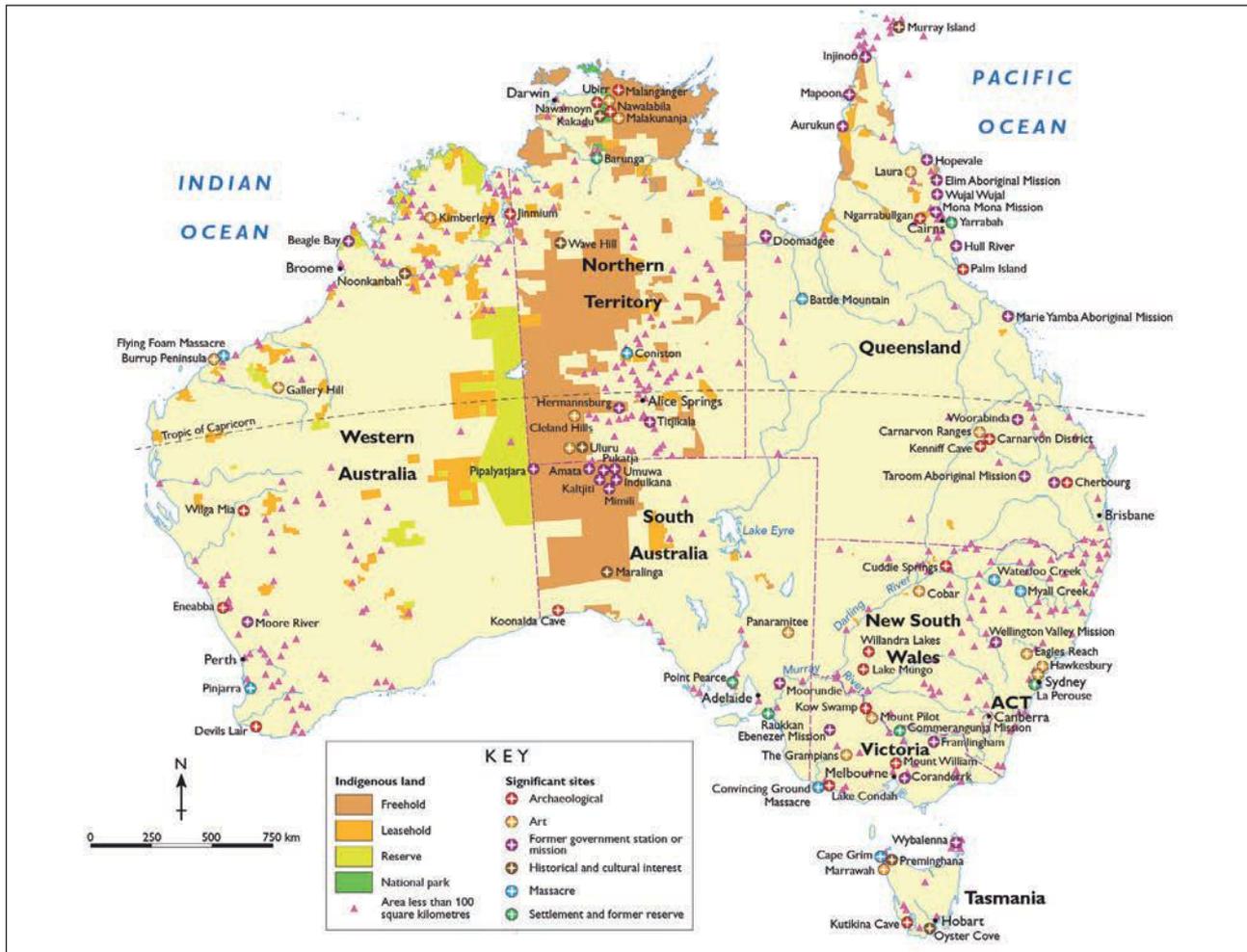
### HOW DOES INTERNATIONAL MIGRATION IMPACT ON THE CONCENTRATION OF PEOPLE INTO URBAN PLACES?

- Investigate the reasons for and effects of international migration to Australia.
- Describe the possible push and pull factors that could influence a person who is seeking to come to Australia as a refugee. [5 marks]
  - Outline the advantages of migration for a country such as Australia. [15 marks]

TOTAL MARKS [ /20]

### RICH TASK

#### AUSTRALIA: INDIGENOUS LANDS AND SIGNIFICANT SITES



Source 4.43

Source: Oxford University Press

#### International migration and Indigenous Australians

By 1900 the number of Indigenous Australians was less than a quarter of what it had been when Europeans first arrived in 1788. As the new immigrants built their

penal colonies, towns and farms, Australia's Indigenous peoples were badly affected. Food became scarce as land was cleared, and access to water and sacred sites became difficult or impossible. Western diseases wiped out entire tribes, as the

people had no natural immunity to them.

The population of the Darung people around Botany Bay, for example, fell by 90 per cent in three years following the arrival of European settlers. In some places there was open conflict between the Indigenous tribes and the white settlers; but armed with rifles, the new arrivals nearly always won. As the Indigenous populations were forced from their traditional lands, many were placed in missions and reserves.

Today, Aboriginal and Torres Strait Islander people have one of the lowest life expectancies in the world. They are under-represented in government, education and employment and over-represented in prisons when compared with the wider Australian population.

### Acquiring geographical knowledge

- 1 Give three examples of how international migration to Australia affected Australia's Indigenous population.

### Processing geographical knowledge

- 2 Do some research on another Indigenous group, such as the Maori in New Zealand or the First Nations people of North America.



**Source 4.44** This plaque commemorates the 28 unarmed Aboriginal people massacred in retaliation for cattle theft at Myall Creek in New South Wales in 1838.

- a How was this group affected by early international migration?
- b How did this group respond to early international migration?
- c Find out their life expectancy, employment and imprisonment rates compared with the rest of their country's population. How do these compare with those of Aboriginal and Torres Straits Islander people in Australia?

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Place, Space, Environment, Change, Sustainability
- » Inquiry skills: Acquiring geographical information, Processing geographical information
- » Tools: Complex maps, Web tools

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

## SKILL DRILL

### Reading complex maps

**Complex maps** contain more than one set of information to understand.

**Step 1** Look carefully at the legend. Complex maps can have more than one part to a legend. These parts will be represented on the map in different ways. For example in Source 4.43 areas of colour are used to show the different types of Indigenous land across Australia. Different-coloured symbols are used to show a range of significant sites.

**Step 2** Train your eyes to look for one set of information at a time. For example, look at the solid blocks of colour on the map and work out what they tell you.

**Step 3** Move to a different set of information and work out what that represents.

**Step 4** Look for concentrations of the same symbol in areas to see if patterns exist.

### Apply the skill

Examine Source 4.43.

- 1 Describe where the largest areas of Indigenous-owned land (freehold) are located.
- 2 Which state has no Indigenous-owned or -leased land over 100 square kilometres?
- 3 The significant sites are harder to pick out on this crowded map but the colours help them to stand out. Describe the location of the Myall Creek massacre site. List the other massacre sites in Australia and state their locations.
- 4 Many art sites are only for Australia's Indigenous people. Where in South Australia is a significant Indigenous art site?

# CHECKPOINT



# 3

## ENVIRONMENTAL CHANGE AND MANAGEMENT



## ENVIRONMENTS

# 5

CHAPTER

## CHANGING AND MANAGING THE ENVIRONMENT

# 6

CHAPTER

## INVESTIGATIVE STUDY: COASTAL CHANGE AND MANAGEMENT

# 7

CHAPTER

Our Earth is Biosphere 1, a global ecosystem composed of living organisms (biotic) and the non-living (abiotic) factors from which they extract their energy and nutrients.

## CHAPTER

# 5



**Source 5.1** The Ngozubba Glacier near Gokyo in Nepal. The Gokyo region of Nepal is an environment that has been shaped by the process of glaciation, which is a form of erosion. Nepal is also on a converging plate boundary, which is responsible for the earthquakes Nepal experiences daily. On 25 April 2015, an earthquake of magnitude 7.8 occurred near the capital of Kathmandu.

## ENVIRONMENTS

Environment refers to all living and non-living things in the natural and human world that support and enrich life. The world in which we live is made up of many different environments. Some environments occur naturally, such as forests, deserts and coral reefs. These are known as **natural environments**. Other environments are built or altered by humans, such as cities, towns and farmlands. These are known as **human environments**.

The concept of environment helps geographers to better understand the interconnections between humans and the environment – that is, how environmental processes affect humans (in positive and negative ways) and how human processes affect the environment (in positive and negative ways).



# 5.1

## WHAT MAKES UP AN ENVIRONMENT?

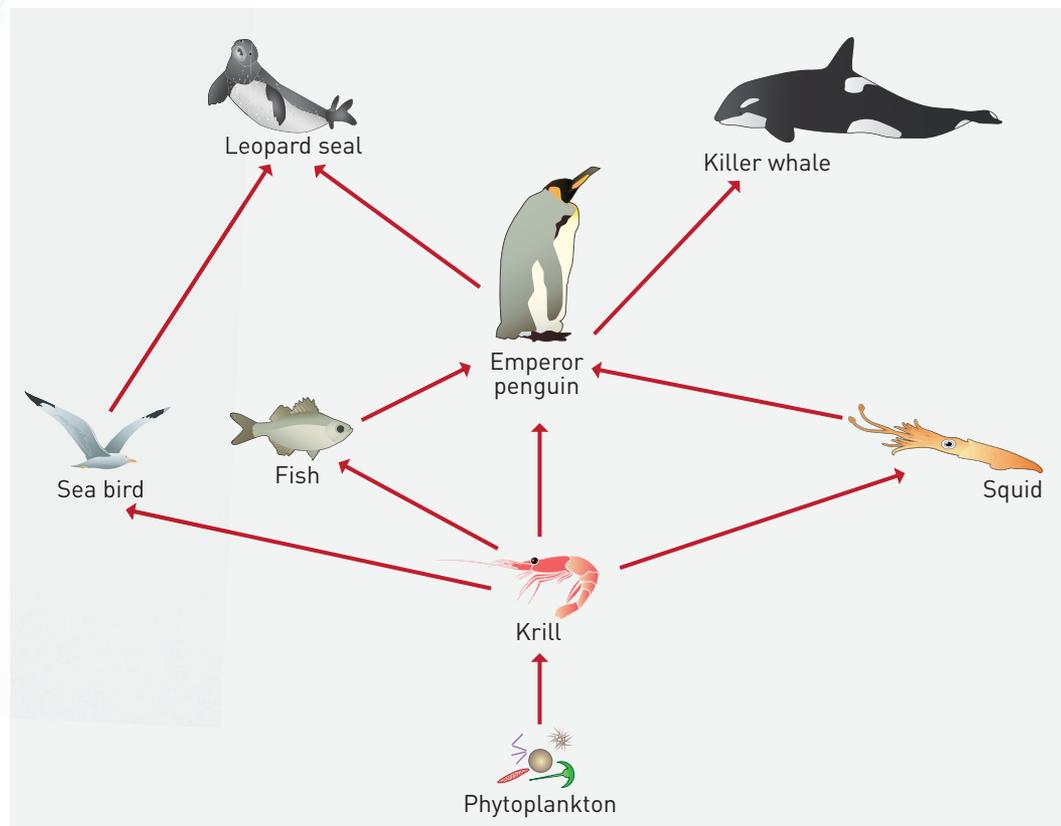
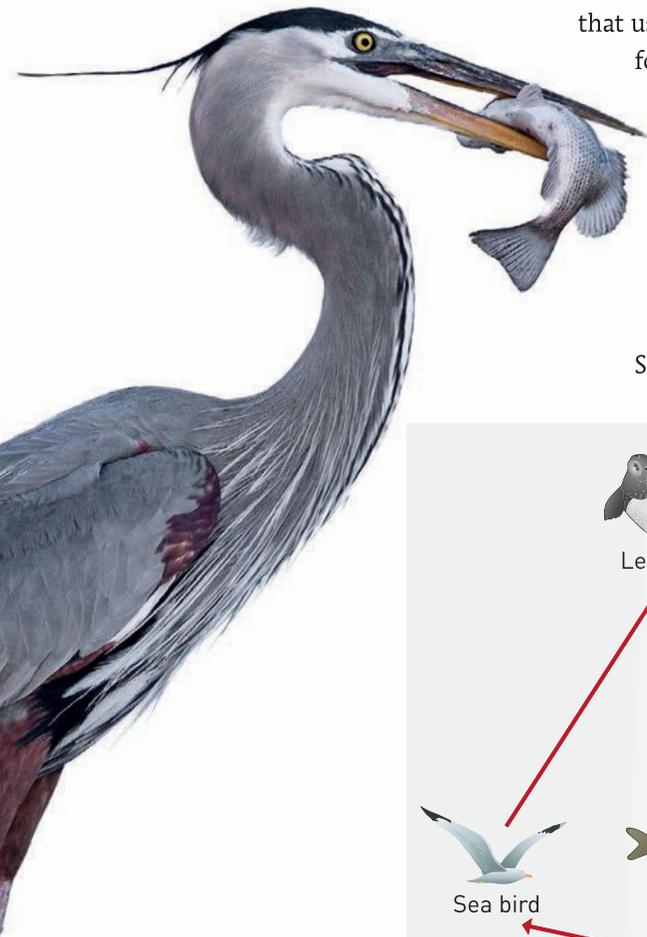
### HOW DO ENVIRONMENTS FUNCTION?

An environment is the interrelationship between its living components (**biotic**) and its non-living components (**abiotic**). The biotic components of an environment include all of the plants (flora) and animals (fauna); it also includes fungi and bacteria, including those found in soil. The abiotic components of an environment include temperature, rainfall, humidity, wind speed and direction, the non-living part of the soil such as sand, and clay and rock.

An **ecosystem** is the living organisms within a community and the non-living components of the environment in which they live. The living and non-living components are linked to each other through the flow of energy involved in food chains and food webs. Each food chain is one possible path that energy and nutrients may take as they move through the ecosystem.

Food chains and food webs consist of **producers** and **consumers**. Producers are those organisms that convert the Sun's energy into food in the form of simple sugars through the process of **photosynthesis**. These organisms are plants. The plants are eaten by animals that use the plants as food. These animals themselves are eaten to provide food for animals higher up the food chain. Those animals that eat either plants or other animals are called consumers. A food chain consists of the link between a single producer and a single consumer. All these producers and consumers are linked together in the environment in a food web.

The Antarctic food web relies on krill, which is a small crustacean. Most of the larger Antarctic animals such as whales, seals, seabirds, fish and squid rely either directly or indirectly on krill as a food source (see Source 5.2).



Source 5.2 This Antarctic food web is an example of a simple food web.



**Source 5.3** Krill are small crustaceans found in all of the world's oceans. Near the bottom of the food chain, krill can be described as the 'engine of the Antarctic' with almost all Antarctic animals feeding on it in some way.



**Source 5.4** Animals migrate from environments where resources are in short supply to areas where they are more abundant. A single Eastern Curlew's annual migratory round trip is around 20 000 kilometres!

To complete this simple Antarctic food web are the bodies of large animals – for example, dead whales that sink to the seafloor – and decomposers such as worms that break down this material. The nutrients released by the decaying flesh provide chemicals for algae and plankton to start a new series of food chains. A healthy food web has an abundance of producers compared with consumers. This balance helps the ecosystem to maintain and recycle nutrients. When one link in the food web is threatened some or all of the links are weakened or stressed. In Source 5.2, if the availability of krill is reduced, the rest of the food web is forced to adapt or starve.

Why is it that some environments, such as the tropics, have many more species than others? One theory is the rate of plant growth. Environments that receive a lot of sunlight and water, such as the tropics, have both high plant-growth rates and high biodiversity. Every species has a story to tell, why it lives where it lives, what is currently preventing it from moving to other places, and what happened in its past to bring it to its current geographic location or habitat. Consider Australia's unique animals, kangaroos, koalas, emus, platypus among others, none of which are found anywhere else in the world? Why not? Or have you ever wondered why there are no penguins in the Northern Hemisphere and no polar bears in the Southern Hemisphere? The polar environments appear to share many similarities.

### REVIEW 5.1.1

#### Remember and understand

- 1 Describe in your own words what an environment is.
- 2 List five different environments you know.

#### Apply and analyse

- 3 Describe how a food chain or food web works.
- 4 For the Antarctic food chain shown in Source 5.2 make two lists categorising each of the organisms as either producers or consumers.
- 5 Redraw the Antarctic food web to include decomposers.

#### Investigate and create

- 6 Conduct some research into the commercial uses of krill.
  - a What is krill used for?
  - b Describe the impact that extensive krill fishing might have on the Antarctic food web.
- 7 What is convergent evolution? Is there a possible relationship between the now extinct great auk of the Arctic and the penguin in Antarctica?

# THE BIOTIC COMPONENTS OF THE ENVIRONMENT

When considering an environment, geographers can look at the different components and scales that are present. The smallest biotic component of an environment is the **individual** organism. The next level of scale is a **population**, which is a group of plants or animals of the same species living in a particular area. The level above that is a **community**, in which populations of different species interact with each other (see Source 5.5). An **ecosystem** is the next level again and can be described as the interaction between the community and its abiotic **habitat**. The habitat is the preferred location of an organism because it has the correct water, temperature, minerals and sunlight that the organism needs to survive. The largest environmental unit, other than the Earth, is a **biome**. This is a region defined by landscapes that share similar climates and types of vegetation; there are eight major global biomes (see Source 1.2).



Individual organism



Population



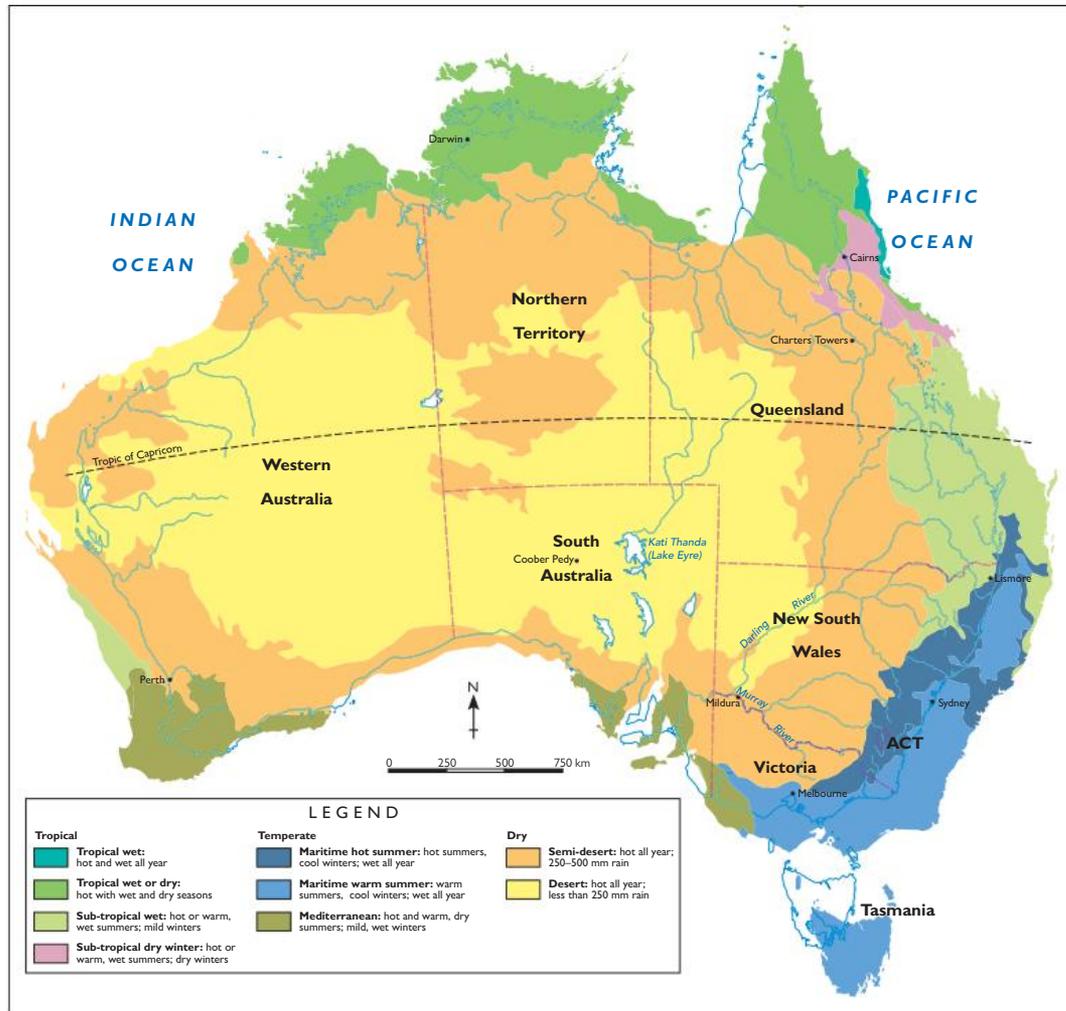
Community

**Source 5.5** An example of an ecosystem hierarchy

## Australian biomes and climate zones

Australia has five terrestrial biomes, which are defined by their major vegetation type. They are mountain vegetation, temperate forest (outside of the tropics), grassland, desert and tropical forest (inside of the tropics) (see Source 1.22 on page 55). Australia also has nine climate zones (see Source 5.6). Climate (rainfall, temperature, humidity, sunlight hours) and soil type have a great influence on the type of plants that grow in an area. This relationship between the climate and the soil type has an influence on the type of biome that exists.

## AUSTRALIA: CLIMATE ZONES



Source 5.6

Source: Oxford University Press

### REVIEW 5.1.2

#### Remember and understand

- 1 List the hierarchy of biotic components of the environment.
- 2 Define the term 'community' in your own words.

#### Apply and analyse

- 3 Refer to Source 1.22. Choose one of the Australian biomes. For that biome, name one plant and one animal species and describe how they interact with one another and how both of them interact with their habitat.
- 4 For each of the five largest climate zones covering Australia in Source 5.6, estimate the percentage of the Australian land mass that each covers.

#### Investigate and create

- 5 Use Sources 1.22 and 5.6 to determine the relationship between Australia's five terrestrial biomes and nine climate zones. Complete the following table:

Climate zone	Characteristics	Terrestrial biome
Tropical wet	Hot and wet all year	
Tropical wet or dry	Hot with wet and dry seasons	
Sub-tropical wet	Hot or warm, wet summers; mild winters	
Sub-tropical dry winter	Hot or warm, wet summers; dry winters	
Maritime hot summer	Hot summers, cool winters; wet all year	
Maritime warm summer	Warm summers, cool winters; wet all year	
Mediterranean	Hot and warm, dry summers; mild, wet winters	
Semi-desert	Hot all year; 250–500 mm rain	
Desert	Hot all year; less than 250 mm rain	

# PROCESSES IN THE ENVIRONMENT

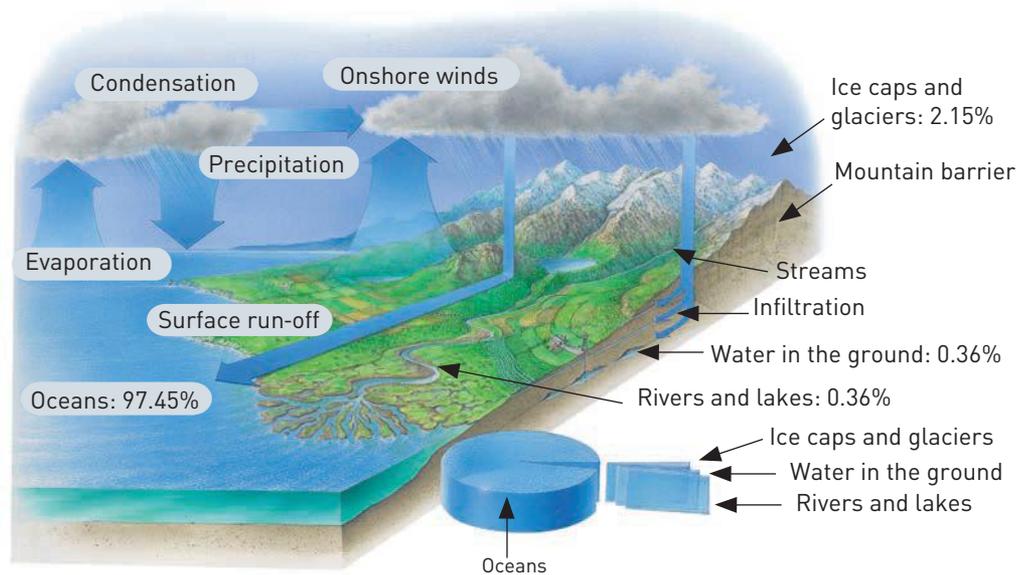
The Earth has a number of physical processes that help sustain life on Earth. These include the **hydrological cycle** (or water cycle), the **carbon cycle** and the **oxygen cycle**.

## The hydrological cycle

The hydrological cycle, or water cycle, is the recycling of water between the sea, land and atmosphere by evaporation, condensation and precipitation (see Source 5.7).

The four major features of the water cycle are evaporation (and transpiration from plants), condensation, precipitation (rain, hail or snow) and collection (run-off on land).

Water in its liquid or solid state evaporates from the sea or land or through transpiration from plants and is added to the atmosphere as water vapour. This water vapour may condense to form clouds and may subsequently be returned to the land and sea by precipitation. The precipitation may find its way to a lake, stream or sea via surface run-off or it may be stored as groundwater through percolation (the movement of water down through the soil), and will eventually find its way into a river via springs. Finally, however, it will be evaporated or transpired, and the cycle will continue.



**Source 5.7** The distribution of water on Earth and the hydrological cycle

## The carbon cycle

Carbon can cycle through the land, oceans and atmosphere over both the short and long term (see Source 5.8):

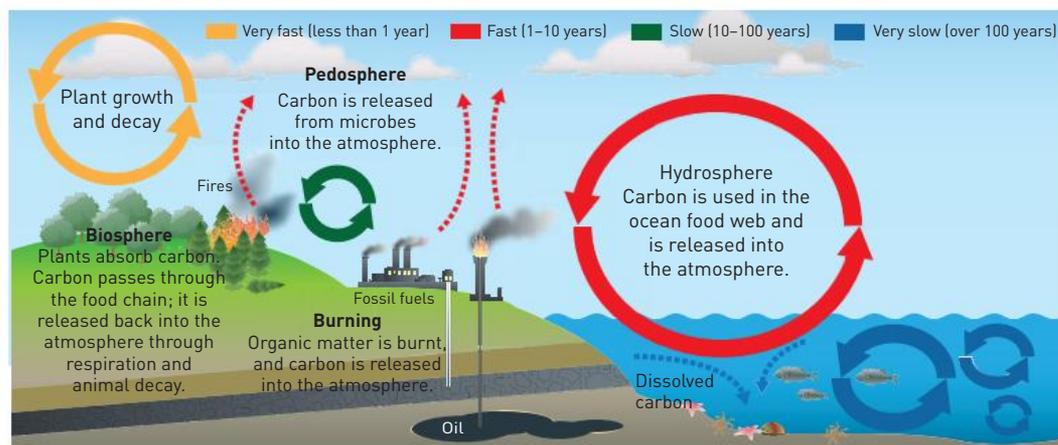
- geological carbon cycle – a long-term cycle that occurs over hundreds to millions of years and has resulted in the bulk of carbon being locked in rocks or in sediments as fossil fuels
- biological/physical carbon cycle – a short-term cycle that occurs over days, weeks, months and years and involves the cycling of carbon through photosynthesis and cellular metabolism.

Carbon is stored over the long term in the trunks and branches of trees. It is also temporarily stored in the bodies of other organisms, such as herbivores or carnivores. When these organisms die, carbon is returned to the atmosphere as carbon dioxide by decomposers.

Carbon is also stored in carbon 'sinks', such as organic matter, rocks and dissolved carbon dioxide in water.

Fire plays an important role in transferring carbon dioxide from the land to the atmosphere. Fires consume biomass and organic matter, producing carbon dioxide as well as methane, carbon monoxide and smoke (solid carbon particles).

Humans have tapped into the geological carbon cycle by extracting oil, natural gas and coal, all of which are hydrocarbons, for use in cars and energy production. Large-scale extraction and the use of these fossil fuels have led to increased levels of carbon dioxide in our atmosphere. Coupled with an increase in deforestation, this increase in carbon dioxide has led to an enhanced **greenhouse effect**, altering temperature and rainfall patterns significantly.



Source 5.8 The carbon cycle

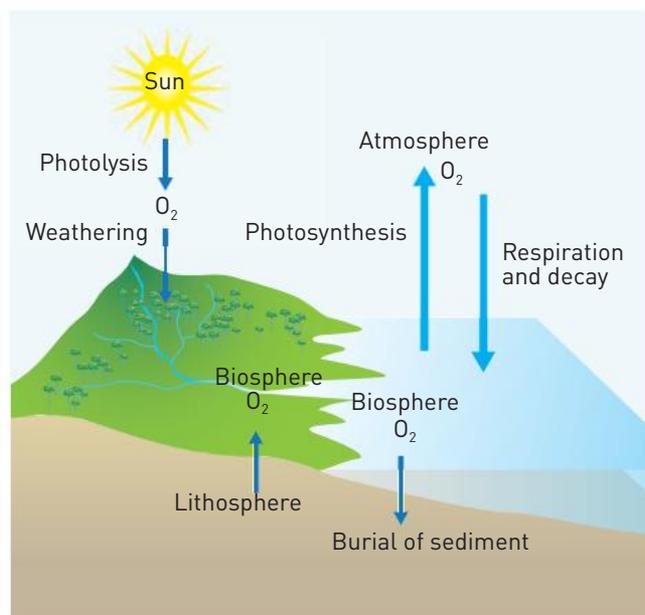
## The oxygen cycle

Oxygen is essential for life on Earth. Earth has a fixed supply of 'useful' oxygen even though it can be found everywhere. There are three reservoirs of oxygen: the atmosphere (0.49%), the Earth's crust or lithosphere (99.5%), and living organisms (0.01%).

In the atmosphere, oxygen exists as the gases  $O_2$  and  $O_3$  (ozone) and in compounds such as water ( $H_2O$ ) and carbon dioxide ( $CO_2$ ). Oxygen is able to dissolve in the oceans, where it is available for uptake by marine organisms.

The oxygen cycle is influenced heavily by processes in the biosphere and atmosphere (see Source 5.9). In the biosphere, photosynthesis releases oxygen and respiration absorbs oxygen. In the atmosphere, oxygen is formed through UV light converting water to oxygen and hydrogen in a process known as **photolysis**.

Oxygen is removed from the atmosphere through the process of cellular respiration, the decay of organisms and the weathering of exposed rocks.



Source 5.9 The oxygen cycle

### REVIEW 5.1.3

#### Remember and understand

- 1 List the three 'cycles' that help sustain life on Earth.
- 2 Describe the features of the hydrological cycle.

#### Apply and analyse

- 3 Describe why the oxygen cycle is important for life on Earth.

- 4 Describe the impacts that humans can have on the carbon cycle through the burning of fossil fuels and deforestation.

#### Investigate and create

- 5 Conduct some research and write a report on what Australian households can do to lower their carbon footprint.

# 5.1

## CHECKPOINT

### HOW DO ENVIRONMENTS FUNCTION?

- Investigate the role and importance of natural environments.
- 1 Describe the two major components that make up an environment. [5 marks]
  - 2 Describe the relationship between climate and the fauna and flora that are found in an environment. [10 marks]
  - 3 Evaluate the impact that increased levels of fossil fuel combustion has had on the carbon cycle and the ability of carbon sinks to store carbon in the short term. Remember that in order to evaluate you must have some criteria. [15 marks]

TOTAL MARKS [ /30]

### RICH TASK

#### Rapid change for the Aeta

The Aeta are a group of Indigenous people living in the Philippines. Traditionally hunter-gatherers, they survived on a diet of fruits, honey, animals and fish collected from their mountain forest home. Today, these forests are being cleared for farms, logging and mines. One important region of Aeta settlement was the island of Luzon, where they lived for thousands of years in small villages on the lush slopes of Mount Pinatubo. In June 1991, Mount Pinatubo, an active volcano, exploded in one of the worst eruptions in history, devastating the Aeta population there. More than 200 000 Aeta lost their homes. After the eruption, many were forced into resettlement camps or urban

areas where they have faced an uphill battle to preserve their traditions. Most are illiterate and have no sense of money or land ownership. The average life expectancy of Aeta men and women is now just 16.5 years.

#### Processing geographical information

- 1 What challenges to their way of life were the Aeta people facing before the eruption of Mount Pinatubo?
- 2 How did the eruption speed up the change for the Aeta living on the slopes of Mount Pinatubo?
- 3 What issues do you think the Aeta people faced when they were moved to resettlement camps?

#### SKILL DRILL

#### Analysing geographical photographs

Photographs are one of the many tools that geographers use to study different environments and places. There are three main types of photographs used commonly by geographers in the field.

##### 1 Ground-level photographs

Taken on ground level, they record exactly what a person would see if they were standing in front of the scene. Ground-level photographs enable the viewer to clearly see the detail in the environment and appreciate the scale of objects in it. Features in the foreground of ground-level photographs generally look bigger and features in the background generally look smaller. Ground-level photographs are useful for geographers because they show a lot of detail. They are also less expensive and easier to produce than other types of photographs.

##### 2 Oblique photographs

Taken on an angle from a high point, they can be taken looking down from a cliff or mountain, or from an aircraft or hot-air balloon (known as aerial oblique). Oblique photographs are useful for geographers because they show a larger area than ground-level photographs. Oblique photographs are not used for making maps because the scale in the foreground is different from the background, making accurate measurements difficult.

##### 3 Vertical photographs

Taken from directly above (this is also referred to as plan view), they can either be taken from an aircraft or a satellite orbiting the Earth. Vertical photographs are particularly useful to geographers and cartographers because

they show the largest areas of any type of photography.

They can be used to make maps because the scale is constant. When taken from low altitudes they can be used to analyse smaller areas; when taken from high altitudes they can be used to analyse extremely large areas.

When analysing a photograph, you need to infer (use factual knowledge to decide) what might be happening and the possible reasons for it. Think of the photograph as the answer to a question, like 'How has the lifestyle of the Aeta changed?' Look for important features that can help provide an answer. Additional questions include:

- What is happening in the photograph?
- What are the reasons for this?
- What do the features tell us about the people or landforms being shown?
- What is the most important or dominant feature in the photograph and why?
- Do you think this feature may have changed over time? Why or why not?
- How do the features relate to each other?

### Apply the skill

- 1 Look carefully at the ground-level photograph shown in Source 5.10.
  - a What does it tell you about the effects the eruption had on the Aeta?
  - b What can you learn about the conditions in the Aeta live in?
- 2 Look carefully at the oblique aerial photograph shown in Source 5.11.
  - a What does the photograph tell you about the scale of the damage to the homes of the Aeta?
  - b Does this photograph help to explain the reasons why the Aeta were forced into resettlement camps?
- 3 Look carefully at the vertical satellite photograph shown in Source 5.12.
  - a Why is it possible to draw a map from a satellite image but not from a ground-level photograph?
  - b What does the photograph tell you about the extent of the damage to the natural environment?



**Source 5.10** A ground-level photograph showing the volcanic ash and mudslides (lahars) that destroyed settlements and forced the Aeta from their homes. They were unable to continue their lifestyle in the devastated environment.



**Source 5.11** An oblique aerial photograph showing an Aeta village destroyed by pyroclastic flows from the Mount Pinatubo eruption



**Source 5.12** A vertical satellite photograph showing the aftermath of the Mount Pinatubo eruption. Torrential rain mixed with ash from the eruption caused mudslides (lahars). The lahars appear as rivers of mud flowing down the slopes of Mount Pinatubo.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

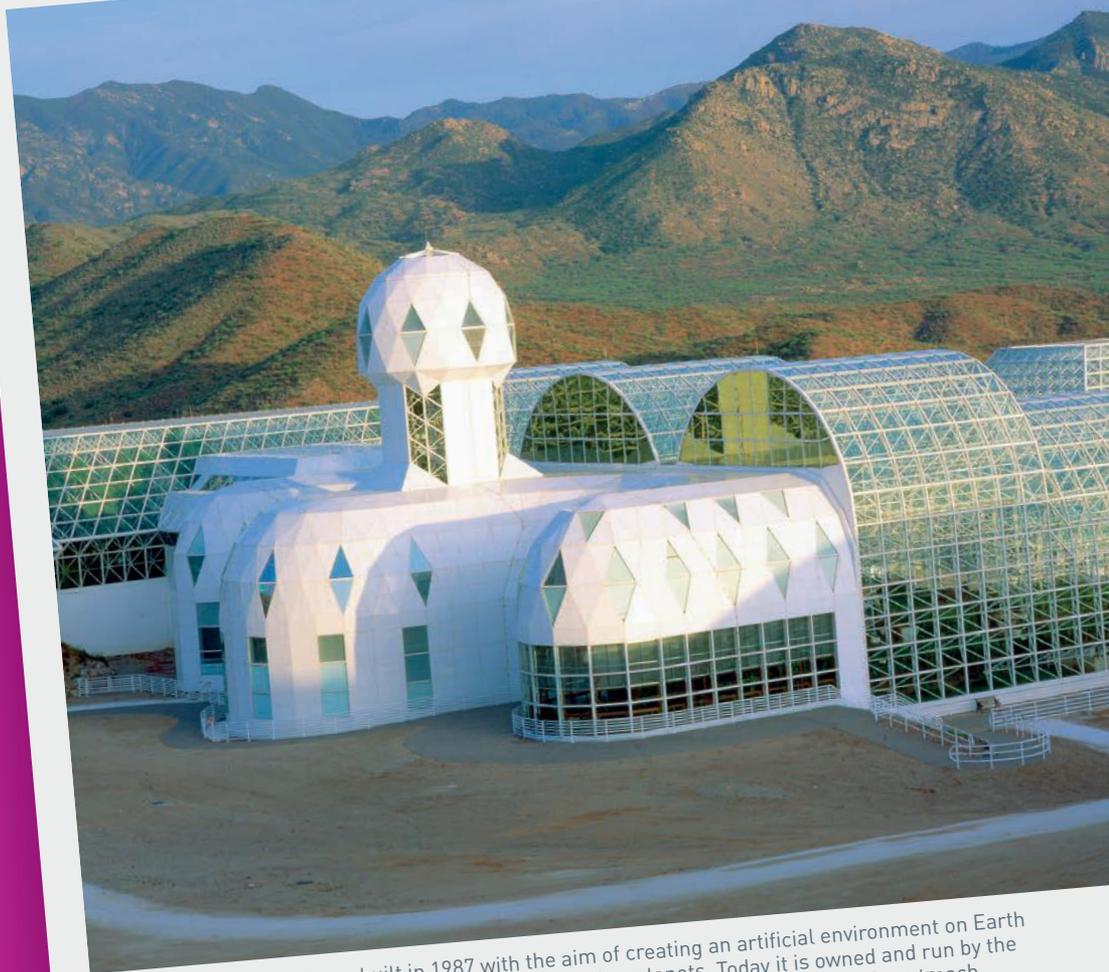
- » Concepts: Change, Space, Place, Environment
- » Inquiry skills: Processing geographical information.
- » Tools: Ground-level, Oblique and Vertical photographs

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

## CHAPTER

# 6



**Source 6.1** Biosphere 2 was built in 1987 with the aim of creating an artificial environment on Earth that could sustain human life and be transferred to other planets. Today it is owned and run by the University of Arizona as a science research facility 'to serve as a centre for research, outreach, teaching and life-long learning about Earth, its living systems, and its place in the Universe'.

## CHANGING AND MANAGING THE ENVIRONMENT

Biosphere 2, one of the world's largest scientific experiments, sits in the Arizona desert. It is a miniature replica of the world's biomes (an environment with distinctive climate, plants and animal species). It was built to explore the possibility of sustaining human life on other planets. Eight people were sealed inside for two years with the aim of surviving without outside help. Despite a cost of US\$200 million, Biosphere 2 could not generate sufficient breathable air, drinkable water or adequate food for the eight people inside, and after 18 months oxygen had to be pumped in from outside. The Earth supports seven billion people every day, supplying us with the water, air and food we need to survive. This is done through a multitude of systems – some tiny, others as large as the Earth itself. Without these systems, life as we know it would not exist. Despite this, many human activities are threatening these systems through climate change, species extinction, land and water degradation and pollution.



# 6.1

## ATTITUDES TO THE ENVIRONMENT

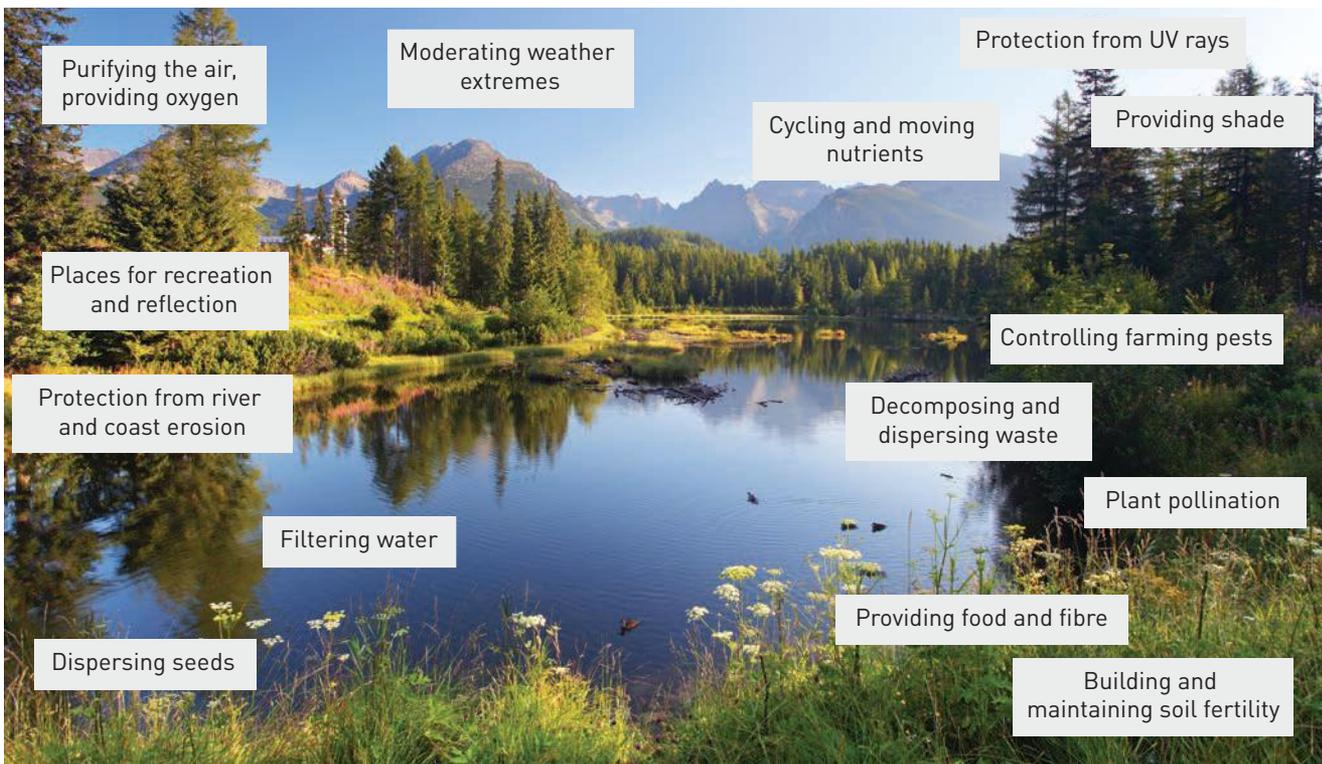
HOW DO PEOPLE'S WORLDVIEWS AFFECT THEIR ATTITUDES TO AND USE OF ENVIRONMENTS?

As far as we know, planet Earth is the only place in the universe capable of supporting human life. This is because the environment here provides organisms such as plants and animals with everything they need to survive: food, light, water and air. Humans, of course, are one of these organisms, and our survival on Earth is largely due to the services provided by the natural environment around us (see Source 6.2).

Unlike most other organisms, however, humans have the ability to degrade the environment to such an extent that the **ecosystem services** on which we rely become threatened. This is now happening around the world in many different places and in many different ways.

### A working environment

The way in which we think about our environment has changed dramatically over the last few decades. Once seen as a bottomless pit of resources providing everything we need, it is now viewed as a fragile system threatened by human actions. The ecosystem services it provides (such as clean air, plant pollination and fertile soil) have long been ignored or



**Source 6.2** Some of the ecosystem services provided by the environment

taken for granted. This is partly because, unlike products we can touch such as food, water and timber, humans have been unable to put a monetary value on these ecosystem services. However, as the environment becomes degraded, the true value of these services is beginning to be recognised.

Over the past 50 years humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet growing demands for food, fresh water, timber, fibre and fuel. This has resulted in substantial and largely irreversible losses in the diversity of life on Earth and the degradation and unsustainable

use of an estimated 60 per cent of ecosystem services (UN Millennium Ecosystem Assessment, 2005) including fresh water, fisheries, air and water purification and the regulation of regional and local climate, natural hazards and pests.

## The four S's of ecosystem services

Ecosystem services can be classified according to the products they provide and the functions they perform. There are four main classifications:

**sources, sinks, services and spirituality.**

### Sources

Sources (also called provisioning services) are those natural products that can be used or converted by humans for our use. For example, mineral deposits such as coal, which we turn into fuel, iron ore, which we use in manufacturing, timber from natural forests, and food sources – from plant crops to deep-sea fish.

### Sinks

Sinks (also called regulating services) are those processes in the natural environment that absorb our waste. For example, micro-organisms in oceans break down oil spills. In a similar way, bacteria in the soil break down human waste.

### Services

Services (also called supporting services) are things that are done for us by the natural environment that don't produce consumable resources. For example, wetlands filter water and slow floodwaters. Forests absorb carbon dioxide and produce oxygen.

### Spirituality

The environment also has a spiritual function for many people. For some, this is a deep connection to the land formed over many generations. For example, the connection that Indigenous Australians have with their tribal lands. For others, it is the experience of spending time in the natural environment and the sense of wellbeing that this brings. For example, people taking part in activities such as surfing and bushwalking often feel a deep connection with the environment. This can also be referred to as cultural services.



**Source 6.3** The Walgal and Ngarigo people have lived in the Australian Alps for thousands of years and many have a deep, spiritual connection to the place.

#### REVIEW 6.1.1

##### Remember and understand

- 1 What are ecosystem services?
- 2 Why do we often take them for granted?

##### Apply and analyse

- 3 Classify each of the ecosystem services shown in Source 6.2 as source, sink, service or spirituality.
- 4 Can you think of one more example of each?
- 5 Examine the image of the Australian Alps (Source 6.3) and give an example of a source, sink, service

and spirituality function of this environment.

##### Investigate and create

- 6 Which of the ecosystem services shown in Source 6.2 do you consider to be the most valuable to humans? Justify your choice.
- 7 Which ecosystem service do you think is most threatened by human activities? What would change if this service could no longer be provided by the environment?





# ONE WORLD, MANY VIEWS

In December 2011 Miranda Gibson, a 30-year-old school teacher, built a platform in a tree 60 metres above the forest floor in Tasmania's Styx Valley. She then set up home on the platform and vowed not to leave it until the tree and the surrounding forest had been granted protection from logging companies. Armed with a laptop and wireless internet connection, she wrote a daily blog, which was viewed by tens of thousands of supporters. She also made the news around the world. Despite freezing cold, snow and rain, she remained up the tree for 449 days, an Australian record, and was forced down only when a nearby bushfire threatened her safety. While she had many supporters around the world, she also had many critics. At one stage, a pro-logging group camped at the base of the tree to protest against Gibson's protest.

Why is it that some people become so passionate about preserving the natural environment while others do not? For example, one person can look at a rainforest and see the beauty of nature, whereas the person standing beside them can only see the money to be made by turning the trees into timber. We can see these differences all over the world, wherever the natural environment is changing.

Studies show that different people view the environment in different ways because of the fundamental beliefs they hold about human beings and our place in the natural world. The reasons for holding these beliefs are very complex but it appears that where we live, our standard of living, our education and our religion all play important roles. Although each person's view of the world is unique, researchers have managed to classify them into four major groups (see Source 6.5). It is important to understand that one view is not necessarily 'better' or 'worse' than another, it is simply different.

## What is your worldview?

In order to evaluate the different ways in which people view the world, American environmental social researchers have developed a set of 15 statements called the New Ecological Paradigm (NEP) scale (see Source 6.6). People are asked to read each of the statements and decide whether they agree or disagree with them on a scale from 1 to 5, where 1 is 'strongly disagree' and 5 is 'strongly agree'. This allows researchers to compare the worldviews of different groups of people within and between countries.

- 1 We are approaching the limit of the number of people the Earth can support.
- 2 Humans have the right to modify the natural environment to suit their needs.
- 3 When humans interfere with nature it often produces disastrous consequences.

**Source 6.4** Miranda Gibson made her home high in the branches of this tree for 449 days. The successful outcome officially extended Tasmania's Wilderness World Heritage Area by 170 000 hectares encompassing this 400-year-old giant eucalypt.



**Source 6.5** Worldviews about the environment

- 4 Human ingenuity will ensure that we do not make the Earth unliveable.
- 5 Humans are seriously abusing the environment.
- 6 The Earth has plenty of natural resources if we just learn how to develop them.
- 7 Plants and animals have as much right as humans to exist.
- 8 The balance of nature is strong enough to cope with the impacts of modern industrial nations.
- 9 Despite our special abilities, humans are still subject to the laws of nature.
- 10 The so-called 'ecological crisis' facing humankind has been greatly exaggerated.
- 11 The Earth is like a spaceship with very limited room and resources.
- 12 Humans were meant to rule over the rest of nature.
- 13 The balance of nature is very delicate and easily upset.
- 14 Humans will eventually learn enough about how nature works to be able to control it.
- 15 If things continue on their present course, we will soon experience a major ecological catastrophe.

Source: Riley E. Dunlap *et al.* (2000). Measuring endorsement of the new ecological paradigm: A revised NEP scale. *Journal of Social Issues*, 56(3), 425–442

**Source 6.6** The New Ecological Paradigm (NEP) scale

## REVIEW 6.1.2

### Remember and understand

- 1 What is the main difference between human-centred and Earth-centred worldviews?
- 2 Use Source 6.5 to classify Miranda Gibson's worldview.

### Apply and analyse

- 3 Read the 15 statements in Source 6.6. In a table, record the numbers of the statements you agree with in one column and the numbers of the statements you disagree with in another. (If you agreed with all or most of the seven even-numbered statements, researchers would classify you as having a human-centred worldview. If you agreed with all or most of the odd-numbered statements, they would classify you as having an Earth-centred worldview.)
  - a Describe your worldview based on your responses to this test. Did you find your results surprising?
  - b Find a classmate with a similar worldview to you and discuss with them their views of Miranda Gibson's anti-logging protest.
  - c Find a classmate with a very different worldview to yours and find out what they think about the anti-logging protest.
  - d Ask an older person, such as one of your parents, to respond to the 15 statements and compare their responses with yours.

### Investigate and create

- 4 Do you think the NEP scale is an accurate way to evaluate people's worldviews? Can you suggest any ways in which this method could be improved?
- 5 Consider Source 6.7. Investigate and outline four current issues, one from each of the following scales – local, regional, national and global – that are affecting your environment, which could be represented by this cartoon. Write a news article headline for each issue.



**Source 6.7** People with different environmental worldviews often disagree about the seriousness of environmental problems and what we should do about them.

# USE OF THE ENVIRONMENT

## Challenges to sustainability

Virtually all human activities affect the natural environment in some way, but humans can reduce these impacts by using the Earth's resources sustainably. The concept of **sustainability** relates to the ongoing capacity of the environment to support the lives of all living things into the future. The sustainable use of resources such as **fossil fuels**, forests and oceans is about carefully conserving these resources so that they meet the needs of today without compromising the ability of future generations to do the same – put simply, it is about using the Earth's resources at levels that allow the planet to replace or replenish them naturally. This is a particularly important concept when we consider our use of the natural resources that supply us with food and water, such as forests, rivers, the oceans and farmland. If resources are used sustainably, the quality of the environment is maintained and the resources will continue to provide for future generations.



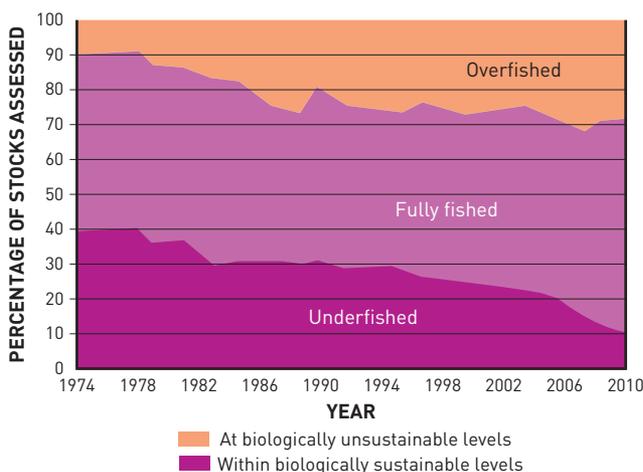
## The fishing industry and world fish production

Fish are a vital food resource, providing over 15 per cent of the animal protein eaten each day by three billion people. Currently, about 540 million people are employed in the fishing (fish catching) or aquaculture (fish farming) industries.

Many of the world's fish species, however, have been fished beyond sustainable levels and their numbers are now in serious decline (see Source 6.8). More than half of the species investigated by the United Nations are described as being 'fully fished' and have no potential for increased production in the future. Another third of fish species are described as being 'overfished'. This means that they are currently being fished at an unsustainable level. However, if effective management plans are put in place now to reduce the numbers taken from the sea, these species may recover.

Unsustainable levels of fishing are being driven by the food demands of an increasing world population and by modern fishing techniques. These techniques include using spotter planes and

GPS to locate large schools of fish, fishing in deeper waters and dragging huge nets along the ocean floor. Fewer and fewer fish are now surviving to adulthood because they are being caught and eaten as juveniles, before they have had a chance to breed and produce more fish.



Source 6.8 Global trends in world marine fish stock since 1974  
Source: FAO 2014 State of the world fisheries and aquaculture ISSN 10205489

## Making fishing sustainable

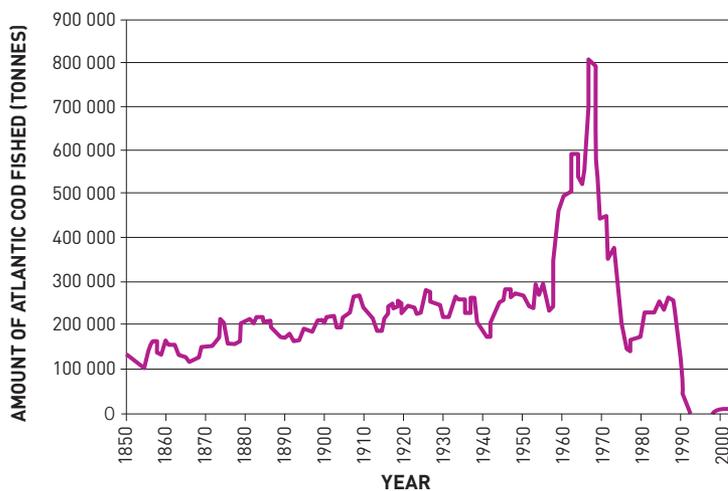
In more recent times, countries such as Australia, New Zealand and the United States have put in place fisheries management plans to make their fishing industries sustainable, and to ensure good numbers of fish stock in the ocean in the future. These plans monitor fish populations and place quotas on the fishing industry, limiting the numbers of fish that can be caught.

Consumers can also play a part in ensuring the sustainability of fish supplies by choosing to eat only fish that have been farmed or caught in sustainable ways.



**Source 6.9** These bluefin tuna are caught in the Mediterranean Sea then fattened in cages before being shot, frozen and shipped to Japan to become sushi. Remaining stocks of wild tuna are listed as endangered species but little is being done to protect them.

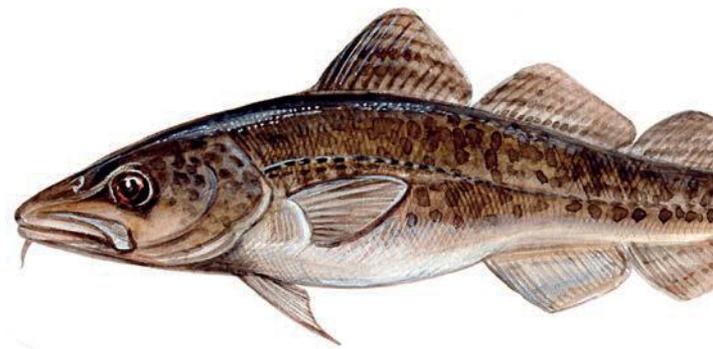
The people of the north-western United States and Canada have fished the coastal waters of the Atlantic Ocean for hundreds of years. The most prized fish of their catch is the Atlantic cod, which once existed in vast numbers. Up until the mid-1950s, around 300 000 tonnes of Atlantic cod were caught each year in the region's waters. By the middle of the 1960s, large-scale fishing trawlers, using vast nets and mechanical winches, were catching 100 tonnes of Atlantic cod an hour. By 1968, the amount caught peaked at more than 800 000 tonnes before the Atlantic cod population collapsed. Despite attempts to protect the remaining cod in the last few decades, the population has been very slow to show any recovery (see Source 6.10).



**Source 6.10** Amount of Atlantic cod fished off the east coast of Newfoundland, 1850–2000

## CASE STUDY

### The disappearing Atlantic cod



**Source 6.11** Large-scale fishing practices implemented from the 1960s onwards devastated the population of Atlantic cod in the United States and Canada.

#### REVIEW 6.1.3

##### Remember and understand

- 1 In your own words, define sustainability.
- 2 Explain why the history of Atlantic cod fishing is an example of unsustainable resource use.

##### Apply and analyse

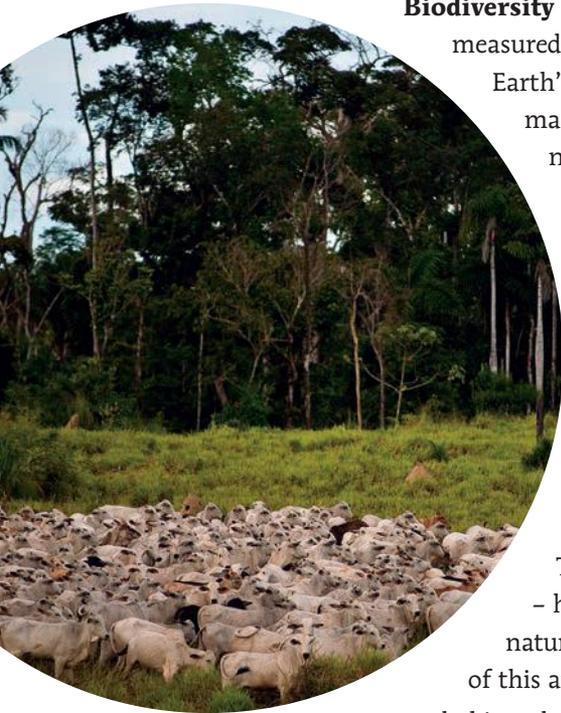
- 3 Copy and annotate Source 6.10 to describe the important trends and changes in the numbers of Atlantic cod caught off the coast of Newfoundland, 1850–2005.

##### Investigate and create

- 4 Aquaculture is seen by many as the best way of providing fish for human consumption in the future. Research this booming industry. Do you see this as a sustainable alternative to traditional fishing?

- 5 Construct your own line graph to explore global trends in fish supplies into the future.
  - a Draw up a set of axes: the vertical axis (y-axis) should show the percentage of fish species from 0 to 100 per cent. The horizontal axis (x-axis) should show the year from 1974 to 2050.
  - b Copy the line showing fish species that are 'overfished' from Source 6.8 onto your graph.
  - c Based on the trend from 1974 to 2010, continue this line in a different colour to show the likely trend until 2050.
  - d Describe the trend shown on your completed graph. If your prediction turns out to be true, what will this mean for the fishing industry and consumers around the world?

# LOSS OF BIODIVERSITY



**Biodiversity** refers to the variety of living organisms on the planet. Biodiversity is measured by the number of species present in a particular ecosystem or region. The Earth's biodiversity is currently under threat, decreasing at a rate that rivals the mass **extinction** of the dinosaurs. It is difficult to give an exact figure on the number of species reaching extinction each year but it has been estimated at between 17 000 and 100 000 species annually. The world's most famous fossil hunter, Dr Richard Leakey, believes that this represents 'a rate comparable with the impact of a giant asteroid slamming into the planet'.

This loss of biodiversity not only affects the natural environment but also has serious consequences for all human beings on Earth. Ecosystem services such as food, fibre and fresh water supplies, crop pollination by insects and birds, and protection against natural disasters are in decline.

## What's causing the loss of biodiversity?

This loss of biodiversity is due almost entirely to the impact of just one species – humans. Our use of the Earth's resources and the changes this use brings to the natural environment are pushing many species to extinction. The five main causes of this are:

- habitat change such as **deforestation**
- over-exploitation of resources such as fresh water
- pollution of land, water and air
- the spread of **invasive species**
- **climate change** brought about by human activity.

## Species facing extinction

The International Union for the Conservation of Nature (IUCN) is an organisation that assesses the likelihood that species will become extinct. Of the almost 50 000 species they have studied, 36 per cent can be considered threatened with extinction. Birds and amphibians (such as frogs) are particularly under threat (see Source 6.14).

## A world without frogs?

The number of frog species in the world is in dramatic decline and many researchers are linking this to climate change. The skin of frogs is particularly thin and permeable, meaning that moisture is able to pass through it easily. With the drier, warmer climate, many frogs are losing more water through their skin than they are taking in.

They are also losing their breeding grounds, as small ponds and water collected in the hollows of trees are drying up and disappearing.

The greatest threat, however, is from disease. A parasitic fungus from Africa, known as amphibian chytrid, has spread across the planet in the last few decades. Warmer

**Source 6.12** Much of the world's land surface is no longer in its natural state. Farmland and cities have replaced areas once covered by forests and grasslands. Farming, as with this beef cattle farm in Brazil, tends to replace hundreds of species with just one. This greatly reduces biodiversity.

**Source 6.13** The last golden toad was seen in 1989, and like 33 other amphibian species since then, it is now considered extinct.



temperatures associated with climate change have created favourable conditions for the spread of this parasite, which was previously held back by cooler night-time temperatures.

After studying the spread of this disease in Central America, a leading researcher in this field stated that ‘disease is the bullet killing frogs, but climate change is pulling the trigger’. He found that two-thirds of all of the region’s species of harlequin frogs were already extinct from this combination of factors. He and other scientists believe that frogs may be the planet’s early warning system on climate change.

#### REVIEW 6.1.4

##### Remember and understand

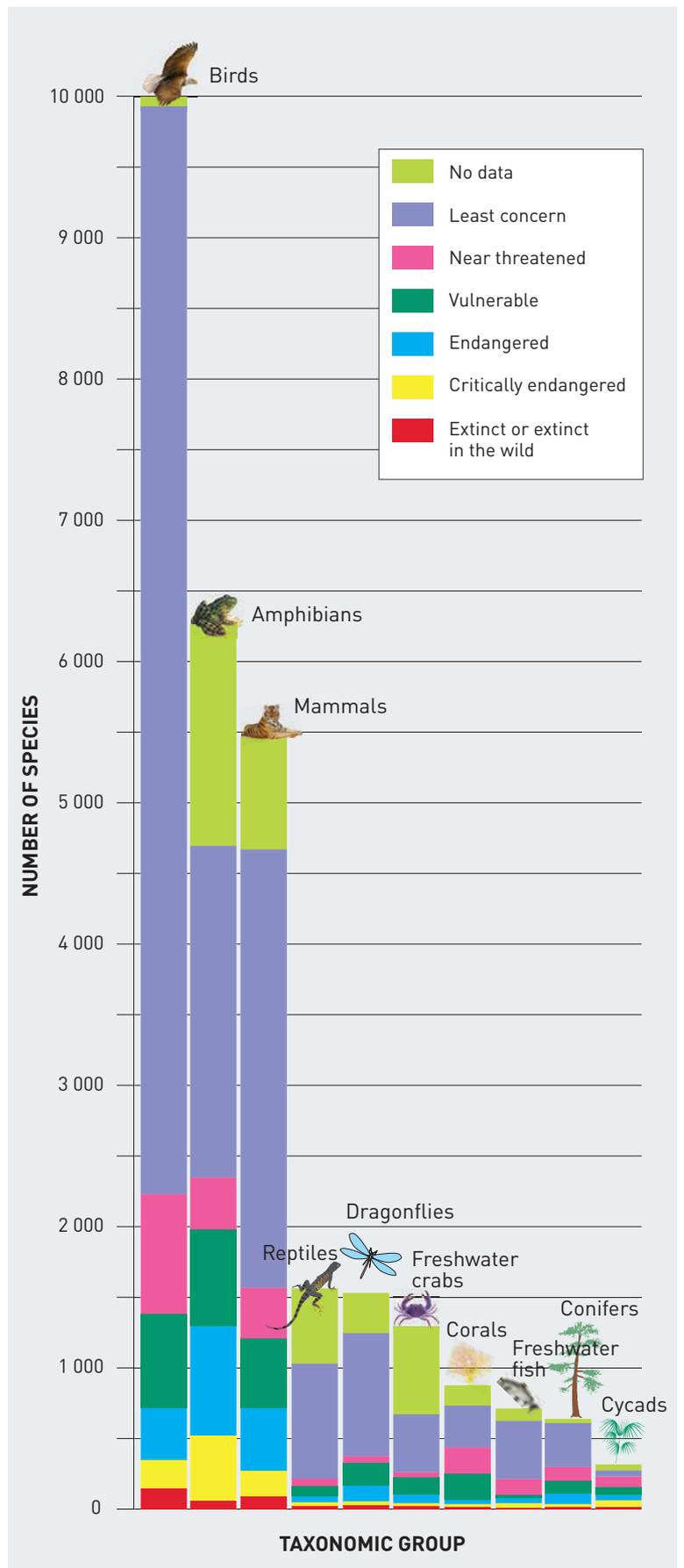
- 1 What is biodiversity?
- 2 Why is biodiversity important?

##### Apply and analyse

- 3 How would a person with a human-centred worldview (see Source 6.5) feel about the environmental change shown in Source 6.12?
- 4 Examine Source 6.14.
  - a Which taxonomic group has suffered the most extinctions? Which of the five main causes of biodiversity loss do you think is most responsible for this?
  - b Use the graph to describe the levels of threat faced by amphibians.
  - c What is the level of threat facing the world’s corals? Find out what ecosystem services would be threatened by a loss of coral species.

##### Investigate and create

- 5 Describe the change in biodiversity shown in Source 6.12. Which of the five main causes of the loss of biodiversity does this illustrate?
- 6 Find an image that illustrates another of the causes and give it a suitable title and caption.
- 7 Search for the IUCN red list on the internet. Use this list to investigate Australia’s Southern Corroboree Frog. How many of these frogs remain in the wild and what dangers do they face?



Source 6.14 IUCN data on the levels of threat faced by the major life groups (known as taxonomic groups)



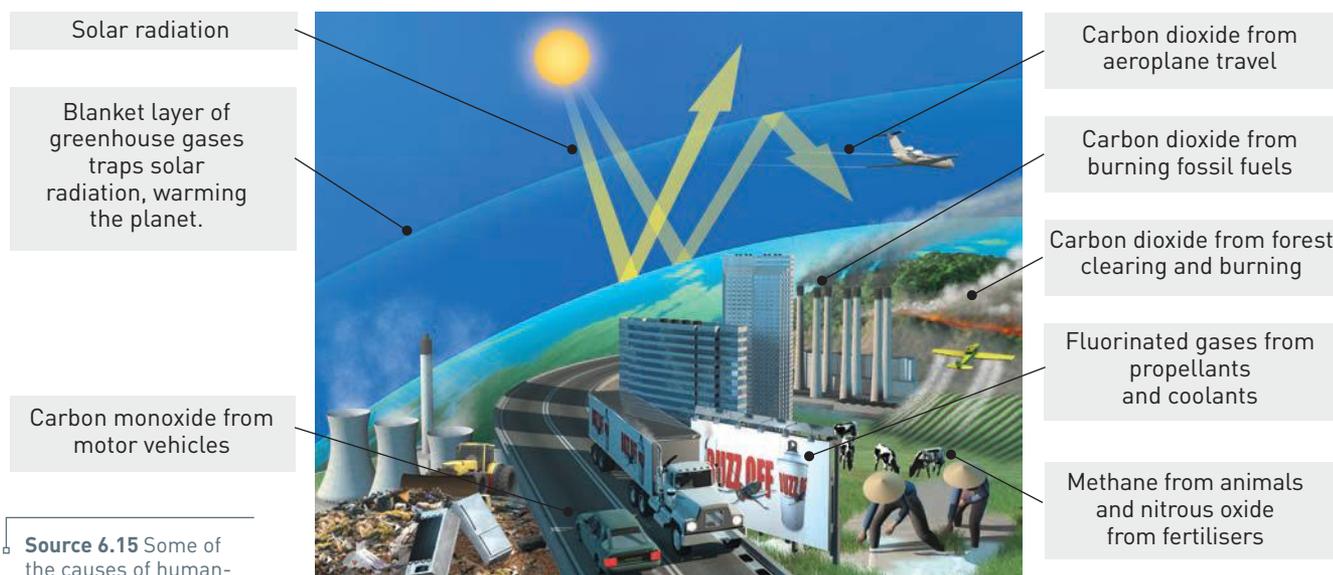
# CLIMATE CHANGE

Although the world's climate has been changing for millions of years, in more recent times there has been an increase in the concentration of certain gases in the atmosphere. Many of these gases – known as greenhouse gases – are found naturally in the environment, but human activities have increased the levels of these gases to a point where they are influencing the global climate. The four main greenhouse gases include:

- carbon dioxide from burning fossil fuels such as coal
- methane from the large-scale farming of livestock
- nitrous oxide from the use of fertilisers
- fluorinated gases from refrigerators and solvents.

Greenhouse gases trap some of the Sun's energy within the atmosphere causing temperatures to rise. This is known as **global warming**.

When temperatures rise, other changes take place in the world's ecosystems. Rainfall patterns change as some places become drier and others become wetter. Ice melts and less snow falls in both the polar regions. Sea levels rise and droughts, floods, cyclones and bushfires become more severe and more frequent. These, and other changes associated with increased greenhouse gases, are changing the world's ecosystems and the services they provide.

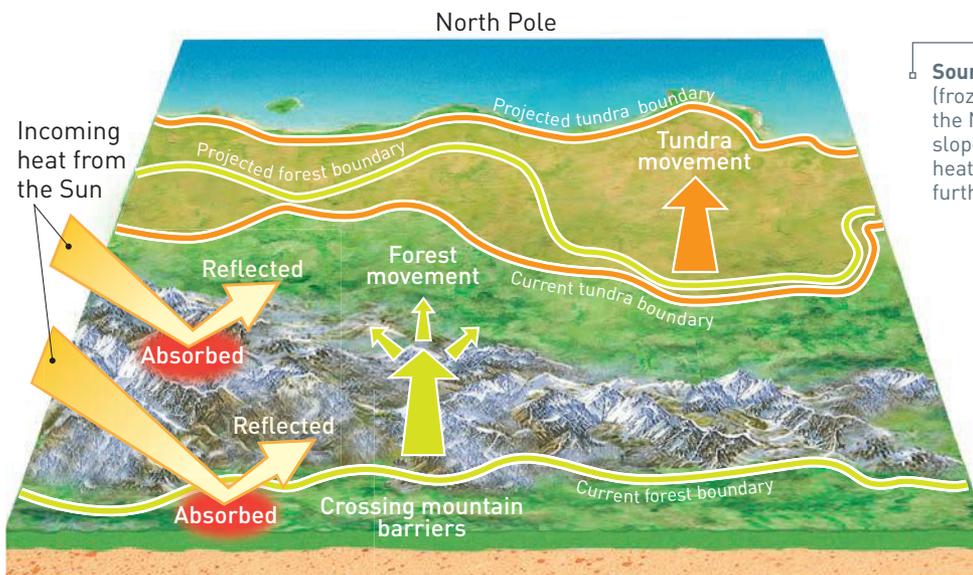


**Source 6.15** Some of the causes of human-induced climate change

## Environmental responses to climate change

Ecosystems develop and flourish under specific environmental conditions. As climate change alters these conditions, the plants and animals within the ecosystems respond in one of four ways:

- They change their basic biology – certain animals may reproduce less often or lay smaller eggs.
- They change the timing of certain events such as flowering – certain plants may flower earlier or later depending on the conditions. This can affect birds that rely on these plants for food.
- They die out – when a species dies out it can have serious effects on the entire ecosystem.
- They move – in general, many plants and animals are moving towards the poles and into higher altitudes as temperatures in these places are similar to those in their previous habitats. This affects plants and animals already living in these places (see Source 6.16).



**Source 6.16** The movement of tundra (frozen, treeless land) and forests towards the North Pole in the Arctic. As mountain slopes become forested they absorb more heat from the Sun rather than reflect it, further increasing temperatures.

One of the largest Indigenous groups in the Arctic region is the Saami people of northern Scandinavia. Numbering around 70 000 people and living in one of the world's harshest environments, many Saami groups rely on traditional reindeer herding for their livelihood. They migrate north in spring and summer and south in winter to find sufficient food, such as grass and small shrubs, for their herds. A typical herd is made up of several thousand reindeer. Saami herders will travel hundreds of kilometres a year with their herds.

While it would seem that warmer temperatures would bring better grazing conditions to the frozen Saami lands, the reverse is actually true. Warmer winter temperatures melt the snow, turning it to water. It then refreezes as a layer of ice, which the reindeer cannot penetrate to reach the lichen below. This ice is known as *cuokke* to the Saami people and can result in their herds starving to death. The Saami respond by keeping their herds in pens and feeding them hay and straw but this food is expensive and difficult to find. These changing conditions may bring an end to the Saami's nomadic way of life, which has existed for thousands of years.

## CASE STUDY

### Climate change and the Saami



**Source 6.17** A Saami man moves his reindeer herd north in spring.

## REVIEW 6.1.5

### Remember and understand

- 1 What are some of the main causes of climate change?
- 2 How might climate change bring an end to the traditional Saami way of life?

### Apply and analyse

- 3 Discuss with a partner how climate change affects ecosystem services (see Source 6.2). Brainstorm these ideas as a class.
- 4 Describe the impact of climate change on plants and animals in the Arctic region.

- 5 Why is more solar radiation absorbed as forests move northwards?

### Investigate and create

- 6 Construct a flow diagram that shows how plants and animals respond to environmental changes. Add examples of these responses to your diagram.
- 7 The Saami people are not the only Indigenous people whose way of life is threatened by climate change. Research the impact of climate change on Indigenous people in the Pacific Islands and compare their situation with the Saami.

# POLLUTION

**Pollution** is any substance released into the environment that has harmful or poisonous effects. Polluting substances reduce the ability of the natural environment to provide ecosystem services. Pollution is often a side effect of a process intended to benefit human beings. Pesticides, for example, are designed to kill harmful insects that damage crops but they can also pollute our water and kill beneficial organisms such as bees. The loss of bees then reduces the amount of pollination that occurs, setting off a chain of negative effects in the environment. Here we look at some common forms of air, water and land pollution.



**Source 6.18** Air pollution in Santiago, Chile, is trapped by the Andes Mountains and can remain over the city for days, even weeks.

## Air pollution

**Source 6.19** When an offshore oil platform exploded in the Gulf of Mexico in 2010, it caused one of the largest oil spills in history.

Air pollution is the contamination of the atmosphere through the release of harmful gases and small particles. Air pollution can happen on a variety of scales. Sometimes it is local (for example, a factory releases smoke and gases through a smokestack affecting the surrounding area). In urban environments such as Santiago, however, factories, vehicles, houses and other sources of pollution combine to produce large-scale pollution, which affects the air quality right across the city (see Source 6.18). When this large-scale pollution causes changes to the atmosphere (for example, pollutants such as carbon dioxide and methane trapping the Sun's heat in the atmosphere and causing global warming), we have pollution on a global scale.

## Water pollution

Water pollution is the contamination of rivers, lakes, wetlands, estuaries, seas and oceans through the release of harmful substances. Water pollution can be caused by human activities on or near the water such as shipping and deep-sea oil drilling. Ships, for example, release waste water and oil into the sea causing pollution. Land activities, sometimes a long way from water, can also lead to pollution entering our waterways. These land activities include farming (especially when using fertilisers and pesticides), littering, land clearing, creating tips and **landfill**, processing sewage and industrial activities. Industrial or farming waste released into a river can travel the length of that river and enter waterways, causing water pollution over a widespread area. Likewise, litter washed down stormwater drains during a storm can end up polluting the ocean.



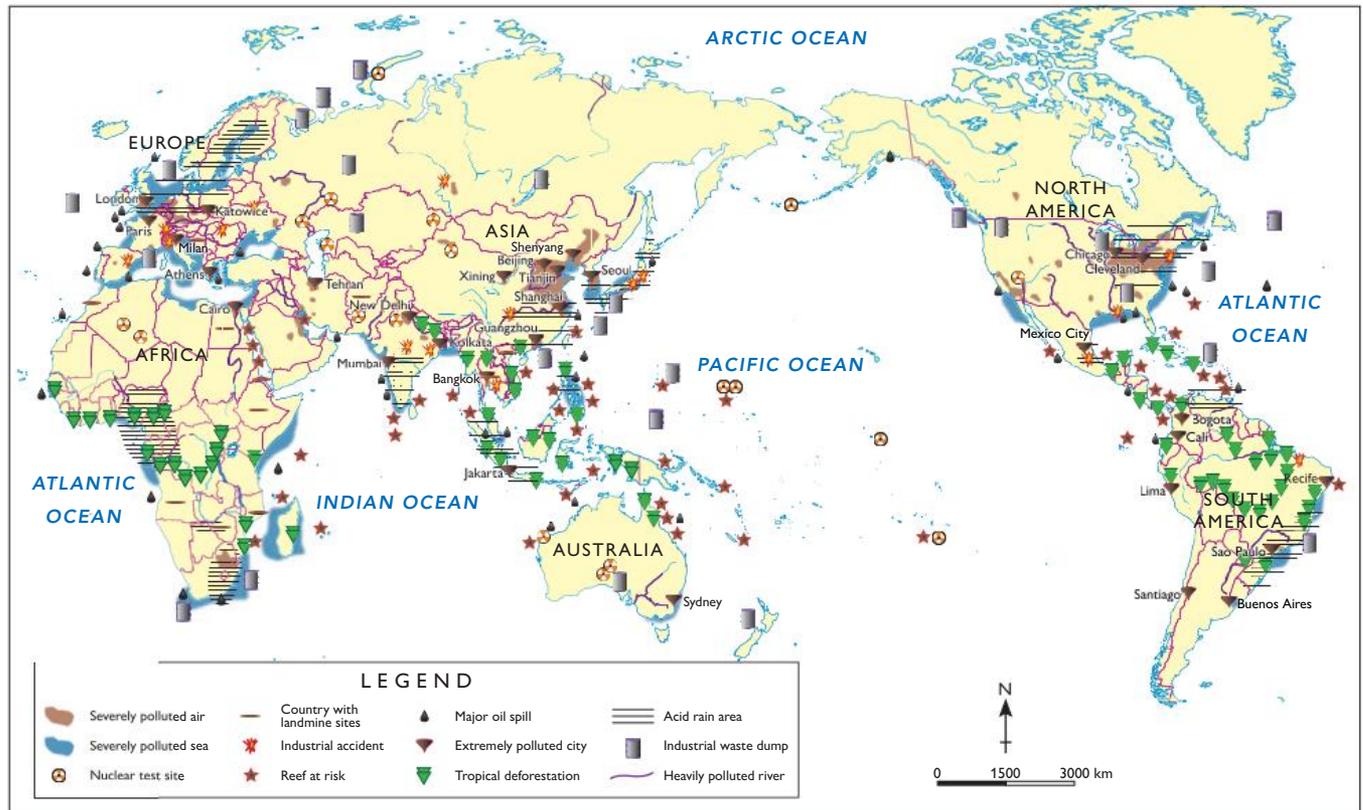
# Land pollution

Land pollution is the contamination of areas of land through the release of harmful substances. Soil contamination is often localised, such as at the sites of old petrol stations, mines, sewage treatment facilities or landfill. Soil contamination can also occur on a much larger scale, such as increasing **salinity** (salt levels) in the soil resulting from rising water tables in Australia’s Murray–Darling Basin. Land pollution can cause the contamination of groundwater, which is often an important source of drinking water.



Source 6.21 Landfill can cause soil contamination.

## WORLD: GLOBAL DISTRIBUTION OF POLLUTION



Source 6.20

Source: Oxford University Press

### REVIEW 6.1.6

#### Remember and understand

- 1 Define and give examples of the main forms of pollution.

#### Apply and analyse

- 2 Examine Source 6.20.
  - a Describe the distribution of severe air pollution.
  - b Use an atlas to list those countries with landmine sites. Are landmines an example of pollution? Why/why not?
  - c Which countries experience three or more types

of pollution? What may be the underlying causes of pollution there?

- 3 In what ways would the explosion of an offshore oil platform (see Source 6.19) pollute the environment?

#### Investigate and create

- 4 Source 6.20 shows acid rain as a form of pollution. Research acid rain and report on its causes, distribution and effects on ecosystem services.
- 5 Which type of pollution do you consider has the greatest impact on ecosystem services?

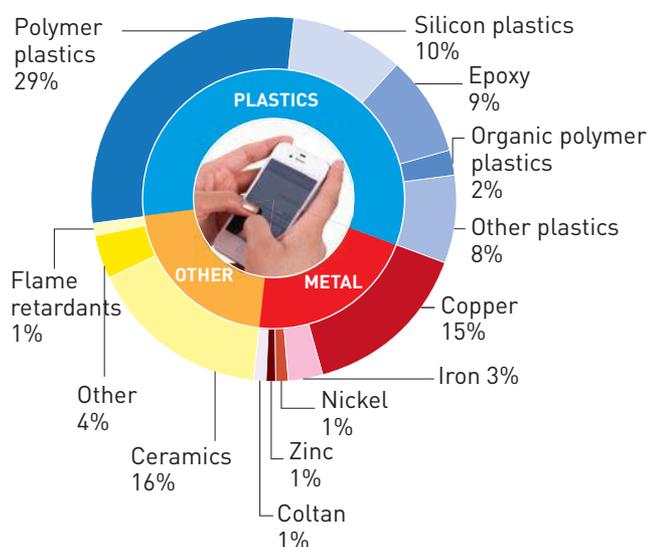
# THE REAL COST OF YOUR MOBILE PHONE

When exploring the ways in which the environment is changing, it is important to look not only at the effects of these changes but also their causes. For example, when investigating declines in fish populations, geographers look for causes such as increases in world population, pollution levels and changing consumption patterns. Similarly, when looking at the environmental changes brought about by industry and mining around the world, geographers need to explore a range of possible causes. One of the main factors driving the growth in mining and production is increased demand for electronic consumer goods such as mobile phones. Current estimates put the number of mobile phone subscribers around the world at about seven billion. This number has increased significantly over the past

decade (see Source 6.26). The **raw materials** used in the production of mobile phones come from different locations around the world. Dramatic increases in demand for these materials have created serious environmental problems in a number of locations.

## Plastics

Plastics are a by-product of refining oil. Oil is usually found in the Earth's crust and is accessed by drilling into the crust, either on land or on the seabed. There are significant environmental risks associated with mining and using oil. These range from the potential for oil spills at the mine site to the greenhouse gases produced when oil is used for fuel. Many plastics are hard to dispose of and take thousands of years to break down. Since the 1950s, more than a billion tonnes of plastic have been discarded around the world.



Source 6.22 The raw components of a mobile phone

## Metals

### Copper

Because copper conducts electrical signals, it is used a great deal in electronic devices. Copper is mined in many places around the world. Chile's Escondida copper mine is the world's largest. The mine is essentially two giant pits dug into the desert floor. Waste rock is left in piles called tailings and copper is transported in pipes 180 kilometres to the coast. Like many large mines, Escondida is located in the desert. This creates problems for the mining operators who need water for their mining operation and their workers. A desalination plant is being built on the coast to provide this water. The water will be piped to the mine.

### Coltan

Coltan is a mineral ore, high in iron, that is used in mobile phones as well as video-game players and some computers. Australia is the world's largest supplier of coltan. The Democratic Republic of the Congo (DRC) in Africa is another large supplier. To reach the coltan in the DRC, miners have stripped away rainforest, including the rainforest in national





**Source 6.23** This bird has died from eating plastic, which it mistook for brightly coloured fish. Thousands of sea birds and other marine animals die each year in this way.

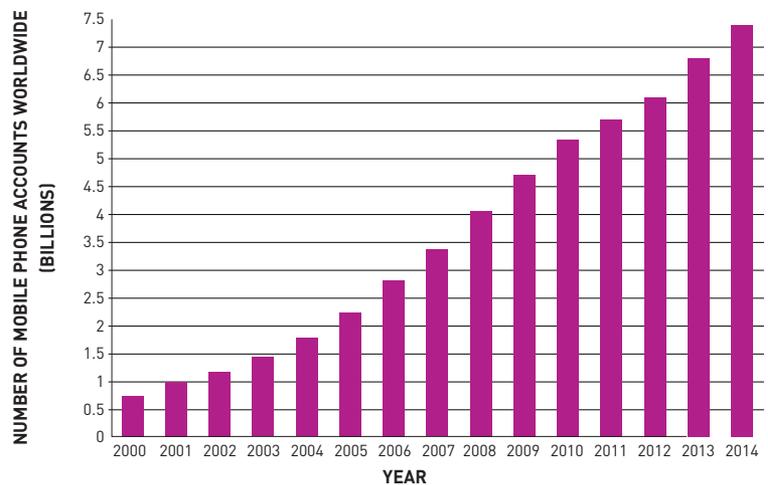
parks. The roads they have cut through the rainforest to reach the mines are also used by local people to hunt wild animals for food. One of the animals hunted by locals for meat in the rainforest is the gorilla. The western lowland gorilla is now a critically endangered animal and has all but vanished from the rainforests of the DRC.



**Source 6.24** A coltan mine in the Democratic Republic of the Congo. As well as causing environmental change there is also evidence that profits from coltan mining are being used by armies in the region to fund long-running and bloody conflicts.



**Source 6.25** The Escondida copper mine in the Chilean desert



**Source 6.26** Growth in the number of mobile phones worldwide

## REVIEW 6.1.7

### Remember and understand

- 1 How does the production and use of plastic change the environment?
- 2 What is coltan? How has the mining of coltan changed the environment in the Democratic Republic of the Congo?

### Apply and analyse

- 3 Examine Source 6.26 carefully.

- a Describe the global trend in mobile phone use over the period shown.
  - b Conduct research to determine the five countries around the world that have experienced the largest growth over this period. Why might this be the case?
- 4 The bird in Source 6.23 was found on the Midway Islands. Use an atlas to locate these

islands and explain where you think the plastic that caused the death of this and many other birds originated.

### Investigate and create

- 5 Select another popular consumer item of your choice and research the environmental changes brought about by its production and use.

## CASE STUDY

# EASTER ISLAND



Easter Island is one of the world's most remote places. It lies in the Pacific Ocean, over 2000 kilometres from the nearest inhabited country. When European explorers first visited the island in the 16th century, they found the local people living in primitive conditions and engaged in almost continual warfare. Most baffling of all were the more than 600 stone statues weighing hundreds of tonnes that dotted the island.

The statues were built by the ancient Polynesians who lived on the island, probably as a tribute to tribal chiefs. To move them from the quarry to prominent sites, islanders used the trunks of large trees to create tracks and rollers. Over time, the population of the island reached about 7000 and there was increased pressure on timber resources for transporting statues as well as for housing, boats, fuel and agriculture. The trees, however, were not being replaced by new growth because rats brought by the original Polynesian sailors as a food source were eating all the seeds.

The destruction of the island's trees and shrubs led to a decline in living conditions for the people. Statue building ceased, the population declined, soils became less fertile and more easily eroded, water quality declined and, as competition for scarce resources increased, tribal warfare broke out.

In many ways, the history of Easter Island serves as a warning to the rest of the world about the dangers of extreme environmental change.



**Source 6.27** A selection of stone moai statues on Easter Island

## REVIEW 6.1.8

### Remember and understand

- 1 Describe the geographic location of Easter Island.
- 2 How did statue building contribute to environmental change on Easter Island?
- 3 Did the Easter Islanders use their resources sustainably? Give three reasons for your answer.

### Investigate and create

- 4 The reasons for the decline of the Easter Islanders are still widely debated. Use the internet to find out about two or more conflicting theories. Why is there often disagreement about historical events?
- 5 What lessons are there from Easter Island for the ways in which we use ecosystem services today?



# HOW DO PEOPLE CHANGE THE LAND?

## Degrading the land

The loss of productivity and decline in fertility of land-based environments as a result of human activities is referred to as **land degradation**. Land degradation currently affects about one-quarter of the world's total land area and about 38 per cent of the world's farmed areas. About 1.5 billion people, including many Australians, are directly affected by land degradation. It is also contributing to climate change, as cleared, degraded land stores much less carbon than natural land cover such as rainforest. The three main types of land degradation are soil degradation, soil erosion and ecosystem decline.

**Source 6.29** Soil can be carried on the wind for thousands of kilometres. This dust storm, which blanketed Sydney, Canberra and Brisbane in 2009, originated near Kati Thanda (Lake Eyre) in South Australia. Dust was carried as far as northern New Zealand.



### Soil degradation

Soil degradation refers to the loss of fertility of the soil, often due to a chemical change. Soil can degrade by becoming compacted by large machinery and hard-hooved animals such as cattle and sheep, or by becoming acidic due to a build-up of fertiliser or a loss of soil nutrients caused by farming the land too intensively. One of the greatest problems for Australia is the build-up of salt in the topsoil (called salinity).

### Soil erosion

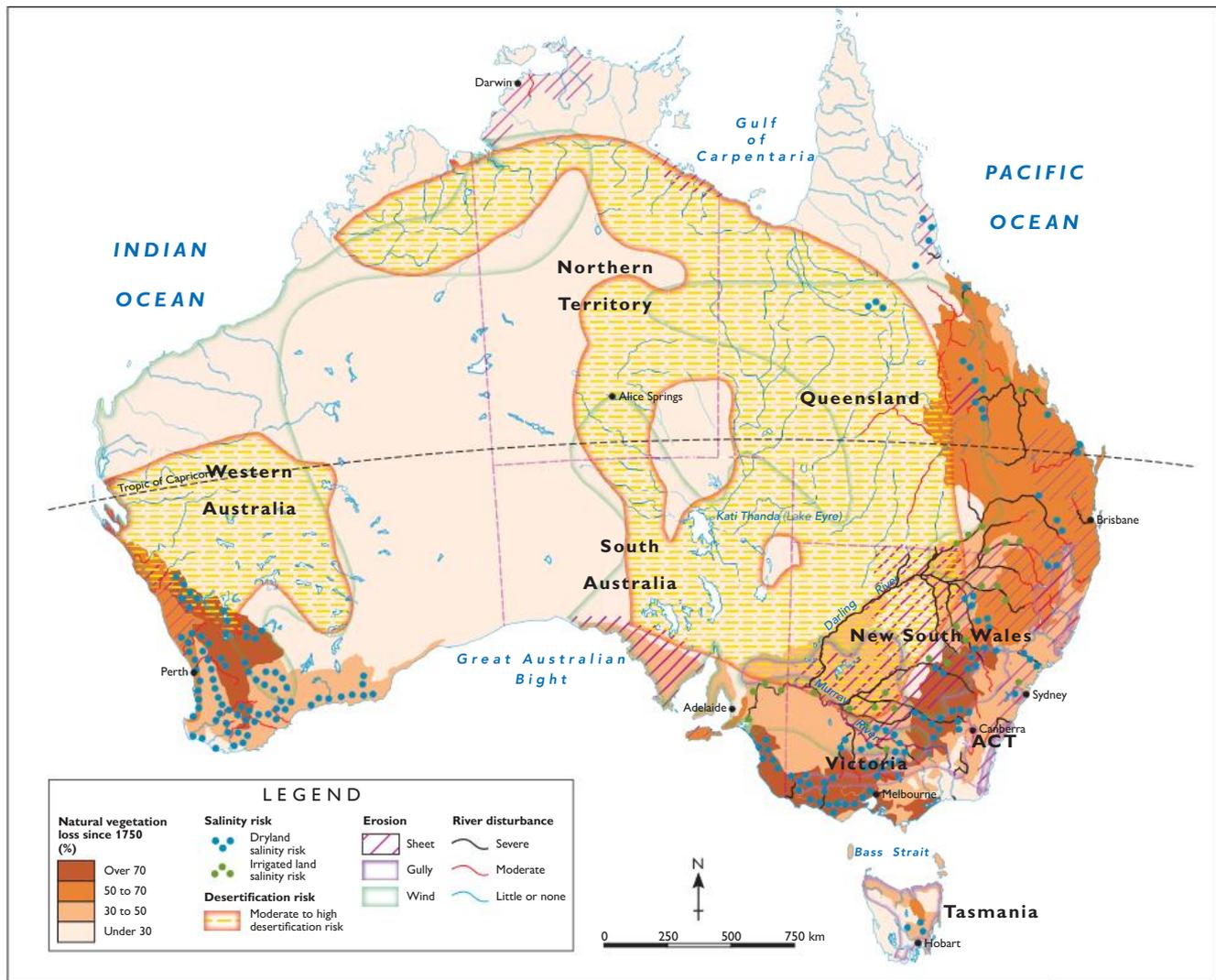
Soil **erosion** is when soil is gradually worn away by natural phenomena such as rivers, rain, waves, glaciers and the wind. Human activities, particularly clearing trees for farming, accelerate erosion in many places. Cleared land is more vulnerable to wind erosion, gully erosion (water scouring away the land) and sheet erosion (the loss of topsoil over a large area). Much of Australia is at risk from one or more of these types of erosion (see Source 6.31).

### Ecosystem decline

As well as soils, the natural ecosystems of an area, such as forests and streams, can become degraded. This may be through a loss of vegetation, the invasion of alien plant and animal pests or a decline in the quality of streams and rivers. When coupled with a decline in soil quality, a degradation of ecosystems can lead to **desertification**, particularly in areas close to existing deserts.

**Source 6.30** In some arid and semi-arid areas of Australia, cattle grazing has led to a breakdown in soil structure and the loss of plants. This can lead to areas such as this becoming desertified.

## AUSTRALIA: DISTRIBUTION OF LAND DEGRADATION



Source 6.31

Source: Oxford University Press

### REVIEW 6.1.9

#### Remember and understand

- 1 What is land degradation?
- 2 Why is land degradation a concern for many people in Australia and around the world?

#### Apply and analyse

- 3 Conduct research to compare the footprint of a cow with that of a kangaroo. What does this tell you about the relative impacts of introduced and native species on Australia's soils?
- 4 Use an atlas to estimate the distance covered by the 2009 dust storm shown in Source 6.29.
- 5 Examine Source 6.31.
  - a Describe the areas of Australia at risk from gully erosion. Use the names of states and specific places in your description. You may need to refer to a more detailed map of

Australia to assist you.

- b Which areas are most at risk from salinity?
- c List those areas that are at risk from erosion, salinity and desertification.
- d Use the SHEEPT method to list the reasons why some places are more at risk of land degradation than others. For more information on the SHEEPT method, refer to section GT.2 of 'The geographer's toolkit'.

#### Investigate and create

- 6 Examine Source 6.30, showing a degraded environment in Australia. Discuss in a small group some steps that could be taken to restore this land. Use these steps to develop and present an action plan. This should include an annotated copy or field sketch of Source 6.30.

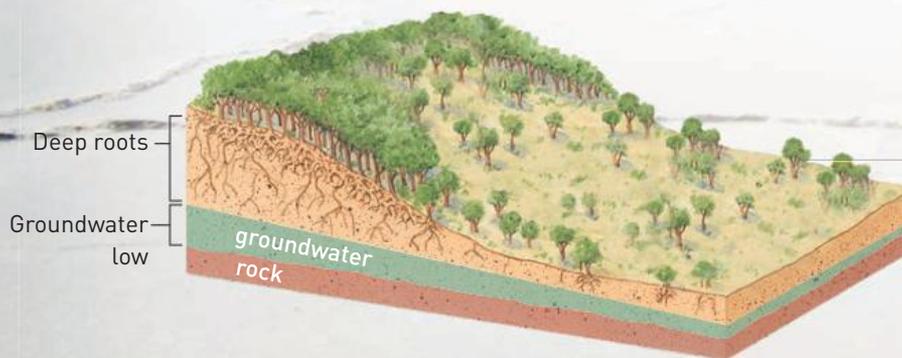
# SOIL DEGRADATION: SALINITY

Salt is a natural part of the Australian environment. Deposited by salt-laden winds from the sea and from the weathering of rocks, it is a component of most soils. It has been estimated, for example, that in parts of Western Australia the soil typically contains between 170 and 950 tonnes of salt per 10 000 square metres. Because this salt has accumulated slowly over millions of years, Australia's native vegetation has adapted to the salty soils. The native deep-rooted trees and shrubs soak up much of the rainwater entering the soil. This keeps the **water table** low in the ground and means the salt stays deep in the soil and away from plant roots.

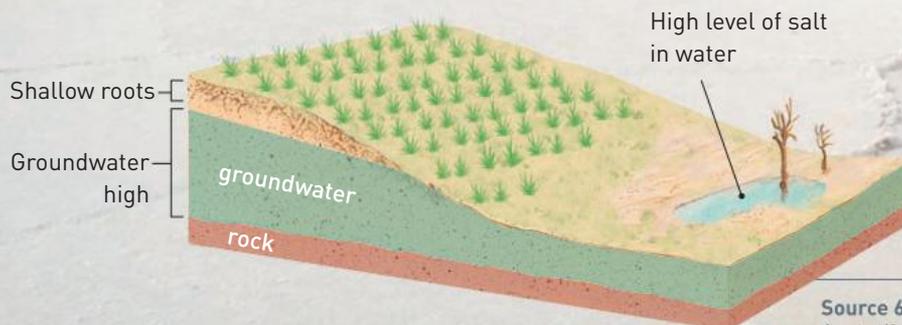
However, changes in the Australian landscape since the arrival of Europeans have significantly altered this system. Large areas of native vegetation have been cleared and replaced with shallow-rooted crops and grasses (see Sources 6.33 and 6.34). This means that much more water is held in the soil and so the water table rises, bringing with it the salt that has accumulated over millions of years. It collects in low-lying areas, killing the introduced plants. As the water evaporates, salt is left at or near the surface, creating large salt pans where nothing can grow (see Source 6.32). The salt also moves across the landscape turning freshwater streams into salty drains.

In some places, **irrigation** also increases the amount of water in the soil. This has the effect of raising the water table and bringing salt to the surface. Studies estimate that salinity currently affects 19 500 Australian farms and 20 000 square kilometres of agricultural land, much of it in Western Australia's wheat belt. At present, it has the potential to affect 46 000 square kilometres of agricultural land. This is expected to increase to 136 000 square kilometres within 50 years. This makes salinity Australia's most serious and widespread land degradation issue.

**Source 6.32** Salt rising to the surface in the Western Australian wheat belt



**Source 6.33** Salt in the Australian landscape before land clearing



**Source 6.34** Salt in the Australian landscape after land clearing

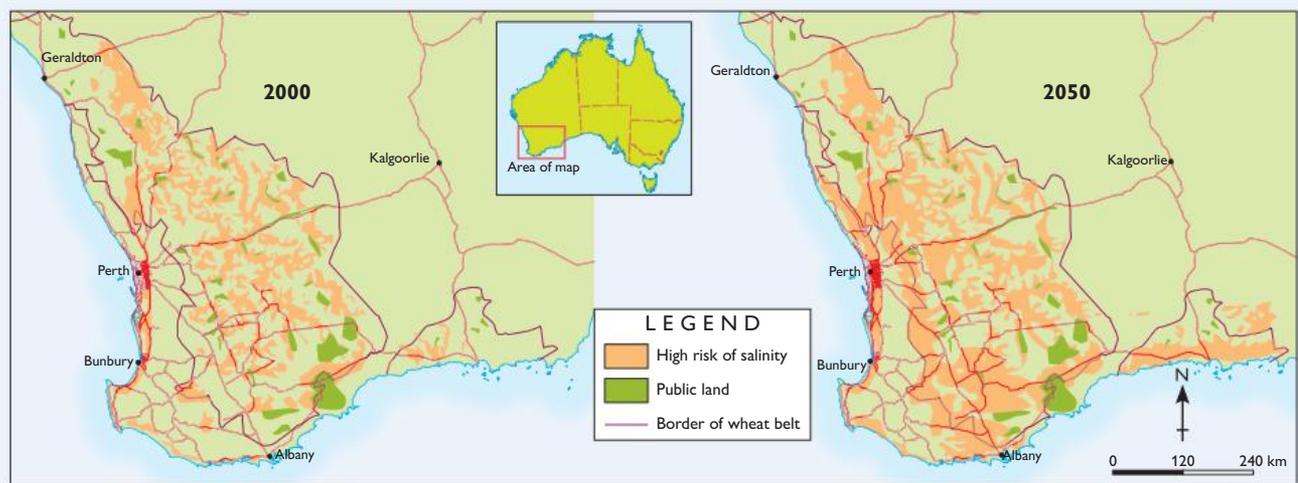
## KEY CONCEPT: CHANGE

### Salinity in the Western Australian wheat belt

The largest area of salty soils in Australia is in the south-west corner of Western Australia, a region known as the wheat belt. This is a vast area of 19.3 million hectares, 16 per cent of which is at risk of salinity due to rising water tables. Most of this is agricultural land and salinity would result in lost profits for farmers of at least \$80 million a year. Source 6.35 shows the areas of the wheat belt with rising water tables in 2000 and the predicted salinity-affected areas in 2050.

Salinity in the wheat belt also poses a threat to biodiversity as plants and animals lose their habitats. As salt accumulates in the low-lying regions in the landscape, such as freshwater lakes, plants and animals that live in these regions are at the greatest risk. At least 1500 plant species in Western Australia suffer from salinity with 450 possibly becoming extinct. Animal species are likely to decline by one-third if salinity continues to spread. For more information on the key concept of change, refer to section GT.1 of 'The geographer's toolkit'.

### WESTERN AUSTRALIA: DRYLAND SALINITY RISK IN THE SOUTH-WEST IN 2000 AND 2050



Source 6.35

Source: Oxford University Press

## REVIEW 6.1.10

### Remember and understand

- 1 Where does salt in the soil come from naturally?
- 2 How did the arrival of European settlers in Australia affect soil salinity?

### Apply and analyse

- 3 Classify the causes of salinity using the SHEEPT method. For more information on SHEEPT, refer to section GT.2 of 'The geographer's toolkit'.
- 4 Examine Source 6.35.
  - a Describe the predicted change in salinity in the wheat belt between 2000 and 2050 both in terms of area and distribution.

- b How do you think this change will impact on the natural environment of the region?
- c One of the largest costs of salinity is road repair. Why do you think this might be the case?

### Investigate and create

- 5 Discuss ways in which farmers may be able to lower the water table and reduce salinity.
- 6 Australia is not the only country to suffer from soil salinity. Research salinity in one other country, such as Bangladesh, Spain or Egypt. Compare the causes and effects of salinity in Australia with those in the country of your choice. What are the similarities and differences?

# ECOSYSTEM DECLINE: DISAPPEARING FORESTS

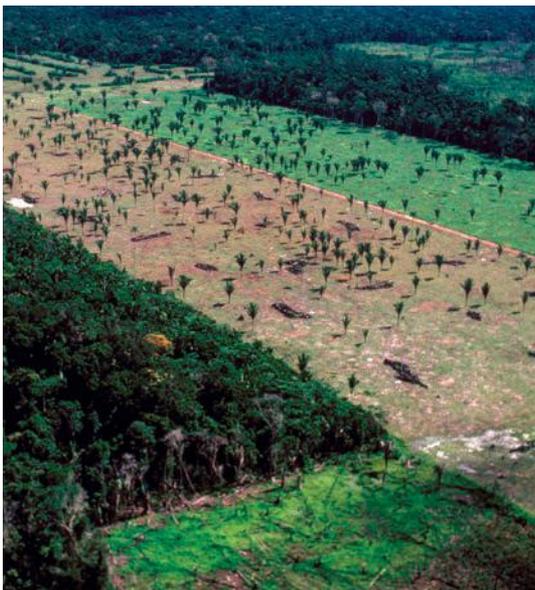
One of the leading causes of land degradation on a global scale is **deforestation**. Forests have been cleared by humans for thousands of years. Traditionally, forests have been cleared for farming, to make way for human settlements and to provide building materials. Today, two key economic realities continue to drive deforestation:

- Trees grow slowly and other crops such as soya beans grow quickly. As populations continue to grow and expand, and people tend to their current needs rather than the needs of future generations, forests continue to be cleared and replaced by farms to provide people with income and food.
- Many ecosystem services provided by forests, such as absorbing and storing carbon and filtering water, do not have a monetary value and cannot be bought and sold. Produce from farms and timber from forests are easily bought and sold so are seen as more valuable to local populations than intact forests.

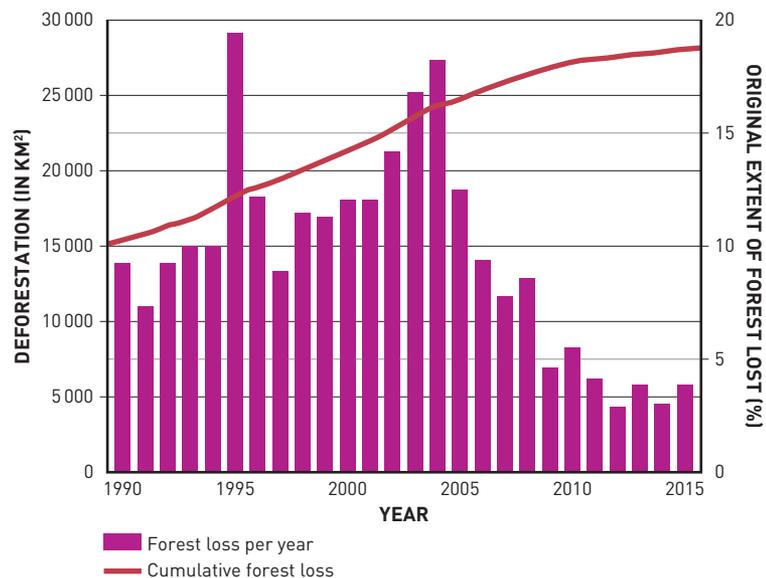
## CASE STUDY

### The Amazon rainforest

The Amazon, the world's largest tropical **rainforest**, provides an example of the changes that are sweeping across many forest biomes today. Well known as a biodiversity hot spot due to its large numbers of plant and animal species, the Amazon is now considered to be an environmental hot spot too. The Amazon covers an area roughly the size of Australia, but since the 1970s, an area the size of New South Wales has been cleared for other uses. In recent years, rainforest clearing has slowed but still continues. Source 6.37 shows deforestation levels since 1990. Some climate scientists believe that unless the remaining rainforest is protected, a combination of climate change, droughts, fires and deforestation will gradually turn the rainforest into **savannah** and **grasslands**.



**Source 6.36** A section of Amazon rainforest in Brazil that has been cleared for cattle ranching



**Source 6.37** Annual and cumulative deforestation of the Amazon rainforest in Brazil

## Using satellite images to analyse environmental change

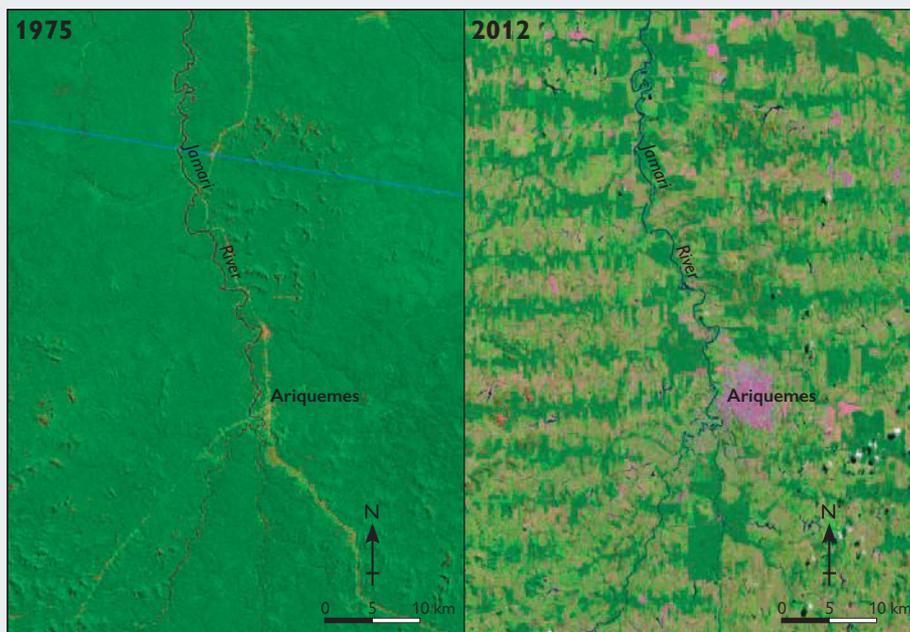
Dual satellite images are a useful tool for observing change over a large region of the Earth's surface. By examining them closely, you can describe changes that have occurred and suggest explanations for these changes.

- Step 1** Examine two satellite images taken at the same location at different points in time.
- Step 2** Locate the area on the Earth's surface using an atlas.
- Step 3** Look closely at the first image. Describe the natural and human features that you can see.
- Step 4** Describe the differences between the first image and the second one.

- Step 5** Try to quantify the changes. For example, if there has been desertification, calculate the area of desert shown in each of the images. The difference will give you the area that has changed over time.
- Step 6** Suggest an explanation for these changes based on your observations.

### Apply the skill

- 1** The two satellite images in Source 6.38 show a section of the Amazon rainforest in the state of Rondônia, western Brazil, in 1975 and 2012. Follow the steps above to describe the satellite images shown and explain the changes that have taken place in this section of the rainforest over the 37-year period.



**Source 6.38** Two satellite images of a section of the Amazon rainforest in the state of Rondônia, western Brazil. The image on the left was taken in 1975 and the image on the right was taken in 2012.

## REVIEW 6.1.11

### Remember and understand

- 1 Why are forests cleared?
- 2 What do many climate scientists believe may happen to the Amazon rainforest in the future?

### Apply and analyse

- 3 Look closely at Source 6.37.
  - a Describe the trend in Amazon forest loss since 1990.
  - b Roughly calculate the average amount of rainforest lost each year.
- 4 Look closely at Source 6.36.
  - a Brainstorm the ecosystem services provided by an intact rainforest. Refer to Source 6.2 for a list of ecosystem services.

- b Highlight those services that will be lost if the rainforest is cleared and underline those services that will be changed but not lost.
- c How would replacing forests with farms affect biodiversity?

### Investigate and create

- 5 Imagine that the Brazilian Government decided to ban forest clearing and instead encourage people to replant the forest.
  - a How would this decision affect ecosystem services and the Brazilian economy?
  - b Is this likely to happen? Give some reasons for your answer.

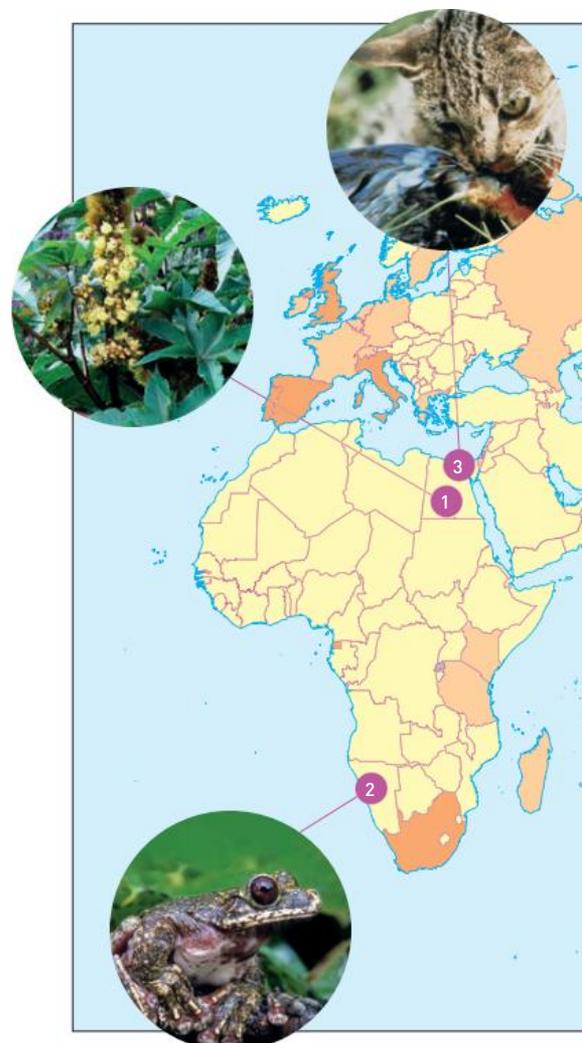
# ECOSYSTEM DECLINE: INVASIVE SPECIES

'Invasive species' is a term used by geographers and scientists to describe groups of organisms (such as plants, animals, bacteria and fungi) found in an area they are not native to. In many cases, invasive species upset the biological diversity of areas they spread to and can have other negative effects. Many ecosystems around the world are threatened by invasive species of plants, animals and insects. Sometimes, invasive species are brought to a new place deliberately. For example, goats and rabbits were brought to Australia on the First Fleet to provide a source of food for the new settlers. Other species may be brought to a new place accidentally. For example, rats often hide aboard ships going to new places. Other marine pests were brought to Australian seas unintentionally in ballast water carried on container ships.

However they move from one place to another, invasive species have the potential to degrade the land and disrupt the natural balance of the ecosystem. They often compete with native species for food, land or water, leading to a loss of biodiversity. Australia has 362 invasive species, the second highest number in the world (see Source 6.39). Some of the world's most successful invasive organisms include the castor oil plant, frog chytrid fungus, domestic cat, black rat, American mink and the water hyacinth.



## WORLD: NUMBERS OF INVASIVE SPECIES BY COUNTRY



### 1 Castor oil plant (*Ricinus communis*)

**Native to:** North-east Africa and the Middle East

**Invaded:** Common on every continent except Antarctica

**Method of invasion:** Carried as an ornamental plant and cash crop in the production of castor oil. Seeds dispersed by rodents and birds

**Preferred biomes:** Grassland, temperate forest

**Impacts:** Displaces native plant species, poisonous to many animal species including humans

### 2 Frog chytrid fungus (*Batrachochytrium dendrobatidis*)

**Native to:** Africa

**Invaded:** All six continents. The fungus has infected 93 frog species, more than half of which are Australian.

**Method of invasion:** Frogs carrying the fungus introduced as a food source and for scientific purposes.

**Preferred biomes:** Rainforests, freshwater sources

**Impacts:** About one-third of all amphibian species have the fungus, causing a decline of frog species worldwide.

### 3 Domestic cat (*Felis catus*)

**Native to:** Unknown (first domesticated in ancient Egypt)

**Invaded:** Virtually every country, listed as a harmful species in more than 60

**Method of invasion:** Carried as pets or to keep down rat numbers and then released or escaped into the wild

**Preferred biomes:** Grasslands, forests and tundra close to water

**Impacts:** Caused or contributed to the extinction of birds and small mammals around the world, particularly on islands

### 4 Black rat (*Rattus rattus*)

**Native to:** South-East Asia, north-east China and India

**Invaded:** Widespread around the world

**Method of invasion:** Deliberately introduced as a food source or accidentally introduced as a stowaway on ships

**Preferred biomes:** Grassland, temperate forest, tropical forest

**Impacts:** Preys on native birds (especially flightless species and the eggs of sea birds), reptiles and insects, eats native plants and seeds, major agricultural pest. They have caused or contributed to the extinction of birds, mammals, reptiles and plants.

### 5 American mink (*Neovison vison*)

**Native to:** North America

**Invaded:** Widespread throughout Europe

**Method of invasion:** Bred in mink farms for their fur, they escape or are released by animal activists

**Preferred biomes:** Forests near wetlands and rivers

**Impacts:** Kills large numbers of native species such as voles and salmon, can drive native mink from their habitats

### 6 Water hyacinth (*Eichhornia crassipes*)

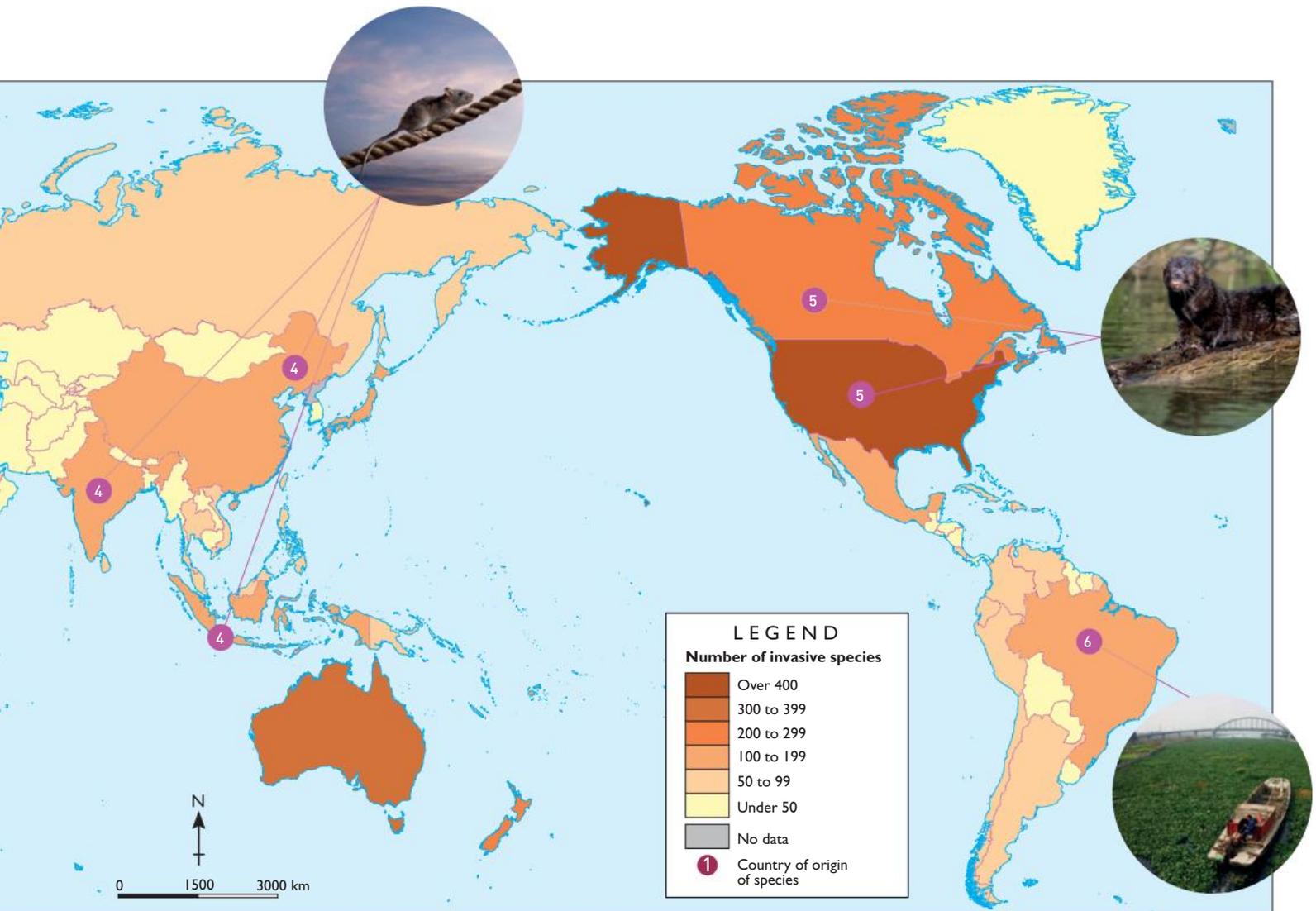
**Native to:** South America

**Invaded:** Widespread in streams and rivers around the world particularly in North America and Europe

**Method of invasion:** Carried as an ornamental plant

**Preferred biomes:** Freshwater sources including rivers, lakes and streams

**Impacts:** Grows as a thick mat clogging rivers and streams, inhibiting plants and some fish species and providing a habitat for other pests including malarial mosquitoes



Source 6.39

Source: Oxford University Press

## REVIEW 6.1.12

### Remember and understand

- 1 How do invasive species move between countries?
- 2 How can an animal that is not a pest in one country become a major pest when introduced to a new country?
- 3 How do rats cause land degradation?

### Apply and analyse

- 4 Compare the six examples of invasive organisms shown. What are some of the similarities? How is each unique? Which do you consider has had the greatest impact?

- 5 Examine Source 6.39.

- a Which countries have the highest numbers of invasive species?
- b Why do you think these countries have so many invasive species? What features do they share that might help to explain the high numbers?
- c Why do you think that Africa and the Middle East have such low numbers of invasive species?

### Investigate and create

- 6 Some researchers consider humans to be an invasive species. Complete a file card for the human

species describing their method of invasion, preferred biomes and impacts.

- 7 Australia is one of the most invaded countries but is also the origin of many plants and animals that are considered invasive species in other countries. These include the golden wattle, Queensland fruit fly, Australian magpie, spotted jellyfish and brushtail possum. Research one of these invading Australians. Describe how and where it has spread and its impact on native plants and animals.

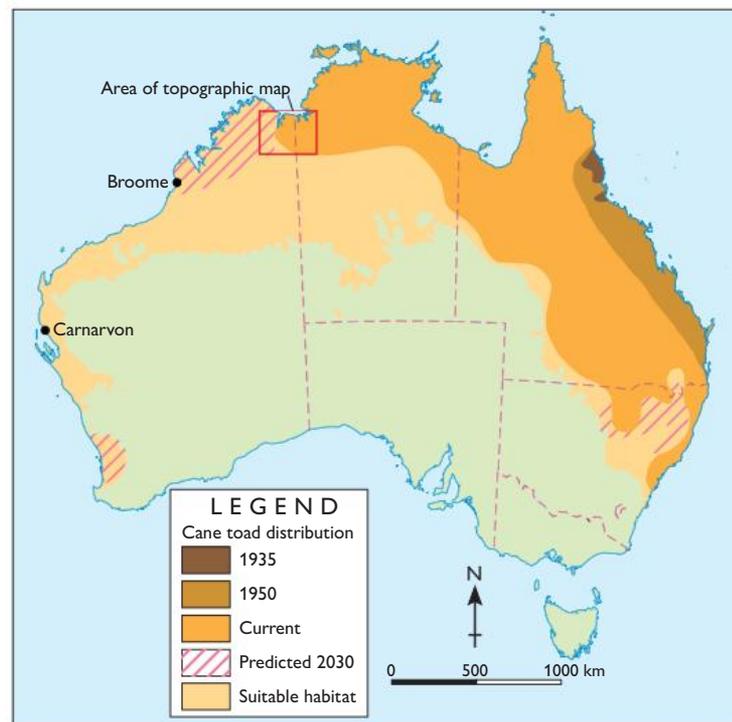
# INVASION OF THE CANE TOAD

Native to Central and South America, cane toads were released in northern Queensland cane fields in 1935 to help control cane beetles, which were eating and destroying the sugarcane plants. The cane toads were of little benefit to the farmers but as they spread beyond the cane fields, southwards into New South Wales and westwards towards Western Australia, they soon became pests themselves. Like many introduced species, cane toads have no natural predators in Australia, so there was little to stop their spread.

Animals such as snakes, goannas, freshwater crocodiles and quolls have eaten frogs for millions of years. They see cane toads as a new food source. However, the poisonous skin of the cane toad kills its attacker within minutes. This is devastating the local populations of these native animals.



AUSTRALIA: DISTRIBUTION OF CANE TOADS, 2012



**Source 6.40** The cane toad has become a serious pest in Queensland and the Northern Territory.

**Source 6.41**

Source: Oxford University Press

## REVIEW 6.1.13

### Remember and understand

Examine Source 6.41.

- 1 Estimate, in square kilometres, the size of the region currently inhabited by cane toads.
- 2 Estimate the size of the region cane toads are predicted to inhabit under current climate conditions.
- 3 How do you think climate change will affect the distribution of cane toads? Why do you think this is the case?

### Investigate and create

- 4 Kakadu National Park in the Northern Territory contains vast areas of protected wetlands and large numbers of unique plants and animals. Cane toads were first detected in the park in 2001 and since then have had a range of devastating effects on this unique environment. Research these effects and the efforts taken by park authorities to minimise them. Discuss the effectiveness of these methods with your classmates.

## Using a topographic map to explore environmental change

Topographic maps are one of the most useful tools used by geographers. By adding extra information, topographic maps can be used to show changes over time and the reasons for these changes. Source 6.42 has been drawn to show the expansion of the cane toad's territory every year from 2006 to 2012. The **contour lines** on the topographic map show the shape of the land over which the cane toads are spreading. Geographers use this information to measure and predict the rate and direction of the cane toad's spread. Follow these steps:

- Step 1** Look closely at the lines and dates showing cane toad expansion to estimate in which direction the spread is moving.
- Step 2** Are the lines becoming closer together or further apart from one year to the next? This will tell you if the rate of spread is increasing or decreasing.
- Step 3** Select an area between two lines that shows a typical rate of spread. Use the scale to estimate

the distance between the lines. This will give you a rate in kilometres per year. Divide this by 52 to give you a rate per week.

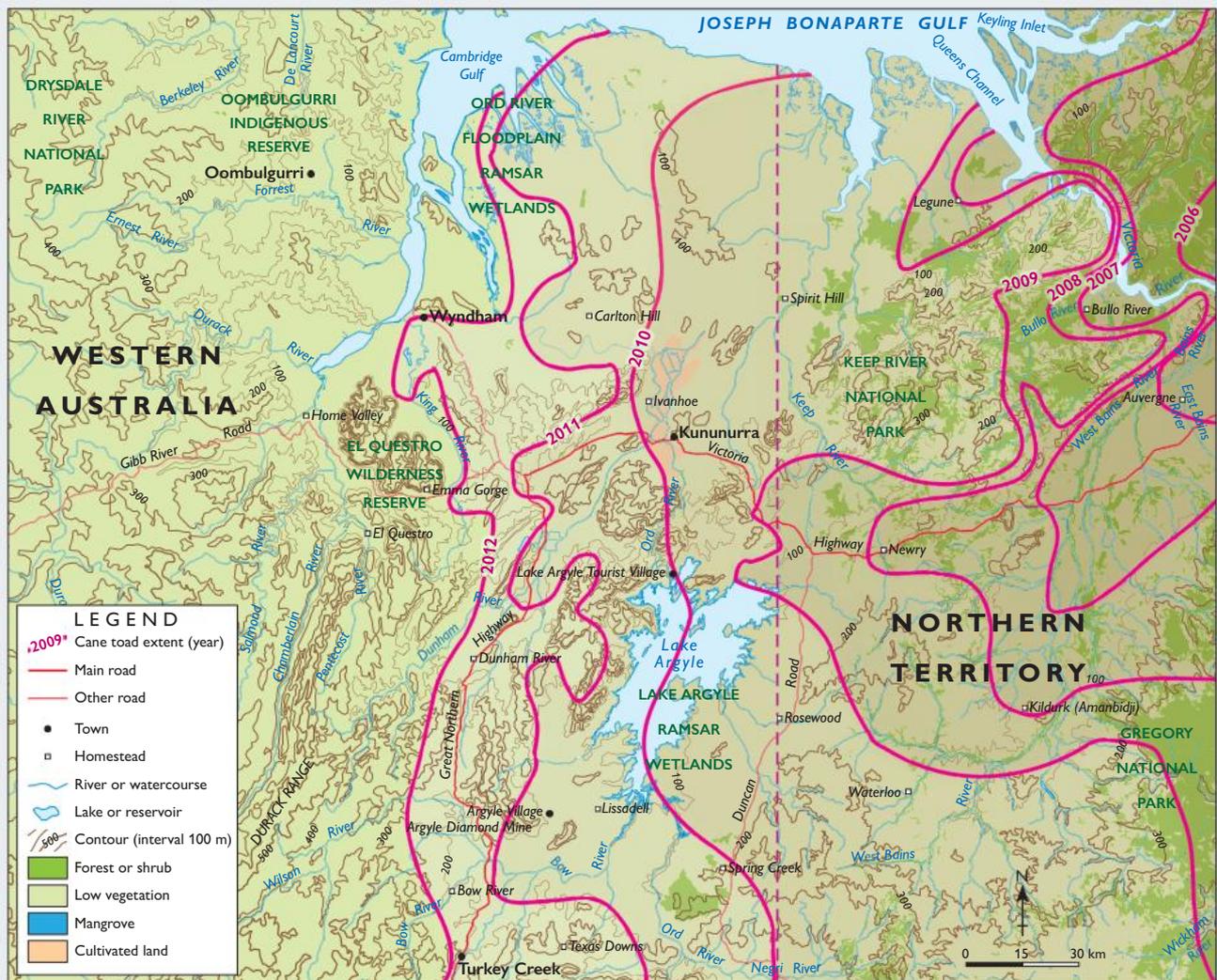
- Step 4** Look at the contour lines and other features shown in the legend to identify any natural or built features that are affecting the pattern and rate of spread being shown on the map.

### Apply the skill

Examine Source 6.42 and complete the following tasks.

- 1 Estimate the direction in which cane toads are spreading across northern Australia.
- 2 Calculate the rate of spread between 2011 and 2012.
- 3 Use the rate of spread, together with the scales in Sources 6.41 and 6.42, to estimate the amount of time it will take cane toads to spread to Broome and Carnarvon.
- 4 What natural features appear to be affecting the rate of spread of the cane toad?

NORTH-EAST WESTERN AUSTRALIA AND NORTH-WEST NORTHERN TERRITORY: ADVANCE OF THE CANE TOAD 2006–2012



Source 6.42

Source: Oxford University Press

# WATER DEGRADATION

Inland waters such as rivers, lakes and wetlands are some of the world's most degraded environments. Human activities have reduced the quality and quantity of clean fresh water in many of these places. Extracting water from rivers to use in homes, factories and farms, and damming rivers for water supply, flood control and hydroelectricity have all affected the health of these inland waters. Pollution from farms and industry sources entering these waters has also caused damage.

People extract large amounts of fresh water from various natural sources. The highest demand for fresh water is for irrigating farms to grow food. In Australia, for example, 70 per cent of the water extracted from rivers and **aquifers** is used in farming. As the world's population and its demand for food and water grow, many of the world's water resources are becoming degraded by having too much water extracted. This has led to shrinking lakes in some regions and increased salinity in the water in others.



**Source 6.43** An irrigation dam near Mahabaleshwar in western India

## Damming the rivers

Of the world's 292 large river systems, two-thirds have been changed by dams and reservoirs. Dams disrupt the flow of water, flooding some areas and stopping water reaching other areas. Damming also disrupts ecosystem services such as the provision of fresh water, fertile soil and food production. The natural interaction between rivers and coastal ecosystems is degraded as fewer nutrients and less water and sediment reach the river mouth and sea.

## Pollutants in the water

Water pollution is the contamination of our rivers, lakes, wetlands, estuaries, seas and oceans. This pollution can be the result of human activities near the water, such as shipping, fishing and oil drilling, or from activities conducted on land, a long way from the waterways. Land activities such as the use of fertilisers and pesticides in farming, littering, clearing land, creating tips and landfill, processing sewage and industrial activities can all cause pollution of the waterways.

The results of water pollution are devastating. People lose access to safe, clean drinking water. Fish and other animals in the water are killed or slowly decline in health and population numbers and important food sources are lost. In extreme cases, water pollution can contribute to widespread food shortages and famine.

**Source 6.44** A toxic bloom of blue-green algae caused by excess nutrients from farm fertilisers has built up in a dam in northern California.



## KEY CONCEPT: SUSTAINABILITY

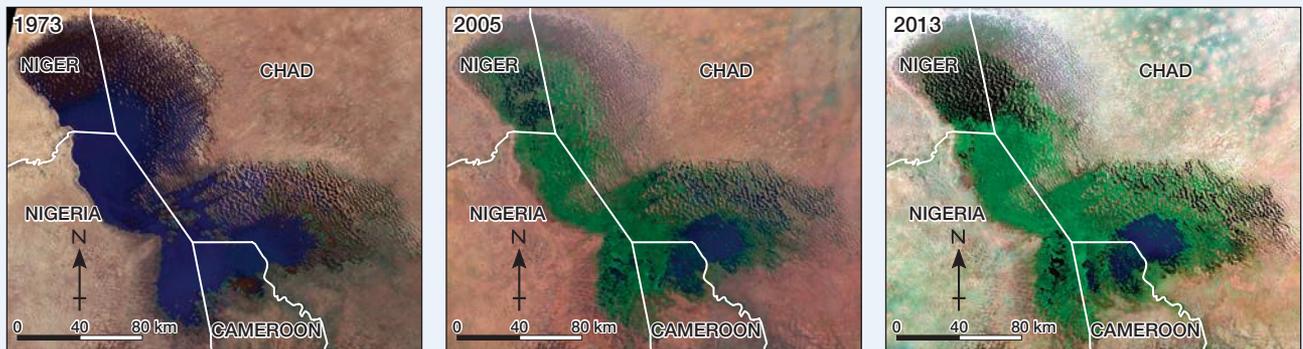
### Africa's disappearing lake

Lake Chad was once one of Africa's largest and most important freshwater lakes. It provided water to millions of people across four countries and supported a great diversity of wildlife. In 1963, it was the world's sixth largest lake with a total surface area of 23000 square kilometres. By 2001, this had declined by almost 75 per cent to a paltry 300 square kilometres. This decline is due to a combination of factors including:

- increasing population in the region (for example, the population of all four affected countries is expected to double by 2050 adding another 300 million people to the region)

- increasing demand for water to irrigate crops
- drying of the climate due to a decrease in the number of large rainfall events such as monsoonal storms
- extremely high rates of evaporation due to the climate and the shallowness of the lake
- increasing desertification in the Lake Chad catchment area.

For more information on the key concept of sustainability, refer to section GT.1 of 'The geographer's toolkit'.



Source 6.45 Satellite images of Lake Chad

## REVIEW 6.1.14

### Remember and understand

- 1 In what ways can building a dam contribute to water degradation downstream?
- 2 Which human activities contribute to water degradation?

### Apply and analyse

- 3 How do you feel about the scene in Source 6.44? What has caused water degradation in this river?
- 4 Use the SHEEPT method to classify the factors responsible for the degradation of freshwater resources around the world. (For more information on the SHEEPT method refer to section GT.2 of 'The geographer's toolkit'.)
- 5 Examine Source 6.45.
  - a Describe the changes in Lake Chad evident in these three satellite images.

- b Do you think that Lake Chad will disappear completely? Give some reasons for your answer.
- 6 Examine Source 6.43.
    - a Why do you think this dam might have been constructed? Give evidence from the photograph for your answer.
    - b How has this dam changed the natural environment?

### Investigate and create

- 7 Construct a flow diagram to explore the links between the factors responsible for the decline of Lake Chad.
- 8 What are some of the issues affecting the health of fresh water resources in your region?

# WATER DEGRADATION IN THE MURRAY-DARLING BASIN



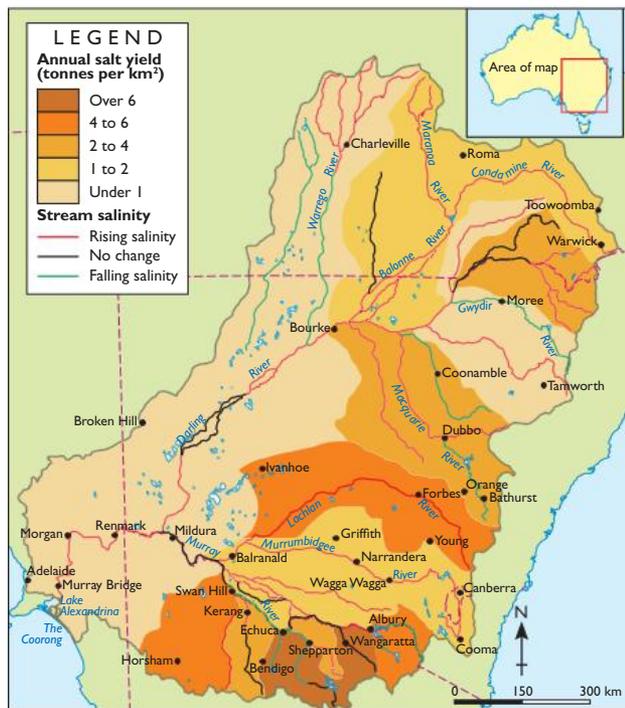
The Murray–Darling Basin is one of Australia’s most important resources. Home to more than two million people, it produces one-third of Australia’s food. It also generates 39 per cent of Australia’s income, raised from selling food and fibre overseas. This includes more than half of Australia’s cereals, including all of its rice and virtually all of its oranges.

Many farmers capture rainwater in dams and use it to irrigate their crops and fields but rainfall in the basin is highly variable. If additional water is needed for irrigation it is drawn from the rivers feeding the basin. Farming, along with the basin-wide clearing of natural vegetation, has led to widespread salinity problems in the soil and water resources of the region.

While the amount of salt in the basin is not increasing, it is becoming more concentrated in certain areas. Brought to the surface by the impact of human activities, it is moving into the streams and rivers. As the salt levels increase, natural ecosystems are placed under stress and cannot cope.

**Source 6.46** Salty water seeps from the ground into streams and lakes near Loxton, South Australia.

## MURRAY-DARLING BASIN: MOVEMENT OF SALT TO THE SURFACE



**Source 6.47**

Source: Oxford University Press

Salt-sensitive plants and animals are dying and are being replaced by plants that flourish in the increasing salinity, changing the ecology of the rivers.

Human activities are being affected too. The water is becoming less suitable for domestic uses such as drinking and cleaning, and cannot be used to irrigate crops and pastures. The salty water also corrodes the metal pipes the water is transported in.

As salt is moved downstream, areas nearer to the mouth of the river are becoming even saltier. In the irrigation regions of northern Victoria, areas of rising water tables are predicted to triple in the next 50 years, bringing more salt to the surface and into the tributaries of the Murray River. Without efforts to remove salt from the system, river salinity at the town of Morgan is expected to increase by 25 per cent in the same time period.

## Managing salinity in the Murray-Darling Basin

There has been a range of responses to the issue of salinity in the Murray–Darling Basin, some at the local scale and others at the regional scale. The effectiveness of these



management responses has differed from place to place, however, and in some instances the response has created new problems. Two main approaches to salinity management in the basin are currently being used. One approach is to improve farming systems so that farmers use less water. Another approach is the use of salt interception schemes.

At 17 places along the Murray River, salty water is pumped from the ground and carried to a basin (known as a salt management basin) before it can flow into a river or stream. The salt management basin is often lined with sheets of plastic so the salt is trapped. It is estimated that these schemes stop half a million tonnes of salt entering the river system. One such scheme operates at Pyramid Creek near the town of Kerang in northern Victoria (Source 6.48). Salt from this scheme is harvested by a private company, Pyramid Salt, and is sold for use as table salt and swimming-pool salt. The company expects to harvest 36 000 tonnes of salt per year under the scheme.

## CASE STUDY

### Salt interception in Pyramid Creek

#### PYRAMID CREEK: SALT INTERCEPTION SCHEME



**Source 6.48** Satellite image of Pyramid Creek near the town of Kerang, northern Victoria, and the Pyramid Salt company with their salt harvesting ponds

#### REVIEW 6.1.15

##### Remember and understand

- 1 Explain why stream salinity is a major problem in the Murray–Darling Basin despite the total amount of salt in the region staying relatively constant.
- 2 Describe the impacts of salinity shown in Source 6.46.

##### Apply and analyse

- 3 Examine Source 6.47.
  - a Which regions of the Murray–Darling Basin produce the most salt?

- b Why do you think this might be the case?
- c List the rivers in the Murray–Darling Basin that have rising salinity.

##### Investigate and create

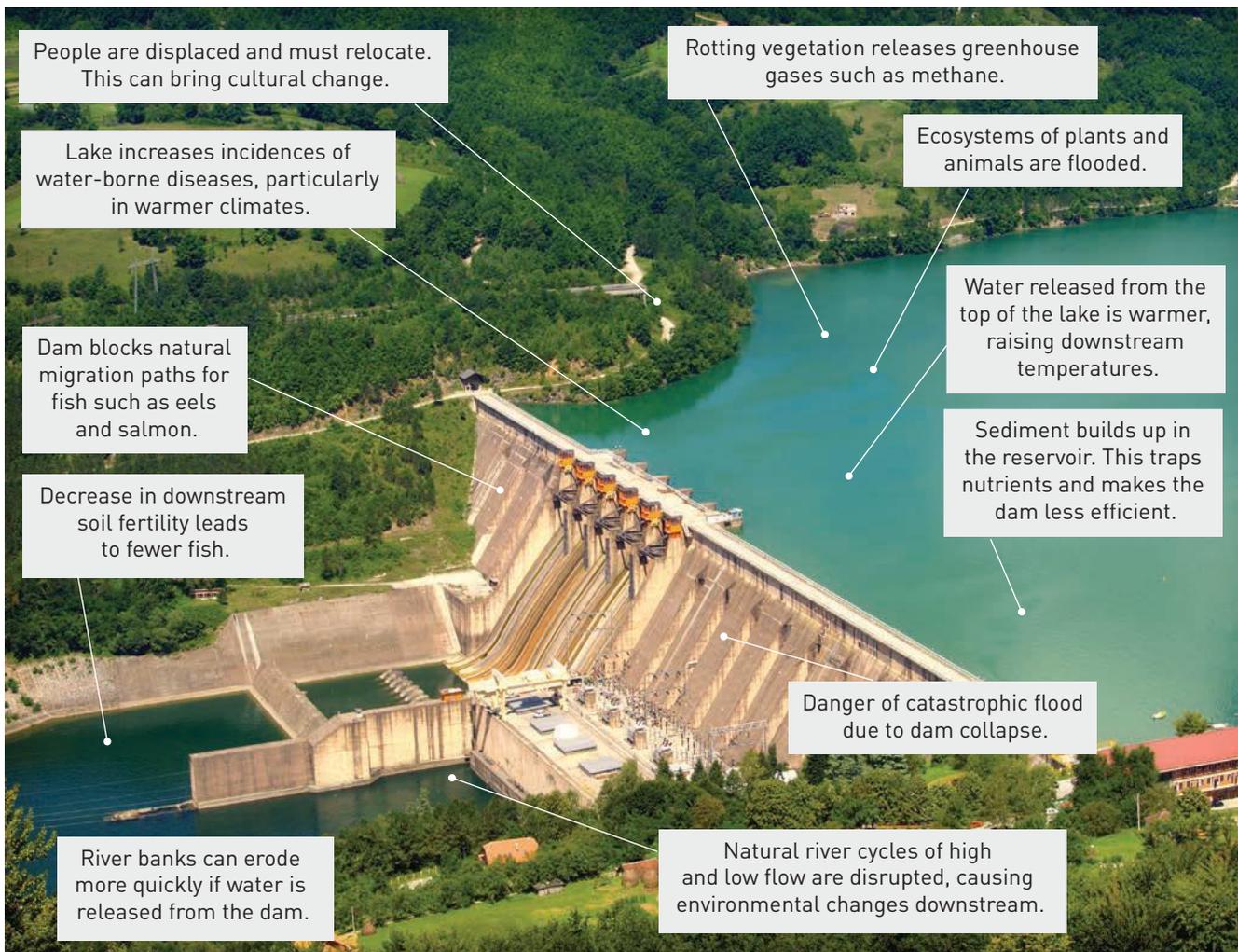
- 4 The managers of the Pyramid Creek salt interception scheme believe that incorporating salt harvesting helps to make the scheme more sustainable. What do you think this means?

# DAMMING THE RIVERS

There are many human activities that bring environmental change to streams and rivers but perhaps the most dramatic of these is building a dam across a river. One of the main reasons dams are built is to allow a reservoir of water to build up behind the dam, which can then be used for the irrigation of farms, a reliable water supply for towns and cities, flood control and recreation. The energy of the moving water can also be captured behind the dam, and when released through pipes and turbines inside the dam can be used to generate electricity.

This type of electricity (hydroelectricity) provides a cleaner alternative to other methods of power generation such as coal and oil burning. As international pressure mounts to reduce carbon emissions, more and more dams are being built across fast-flowing rivers all over the world. Generally speaking, the bigger the dam, the greater the amount of electricity it can generate. Big dams (over 15 metres high) are now considered the most efficient. There are more than 50 000 big dams in the world, half of which are in China, where there are 1600 more under construction. China is by far the world's leading hydroelectricity generator and is home to the Three Gorges Dam, the largest dam in the world.

While big dams bring many benefits, they can also create problems for the environment. Source 6.49 shows some of the human and environmental impacts of damming a fast-flowing river.



Source 6.49 Some of the human and environmental impacts of damming rivers

## KEY CONCEPT: SUSTAINABILITY

### The world's largest river restoration project

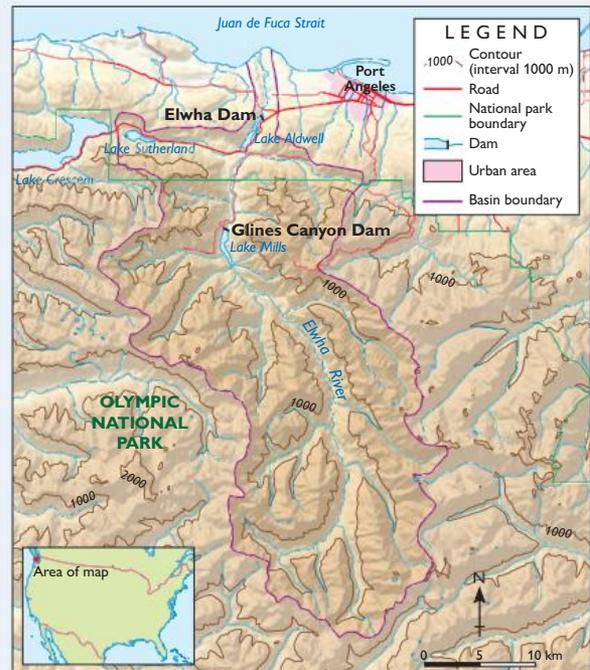
While much of the world seems engaged in a dam-building frenzy, in the north-western United States two large dams are being torn down piece by piece. For nearly 100 years there have been hydroelectricity dams on the Elwha River in Washington State, but in 2011 excavators mounted on barges began dismantling them.

Most of the Elwha River runs through the Olympic National Park. Studies on the impact of the dams found that natural ecosystems had significantly declined in quality and capacity as a result of the dams. The greatest impact was on the Chinook salmon, whose migration route to spawning rivers had been blocked. This resulted in a 70 per cent decrease in spawning sites (where salmon reproduce). This then affected river fertility and reduced the amount of food available to wildlife such as bears in the national park. By removing the dams, it is hoped that the natural ecosystems will be restored.

For more information on the key concept of sustainability, refer to section GT.1 of 'The geographer's toolkit'.



### ELWHA RIVER: FORMER LOCATIONS OF THE ELWHA RIVER DAM AND THE GLINES CANYON DAM



Source 6.50

Source: Oxford University Press

Source 6.51 The 64-metre-high Glines Canyon dam partially removed in March 2012

## REVIEW 6.1.16

### Remember and understand

- 1 Why are many fast-flowing rivers dammed?
- 2 Why has the Glines Canyon dam been removed?

### Apply and analyse

- 3 Most of the world's big dams are in China. Brainstorm the factors that may be responsible for this. Classify them using the SHEEPT method. (For more information on the SHEEPT method, refer to section GT.2 of 'The geographer's toolkit'.)
- 4 Examine Source 6.50.
  - a Describe the location of the dams on the Elwha River.

- b Estimate the length of this river and the area of its catchment.
- c Why is it important to consider the whole catchment rather than just the river when analysing the impact of a dam?

### Investigate and create

- 5 Source 6.49 shows some of the negative impacts of dams. Create a similar diagram with a dam's potential positive impacts on people and the environment.
- 6 Debate this topic: 'Despite their negative impacts, dams are beneficial to people and the environment.'



# POLLUTANTS IN OUR WATER

More than one billion people around the world today lack access to safe drinking water. This is due to many factors, one of which is the contamination of freshwater sources such as rivers, streams and groundwater with harmful substances. As well as making water unsafe to drink, pollutants reduce the ability of the environment to provide other ecosystem services such as food supply, pest control and recreation.

Pollutants that enter our waters can be classified as either physical, chemical or biological.

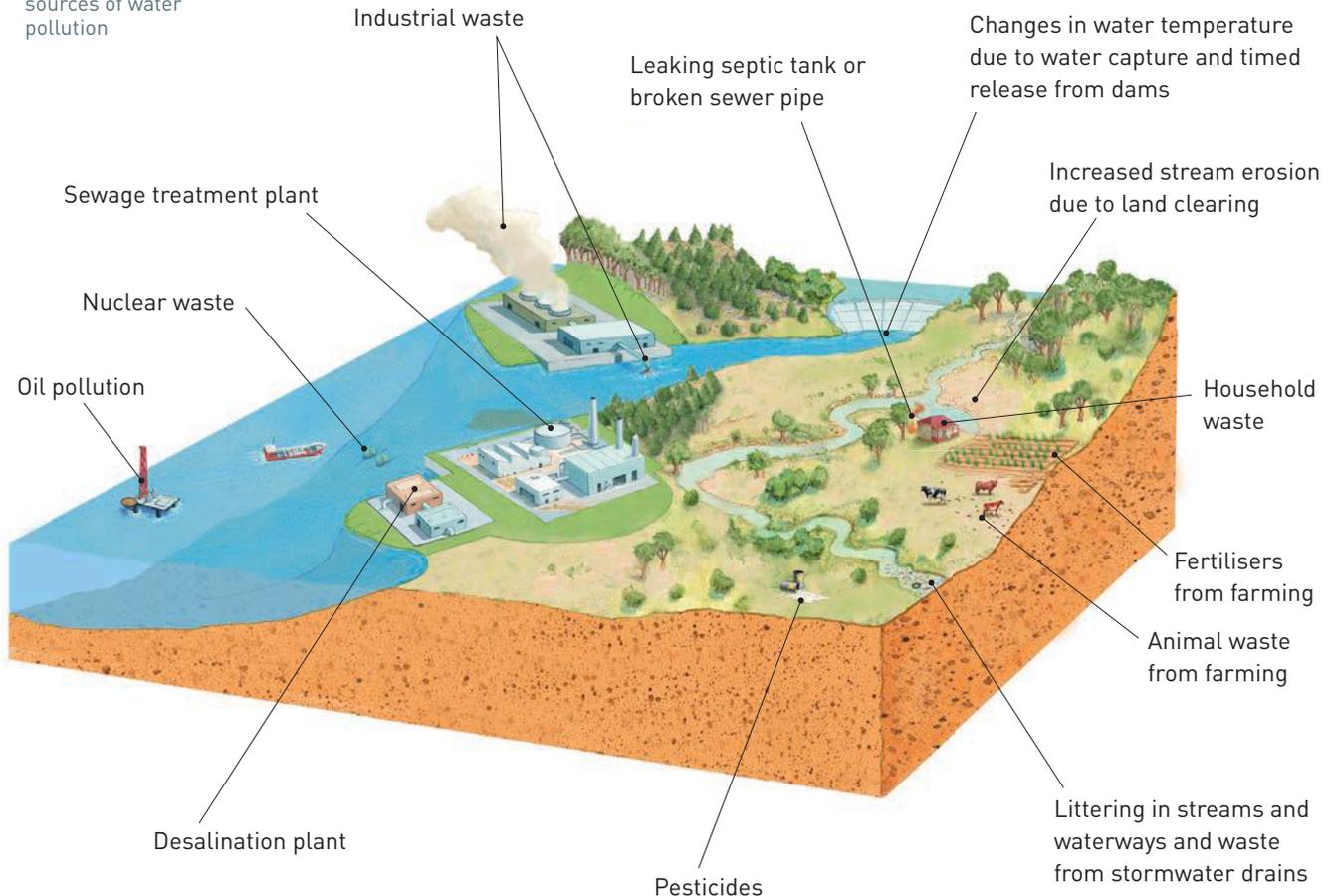
## Physical pollutants

**Physical pollutants** include particles of soil eroded from the landscape and washed into the waterways and any litter such as plastic bags, cigarette butts, shopping trolleys and tyres. It is estimated, for example, that more than seven billion cigarette butts are littered in Australia each year. Many of these end up washed into drains and carried to streams and coasts where they release chemicals and present a danger to marine life and sea birds.

Soil washing into the waterways is a major source of pollution. These particles of soil can make water cloudy and prevent sunlight entering the water, affecting the plants and animals. When the sediment settles, it can smother small animals and plants living in the water. These sediment particles may also have other substances bound to them such as chemicals and bacteria that can cause pollution.

**Source 6.52** An estimated 100 million tonnes of mining waste was discharged into the Queen River in Tasmania between 1893 and 1995, giving it the reputation as Australia's most polluted river.

**Source 6.53** Major sources of water pollution



## KEY CONCEPT: PLACE

### The Ganges River

One of the world's most polluted rivers is the Ganges River of India. An estimated 2900 million litres of sewage is emptied into the river every day, creating a toxic river. In addition, the river is used to dispose of medical waste, dead bodies and waste from tanneries (where leather is made from animal skins) and other factories. A count of harmful bacteria in the river found levels 100 times higher than those considered safe for human use. Millions of people rely on the water of the Ganges for drinking, bathing and cleaning, as well as for its spiritual significance.

For more information on the key concept of place, refer to section GT.1 of 'The geographer's toolkit'.



**Source 6.54** Around two million people a day bathe in the Ganges River, one of the world's most polluted rivers.

## Chemical pollutants

**Chemical pollutants** include heavy metals, oils, pesticides, industrial chemicals and salt. When the concentration of chemicals in waterways reaches levels that are above natural levels it causes pollution. For example, too much of a naturally occurring plant nutrient changes the chemical balance of water, causing excessive plant and algae growth.

## Biological pollutants

**Biological pollutants** include bacteria, parasites and invasive plants and animals. Biological pollutants come from a range of sources including sewage treatment plants, farms, factories and storm water. They can cause harm to other plants and animals in the water, or cause harm to people who drink the water. Bacterial and parasitical pollution such as giardia in the water is usually spread by human and animal waste entering waterways, causing illness.

### REVIEW 6.1.17

#### Remember and understand

- 1 What are the three main types of water pollution?
- 2 Which of these is the main source of pollutants in the Ganges River?

#### Apply and analyse

- 3 Examine Source 6.53, showing some of the main sources of water pollution. Classify each of these as physical, chemical or biological.
- 4 Besides water pollution, what other environmental impacts of mining can you identify in Source 6.52, showing the Queen River valley? How might these also contribute to water pollution?
- 5 There have been several government attempts to reduce pollution in the Ganges River but these have

been largely ineffective. Discuss some possible reasons for this with a partner and then with your class.

#### Investigate and create

- 6 The United Nations considers these 10 rivers to be the most 'at risk': Salween-Nu, Danube, La Plata, Rio Grande, Ganges, Indus, Nile, Murray-Darling, Mekong and Yangtze.
  - a Locate each of these rivers on a world map and describe their distribution.
  - b Select one of these rivers and research the problems it faces.
  - c Present your findings to the class.

# 6.1

## CHECKPOINT

### HOW DO PEOPLE'S WORLDVIEWS AFFECT THEIR ATTITUDES TO AND USE OF ENVIRONMENTS?

- Investigate human-induced environmental changes across a range of scales.
- 1 Identify five ecosystem services provided by the environment? [5 marks]
  - 2 Why is it that some people become passionate about preserving the natural environment while others do not? Give two reasons. [4 marks]
  - 3 Construct an argument for each of the four worldviews: egocentric, anthropocentric, ecocentric and biocentric. [16 marks]
    - In one sentence, describe the worldview.
    - What is your position on the worldview (are you for it or against it)?
    - Give three reasons for your position.
    - Give at least two facts to back up each reason you have.
    - Sum up the reasons in one concluding sentence.
  - 4 Explain the concept of living sustainably. [5 marks]
  - 5 Building dams on rivers creates both positive and negative changes to natural environments. Outline two positive and two negative changes that may result from damming a fast-flowing river. [4 marks]
  - 6 Describe three of the causes of human-induced climate change. [6 marks]
  - 7 What impact is the increasing global population having on the quality of the Earth's environment? [10 marks]

TOTAL MARKS [ /50]

### RICH TASK

#### Biosphere 2

Biosphere 2 was widely reported to be a catastrophe. In 1999, when *Time* magazine did its end-of-the-century summary of the 20th century, it included Biosphere 2 in its list of the worst 100 ideas. As an attempt to create a balanced and self-sustaining replica of Earth's



Source 6.55 Layout of the biomes and human habitat of Biosphere 2

ecosystems, Biosphere 2 was a miserable (and expensive) failure. Numerous problems plagued the crew almost from the beginning.

Biosphere 2 was the largest closed ecological system in the world. Located near Oracle, Arizona, the glass and space-frame structure measured nearly 200 000 cubic metres and stretched up to 26 metres at its highest point. Its steel struts were covered with a finish that insured against corrosion from inside or outside the biosphere. All air, water and nutrient cycles were completely closed and recycled within this system.

The monitoring of climate, air, soils and water within Biosphere 2 was unprecedented. Over 1000 sensors distributed throughout the biosphere sent information to the sophisticated monitoring and control system located on-site at Mission Control. This elaborate computer network provided a continuous display of environmental variables and the status of engineering controls – while constantly updating the permanent database.

The ecological systems of Biosphere 2 included agriculture, a human habitat and five wilderness biomes of an ocean, a tropical rainforest, a savannah, a marsh and a desert. Each different biome was built from scratch – with carefully selected soils, water and plant and animal life collected from all over the world. Biosphere 2 sustained high biodiversity with approximately 3800 living species within its glass walls.

**Source 6.56** Simulating Earth: Comparing the features of Biosphere 1 and 2

	Biosphere 1	Biosphere 2
Location	EARTH, solar system	Oracle, Arizona, USA
Foot print	311.22 billion hectares	7.78 hectares
Biomes	13 wilderness biomes	5 wilderness biomes
Species	10–40 million	3800
Population	7.3 billion humans	8 humans
Energy source	Sun, fossil fuels	Sun, fossil fuels
Age	3.5 billion years	25 years

Source: Adapted from TED talk 'Jayne Poynter: Life in Biosphere 2', March 2009

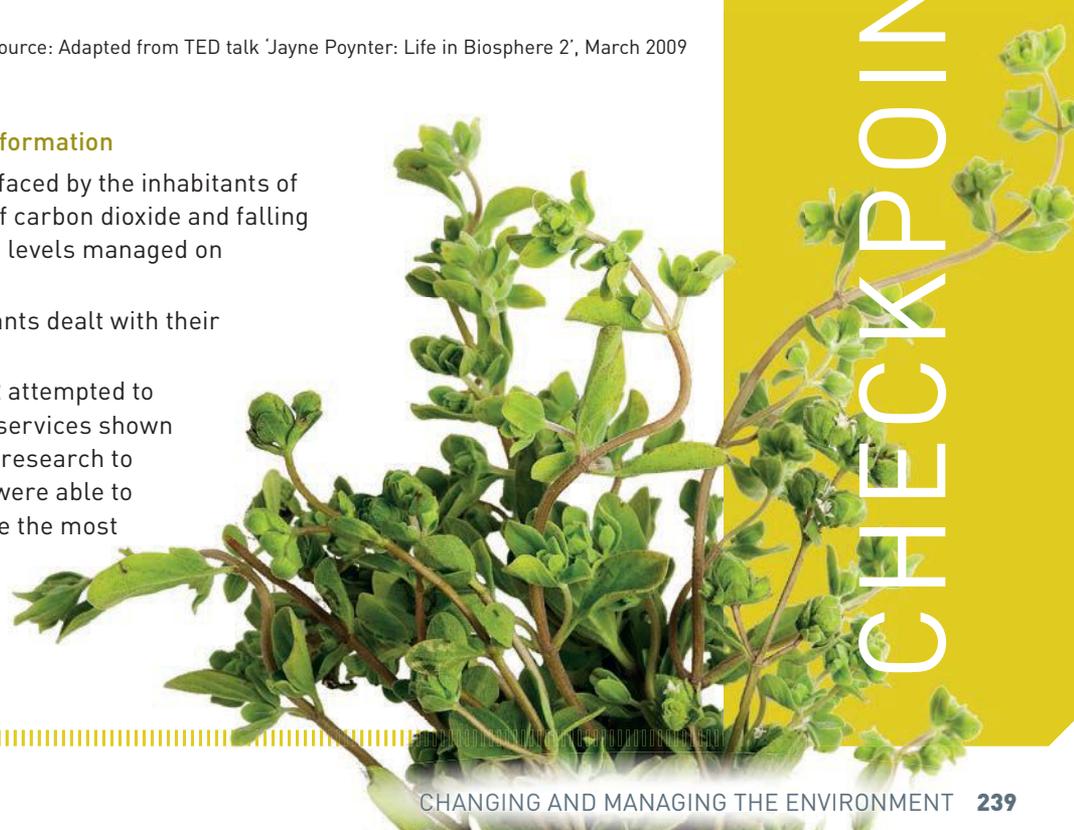
### Communicating geographical information

- 1 One of the biggest problems faced by the inhabitants of Biosphere 2 was a build-up of carbon dioxide and falling oxygen levels. How are these levels managed on Earth?
- 2 How do you think the inhabitants dealt with their waste?
- 3 The designers of Biosphere 2 attempted to provide all of the ecosystem services shown in Source 6.2. Conduct some research to find out which services they were able to provide easily and which were the most difficult to provide.

In this Checkpoint and Rich Task, you will be applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Sustainability, Scale, Environment, Change
  - » Inquiry skills: Communicating geographical information
  - » Tools: Data tables
- For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT



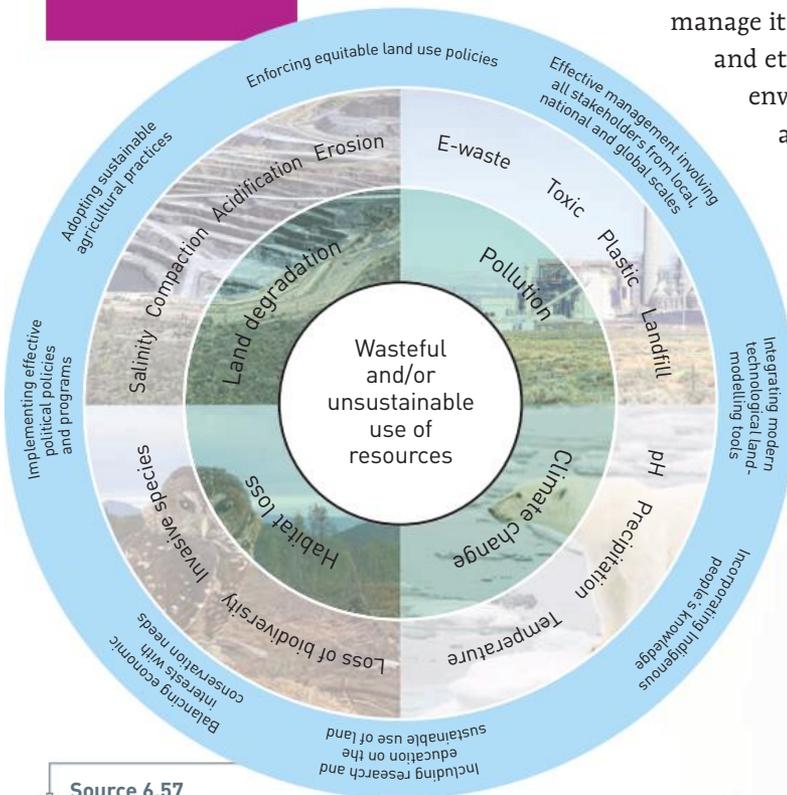
# 6.2 CHOICE, CHANCE, CHANGE

WHAT ARE THE CAUSES AND CONSEQUENCES OF CHANGE IN ENVIRONMENTS AND HOW CAN THIS CHANGE BE MANAGED?

Choosing to live sustainably means using the Earth's natural resources without depleting or degrading the resource base supplying them. The challenge is to balance acceptable use with protection of the dependent natural resources. Failure to do this results in change. Too much change may result in environmental problems (as seen in Source 6.57) as ecosystems are unable to return to their original state without significant modification(s). For example, clearing a forest permanently removes an owl's habitat, it may survive if there is a similar forest nearby and not too many other owls to compete with for food, or it may become a new addition to the IUCN red list of threatened species. The owl's best chance for survival is appropriate management. Strategies may include the application of technology, education, legal regulation, changes in behaviour or the introduction of traditional practices.

Major environmental worldviews differ on which is more important – human needs and wants or the overall health of ecosystems and the world environment. The way we view the seriousness of environmental change and how to manage it depends on both our environmental worldview and ethics. Experts have disagreed about how serious our environmental changes are and what we should do about them. However, many environmental scientists and leaders now believe that we must make a shift towards a more sustainable lifestyle in our lifetime.

Environmentalist Lester R Brown, in 2006, warned of the urgent need to manage the changes: 'We are entering a new world, one where collisions between our demands and the Earth's capacity to satisfy them are becoming daily events. Our global economy is outgrowing the capacity of the Earth to support it. No economy, however technologically advanced, can survive the collapse of environmental support systems.' So, what do we do? Paul Hawken, in 2009, succinctly stated the challenge: 'First we need to decide what needs to be done. Then we do it. And then we ask if it is possible.'

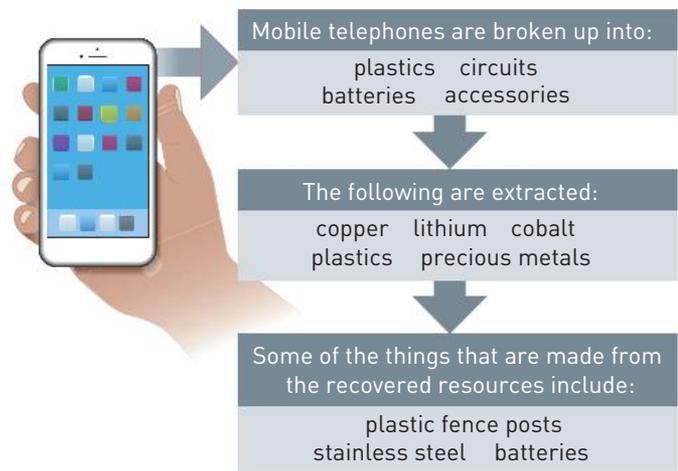


**Source 6.57** Environmental change is dependent on human decisions about management.

**Source 6.58** The major difference in worldview is the emphasis placed on the role of humans in dealing with environmental changes/problems.

Increasing constraints/controls placed on the use of natural resources		
Exploitation [Planetary Management]	Conservation/Sustainable use [Stewardship]	Preservation [Environmental Wisdom]
<p>Humans are the most important element.</p> <p>Technological advancements are paramount.</p> <p>Human use of natural resources to produce the materials we need to provide for growing human population, e.g. clearing of forest to mine coal</p>	<p>All living things are the most important = balance.</p> <p>Human use of natural resources to produce the materials we need without depleting them or damaging the resource base, e.g. fishing licences and controls on size and species fished</p>	<p>Integrity of nature is the most important element.</p> <p>Human use that attempts to maintain natural ecological integrity and processes through legal regulation, minimising human impact and often banning certain activities, e.g. national parks</p>

**Source 6.59** Represents a shift in thinking to include more human responsibility to protect both human health and the environment



**From:**

- pollution clean-up
- waste disposal
- protecting species
- environmental degradation
- increased resource use
- conspicuous consumption
- population growth
- depleting and degrading natural capital

**To:**

- pollution prevention
- waste prevention and reduction
- habitat protection
- environmental restoration
- more efficient resource use
- living simply
- stabilised population growth
- protecting natural capital and living on what we can produce from it

**REVIEW 6.2.1**

**Remember and understand**

- 1 Why do we need to manage environmental change?
- 2 How is stewardship seen as a compromise between environmental wisdom and planetary management?

**Apply and analyse**

- 3 Examine Source 6.57 carefully before completing the following tasks.
  - a Describe the human-induced environmental changes and identify the ecosystem services that have been affected.
  - b Outline the consequences of the environmental changes.
  - c Explain how pollution, climate change and land degradation could also contribute to the owl's habitat loss.

- d Discuss the importance of a variety of sustainable management approaches to avoid future habitat loss.

**Investigate and create**

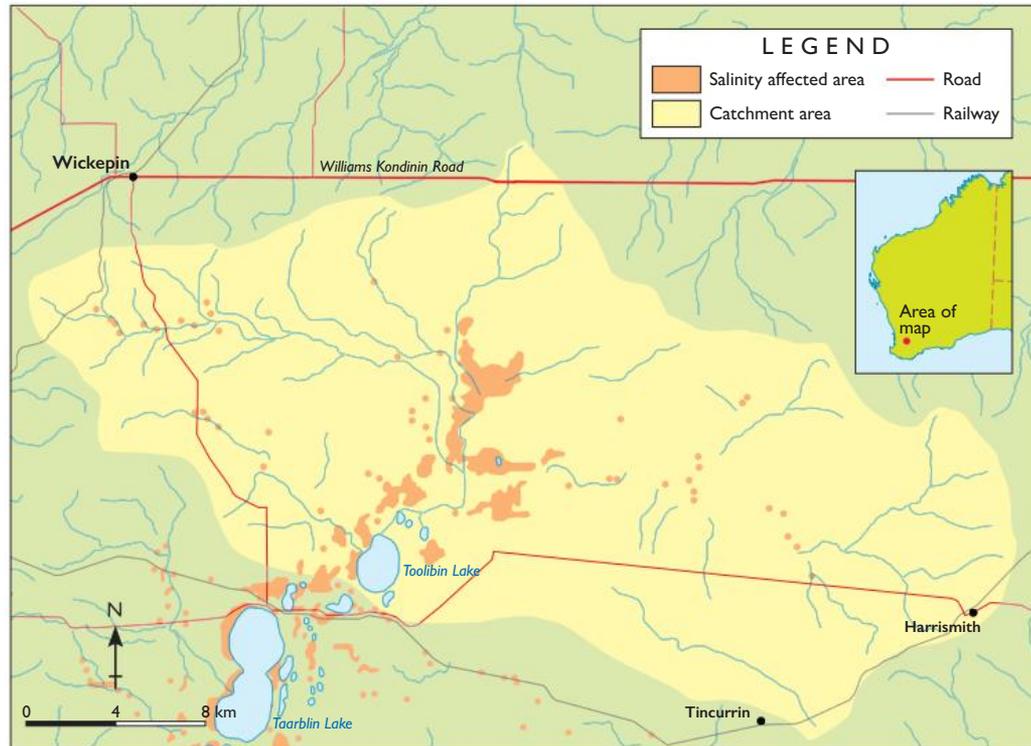
- 4 Most social change results from individual actions and individuals acting together to bring about change. Estimate your own ecological footprint by using one of the calculator tools available on the internet.
  - a Is your ecological footprint larger or smaller than you expected?
  - b Explain why you think that this is so.
  - c List three ways in which you could reduce your ecological footprint. Try to maintain the three ways for a full week and then write an editorial for the Sunday newspaper to report on your experience.

# TOOLIBIN LAKE

## Repairing degraded land

In many local areas, attempts are being made to repair the damage of the past. These attempts tend to be small in scale, as repairing degraded land is expensive and difficult to achieve over a large area. For the repairs to be effective and not cause further damage, it is important for those undertaking the work to have a detailed understanding of the complex ecology of the site.

### TOOLIBIN LAKE: AREAS OF SALINITY



#### Source 6.60

Source: Oxford University Press

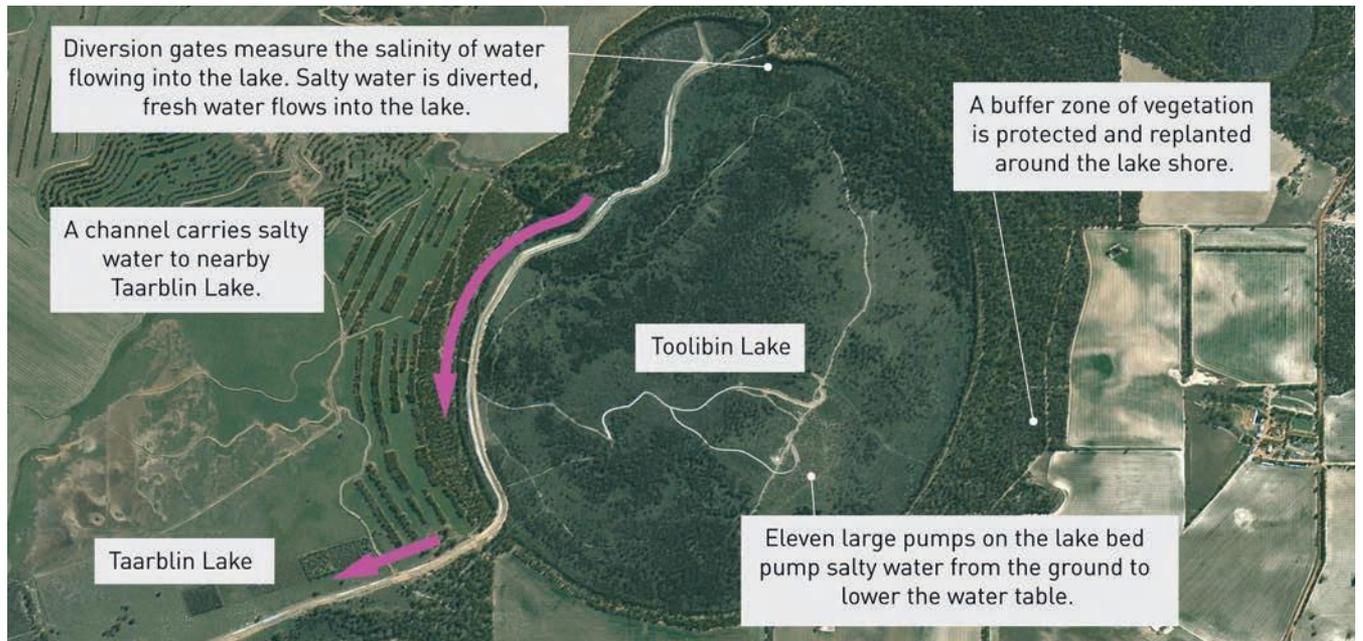
## Fighting salinity at Toolibin Lake

Toolibin Lake, in the Western Australian wheat belt, is a small ephemeral wetland (meaning it only fills with water occasionally, depending on rainfall).

As one of the last remaining freshwater wetlands in the region, it contains important habitats for a number of plant and animal species, many of which are endangered. In the 1970s, the lake bed began to show signs of increasing salinity and many trees died. Source 6.60 shows the distribution of salinity in the area. A geographic investigation found that this was due to the flow of salty water into the lake from surrounding farmland together with a rising water table. In the 1990s, a number of measures were put in place to lower the water table and reduce the salinity (Source 6.61).

These measures included measuring the salt levels in the stream that flows into the lake and diverting excessively salty water to a nearby lake. Pumps on the lake bed were installed to lower the water table and to remove salty water from the soil. Around the lake, belts of trees were planted to intercept water as it flowed towards the lake and also to help in lowering the water table.

A review of these measures in 2010 showed that the water table had been held below the target of 1.5 metres across most of the lake. However, an analysis of satellite imagery from 1990 to 2009 showed that in some areas of the lake, trees had flourished but in other areas, they had continued to decline.



Researchers then examined the ways in which the two dominant tree species, sheoak and paperbark, had responded to changing water and salt levels. They found that the trees had responded in very different ways. New sheoak seedlings were found on the floor of the lake but the paperbark trees had continued to decline in health and numbers. This information could then be used to develop new management plans for the lake. Much of this is now centred on working with the local Landcare group. Landcare is a national network of thousands of locally based community groups who care for the natural resources of Australia. In Toolibin Lake much of this work has focused on increasing the number of trees planted on surrounding farms. The farms in the area tend to grow cereal crops such as wheat. Getting the farmers to put trees on their farms will further reduce salinity across the region.

**Source 6.61** An aerial photograph of Toolibin Lake showing the measures used to lower the water table and reduce salinity



**Source 6.62** The red-tailed phascogale, a small marsupial, is one of 32 rare or endangered animal species in the wheat belt.

## Building an eco-bridge

Additional measures are being introduced to help endangered animals in the region such as the red-tailed phascogale, which is a small marsupial. Farmers and other land managers are being encouraged to plant trees in corridors between existing stands of native trees, fence off remaining vegetation and creeks, and control feral pests such as cats and foxes. It is hoped that these activities will provide a large, linked safe area, known as an eco-bridge, for native species to thrive.

### REVIEW 6.2.2

#### Remember and understand

- 1 Where is Toolibin Lake located?
- 2 Why is the water in Toolibin Lake becoming salty?

#### Apply and analyse

- 3 Examine Sources 6.60 and 6.61 carefully before completing the following tasks.
  - a What are some of the possible causes of salinity that you can identify?
  - b What are some of the measures that were used to try and reduce salt levels in the lake?

- 4 What is an eco-bridge? Explain how the measures put in place to protect endangered species could also help to reduce salinity.

#### Investigate and create

- 5 In small groups, discuss why repairing land degradation in the Toolibin Lake area has been so difficult. What do you think this means for repairing the damage of a much larger area such as the entire Western Australian wheat belt?
- 6 Research a Landcare project in an area close to you. Who are involved in this project and what are their aims?

# MANAGING OUR FORESTS

Many of the world's forested areas have been altered by human activities. It has been estimated that of the 60 million square kilometres of forest that once covered the Earth, only about two-thirds still remains. Each year the world loses about 50 000 square kilometres of forest, most of it converted to farmland to support growing populations. For reference, the entire state of Tasmania is around 70 000 square kilometres. While deforestation may seem to be an unstoppable process, there are encouraging signs of change in some countries, including Australia.

As nations become more economically developed, rates of deforestation slow. In North America, for example, the total area of forest is increasing rather than decreasing. Similarly, rates of deforestation in Brazil have been declining for several years, as the country becomes more economically developed. There is also a greater awareness of the value of leaving forests intact due to the ecosystem services they provide, particularly the storage of carbon. In many places around the world, forests are being replanted to offset **carbon emissions** and to reclaim degraded land.

**Source 6.63** In the Philippines, local volunteers are replanting mangrove trees to restore important ecosystem services such as protection from storms, food supply and carbon storage.



**Source 6.64** Methods of slowing and reversing deforestation

## Slowing and reversing deforestation

- Conserving the remaining forests; for example, in reserves such as national parks
- Pricing forest ecosystem services such as carbon storage to encourage countries to protect forests
- Selective logging by cutting down only a few trees rather than clearing a whole forest
- The replacement and replanting of trees to increase forested areas
- Using timber grown in plantations rather than sourced from native forests
- New and improved farming practices to reduce the need for land to be cleared

## The Tarkine Wilderness Area

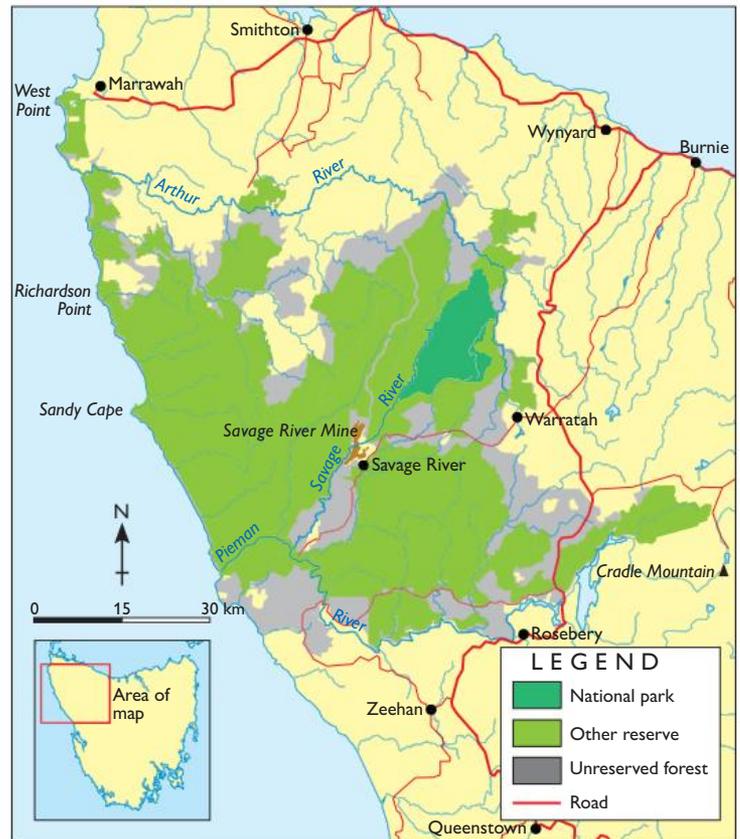
The Tarkine Wilderness Area of north-west Tasmania is home to one of Australia's most remarkable rainforests (Source 6.66). The forest is believed to have survived largely intact from the time when Australia was part of the ancient supercontinent Gondwana. It provides a habitat for over 60 rare, threatened and endangered species of plants and animals and has been described as one of the world's greatest archaeological sites because of evidence of ancient Aboriginal habitation.



**Source 6.65** The Savage River open-cut mine in the Tarkine Wilderness Area

Much of the Tarkine Wilderness Area is administered by Forestry Tasmania, a forest management company owned and operated by the Tasmanian Government, which has allowed some logging of the rainforest and several mines to operate in the area. Ten more mines are planned and mining companies have been given licences to examine 56 other potential sites. Environmental groups have campaigned for decades to have the forest protected as part of a **national park**. Although the Tarkine has been given National Heritage status, only about 5 per cent of the Tarkine rainforest is protected. Environmental campaigners continue to fight for more conservation of Tasmania's old-growth forests and protection from mining and logging interests.

### TASMANIA: THE TARKINE WILDERNESS AREA



**Source 6.66**

Source: Oxford University Press

### REVIEW 6.2.3

#### Remember and understand

- 1 What environmental factors have motivated the people shown in Source 6.63 to carry out this work?

#### Apply and analyse

- 2 Why do you think deforestation often slows when nations become more affluent and economically developed?
- 3 Describe the Savage River mine shown in Source 6.65. How has it changed the natural environment?

#### Investigate and create

- 4 While some people support the idea of a Tarkine National Park, others are opposed. Compile a list

of groups and individuals who you think would be supporters of the national park plan and another list of those you think would be against it. Beside each group you have listed, explain the likely motivation for their position.

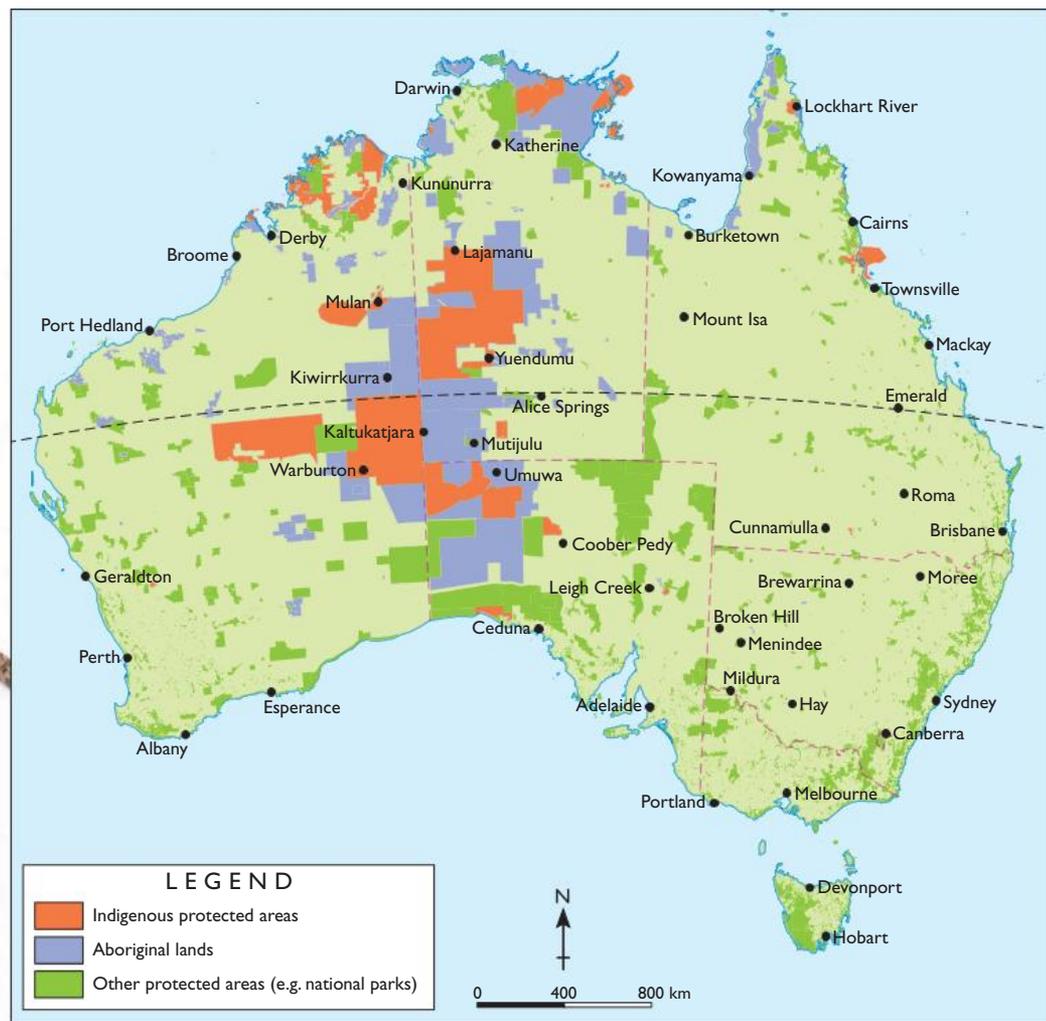
- 5 Why is conserving forests often difficult to achieve?
- 6 Compare the issues facing the Tarkine Wilderness Area with those facing the Amazon rainforest. What are the similarities and differences?
- 7 Examine Source 6.64. Rank these methods in order from most effective to least effective. Justify your ranking.

# CARING FOR COUNTRY

Indigenous Australians have a special connection with the land. They feel responsible for looking after the stories, places, resources and culture of an area. This is sometimes referred to as 'caring for Country'. Important aspects of caring for Country are connecting with ancestors and maintaining the natural resources of a region. In this way, Indigenous Australians seek to live sustainably. This concept of caring for Country applies to all landscapes including the forests, deserts, wetlands and mountains.

The Australian Government recognises the special connection that Indigenous Australians have with the land in a number of ways, one of these is the establishment of a network of Indigenous Protected Areas. In these areas, the traditional owners of the land have agreed to promote biodiversity and to protect the natural and cultural values of the land. At present, there are 42 Indigenous Protected Areas across Australia covering a total of 420 000 square kilometres. These areas protect some of Australia's most fragile and vulnerable environments.

AUSTRALIA: INDIGENOUS PROTECTED AREAS, ABORIGINAL LANDS AND OTHER PROTECTED AREAS, 2012



Source 6.67

Source: Oxford University Press



## KEY CONCEPT: PLACE

### Mandingalbay Yidinji Indigenous Protected Area

We had a native title determination and Indigenous Land Use Agreements, but it wasn't until we started developing the Indigenous Protected Area project that we could see a way of 'putting country back together' – to manage country in a tenure-blind way with our partners.

Dale Mundraby, Mandingalbay Yidinji traditional owner

Trinity Inlet is a large saltwater estuary in Far North Queensland. On the west bank of this estuary is the city of Cairns, while on the east bank lies the Mandingalbay Yidinji Indigenous Protected Area. Covering almost 10 000 hectares, the Indigenous Protected Area is a world of saltwater wetlands, rugged ranges covered in rainforest, mangroves, salt marshes and sandy beaches. It is home to many rare and endangered plants and animals including the cassowary (see Source 6.69) and several frog species found nowhere else in the world.



**Source 6.68** An oblique aerial photograph looking north-east towards the Mandingalbay Yidinji Indigenous Protected Area from Cairns

**Source 6.69** Australia's second largest bird, the cassowary, is vulnerable to extinction due to the loss of rainforest across large parts of Queensland.

Prior to 2011, this region was divided into a number of reserves, national parks and private plots. Unsustainable farming practices led to a loss of biodiversity, particularly in the saltwater wetland of Trinity Inlet. Following a successful native title application, the Indigenous Protected Area was established in a process that the local Aboriginal people, the Mandingalbay Yidinji, described as 'putting country back together'. The traditional owners now work in partnership with governments to restore the area.

Specific programs include trapping feral pigs, collecting seeds and re-vegetating mangroves in barren areas, as well as building walking tracks and other facilities for visitors. The managers of the Indigenous Protected Area see **ecotourism** as the future of the region, once plants become established and birds and animals return to the area.

For more information on the key concept of place, refer to section GT.1 of 'The geographer's toolkit'.



## REVIEW 6.2.4

### Remember and understand

- 1 What is an Indigenous Protected Area?
- 2 What do you think Mandingalbay Yidinji traditional owner Dale Mundraby means by 'putting country back together'?

### Apply and analyse

- 3 The Mandingalbay Yidinji Indigenous Protected Area is located very close to the city of Cairns. How is this both an opportunity and a challenge for the managers of the Indigenous Protected Area?
- 4 Examine Source 6.67.
  - a What is the closest Indigenous Protected Area to your home?

- b Describe the distribution of Indigenous Protected Areas and Aboriginal lands in Australia. What could account for this distribution pattern?

### Investigate and create

- 5 Complete a geographic sketch of the oblique aerial photograph provided (Source 6.68). On your sketch label Cairns, Trinity Inlet, saltwater wetlands, mangroves, agricultural land, mountain ranges and rainforests. You will need to consult an atlas or use the internet to help you.
- 6 In your own words, define ecotourism. Do you think that ecotourism is a sustainable use of this Indigenous Protected Area?

# LIVING WATER

Indigenous Australians have been part of the Australian landscape for more than 40 000 years. Over that time they have developed relationships with the land and the water that have helped them to survive and thrive in some of the harshest environments on Earth. As non-Indigenous Australians struggle with issues such as **water scarcity** and degradation, some are learning that the principles followed by Aboriginal and Torres Strait Islander Peoples provide a model that can help them to view and use water more sustainably.

While Indigenous views and values vary from place to place and are both diverse and complex, it is possible to see some common principles with regard to their relationship with water. For example, many Aboriginal peoples refer to permanent sources of water as 'living water'. This describes the importance of water as not only a life-giving force but also of having a life of its own. Indigenous people do not see water as a mere commodity or resource but as a sacred source of life.

Water is the life for us all. It's the main part. If we are gonna lose that I don't know where we gonna stand. If that water go away, everything will die. That's the power of water.

John 'Dudu' Nangkiryn  
Key concept: interconnection

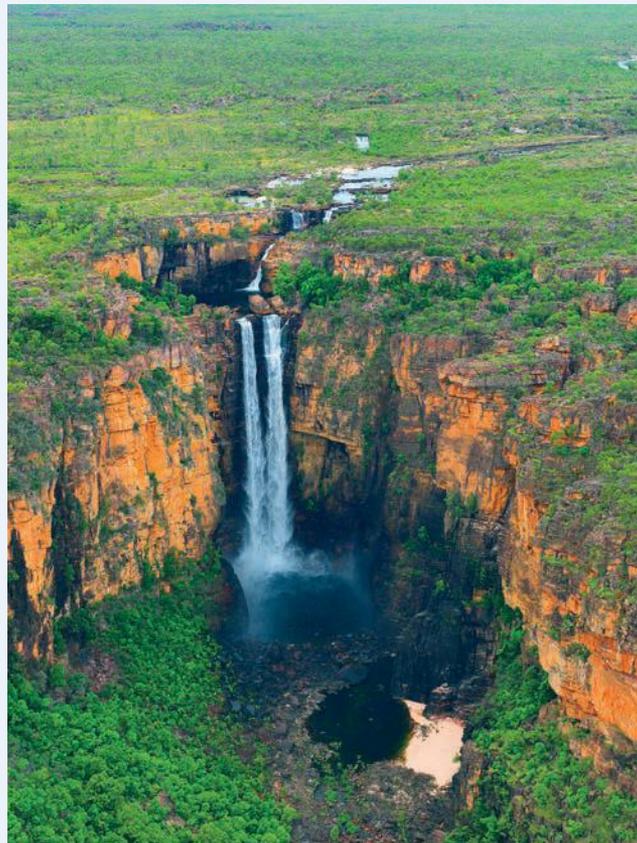
## KEY CONCEPT: INTERCONNECTION

### Holistic views of the natural world

Indigenous Australians believe that all features of a landscape (land, water, animals, plants and people) are inextricably linked together to form one interconnected whole. Change in one part of the landscape will bring change to the others. This fundamental belief is a key component of Aboriginal views of creation as well as the management of land and water. This traditional view, dating back tens of thousands of years, is now accepted as scientific fact by many researchers and scientists, who refer to it as interconnection.

This holistic view of landscapes links Indigenous people with the natural world. Indigenous people believe that they have custodial or stewardship responsibility for the land and water in the country in which they live and that this responsibility is passed to them by their ancestors and from them to their descendants. Water resources such as rivers, lakes, billabongs and groundwater are protected by a complex series of laws, customs and beliefs. The Nyungar people of south-western Western Australia, for example, throw a handful of sand into streams and lakes as they approach, in order to warn the spirit of the water of their presence.

For more information on the key concept of interconnection, refer to section GT.1 of 'The geographer's toolkit'.



**Source 6.70** According to the traditional beliefs of the Gagudju people of Kakadu, a creator-being, known as Al mudj, created the waterholes of the region. Al mudj brings the wet season every year, may appear as a rainbow, can punish people by drowning them and lives in a pool beneath a waterfall.

## The Police Lagoons

The views of Indigenous Australians with regard to the management of water can, at times, conflict with the views of non-Indigenous Australians, many of whom believe that water is a commodity that can be bought, sold and traded. There are, however, many examples of communities who have been able to take into account both sets of views when developing water management strategies.

One of these is the town of Dirranbandi and the nearby Police Lagoons, a series of wetlands beside the Balonne River in southern Queensland. The Police Lagoons are ephemeral wetlands, which means they only fill with water during the rainy season. Before European settlement, the lagoons filled with water once a year and provided an important habitat for plants and animals. The lagoons were also an important meeting place for ceremonies, including burials, for the Kamilaroi and Kooma Indigenous peoples, as well as a source of food. With the development of large-scale farming in the region, including the establishment of Cubbie Station, the largest cotton farm in Australia, the Balonne River floods less often and the lagoons are without water for longer periods of time.

Following consultation with local Indigenous people, a new management plan for the lagoons is being developed that will take into account the cultural needs of the Indigenous population and emphasise sustainability. Information and knowledge will also be shared between the Indigenous community and government geographers. This will lead to a healthier wetland and see more frequent flooding of the lagoons.



Source 6.71 Satellite image of the Balonne River floodplain in southern Queensland

### REVIEW 6.2.5

#### Remember and understand

- 1 Why do the views of Indigenous and non-Indigenous Australians sometimes conflict?
- 2 Why do you think that Indigenous views are often ignored when decisions about water use are made?

#### Apply and analyse

- 3 How might the Indigenous concept of interconnection help non-Indigenous Australians to better manage scarce water resources in arid regions of Australia?
- 4 What are your beliefs about the natural environment? Where do these beliefs come from?
- 5 Examine Source 6.71.
  - a Describe the location of the Police Lagoons.
  - b This is an ephemeral wetland. Explain how an ephemeral wetland operates.

- c Why are these wetlands significant to local Aboriginal peoples?
- d What land uses can you identify in the satellite image?
- e How do these land uses put pressure on the water resources in this region?

#### Investigate and create

- 6 Discuss a set of guidelines or rules that could be introduced to help water users and managers use the expertise and knowledge of Indigenous peoples in making decisions about water use in Australia.
- 7 Research the interconnection between water resources in your local area and Indigenous Australians. How have these interconnections changed over time?

# 6.2

## CHECKPOINT

### WHAT ARE THE CAUSES AND CONSEQUENCES OF CHANGE IN ENVIRONMENTS AND HOW CAN THIS CHANGE BE MANAGED?

- Investigate environmental management, including different worldviews and the management approaches of Aboriginal and Torres Strait Islander Peoples.

- 1 How do human factors contribute to land degradation? [4 marks]
- 2 Identify and explain three management measures used to address pollution. [6 marks]
- 3 Which worldview most resembles the sustainable use and management of resources? [2 marks]
- 4 Suggest two individual and two collective actions to slow down and reverse deforestation. [8 marks]
- 5 Assess the contribution of technology to managing land degradation in the Murray–Darling Basin. Create a table with two columns. List six environmental consequences of land degradation and suggest an appropriate management strategy. [12 marks]
- 6 Explain the concept of ‘caring for country’. [3 marks]

TOTAL MARKS [ /35]

### RICH TASK

#### Return to Eden

The region at the **confluence** of the Tigris and Euphrates Rivers in Iraq once supported one of the world’s great wetlands – the area where farming was first developed as well as the location of the world’s first towns. For this reason, many thought of the area as the Garden of Eden. The wetlands once covered 20 000 square kilometres and supported complex communities of plants, animals, birds and people.

Between the 1970s and 2002, however, the area of the marshes shrunk by more than 90 per cent and the only major marsh that survived was the Al Hawizeh marsh sitting on the Iraq and Iran borders. This was because of new irrigation dams that drew water from the rivers upstream to support further agriculture. Much of the marshland became dry and the ecosystems collapsed. The numbers of migratory birds declined dramatically and the local people were forced to move to the cities.

Since 2003 many of the drainage structures have been dismantled and the marshes allowed to relood. By the end of 2006, more than half of the region had been relooded and much of the original vegetation had recovered. Farmers are also returning to the area. In 2013 the Mesopotamian Marshland was declared Iraq’s first national park.

The decline and rebirth of the Mesopotamian Marshes is an example of the pressure faced by many of the world’s freshwater resources but it is also a beacon of hope as it shows that areas can be restored.

Select one of these other examples of water resources under pressure: Aral Sea, tributaries of the Dead Sea, Kara-Bogaz-Gol lagoon, Everglades wetlands, Lake Chad, Lake Balkash, Lake Chapala, Lake Nakuru or the Coorong.

#### Acquiring geographical information

- 1 Research the changes that have occurred over time.

#### Processing geographical information

- 2 Describe the causes of these changes.
- 3 Describe any attempts that have been made to restore the natural environment and comment on their effectiveness.

#### Communicating geographical information

- 4 Present your findings as an annotated visual display (AVD). Use images such as satellite images, maps and aerial photographs in your display.

## Constructing overlay maps from satellite images

**Overlay maps** allow geographers to show a place at two different times so that they can instantly see any changes that have taken place. To construct an overlay map from two satellite images, follow these steps:

**Step 1** Construct a base map of the region using the earlier satellite image.

This should be traced to make it as accurate as possible. Draw a rectangle the same size and shape as the satellite image. Add key natural and human features: rivers, canals, towns and lakes.

**Step 2** Add labels to rivers and towns. Add a north arrow, legend and title.

Include the date of the image, scale and source.

**Step 3** On a plastic sheet or piece of tracing paper, construct a map of the same region from a later satellite image.

Ensure that the two satellite images you use show the same region at the same scale. This map will sit on top

of your base map, so line up features that have stayed the same.

**Step 4** Place the overlay map on top of the base map and use a piece of tape like a hinge along the top.

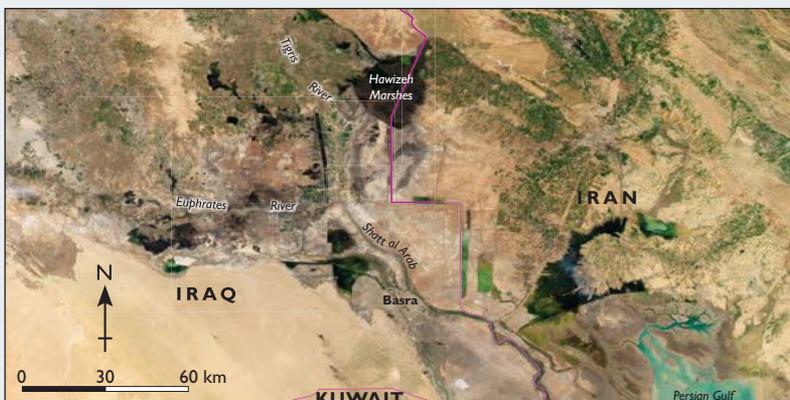
**Step 5** Add a title to the overlay map that does not cover the one on the base map. A north arrow, legend, scale and source should not be needed as these are the same as for the base map.

### Apply the skill

- 1 Construct an overlay map of the marshes using the 2000 and 2010 satellite images in Source 6.72. You can download larger versions of these maps from your obook.
- 2 Describe the changes to the rivers and marshes of this region from 2000 to 2010 as shown in your overlay map.
- 3 Describe the scale of this series of environmental changes. Is this change at the local, regional, national, international or global scale?

#### Source 6.72

Satellite images of the Mesopotamian Marshes from 2000 and 2010 (the green areas show the extent of the marshes)



In this Checkpoint and Rich Task, you will be applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Change, Environment, Sustainability, Place
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information

- » Tools: Maps, GIS, Satellite images

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

## CHAPTER

# 7



**Source 7.1** Coastal landscapes are popular places as this photograph of a crowded beach in Scheveningen, the Netherlands, demonstrates. Changes brought about by humans in areas like this need to be carefully managed to prevent serious damage to coastal environments.

# INVESTIGATIVE STUDY: COASTAL CHANGE AND MANAGEMENT

Coasts are one of the Earth's most threatened environments. Home to more than one billion people, they are vulnerable to changes in the ocean and on land. Human activities have affected coastal biodiversity, and polluted coastal environments are now at further risk from the effects of climate change. While these changes are of serious concern, geographers can play a role in finding solutions and developing strategies for managing coastal environments.

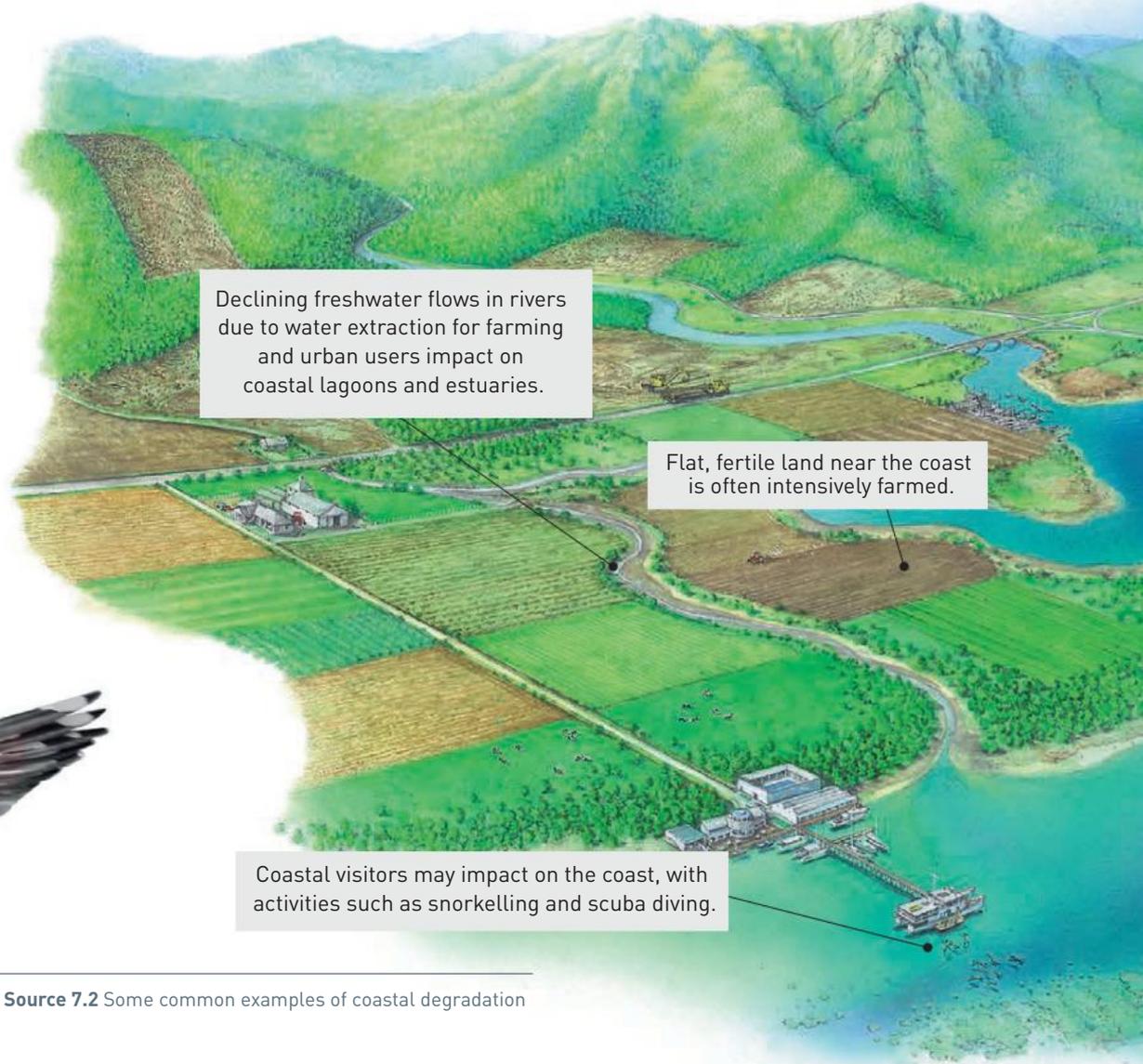
This chapter will work step-by-step through an investigative study of coasts in Australia and other regions. A detailed investigation of Australia's coastline is given in this chapter, alongside many other country examples as comparisons, which lend themselves to further research.



# 7.1

## CHANGE IN COASTAL ENVIRONMENTS

WHY IS AN UNDERSTANDING OF ENVIRONMENTAL PROCESSES AND INTERCONNECTIONS ESSENTIAL FOR SUSTAINABLE MANAGEMENT OF COASTAL ENVIRONMENTS?

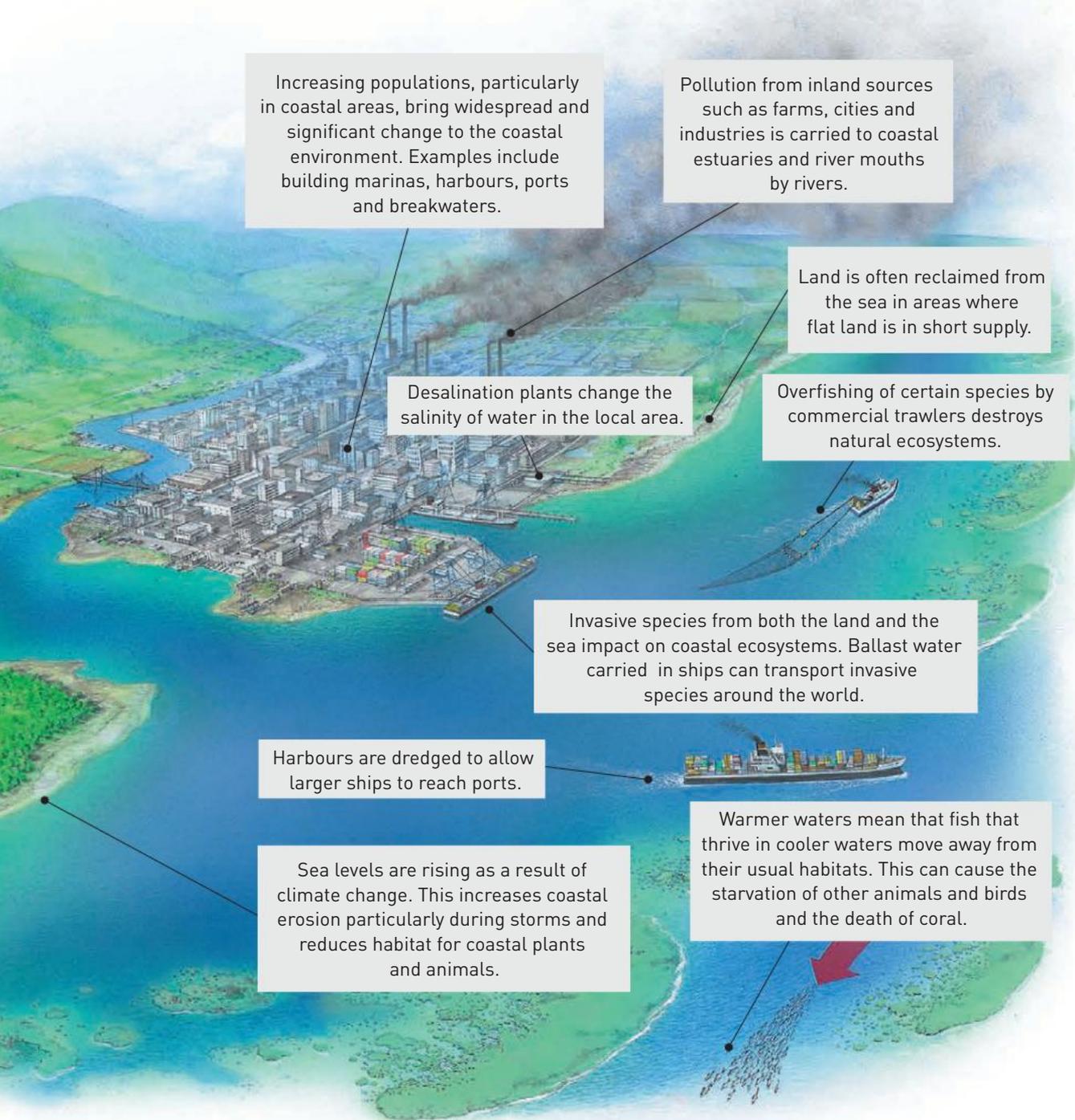


Source 7.2 Some common examples of coastal degradation

Coasts are very dynamic places – they are constantly changing. Crashing waves, strong currents, tidal waters and hazards (such as storms and tsunamis) all transform coastal environments. People, too, bring about many changes to these environments. From simple activities, such as walking across a sand dune, to complex study activities, such as the construction of shipping ports and sea walls, humans have serious effects on coastal areas. In many cases, these activities are responsible for coastal degradation.

Coastal degradation can be observed on many scales. It may be local, like when litter is dropped on a popular holiday beach, or regional, like when an oil spill washes ashore along hundreds of kilometres of coastline. The effects of coastal degradation are varied, and can include the loss of plant and animal species, or the arrival of an invasive species that permanently affects biodiversity in the area. Examples of coastal degradation can include sand dunes being washed into the sea, changing the coastline, or blooms of toxic algae damaging the marine environment. Source 7.2 provides an overview of some common forms of coastal degradation.

Over the course of this chapter we will be exploring some of the changes that are having the greatest impact on coastal environments. These include climate change, population growth in coastal areas, the loss of coastal biodiversity and marine pollution.



Increasing populations, particularly in coastal areas, bring widespread and significant change to the coastal environment. Examples include building marinas, harbours, ports and breakwaters.

Pollution from inland sources such as farms, cities and industries is carried to coastal estuaries and river mouths by rivers.

Land is often reclaimed from the sea in areas where flat land is in short supply.

Desalination plants change the salinity of water in the local area.

Overfishing of certain species by commercial trawlers destroys natural ecosystems.

Invasive species from both the land and the sea impact on coastal ecosystems. Ballast water carried in ships can transport invasive species around the world.

Harbours are dredged to allow larger ships to reach ports.

Warmer waters mean that fish that thrive in cooler waters move away from their usual habitats. This can cause the starvation of other animals and birds and the death of coral.

Sea levels are rising as a result of climate change. This increases coastal erosion particularly during storms and reduces habitat for coastal plants and animals.

## REVIEW 7.1.1

### Remember and understand

- 1 What are some of the changes currently impacting coastal environments?
- 2 Are coastal environments close to cities more at risk from degradation than those in remote areas? Give some reasons for your answer.

### Apply and analyse

- 3 The three main drivers of environmental degradation are climate change, population growth and economic growth. Examine Source 7.2.
  - a Classify each of the causes of coastal degradation shown according to one of these three drivers.

- b Are there any changes that could not be classified in this way?
- c Which of the three drivers appears to be responsible for most of the changes shown?
- d Classify each of the changes shown according to whether they are taking place on the local, regional, national, international or global scale.

### Investigate and create

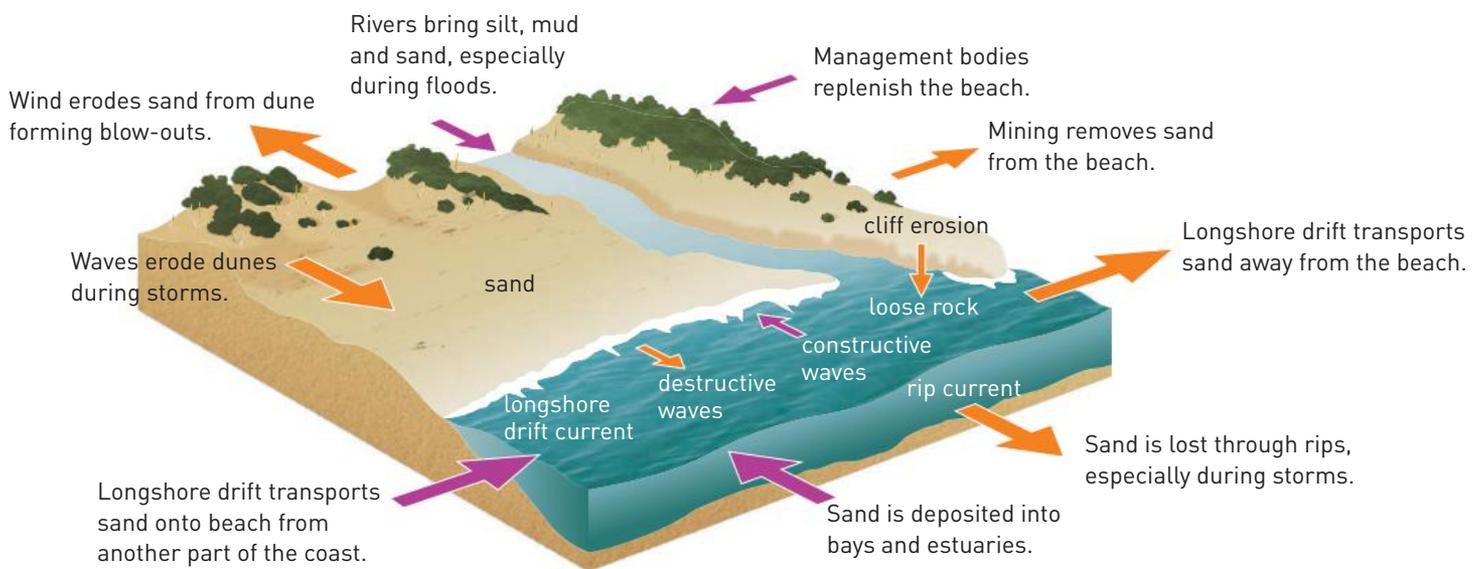
- 4 Use the geographical concept of interconnection to describe the links between changes on the land and changes at the coast. Apply these to an area you know.

# A DYNAMIC BALANCE

While this chapter focuses primarily on the ways in which human activities bring about changes to coastal environments, it is also important to remember that natural processes are constantly shaping and changing the coast too. Rocks are eroded and material such as sand is transported by the energy of waves, tides and currents, creating a landscape that is constantly evolving. All this change means that coasts are very complex environments to study and understand.

## Understanding natural processes in coastal environments

Geographers often use models – such as the systems model – to understand environments, study the relationships between environments, and learn more about the intricate forces that cause changes.



**Source 7.3** How natural processes change coastal environments. Green arrows represent inputs while red arrows represent outputs.



To apply a systems model to a coastline, each individual **landform** is considered to be a separate compartment. Energy such as wind and waves, and matter such as water and sand, are studied as they arrive at and leave each compartment. Arriving energy and matter are referred to as inputs and leaving energy and matter are outputs.

If the inputs are greater than the outputs, then the coastline and its landforms such as dunes and **spits** increase in size and the coast grows outwards. If the outputs are greater than the inputs, then landforms decrease in size and the coast retreats (see Source 7.3)

**Source 7.4** A range of coastal landforms are evident at Cape Byron, the easternmost point on the Australian mainland.

## KEY CONCEPT: CHANGE

### Dynamic equilibrium

Energy inputs on the coast – the waves and wind – often erode and transport matter, particularly sand. When matter is transported, the shape of the beach changes. When coastal landforms are in balance with energy inputs this is known as dynamic equilibrium. In this state, energy inputs are absorbed with no movement of matter, and the shapes of the landforms remain unchanged.

When dynamic equilibrium does not exist, inputs and outputs do not remain in balance, and the landscape changes.

In the case of a storm, energy inputs will not be constant, so erosion and deposits will not be in balance. Matter is eroded and transported offshore and the shape of the beach changes. Once the storm ends and the energy inputs return to 'normal' again, dynamic equilibrium returns and the beach will remain unchanged for as long as the energy inputs remain constant.

For more information on the key concept of change, refer to section GT.1 of 'The geographer's toolkit'.



**Source 7.5** A massive storm struck the north-east coast of the United States in 2012, reducing the width of the beaches by an average of 9–12 metres, and up to 46 metres in some places. The storm disrupted the dynamic equilibrium of this environment.

## REVIEW 7.1.2

### Remember and understand

- 1 What are the main energy and matter inputs in coastal environments?

### Apply and analyse

- 2 Use the systems model to describe the changes that are taking place in Source 7.4.
- 3 Examine Source 7.5.
  - a What evidence is there for the movement of sand?
  - b How has this movement changed the shape and location of the coastline?
  - c Explain whether this is an example of dynamic equilibrium.

### Investigate and create

- 4 While many coastlines were heavily eroded by the 2012 storm on the north-east coast of the United States (Source 7.5), others hardly changed.
  - a Brainstorm some reasons why variations exist in the way coasts are changed.
  - b Rank your reasons from the one most likely to explain these variations to the one least likely. Justify your rankings.
- 5 Complete an annotated photo sketch of Source 7.4. On your sketch, label the individual compartments that geographers would study.

# UNDERSTANDING SPATIAL VARIATIONS

Each place on the Earth's surface is unique. In the same way that no two people are exactly alike, natural environments such as forests, glaciers and coasts all differ. The reasons for these variations may be complex but recognising them is a critical part of understanding why different places have different problems. Geographers examine these differences (also known as **spatial variations**) and use what they find to propose solutions and responses to environmental change and/or issues. It is important to remember that these solutions and responses need to be site-specific. They may work in one place but not work in another. Some environments are also more resilient to change than others.

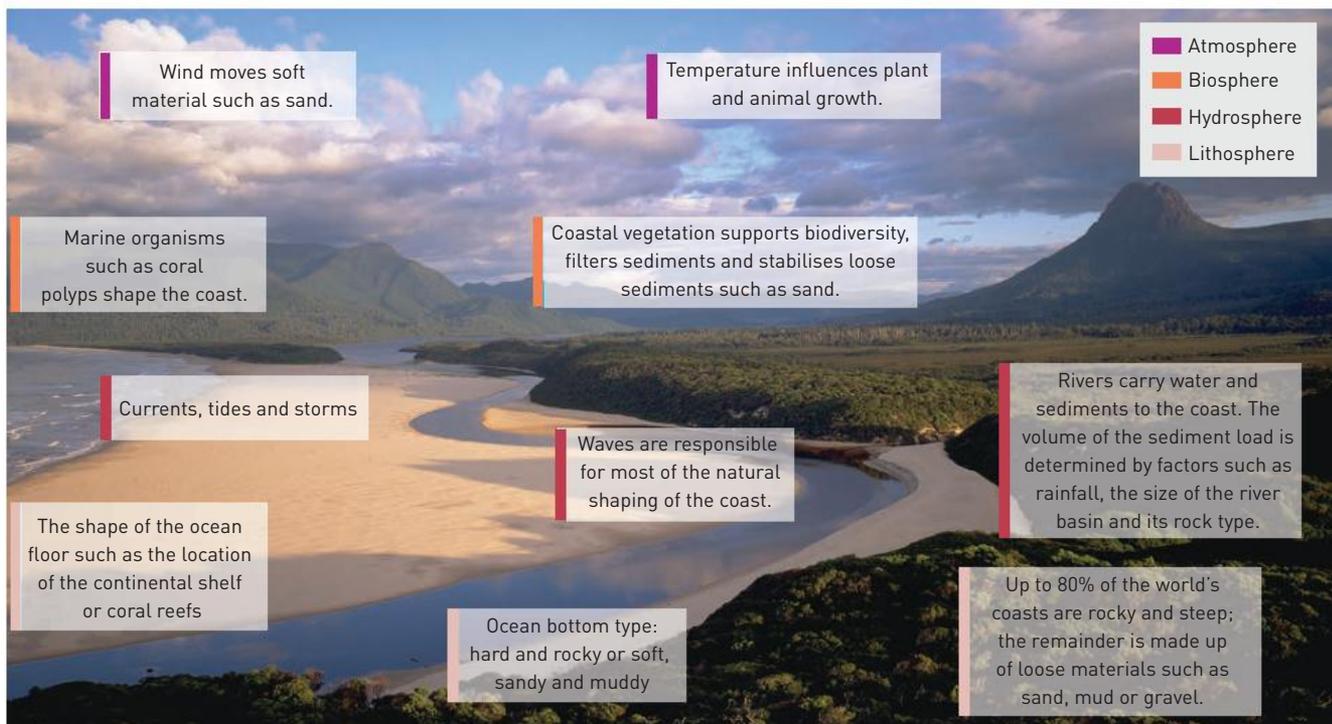
The factors that need to be looked at when considering spatial variations in environments can be divided into two groups – natural factors and human factors.

## Natural factors

Geographers often use models to help them to understand processes that take place in the natural world. One of these models, known as the four spheres model, is particularly useful when investigating the natural factors that influence spatial variations. The four spheres that interact to form unique landscapes include:

- 1 the **atmosphere** – all of the gases that surround the Earth
- 2 the **biosphere** – all living things on Earth (i.e. plants, animals, humans and other organisms)
- 3 the **hydrosphere** – all of the water on Earth (i.e. in solid, liquid and gaseous forms)
- 4 the **lithosphere** – the outer rocky layer of Earth (i.e. crust).

Source 7.6 provides an example of how the four spheres model can be used to investigate and describe how natural factors interact to shape coastal environments.



Source 7.6 An analysis of an Australian coastal environment using the four spheres model

# Human factors

People have always been drawn to the coast. Coastal environments provide us with many ecosystem services that we need to live and thrive such as food, shelter, transport, recreation and flat land for building. Areas near the mouths of rivers also provide fresh water and fertile soil. Human influence tends to be concentrated in certain places on the coast where these ecosystem services are most available. In these places, the coastlines are now so altered by human activities that some geographers refer to them as anthropogenic coasts (see Source 7.7), meaning humans have become the dominant force in these environments.

Source 7.7
<b>Features of an anthropogenic coast</b>
Coastal protection constructions such as sea walls
Cleared vegetation
Dredged shipping channels
Mining operations including sand mining and oil drilling
Fishing and aquaculture
Coastal agriculture
Forestry
Shipbuilding and other industries
Shipping and port facilities
Dammed rivers for hydroelectric power generation
Naval and other defence operations
Tourism and recreation
Roads
Draining coastal wetlands and salt marshes
Land reclamation
Cities



**Source 7.8** The Gold Coast in Queensland is an example of an anthropogenic coast.

**REVIEW 7.1.3**

**Remember and understand**

- 1 Name the four interconnected spheres that make up the Earth.
- 2 List four ecosystem services that the coast provides us with.

**Apply and analyse**

- 3 Would rocky coasts be more resilient to change than sandy coasts? Give some reasons for your answer.

**Investigate and create**

- 4 In the same way that natural factors can be classified, so too can human factors. One method is to classify them as social, historic, environmental, economic, political or technological (making the acronym SHEEPT). Use this method to classify the human factors listed in Source 7.7. For more information on the SHEEPT method, refer to section GT.2 of 'The geographer's toolkit'.

# 7.1

## CHECKPOINT

### WHY IS AN UNDERSTANDING OF ENVIRONMENTAL PROCESSES AND INTERCONNECTIONS ESSENTIAL FOR SUSTAINABLE MANAGEMENT OF COASTAL ENVIRONMENTS?

- Investigate the biophysical processes essential to the functioning of the coastal environment.
- 1 For a selected coastline (you may be familiar with or have visited) describe the natural and human processes that have shaped it. [10 marks]
  - 2 Select one of the causes of coastal degradation shown in Source 7.2.
    - a Find, identify and describe an example from this chapter where the selected cause has become a problem. [5 marks]
    - b Suggest a solution for the problem(s) this has created. [5 marks]
  - 3 Select a coast that you know well (or one that you have visited on a field trip or holiday). Describe the energy and matter inputs and outputs in this environment and explain how these have shaped the coastline. For example, a series of sand dunes may have been formed by low energy waves bringing sand from a river mouth. [15 marks]

TOTAL MARKS [ /35]

## RICH TASK

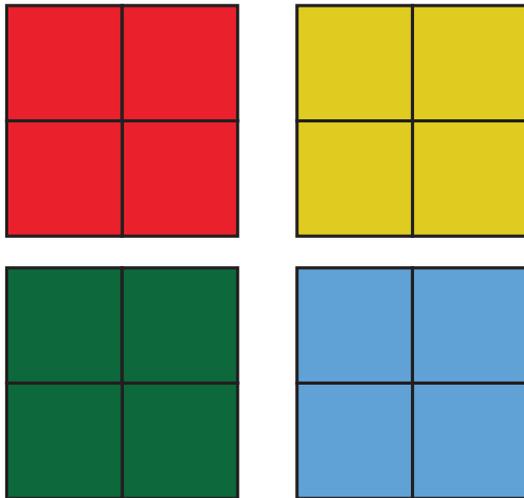


**Source 7.9** A recent east-coast low storm event at Collaroy caused devastating damage to the local coastal environment.

### Virtual field trip

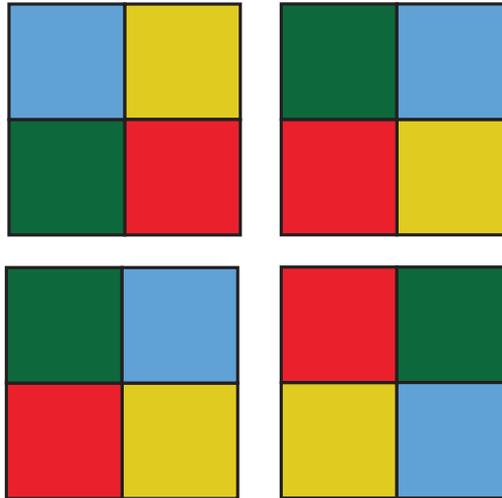
In groups, complete a virtual field trip of any coastal location in Australia by using, for example, Google Earth, a documentary study or news piece. Your teacher may limit you to a NSW beach, or allow different groups to study areas in different states. EVERY MEMBER of the group must become an expert on their chosen location and share their knowledge with others at the completion of the activity. This type of activity is called a JIGSAW TASK because each student must 'know their stuff' to help teach others. Each individual piece completes the jigsaw (follow the steps below).

**Step 1** Organise into groups (this works best with the group size equal to the number of groups). Each group selects one site each and every member becomes an expert.



**Step 2** Groups now change members so each new group has only one member of the original group. Each group member now takes a turn to explain to the others what they have discovered about their site (see the questions below). Now each student has learned about four sites and shared so many more ideas.

Note: This activity will be used again in Checkpoint 7.2.



### Communicating geographical information

- 1 Describe the location of the site you have chosen.
- 2 Complete an annotated 'virtual field sketch' of the site, making reference to the natural processes that have shaped the area.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Place, Change, Environment, Interconnection, Sustainability
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Maps, Fieldwork, Visual representations

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

# 7.2

## CLIMATE CHANGE AND COASTS

### WHAT ARE THE CAUSES AND CONSEQUENCES OF ENVIRONMENTAL CHANGE?

The world's climate is changing. Human activities such as land clearing and fossil fuel burning have led to increased amounts of carbon dioxide in the atmosphere. This is leading to **global warming**. As a result, the Earth's natural ecosystems are changing or adapting to the higher temperatures. Plants and animals that are unable to adapt to the warmer conditions are either moving towards the poles, where conditions are cooler, or facing extinction.

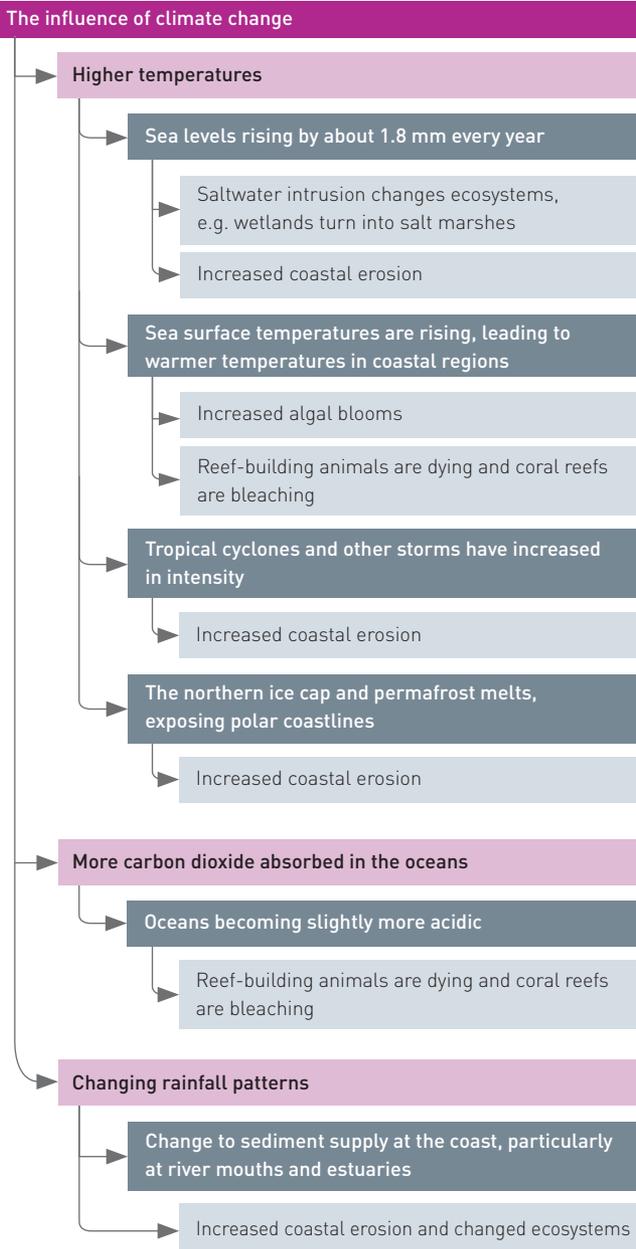
Global warming is also affecting coasts. In fact, coastal systems are undergoing greater change than virtually any other environment. As the interface between the land and the sea, coastal systems face pressures from changes in both of these places. Source 7.10 summarises the effects of climate change on coastal areas. One of the greatest concerns for Australian coastal areas is the rising of sea levels.

As the climate warms, land ice is melting. For example, the Greenland ice sheet, which covers 80 per cent of Greenland, is melting an average of 195 cubic kilometres per year. The water from this melting ice ends up in our oceans. Rising sea temperatures are also causing the ocean to expand as a result of the warmer water.

It can be difficult to convince people that sea levels are rising. This is because ocean and coastal waters are constantly changing as waves, tides and currents keep them in movement. Also, sea levels are rising very slowly. This doesn't mean that they are not rising, however. In fact, sea levels have been rising for at least a century. Scientists use a combination of tide gauges and new technologies such as satellite altimeters (instruments used to measure altitude) to monitor and measure sea-level changes. These measures show that sea levels have risen by about 1.8 millimetres per year over the last century and by about 3 millimetres per year since the mid 1990s.

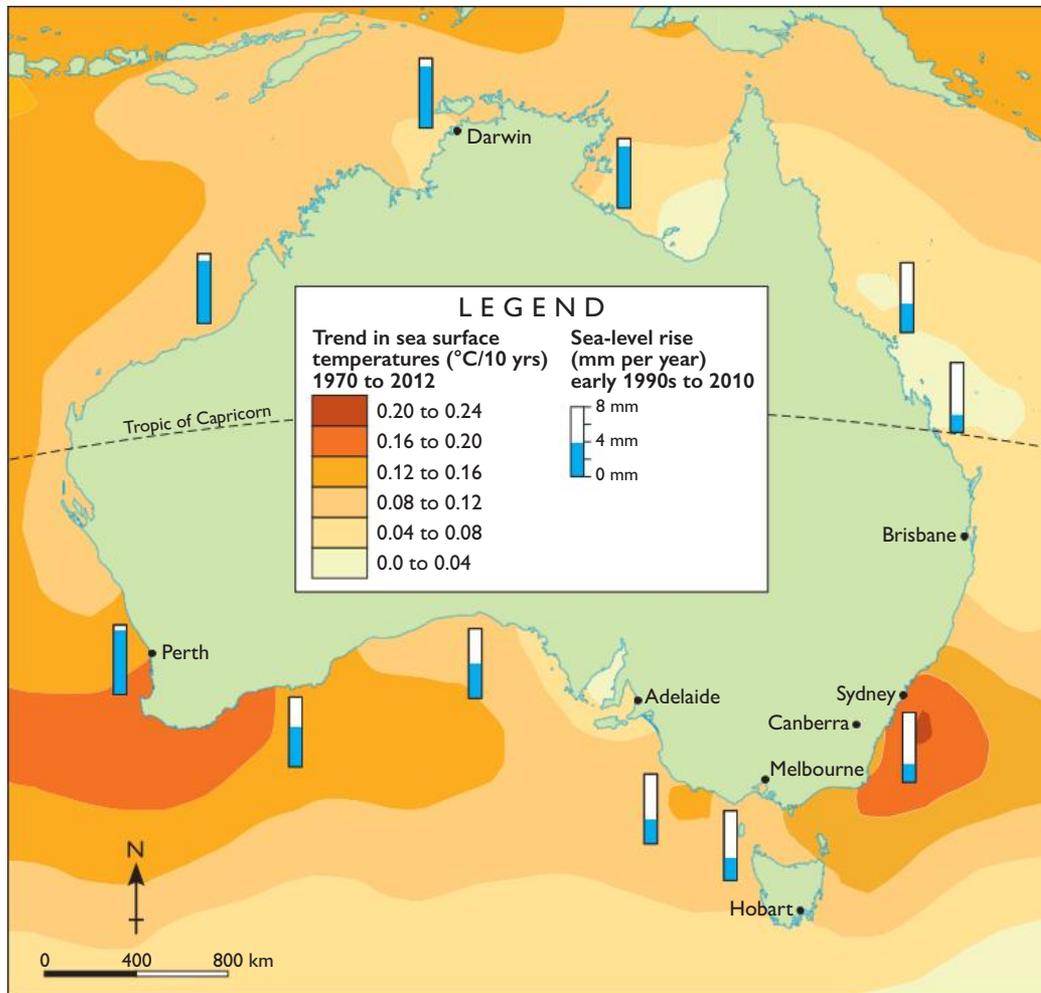
### The physical impact of rising seas

An Australian Government report in 2011 stated: 'Sea levels are rising around Australia. A sea-level rise of a metre or more during this century is plausible. It could be less or much more. Between 16 000 and 250 000 individual homes are potentially at risk of inundation from a 1.1 metre rise in sea level.'



Source 7.10 The influence of climate change on the coast

## AUSTRALIA: TREND IN SEA SURFACE TEMPERATURES AND SEA-LEVEL RISE



Source 7.11

Source: Oxford University Press

As well as the risk to homes situated on the coastline, rising sea levels are expected to cause:

- an increase in the erosion of beaches, with some beaches expected to disappear completely
- an increase in the incidence of flooding in low-lying coastal areas
- salt water to enter coastal aquifers, destroying freshwater sources
- an increase in the severity of extreme weather events such as cyclones, bringing with them increased incidences of serious storm damage.

## The impact of climate change on the Great Barrier Reef

Queensland's Great Barrier Reef is not only one of the world's most beautiful natural treasures, it is also one of its most important. Extending over 2300 kilometres and 14 degrees of latitude, the reef contains over 2900 separate coral reefs and some of the world's most extensive mangrove and seagrass ecosystems. But the combined effects of a changing climate – rising sea temperatures, rising sea levels, **ocean acidification** and extreme weather events – are causing problems for this remarkable natural environment.



Source 7.12 An example of mass coral bleaching on the Great Barrier Reef

## Rising sea temperatures

Studies show that the current temperatures of the Coral Sea are warmer now than at any time over the last 300 years. On average, temperatures are 0.4 degree Celsius warmer than they were in the late 1800s. As average temperatures rise, warm weather events heat the sea surface to a temperature that coral polyps (the tiny organisms that construct the coral reef) cannot tolerate. The coral polyps feed on algae but the warmer water temperature causes a build-up of poisons in the algae. In order to survive, the polyps expel the algae on which they feed, as well as some of their own tissue. This process turns the coral white and is known as coral bleaching. Over the short term, bleaching does not kill the coral polyps. However, if sea temperatures remain high over an extended period, the coral polyps eventually starve and the reef will die out.



## Rising sea levels

In the Coral Sea, sea levels are rising by about 3 millimetres per year. This is expected to have little impact on the coral reefs as they can grow upwards by about 6 millimetres per year. Surrounding ecosystems, however, are likely to be severely affected. As salt water intrudes further inland, environments such as mangroves and freshwater lakes are expected to change significantly. Low-lying islands are also expected to disappear beneath the rising seas, changing the distribution of nesting birds and turtles.

## Ocean acidification

Ocean acidification is a term used to describe the change in water chemistry caused when the carbon dioxide we pump into the atmosphere is absorbed into the ocean. The extra carbon dioxide in the water makes it more acidic. Ocean acidification can have dire consequences for a coral reef.

As carbon dioxide is absorbed into the ocean, it reduces the amount of carbonate (a kind of salt) in the water. Marine animals need this carbonate to make their shells and skeletons. Reef-building animals such as coral polyps then use these shells and skeletons to create a reef. With fewer shells and skeletons available, construction of the reef is seriously limited. Over the long term, ocean acidification is expected to be the greatest challenge facing the Great Barrier Reef.

## Extreme weather events

Increases in the severity and frequency of flooding and tropical cyclones also pose serious threats to the reef. Flooding brings increased sediment to the reef and this sediment smothers plants. Pesticides and other chemicals are also carried by floodwaters, adding to the levels of pollution in the water around the reef.

Cyclones generate large and powerful waves, which damage corals and the reef structure. One of the worst cyclones to hit the reef in recent times was Cyclone Yasi in 2011. Reefs are able to recover from these natural events but need time to do so. As extreme weather events become more frequent, reefs have less recovery time.

## Coastal squeeze

As sea levels rise, important coastal ecosystems such as mangroves and salt marshes respond by retreating inland. However, in many places, sea walls and other coastal structures mean they cannot move and are therefore trapped in a narrowing strip of land. This process is

**Source 7.13** Although the tiny Pacific island nation of Tuvalu is not one of the world's major polluters, the impact of global sea-level rise will be catastrophic.

known as coastal squeeze. This has led to healthy salt marshes and mangrove forests that are highly effective natural barriers to erosion being killed off by built structures that, in many cases, are much less effective at controlling erosion.

## The impact on other nations

What will the impact be on other nations? There are only 42 nations of the world's 209 countries that do not have to worry about rising sea levels. These are **landlocked** countries. That means about 80 per cent of the world will suffer from the effects of rising sea levels. In 2015, after many somewhat failed attempts, the United Nations Paris Climate Change Agreement was signed by 195 countries. This was the first step in the global community working together to reduce the causes of climate change and stem the rise of sea levels.

The more developed nations, such as the United States and Australia, and those rapidly developing, such as China, are the major polluters because of their highly industrialised economies and reliance on fossil fuels. This is often at the expense of the less developed nations who have been exploited for their resources in the past and are now suffering from the impacts of climate change. It is these poorer countries who also do not have the technology and/or capability to reduce the impacts of sea-level rises. Relocating people, building large-scale engineering projects, enforcing building legislation and the ability to educate and act are all measures more easily at the disposal of the 'rich', developed nations.

Two countries expected to be heavily affected by continuing sea-level rises are Tuvalu (Source 7.13) and Bangladesh (see Source 7.45).



**Source 7.14** The impact of flooding in one of the world's most visited city squares, Piazza San Marco, Venice (Italy).

### REVIEW 7.2.1

#### Remember and understand

- 1 What is coastal squeeze? What causes this problem?
- 2 Why are sea levels around the world rising and how do rising sea levels impact on nesting birds and turtles?
- 3 Why is coastal erosion expected to increase as sea levels continue to rise?

#### Apply and analyse

- 4 Examine Source 7.11.
  - a Describe the general pattern in sea surface temperature rises around Australia over the period 1970–2012.
  - b Which regions of Australia experienced the greatest rises in sea levels from the early 1990s to 2010?

- c Based on the data provided, are you able to identify any links between sea surface temperature rise and rises in sea levels around Australia? Why or why not?
- 5 Add four boxes to Source 7.10 to provide additional examples of the impacts that rising sea levels and sea surface temperatures will have on natural and human environments.

#### Investigate and create

- 6 Construct a flow chart or mind map showing the impact of ocean acidification on coral reefs.
- 7 Rank the four impacts of climate change affecting the Great Barrier Reef described here from the one likely to have the greatest impact on the reef to the one likely to have the least impact. Write a paragraph justifying your ranking.

# THE IMPACT OF POPULATION GROWTH ON COASTS

About one-quarter of the world's population live within 100 kilometres of the coast. Most of the world's megacities in both the developed and developing world are located on the coast and many of them are growing rapidly. In China, for example, 1000 people a day move to coastal cities from the country's interior. The impact of billions of people in millions of coastal cities, towns, villages and farms has caused one United Nations expert to state that 'humankind is in the process of annihilating coastal and ocean ecosystems'.



**Source 7.15** The contrast between the natural and built-up environments of Tokyo Bay, Japan: a beach in Tokyo Bay (left), and reclaimed land near the CBD (right).

## The impact of human settlements on coastal areas

The coast has always been an attractive place for human settlement. Coastal regions provide access to food and water, and people have long used boats and ships for transportation. But the growing number of people along the coast, together with increasing levels of trade and movement between settlements have had many detrimental effects on coastal ecosystems:

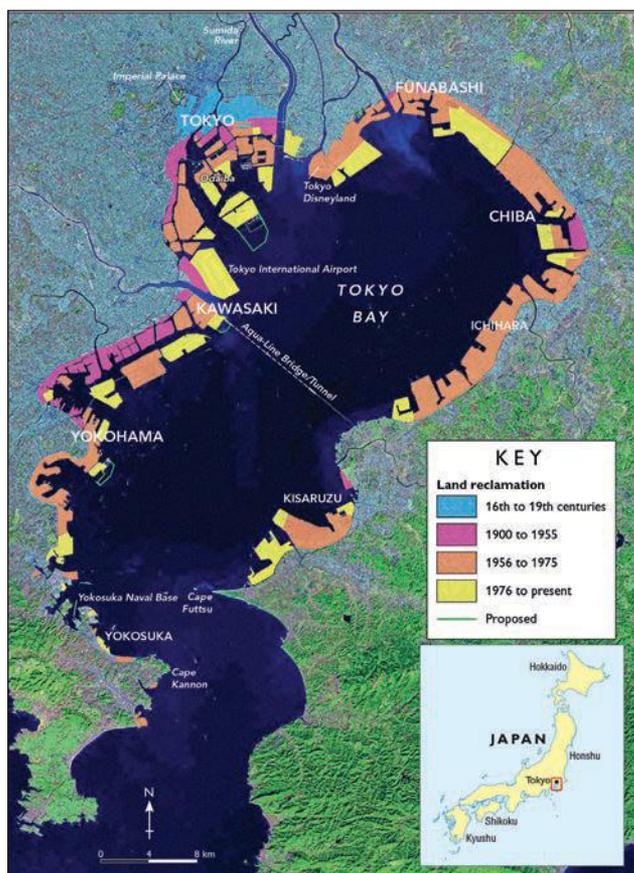
- Engineering structures such as sea walls, **groynes**, breakwaters, training walls and marinas have hardened the coast and changed natural cycles of **erosion** and **deposition**.
- Changing the natural flow of water by dredging channels, diverting rivers and building dams has altered the amount of fresh water and sediment arriving at the coast, affecting natural ecosystems and landforms.
- Discharging sewage into the ocean, the run-off of fertilisers from farms and other contaminants entering coastal waters have caused pollution in the oceans.
- Increased numbers of people in coastal areas have led to overfishing of the fish and shellfish. In some places coastal fish stocks have fallen by 90 per cent in the last 30 years.
- Ports are often an entry point for invasive species that bring dramatic changes to coastal ecosystems.
- The presence of large numbers of people on beaches have an impact: people leave litter on beaches, they walk over native plants and impose walkways, they can destroy breeding areas of sea birds, and they bring predators such as dogs into the environment.
- Tourism often takes people to coastal regions and this places huge pressure on this vulnerable environment. In less developed countries, coastal tourism may be the major source of income and sometimes there is a conflict of interest between protection, overuse and damage.



## Continued growth and competition for land

Many coasts have been converted from natural ecosystems to human landscapes. Cities need space to grow and harbours for trade and transport. Mangroves, marshes and **estuaries** have been drained and filled in, sand dunes flattened and built over and communities of coastal plants cleared. In some places, land for expansion has been so scarce that new land has been built in bays and estuaries from rocks, rubbish and silt from the sea bed (known as **land reclamation**).

### TOKYO BAY: EXTENT OF RECLAIMED LAND



### CASE STUDY

#### Tokyo Bay

The largest example of reclaimed land is Japan's Tokyo Bay. Twenty per cent of the bay has been filled in to create 250 square kilometres of new land. This new land was created around the edge of the bay using urban waste and silt from the bottom of Tokyo Bay. The reclaimed land is now home to some of the world's most expensive real estate including an international airport and Tokyo Disneyland.

In September 2013, Tokyo was selected as the host city for the 2020 Summer Olympic Games. Many of the sporting venues will be built on reclaimed land and this is expected to further increase the property values in the areas surrounding Tokyo Bay.

#### Source 7.16

Source: National Geographic

### REVIEW 7.2.2

#### Remember and understand

- 1 What is land reclamation and why is it used?
- 2 Describe the changes to coastal ecosystems as a result of coastal city growth.

#### Apply and analyse

- 3 Use an atlas to research the location of the world's megacities (cities with over 10 million people). How many megacities are coastal? How many of these coastal megacities are on river mouths or estuaries?
- 4 Why would the previously described impacts of climate change be particularly serious for the populations of small island communities?

#### Investigate and create

- 5 Construct an overlay map of Tokyo Bay using Source 7.16. On the base map show the natural outline of the bay. On the overlay show the total area of reclaimed land. Describe the spatial change over time shown on your map.
- 6 Use Google Earth to explore Tokyo Bay's coastline. Estimate the percentage of the coastline that is:
  - a heavily modified (for example, reclaimed land)
  - b lightly modified (for example, sea walls or groynes constructed)
  - c not modified.

# LOSS OF COASTAL BIODIVERSITY

The number of plant and animal species on a global scale is in decline. The drivers of this wave of extinction are all caused by human activities such as the destruction of habitats, overexploitation of ecosystem services, pollution, climate change and the introduction of invasive species. Recent studies of the four key coastal ecosystems – mangroves, seagrass beds, salt marshes and coral reefs – reveal that all are declining in size and biodiversity.



## Mangroves

Mangroves provide a wide range of crucial ecosystem services in many tropical areas including providing wood, protecting communities from the effects of offshore storms and as breeding grounds for fish and crustaceans. Despite their importance, about one-fifth of the world's mangroves have been lost since 1980, an estimated area of 36 000 square kilometres (see Source 7.17). Countries such as Kenya, Liberia and Puerto Rico have already lost over 70 per cent of their mangrove forests. Currently, the United Nations estimates that mangrove forests are being cleared at four times the rate of land forests. Mangroves have been cleared to make way for agricultural land, harbours, housing and fish farms.

**Source 7.17** Many mangrove forests, such as here in Malaysia, have been cleared to make way for shrimp farms.

## Seagrass beds

Seagrass beds are an important ecosystem for dugongs and manatees (both large sea mammals) and the leafy seadragon (see Source 7.18), as well as providing food for hundreds of other species. Seagrass beds are also important for stabilising sediments in the water, absorbing carbon dioxide and protecting against erosion. Over the last 200 years about 30 per cent of the world's seagrass beds have disappeared, many of them within the last few decades. The main threats to seagrass beds and the biodiversity they support are the dredging of the sea bed, the development of tourist marinas and water pollution from rivers and streams.

## Salt marshes

Salt marshes are intertidal habitats, meaning they are above water at low tide and under water at high tide. Salt marshes are essential for healthy fisheries and coasts. They provide food, refuge and a habitat for the offspring of more than 75 per cent of marine species including shrimp, crab and many fish. Birds also feed on the marshes. Salt marshes protect shorelines from erosion and reduce flooding by slowing and absorbing rainwater (see Source 7.19). They also help to maintain water quality by filtering run-off and absorbing excess nutrients. Twenty-five per cent of the world's salt marshes have already been lost; many turned into agricultural land for farming.

**Source 7.18** The amazing leafy seadragon, threatened by a loss of seagrass near Australia's southern cities



**Source 7.19** Salt marshes protect shorelines from erosion and reduce flooding.

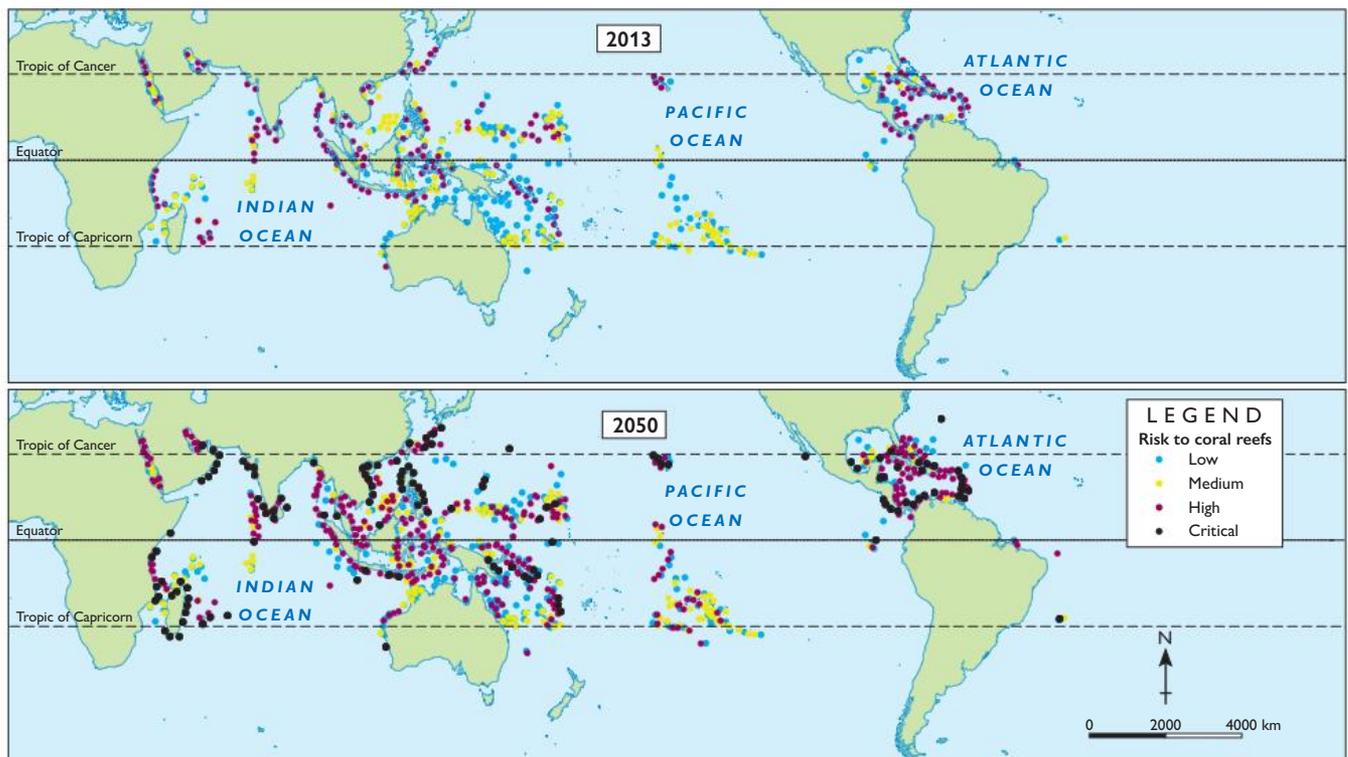
## Coral reefs

Coral reefs are home to one-quarter of the world's fish species. The richest area of coral is the western Pacific Ocean. In the 1980s, 66 per cent of the region's reefs were covered in living coral but by 2004 this had declined to just 4 per cent. In the Caribbean Sea, the amount of living coral fell by one-quarter in a single year.

Up to a billion people rely on the ecosystem services provided by coral reefs, including food, protection from waves and storms and income from reef-based tourism. Despite their importance, the coral reefs are under threat.

As well as threats from warmer sea temperatures causing coral bleaching, coral reefs are in danger from human activities, such as land-based industries increasing levels of sediment and pesticides in the ocean, and from invasive species such as the crown-of-thorns starfish.

### WORLD: CORAL REEFS AT RISK IN 2013 AND PROJECTED TO BE AT RISK IN 2050



Source 7.20

Source: Oxford University Press

### REVIEW 7.2.3

#### Remember and understand

- 1 What ecosystem services are provided by the four coastal habitats discussed? Classify these as sinks, sources, services or spiritual functions.

#### Apply and analyse

- 2 What are the five drivers of biodiversity loss in coastal habitats? Give an example of each of these.
- 3 Examine Source 7.20.
  - a Describe the distribution of the world's coral reefs using the PQE method. For more information on the PQE method, refer to section GT. 2 of 'The geographer's toolkit'.

- b Which reefs were most at risk in 2013?
- c Which reefs are projected to be at risk by 2050?

#### Investigate and create

- 4 Sketch Source 7.17 and shade intact mangroves and disturbed mangroves using two different colours. Label features of the natural and human environments.
- 5 Research the threats faced by one coastal species in Australia such as the dugong, orange-bellied parrot, coastal emu, grey nurse shark, marine turtles or sea snake, and present your findings to the class.

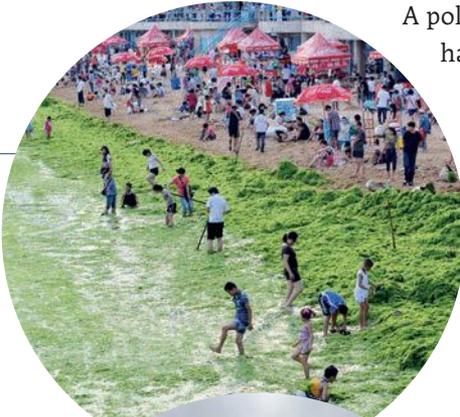
# COASTAL AND MARINE POLLUTION

A pollutant is any substance released into the environment that has a harmful or negative effect on the natural environment. Coasts are particularly vulnerable to the damaging effects of **pollution** as pollutants released on land and in the sea usually find their way to the coast, carried by rivers, tides, waves and ocean currents.

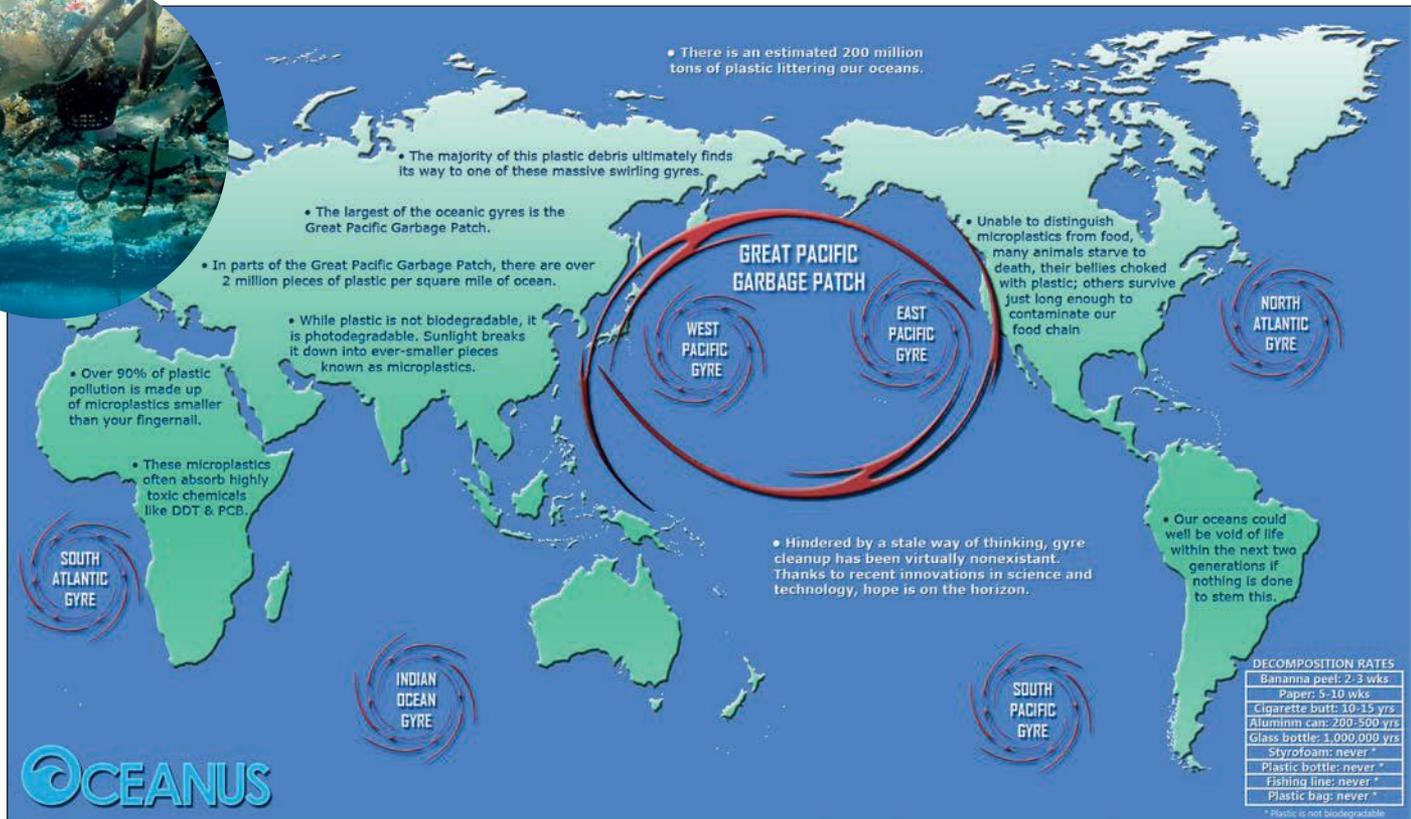
## Sources of coastal pollution

While it might be tempting to think that most coastal pollution comes from people using the coast such as beach-goers and people fishing, this is generally not the case. Rivers carry urban pollutants such as sewage, industrial waste, chemicals, plastics and water washed from streets and yards as stormwater to the coast. Rivers also bring pollutants from rural areas such as animal manure, pesticides and fertilisers washed from the land in heavy rain. Deforestation in river catchments also increases the amount of sediment and fresh water carried to the coast. As well as causing garbage dumps to form in the oceans (see Source 7.23), one of the most serious consequences of coastal and marine pollution is the formation of dead zones in the ocean (see Source 7.24).

**Source 7.21** This bloom of algae, triggered by fertilisers washed from farms, covered beaches in southern China in 2011.



**Source 7.22** In Bangladesh, men desperate for work perform one of the world's most dangerous coastal jobs, breaking down ships to resell the materials. Once a 'tourist attraction', but now guarded to protect the interests of the companies but not the workers.



**Source 7.23** The Great Pacific Garbage Patch is the world's largest trash vortex, containing a soupy collection of marine debris – mostly plastics.

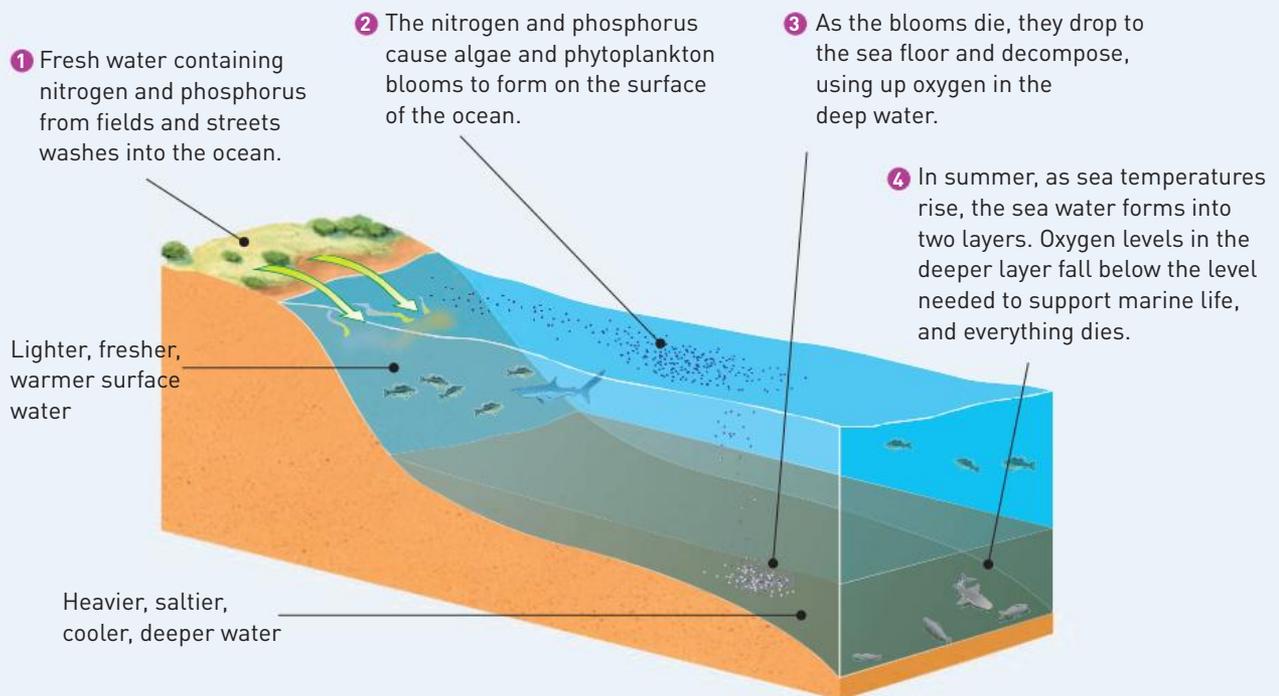
## KEY CONCEPT: ENVIRONMENT

### Marine dead zones

Marine dead zones are areas of fresh water or salt water where oxygen concentration has become too low to support life. Some rivers carry a cocktail of pollutants, all of which arrive at the coast. Waves, tides and currents then carry these pollutants along the coast and out to sea where they can cause great environmental damage. Arguably the most serious damage is the creation of marine dead zones in the ocean, devoid of oxygen and marine life. Dead zones form in summer with the warmer weather conditions encouraging algae blooms that then go on to deplete oxygen levels in deeper seas.

Although the number and size of marine dead zones fluctuate, they are on the increase. In the 1960s, only 39 dead zones were identified, compared with 405 in 2000. Some dead zones are only a few square kilometres in size and last only a few months. The largest dead zones, however, are massive. Dead zones in the Baltic Sea and Gulf of Mexico can be more than 18 000 square kilometres in size.

For more information on the key concept of environment, refer to section GT.1 of 'The geographer's toolkit'.



Source 7.24 How a marine dead zone forms

### REVIEW 7.2.4

#### Remember and understand

- 1 What is meant by the term 'marine dead zone'?
- 2 What are the causes of marine dead zones and what are the effects of these zones?

#### Apply and analyse

- 3 Why do dead zones grow and decline throughout the year?

#### Investigate

- 4 Marine dead zones can be explored through the geographical concept of environment but they could

also be used as an example of the geographical concept of interconnection. Describe how dead zones relate to interconnection.

- 5 In pairs, discuss possible solutions to the problem of marine dead zones, the tanker graveyard in Bangladesh or the Great Pacific Garbage Patch and present your ideas to the class. As starting points, you may wish to research the ways in which communities and nations have responded to a large dead zone in the Black Sea, or the floating booms, designed by a high school student, to catch ocean rubbish.

# 7.2

## CHECKPOINT

### WHAT ARE THE CAUSES AND CONSEQUENCES OF ENVIRONMENTAL CHANGE?

- Investigate the causes, extent and consequences of the environmental change.
- Imagine that the Great Barrier Reef disappeared due to the combined effects of climate change. Discuss how this would affect the Queensland coast and the Queensland economy? [5 marks]
  - Would the population impact on coasts be greatest in developing or developed countries? Discuss this with a partner and write down your ideas for further class discussion. [10 marks]
  - Compare the four main areas that would be impacted through a loss of biodiversity in coastal environments. Rank them in order from which you think is most important to the least important. Justify your reasons. [10 marks]

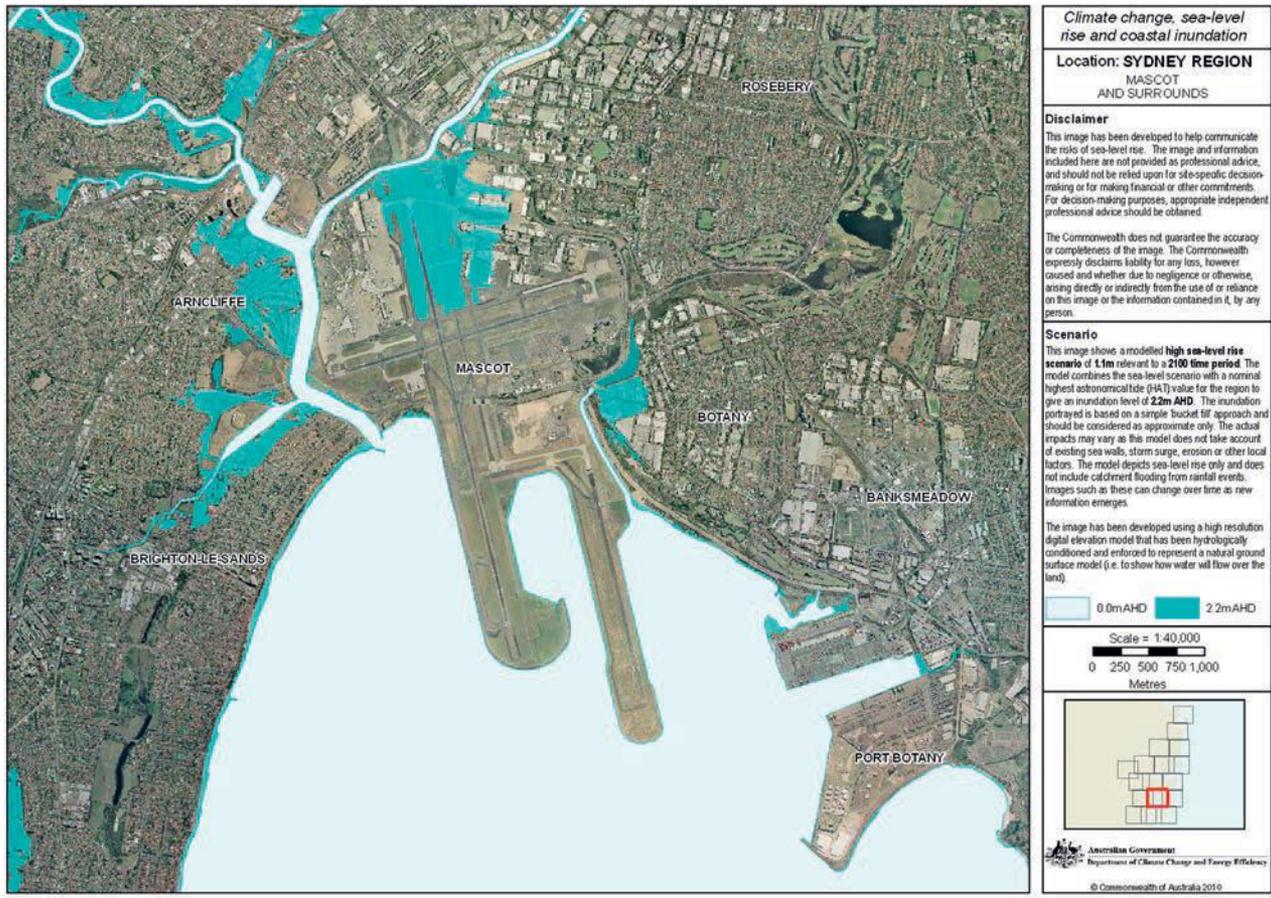
TOTAL MARKS [ /25]

### RICH TASK

#### Sea-level rise

Human impacts on the environment can happen on a global, regional or local scale. Here we investigate a couple of examples

and then go back to your virtual field trip to look at the human impacts there.



Source 7.25 Ozcoasts 110-centimetre sea-level rise prediction for Botany Bay by 2100

### Acquiring geographical information

- 1 Describe the impacts that a 110-centimetre sea-level rise would have. Visit the OzCoasts website ([www.ozcoasts.gov.au](http://www.ozcoasts.gov.au)) and locate the sea-level rise maps section. Use these maps to examine the predicted sea-level rise in a capital city or region of your choice. [5 marks]
- 2 Examine Source 7.26.
  - a Describe the distribution of the world's largest marine dead zones using the PQE method. For more information on the PQE method refer to section GT.2 of 'The geographer's toolkit'.
  - b Describe and account for the relationship between marine dead zones and areas of high population density.

### Virtual field trip (continued)

Returning to the same site you chose for your virtual field trip in Rich Task 7.1, now analyse more deeply the human impacts on the area. Again this can be completed as a group jigsaw activity (see Rich Task 7.1) or individually.

- 3 Analyse – which means break down into specific parts – the causes of environmental change on your chosen coastline?

### Communicating geographical information

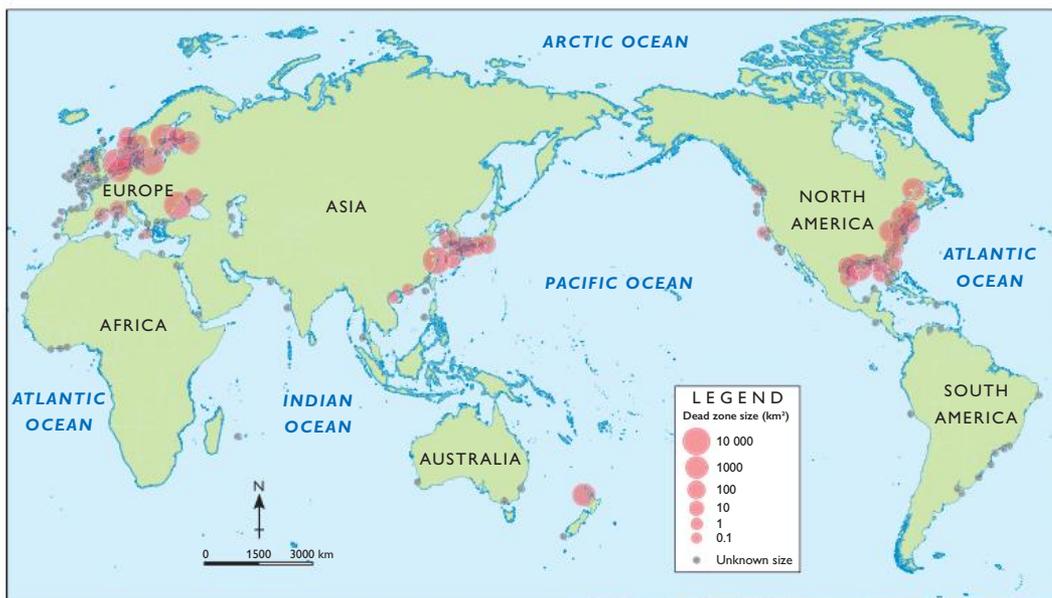
- 4 Complete a timeline of the events that have led up to the most present problems. Include any major events; for example, storms, any times where improvements have been made or attempted, and times when poor decisions have resulted in more negative impacts.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Place, Environment, Interconnection, Scale, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Maps, Spatial technologies

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

### WORLD: LOCATION OF MARINE DEAD ZONES



Source 7.26

Source: Oxford University Press

# CHECKPOINT

# 7.3

## THE ROLE OF GEOGRAPHERS IN MANAGING ENVIRONMENTAL CHANGE

HOW CAN COASTAL CHANGES BE MANAGED?

Geographers have an important role to play in the management of environmental change. Because geographers draw on knowledge and skills from the natural sciences (such as geology, biology, chemistry and physics), the social sciences (such as psychology, history and economics) and humanities (such as philosophy), they are uniquely placed to see the 'whole picture' when examining environmental change. Geographers can, for example, consider the reasons why people act in a certain way and consider the impacts of these actions on the environment. They can also help to explain why people respond to change in different ways and, most importantly, recommend a course of action that is beneficial to both the natural environment and people.

### Fieldwork case study

When examining environmental change such as coastal erosion, geographers often begin by developing a set of geographical questions. The geographer then sets out to answer these questions using a range of geographic tools. One of the most useful tools is fieldwork – visiting the environment being studied and observing it firsthand.

When exploring changes at the coast, geographers use a range of specific techniques. These include constructing cross-sections of dunes, cliffs and other landforms, photographing evidence of change and measuring **longshore drift**. By visiting the same site at regular intervals (for example, once a year) geographers can also observe changes that have occurred between their visits. It may be important to visit the site at different times of the year to observe seasonal changes such as the effects of storm waves during winter or the impacts of holiday-makers during summer. The following case study is an example of the sort of environmental issues that might be explored by a geographer completing fieldwork.

### CASE STUDY

#### Coastal issues at Old Bar, New South Wales

The small coastal town of Old Bar, located on the mid-north coast of New South Wales, faces a range of environmental changes. The town is located on a dune system within a river delta and is home to around 4000 permanent residents. It also has a large number of visitors, particularly during holiday times. The dunes are eroding rapidly at a rate of up



**Source 7.27** An oblique aerial photograph of Old Bar showing the location of a proposed real estate development

to 1 metre per year and this is threatening homes and infrastructure. Studies have found that the dunes in this area have experienced periods of erosion in the past but that rising sea levels are making the current situation more severe.

Local residents are worried that trail-bike riders on the dunes are causing more damage and that the old site of a sand-mining business, which operated back in the 1980s, is an erosion hot spot. Some are also concerned that a proposed 10-hectare housing estate south of the town will further damage the dunes. Many residents believe that building two artificial reefs at the cost of \$10 million would protect the coast from further erosion. However, an expert study recommended that a managed retreat coupled with a sloping sea wall of sand-filled bags and regular beach nourishment was a better option.

### Photographs from fieldwork at Old Bar



**Source 7.29** In some places, the beach is composed of pebbles as well as sand.



**Source 7.28** Dune erosion has destroyed some homes and is threatening others.



**Source 7.30** Evidence of erosion includes this large Norfolk pine tree that has fallen onto the beach.

## REVIEW 7.3.1

### Remember and understand

- 1 Why is fieldwork an essential tool for geographers?
- 2 Why are geographers uniquely placed to help describe and manage environmental change?

### Apply and analyse

- 3 Look carefully at the photographs on these pages. Create a series of geographical questions that could be used as the basis of a field trip to Old Bar. You may like to begin your questions with the words 'what', 'where', 'how', 'why', 'what impact' and 'what should'. Share your questions with a partner and then with the class.

- 4 Why would many residents prefer artificial reefs to be constructed rather than implementing the soft engineering approach of managed retreat?
- 5 What would be the advantages and disadvantages of sea walls and beach nourishment at Old Bar?

### Investigate and create

- 6 Read section GT.3 of 'The geographer's toolkit' and use the tip on conducting successful fieldwork to design your own fieldwork investigation of Old Bar. Outline the five stages of your inquiry, making sure that you investigate the:
  - a causes of coastal erosion
  - b effects of coastal erosion
  - c responses to coastal erosion.

## STRANGE BUT TRUE

Canada has the longest coastline in the world, Australia sits sixth and Monaco has the shortest. Coastal management differs across the globe and so does its importance. It's not always the longest coastline that needs the most management.

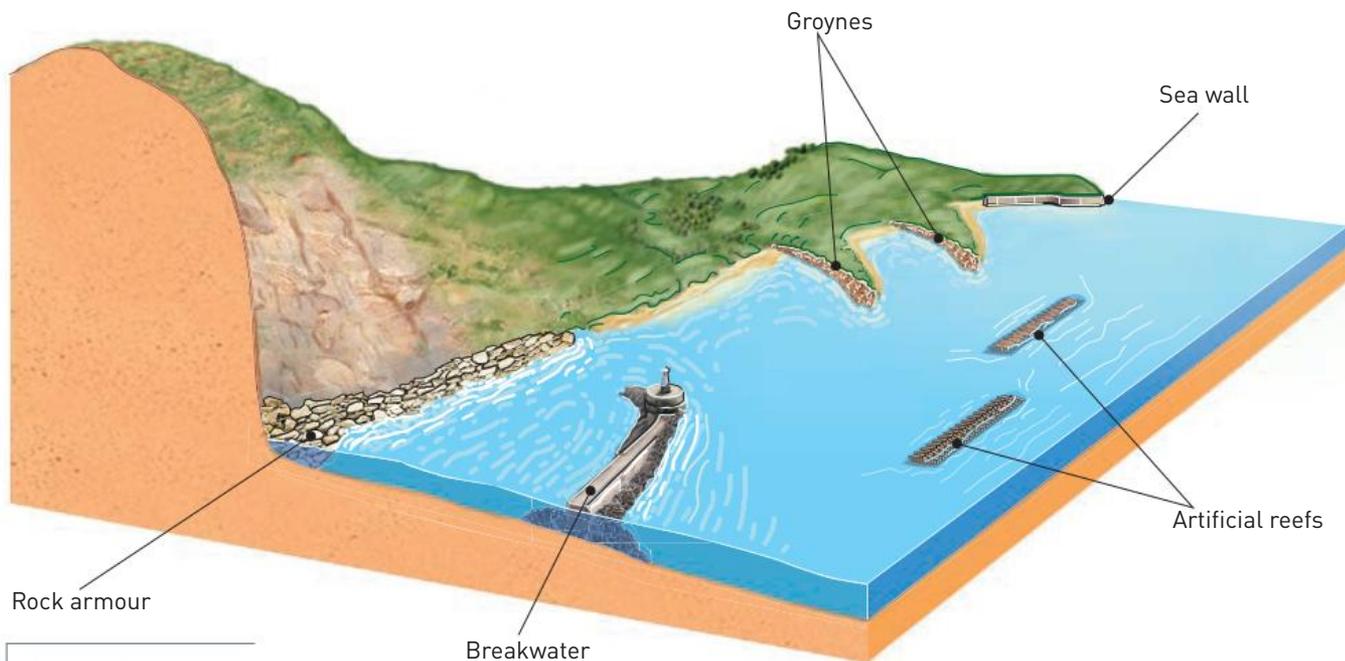
# NEW WAYS OF MANAGING COASTS

Many attempts have been made by people in the past to try to control the natural coastal processes of erosion, transportation and deposition. Unfortunately, due to a poor understanding of these natural processes, attempts have often made problems worse or simply moved them to another part of the coast. In addition, issues have tended to be managed on a local scale without regard for the broader environments that influence the coast such as river catchments and marine ecosystems.

More recently, a greater understanding of natural processes as well as a recognition of the widespread impacts of coastal management has led to new approaches. These include soft engineering (using natural processes), integrated coastal zone management (ICZM), and the protection of coastal ecosystems with special marine reserves.

## Managing natural processes: Hard versus soft engineering techniques

One of the key principles underpinning effective coastal management is to work with natural processes. In the past, coastal management has tended to use 'hard' engineering. Hard engineering refers to the building of structures such as sea walls, groynes, artificial reefs, rock armour and **breakwaters** to protect coastlines from the erosive effects of waves or to trap sand. The main hard engineering techniques are shown in Source 7.31.



**Source 7.31** A stretch of coastline showing a number of hard engineering techniques commonly used around the world today

Many people in coastal areas like these hard options as the results are obvious and immediate. These structures tend to be expensive, however, and to have a high impact on natural environments. In many cases, they also create other problems or simply move the problem further along the coast.

By comparison, soft engineering coastal management techniques use the natural processes of the coast. They are often less expensive than hard engineering options, and are considered to be more sustainable as they have less impact on the natural environment. There are two main types of soft engineering – beach nourishment and managed retreat:

- Beach nourishment replaces beach material such as sand that has been removed by erosion or longshore drift (see Source 7.32). Beaches are a natural defence against erosion and coastal flooding and are a desirable feature of the landscape for residents and tourists alike. The natural process that eroded the beach in the first place will continue, however, so the beach needs to be nourished again and again.
- Managed retreat involves the relocation of human settlements and hard engineering defences such as sea walls and groynes so that the natural processes of erosion and deposition can take place. In many cases, low-lying areas flood allowing salt marshes, wetlands and mudflats to re-establish themselves in these areas (see Source 7.33). Over time, these habitats provide a natural defence against further erosion. Unlike many hard engineering techniques, managed retreat can be relatively inexpensive, depending on the location. However, people living in these regions can be unwilling to relocate and need to be compensated for the loss of their properties.



**Source 7.32** In the Netherlands a vast sand peninsula 2 kilometres long and 1 kilometre wide has been constructed. Dubbed the 'sand engine', waves and currents are redistributing the peninsula along the shore where it is expected to nourish the beaches and form sand dunes.



**Source 7.33** Managed retreat at Abbots Hall Farm in Essex, England, has allowed salt marshes to be re-established.

## REVIEW 7.3.2

### Remember and understand

- 1 What are the main differences between hard and soft engineering techniques?
- 2 Describe the process that is occurring at Abbots Hall Farm (see Source 7.33).

### Investigate and create

- 4 Match the hard engineering technique with its function and possible disadvantage.

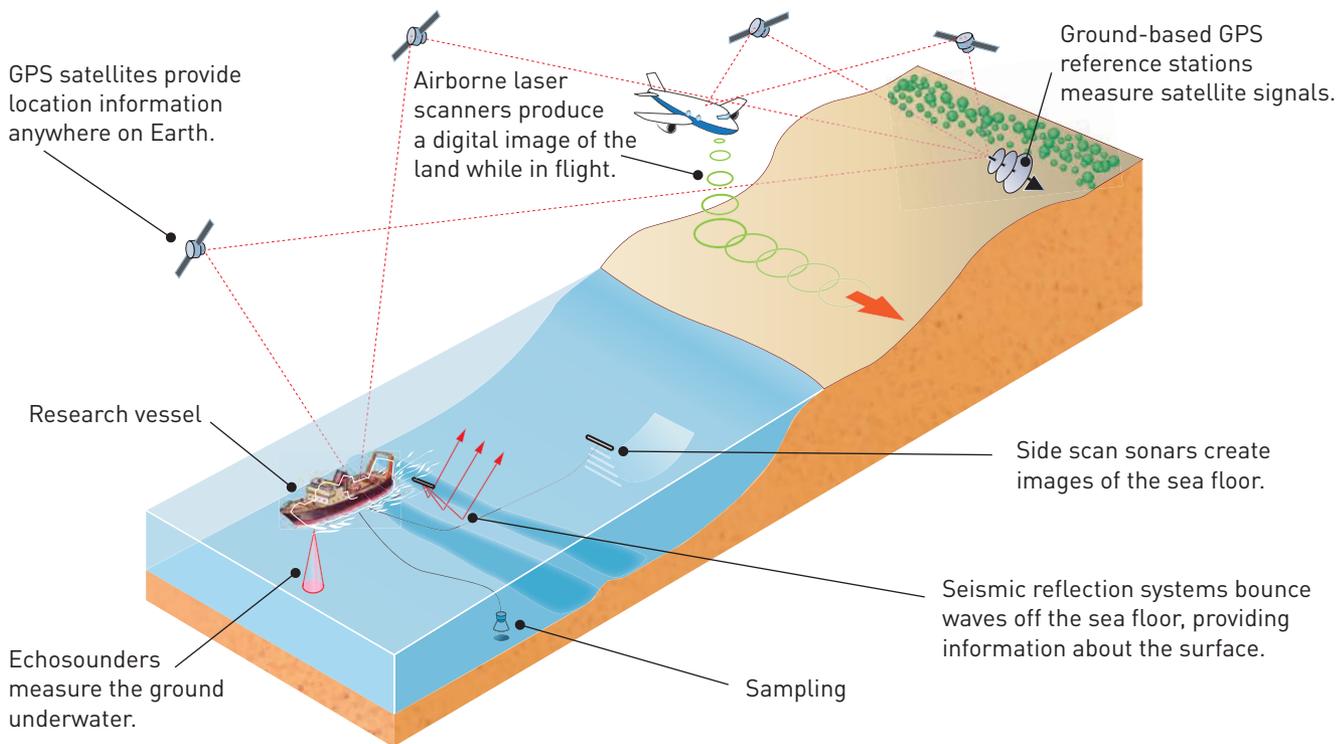
Technique	Function	Possible disadvantage
Sea wall	Absorbs the energy of waves and allows the build-up of sand to form a beach	Can be difficult and expensive to find and place suitable rocks to form the wall
Groyne	Protects cliffs, land and buildings from erosion and can also lessen the risk of coastal flooding from storm surges	May weaken longshore drift and allow sand to build up – sometimes creating a <b>tombolo</b>
Rock armour	Absorbs the energy of waves and provides a safe harbour for boats	Can ruin the appearance of the beach and be costly to maintain
Breakwater	Traps material carried by longshore drift and allows a beach to be built up	Can be very expensive to build and maintain; it reflects rather than absorbs wave energy so waves may continue to cause erosion elsewhere

# USING SPATIAL TECHNOLOGIES



Geographers use a range of tools to describe and predict environmental change. These tools may be as simple as direct observation or involve measuring and recording the changing width of a beach with a tape measure. Increasingly, however, digital tools are being used to measure change and to help manage dynamic environments such as coasts, forests and farms (see Source 7.34). These tools rely on the collection of data from sources such as the **global positioning system (GPS)**, aerial photographs, ships and tide meters. The data collected is then analysed by computer programs and made available for use by **geographic information systems (GIS)** and **digital terrain modelling (DTM)** as well as other applications.

As more and more coastal communities become concerned about the impacts of rising sea levels due to climate change, there is a greater demand for more advanced methods of monitoring the coastline. This is driving a boom in coastline monitoring through spatial technologies and is making more data and information about coastal changes available to geographers than ever before.



Source 7.34 Geographers use a range of digital data-collection methods.

## Digital terrain models

A digital terrain model (DTM) shows the relief (or shape) of the land in three dimensions (see Sources 7.35 and 7.36). Much of the data needed to create a DTM is collected from special sensors on satellites. This data is represented as a raster (grid of squares) and manipulated by technicians to form a model of the Earth's surface. These models can help geographers 'see through' features of the environment such as coastal waters and forests to examine the terrain below. They can be used to predict areas at risk from erosion and other hazards, such as coastal flooding. This information can then be used to help manage the environment to limit the effects of these potential hazards and disasters.



**Source 7.35** In this DTM, the height of the land and the depth of the sea are represented by changes in colour.



**Source 7.36** The same data used to create the first DTM has been combined with an aerial photograph to create a more realistic digital representation of the landscape.

## KEY CONCEPT: INTERCONNECTION

### Geographic information systems

A geographic information system (GIS) uses digital data to create a series of maps of a particular landscape. Each map focuses on a different aspect of the environment, such as the ocean depth, salinity, roads, settlements and relief. Using a GIS program, the maps are presented as a series of layers that can be switched on and off. This enables geographers to compare different aspects of the environment and look for interconnections between them.

The GIS is particularly useful in examining and managing change in coastal environments. It allows geographers to isolate different and competing land uses, to see beyond political and physical boundaries and to measure change over time.

The Netherlands provides a good example of the use of this technology. Every year, the entire 350-kilometre-long Dutch coastline is digitally mapped and measured using methods similar to those shown in Source 7.34. The maps and cross-sections produced in this annual survey are compared with the first survey of this kind, undertaken in 1990. Areas of coastal erosion and accretion (growth) are clearly displayed on GIS maps and are used by

coastal managers to make changes in coastal defence strategies such as beach nourishment and sea walls.

For more information on the key concept of interconnection, refer to section GT.1 of 'The geographer's toolkit'.



**Source 7.37** A GIS map of North Africa and Europe. A range of GIS tools are shown in the left-hand margin and the map layers available in the right-hand margin. By manipulating these tools and layers, geographers can create their own maps and examine regions in great detail.

## REVIEW 7.3.3

### Remember and understand

- 1 Why do geographers use digital tools?
- 2 How is data collected to create GIS and DTMs?

### Apply and analyse

- 3 Examine Sources 7.35 and 7.36.
  - a What evidence is there that this coastline is under threat of erosion?
  - b Which of these DTMs would be most useful to an engineer planning the placement of new groynes? Give some reasons for your answer.
  - c Who would find these models useful?

### Investigate and create

- 4 Examine Source 7.27 showing the proposed real estate development site at Old Bar in New South Wales before completing the following tasks.
  - a Imagine that the developer at Old Bar has asked you to suggest a range of digital data-collection methods to create a GIS that will assist them with their planning. Describe the most relevant data-collection methods to use.
  - b Now sketch the map layers that you think the developer would most like to see included in the program.

# CHANGE AT RAINBOW BEACH, QUEENSLAND

Rainbow Beach is a small community located on a massive dune system that runs along the Queensland coast near the southern tip of Fraser Island. Formed over two million years, the dunes are part of one of the world's greatest sand dune complexes that includes Fraser Island – the world's largest sand island. In places, the dune system is 200 metres high and is held in place by large areas of scrub, forest and grasses.



**Source 7.38** An **oblique aerial photograph** of Rainbow Beach, looking south. The foredune and two blowout dunes (known locally as the Carlo Sand Blow and the Little Sand Blow) can be seen to the south of the town.



**Source 7.39** A 2009 storm severely eroded the Rainbow Beach foredune, placing the Surf Life Saving tower in danger of collapse.

While Aboriginal occupation of the region dates back 5500 years, European settlement began with a sand-mining operation north of the town in the mid-1960s. A road built to reach the sand mine was soon used by tourists to access Fraser Island and the new town of Rainbow Beach (see Source 7.38). The sand-mining operation finished in 1976 but the population of the small town continued to grow slowly. Now home to about 1000 full-time residents, visitor numbers swell in summer holiday periods as people arrive to use the camping ground as well as several hotels and resorts.

The key management issue faced by the region is the erosion of the sand dunes, particularly during storms. This is an example of a potential conflict between natural processes and human activities. Sand dunes naturally change in response to long- and short-term changes in wind patterns, sand supply and sea levels. The erosion of the foredune at Rainbow Beach (a dune ridge running parallel to the ocean) is a natural event. However, as the erosion is now putting buildings at risk and making the beach unsuitable for recreation activities, some local residents and the Gympie Regional Council are proposing to try and control the erosion.

A study of the region found that the risk of severe dune erosion at Rainbow Beach is very low but some people are still concerned that during a severe storm important buildings could be lost. The council plans to install large sandbags at the base of the dunes in front of the Surf Life Saving tower, along 260 metres, to slow erosion and protect a new amenity block that has been built on top of the dunes.

## KEY CONCEPT: PLACE

### Coastcare at Rainbow Beach

There are 2000 Coastcare groups in Australia. Each group is made up of volunteers who work with local governments to identify problems and then work together to solve them. At Rainbow Beach, the local group has identified the loss of native vegetation, the trampling of dune vegetation by visitors accessing the beach, sand skiing on the sand blows, coastal erosion, environmental weeds, beach parking and rising sea levels due to climate change as the key issues in the area.

Some of the projects the Coastcare group at Rainbow Beach have undertaken include restoring



**Source 7.40** A range of management strategies are in place at the main beach in Rainbow Beach. The fencing and walkway direct people to enter the beach on this path, protecting surrounding dunes.

native plants and removing weeds, protecting the dunes, monitoring bird populations and improving wetland areas.

For more information on the key concept of place, refer to section GT.1 of 'The geographer's toolkit'.



**Source 7.41** Rainbow Beach has a very active Coastcare group.

## REVIEW 7.3.4

### Remember and understand

- 1 Describe the natural environment of Rainbow Beach.
- 2 Describe the human activities bringing about change to this place.
- 3 What is Coastcare?

### Apply and analyse

- 4 Is the plan to place sandbags at the base of the dunes an example of hard or soft engineering? Give some reasons for your answer.
- 5 What management strategies can you identify in Sources 7.40 and 7.41? What is each strategy designed to achieve and how effective do you think each will be in achieving its aims?

- 6 What are the similarities and differences between changes at Rainbow Beach and changes at Abbots Hall Farm in Essex (see Source 7.33)?

### Investigate and create

- 7 The Little Sand Blow is increasing in size as it moves westward. Construct a flow diagram or field sketch that shows the:
  - natural processes responsible for this movement
  - human activities that may be contributing to the movement
  - impacts of this movement on the environment
  - possible responses by the local government and Coastcare group.

# INTEGRATED COASTAL ZONE MANAGEMENT



**Source 7.42** The challenges facing many coastal environments require an integrated approach.

In response to the serious issues facing coastal and marine ecosystems, a major United Nations conference held in 1992, called the Earth Summit, proposed a new system for managing coastal environments. Known as Integrated Coastal Zone Management (ICZM) it is now a widespread practice in many coastal nations, such as New Zealand, India, Canada, Bangladesh and the Netherlands.

The United Nations recognises that one of the common issues associated with coastal management is that government departments and interest groups often propose very different solutions to issues depending on their own needs and interests. In most cases, these solutions ignore the needs of other coastal users. The many coastal interest groups include residents, the tourism industry, fisheries, farmers, forestry, manufacturing, mining, waste disposal, marine transportation and real estate developers.

The key to ICZM is that it seeks to pull together the many groups and individuals with an interest in the coast in an integrated way when devising a management plan. The key principles of ICZM are outlined in Source 7.43. The success of ICZM is then dependent on funding, consistent government priorities and the expertise available to organise and manage large projects.

## Eight principles of Integrated Coastal Zone Management

- ▶ Involve all relevant governments
- ▶ Take a long-term view
- ▶ Use a holistic approach
- ▶ Consider local conditions
- ▶ Work with natural processes
- ▶ Get people involved
- ▶ Use a range of approaches
- ▶ Be prepared to change strategy

**Source 7.43** The eight key principles of Integrated Coastal Zone Management

## ICZM in Bangladesh

Each ICZM plan is designed to best address the issues of the country it has been developed for. In Bangladesh, for example, the key issues are rising sea levels, which bring saltwater floods to low-lying communities, and the impacts of cyclones and storm surges. It is estimated that a 1-metre rise in sea level would leave 17 000 square kilometres of land in Bangladesh submerged and 15 million people without a home (see Source 7.45). It will affect 1 million hectares of farmland and threaten the freshwater supplies of three major cities.

In response to these threats the Bangladeshi government, with the assistance of the World Bank and expertise from the Netherlands, has developed an ICZM strategy that focuses on disaster mitigation. To date 150 000 hectares of mangroves have been replanted and more than 2500 cyclone shelters constructed.



**Source 7.44** A nursery for mangrove trees. These will be used to replace some mangrove areas lost to farming and forestry and help to reduce flooding.

## BANGLADESH: PREDICTED IMPACT OF 1-METRE SEA-LEVEL RISE



**Source 7.45**

Source: Oxford University Press

## REVIEW 7.3.5

## Remember and understand

- 1 What is ICZM?
- 2 How and why has ICZM been implemented in Bangladesh?

## Apply and analyse

- 3 Source 7.24 illustrates a significant problem in many coastal areas – marine dead zones. Work with a partner to use the eight key principles of ICZM to suggest how people could manage this issue. For example, using a holistic approach

might mean getting farmers to be more careful in their use of fertilisers. Perhaps nutrient levels in streams could be monitored so that farmers could better manage their application of fertiliser, particularly in times of heavy rainfall.

## Investigate and create

- 4 What do you see as some of the barriers to ICZM principles being adopted in Bangladesh?
- 5 What do you see as some of the advantages in managing coastal changes using this approach?

# ICZM IN THE NETHERLANDS

The province of Zeeland in the Netherlands is a large agricultural area that is home to more than 380 000 people (Source 7.47). Much of the region lies below sea level. The land has been drained and reclaimed, creating new islands that are linked by bridges and tunnels. The area has an intricate series of levees (known as dykes) and dams that hold back the waters of the North Sea and regulate the flow of the rivers to the sea. The province also supports a large fishing industry and is home to the largest national park in the Netherlands.

In Zeeland, ICZM is used to reduce flooding from storm surges. The largest of the flood protection dams, the 9-kilometre-long Oosterscheldekering, links two of the largest islands in Zeeland. The 62 steel doors that make up the barrier can be lowered or raised in response to tides, storms and other sea level changes (see Source 7.46). For most of the year, sea water can



**Source 7.46** The Oosterscheldekering storm surge barrier in Zeeland



**Source 7.47** A vertical aerial photograph of Zeeland showing a number of dams and storm surge barriers (including Oosterscheldekering)

flow freely beneath the dam so that marine ecosystems in the bays and estuaries of the delta can be maintained.

The dam, which was opened in 1986, has been declared one of the Seven Wonders of the Modern World and bears a plaque with the words, 'Here the tide is ruled by the wind, the moon and us (the Dutch).' Any long-term changes in sea level due to climate change will place greater pressure on this region and on these amazing engineering works.

The series of dams, storm surge barriers and bridges have provided many benefits for the people of the Zeeland region. As well as protecting them from storm surges and flooding, large areas of former saltwater estuaries have been converted into freshwater lakes, creating a reliable supply of water. The dams and bridges also link together island communities that had been isolated for hundreds of years and the calmer waters of the river mouths and estuaries are safe for shipping and recreational boating.

## ZEELAND: TOPOGRAPHIC MAP



Source 7.48

Source: Oxford University Press

### REVIEW 7.3.6

#### Remember and understand

- 1 Why was the Oosterscheldekering constructed?
- 2 Locate the province of Zeeland in an atlas or on Google Earth and describe its location.

#### Apply and analyse

- 3 Use the eight key principles of ICZM (see Source 7.43) to comment on the flood protection provided by Oosterscheldekering. For example, how does this barrier take local conditions into account?
- 4 Examine Sources 7.47 and 7.48.
  - a What factors do you think may be responsible for the large sandbanks forming in the Oosterschelde?

- b Identify the different land uses on the island of Schouwen-Duiveland.
- c Describe the relief of the island using the contour lines on the map.
- d Describe the southern shore of the island.

#### Investigate and create

- 5 Draw a sketch map of the vertical aerial photograph in Source 7.47. On your map label the key natural and human features of the landscape.
- 6 The Oosterscheldekering is only one part of a much larger flood protection scheme. Use Google Earth to examine the region and find other examples of flood protection.

# REDUCING THE IMPACTS OF COASTAL TOURISM

Tourism is the world's largest industry. It generates more than \$US8 trillion a year in income and employs about 220 million people worldwide. Tourism in coastal areas has experienced a surge in recent years, and for many coastal communities it has become the largest contributor to their economy. While tourism has the potential to alleviate poverty and bring better infrastructure such as new roads and public services, it also has the potential to bring about major environmental degradation.

Tourism not only attracts visitors to coastal areas but also locals, who move to the coast for work, providing the goods and services tourists require. Tourism also brings developments such as hotels, jetties, roads, airports and shopping strips, often with minimal or hurried planning. The result is that many coastal tourism hubs are under significant environmental pressure.

The potential negative environmental impacts of tourism are many. Greater numbers of people bring increased pollution and landfill (see Source 7.49). As ecosystems such as mangroves, wetlands and reefs are removed to make way for hotel developments, there is a subsequent decline in biodiversity and an increased risk of beach loss from erosion and natural disasters. In addition, an increased demand for fresh water, food (especially seafood), energy and sanitation make tourism a huge consumer of natural resources.

## Ecotourism: A way forward?

Ecotourism is one option that coastal tourism operators are using to make their industry more sustainable. It is also a strong marketing tool, appealing to tourists who want more environmentally friendly travel. The International Ecotourism



Source 7.49 Cruise ships that carry up to 4000 passengers each contribute to the 70 000 tonnes of waste generated annually from tourism in the Caribbean region.

Society (TIES) defines ecotourism as ‘responsible travel to natural areas that conserves the environment and improves the wellbeing of local people’. TIES believes that those who implement and participate in ecotourism activities should:

- minimise environmental impacts
- build environmental and cultural awareness and respect
- provide positive experiences for both visitors and hosts
- provide direct financial support for conservation
- provide financial benefits and empowerment for local people
- ensure sensitivity to the host country’s political, environmental and social climate.



## KEY CONCEPT: SUSTAINABILITY

### The Penguin Parade

One of Australia’s most popular tourist attractions is the nightly arrival of hundreds of Little Penguins at Summerlands Beach on Phillip Island (Victoria). This natural event attracts around one million visitors per year, more than half of whom are from overseas. As well as a tourist attraction, the Penguin Parade is also an example of minimal impact ecotourism and conservation.

As a non-profit organisation, the Phillip Island Nature Park uses the income generated from the parade to protect, conserve and restore the natural environment of the region. The organisation has become a world expert on the Little Penguins and carries out vital research on seals and sea birds. In order to protect the penguins, rangers undertake large- and small-scale revegetation and habitat restoration programs. As a result, the penguin population climbed from 19 000 in the 1980s to near 70 000 in 2013.

Much of the restoration and revegetation work is on the site of a former housing estate located adjacent to the Penguin Parade. Between 1985 and 2010, the Victorian Government purchased and removed hundreds of holiday homes, as well as the roads,

gardens, power cables and septic tanks that made up the Summerlands Estate. The area is now prime habitat for the penguins. Future plans include moving the visitor centre and car parks so that the land on which they now sit can also be restored to natural habitat.

For more information on the key concept of sustainability, refer to section GT.1 of ‘The geographer’s toolkit’.



**Source 7.50** Raised boardwalks and viewing platforms minimise the environmental impact of visitors to the Penguin Parade and allow penguins to move freely from the ocean to their burrows every evening.

## REVIEW 7.3.7

### Remember and understand

- 1 What is ecotourism?
- 2 In what ways can the Penguin Parade on Phillip Island be considered to be an example of ecotourism?

### Apply and analyse

- 3 Source 7.49 shows a cruise ship docking at a Caribbean port. Describe the changes that have been made to the coast as a result of the tourism that can be seen in this photo.
- 4 Compare these changes with those that have occurred at the Penguin Parade.

### Investigate and create

- 5 Imagine that an international tourism operator has proposed to build a port for cruise ships at Rainbow Beach (see Source 7.38) and that you have been appointed the company’s environmental consultant. Brainstorm the impacts of this development on the natural environment. Use the ecotourism principles provided to make recommendations that minimise these impacts. Prepare a report for the tourism operator with your recommendations. You may like to include a map and sketches in your report.

# DEVELOPING RESPONSES TO ENVIRONMENTAL ISSUES

Once an environmental issue has been identified and assessed, it is often necessary to come up with a suitable response. Remembering that each environmental issue is unique, the environmental response must also be individually designed for that particular environment. Management responses that are effective in one place may be ineffective or even damaging in other places.

When considering a suitable response to environmental issues, questions to ask include:

- Does the response deal with the causes of the issue as well as its effects?
- Is the response affordable, both in the short and long term?
- Is the response beneficial to all natural environments, or does it just move the problem and perhaps result in greater environmental changes in another place?
- Is the response fair to all of the relevant stakeholders?

## CASE STUDY

### Sierra Leone's disappearing beaches

Sand mining is having a serious environmental impact on the coastal environment in the African nation of Sierra Leone.

The capital city, Freetown, is experiencing a population and building boom. The population is growing by about 70 000 people per year and there is a growing demand for new housing as well as commercial and industrial buildings. Many of these buildings are made from concrete, which requires vast quantities of cheap, good quality sand. Sand-mining operations can involve up to 40 trucks at a time, each with a team of diggers, who shovel sand from a beach. This process is creating changes in both the natural

environment, as the sea is able to penetrate further inland, and the human environment. Local residents are being affected as the remaining dunes are eroding rapidly and houses are falling into the sea.

#### Possible responses

Sierra Leone is trying to build a viable tourism industry to boost the nation's economy but tourist resorts are in danger of losing their beaches and their potential customers. A possible response to this problem would be to declare sand mining illegal and arrest those who continue to take sand from the beaches. Another possible response to this problem would be the importation of sand from other places.

Some of the factors that would need to be considered when planning a response are:

- Sierra Leone is one of the world's poorest countries. Many people struggle to earn enough money to provide adequate food, shelter and water for their families. Sand mining provides a source of income for hundreds of men and their families.
- Coastal areas are often heavily used for many purposes: fishing, residences, tourism, recreation and a source of building materials.



Source 7.51 Hamilton and Lakka beaches shown on the edge of Freetown's urban sprawl

- As dunes disappear, coastal erosion is accelerating and is now up to 6 metres per year in some places.
- Climate change is expected to raise sea levels and to increase the number and severity of storms generating large, destructive waves.
- Sierra Leone's police force has not enforced previous bans on sand mining.
- Corrupt local officials accept payments from the construction companies to continue.
- The main sources of sand, Hamilton and Lakka beaches, are located within Freetown's urban sprawl (see Source 7.51).



**Source 7.52** Sand mining on Hamilton Beach, Freetown, Sierra Leone

## SKILL DRILL

### Evaluating possible responses to environmental issues

Complex environmental issues often require complex responses. Geographers can propose possible responses or assess the environmental, economic and social sustainability of responses proposed by governments. Geographers can evaluate possible responses against a set of criteria. For example, the issue of sand mining in Sierra Leone requires an urgent response. If the situation continues, hundreds of people will lose their homes, the tourist industry will collapse and many people will lose their jobs. The area around Freetown will also lose many ecosystem services such as storm protection.

When evaluating possible responses to environmental issues follow these steps:

- Step 1** Read all of the background information carefully and make sure that you understand it well. You may also like to conduct some additional research if anything is unclear.
- Step 2** In some cases, you may be required to suggest your own responses to environmental issues. In other cases, you will evaluate responses suggested by others. For example, in the case of Sierra Leone:

Response 1 – Declare sand mining illegal and arrest those who continue to take sand from beaches

Response 2 – Import sand from other places.

- Step 3** Develop a set of criteria to evaluate each of the suggested responses. These criteria should consider all sides of the issue, such as economic viability, environmental sustainability and social justice.
- Step 4** Create a table to evaluate each response against each criterion. You may like to use symbols such as:
- ✓ – criterion met      % – criterion partly met  
 × – criterion not met      ? – unsure.
- Step 5** Use the data table to select the best response to the issue. You may need to reconsider particular aspects of the response (and make modifications) to come up with the best response. In other cases, you may need to combine aspects to come up with the best solution.
- Step 6** Based on your evaluation, present your final recommendation. Include maps and diagrams to help describe the proposal and the intended benefits.

#### Apply the skill

- 1 Follow the steps to develop a sustainable response to beach sand mining in Sierra Leone.

### REVIEW 7.3.8

#### Remember and understand

- 1 Why is beach sand mining a problem?
- 2 Why doesn't the Sierra Leone Government just ban beach sand mining?

#### Apply and analyse

- 3 List the effects of illegal sand mining and rank them from the most to least significant in terms of the severity of the environmental impact.

#### Investigate and create

- 4 Beach sand mining occurs in other countries including India, Jamaica and New Zealand. Research one of these places and make a list of the underlying reasons for the practice.
- 5 Using Source 7.7, identify the human factors that are shaping the coastline of Sierra Leone. How do these differ from those shaping the coastline at Old Bar (see pp. 274–275)?

# 7.3

## CHECKPOINT

### HOW CAN COASTAL CHANGES BE MANAGED?

- Investigate the management of the environmental change.
- 1 Why is it that many coastal management issues are so hard to solve? [10 marks]
  - 2 What role do geographers play in coordinating a managed response to the issues? [10 marks]
  - 3 How can developed countries like Australia help the people and governments of less developed countries to better plan a managed approach to coastal developments? [10 marks]

TOTAL MARKS [ /30]

### RICH TASK

This rich task has been designed to be used as an investigative study of coastal management practices (using two case studies); ONE uses an Australian-based example and the other investigates ONE overseas example. You can use the steps laid out in the skill drill 'Reading complex maps' on page 189 to help you answer the map questions in this rich task.

#### Case study 1: Ningaloo Coast

On the north-west tip of Western Australia is one of the world's most spectacular coastal environments. Long white beaches run along the shore, and visitors can swim out from the beach to Australia's longest fringing reef (a reef that lies extremely close to shore). The region has about 300 000 visitors a year, many of them arriving between April and July for a chance to snorkel with whale sharks. The region is also home to dugongs and visited by humpback whales and greenback turtles.

Much of the region is under some form of legal protection as part of the Ningaloo Marine Reserve and Cape Range National Park. It is also Australia's newest World Heritage site, having been added to the World Heritage List in 2011.

Though a remote and relatively pristine area, the Ningaloo Coast faces a number of potential

environmental threats. These include:

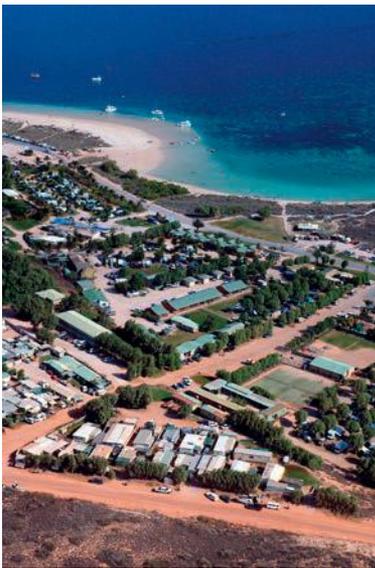
- oil and gas exploration off the coast
- damage to coral reefs from boat owners anchoring in the fragile reef areas
- illegal fishing
- plastic bags killing turtles and whales by intestinal blockage
- damage to vegetation from off-road driving
- waste disposal and pollution
- increasing level of water consumption
- potential for bushfires
- invasive species (foxes, goats, cats) destroying or attacking native plants and animals.

Other potential issues in the area include a RAAF bombing range south of Cape Range National Park, which may threaten important limestone caves and sinkholes, and livestock from local farms that could damage vegetation if they are not appropriately managed. In addition, the development of oil and gas reserves in offshore basins and shelves could present a future threat to the coast and reef.

#### Acquiring geographical information

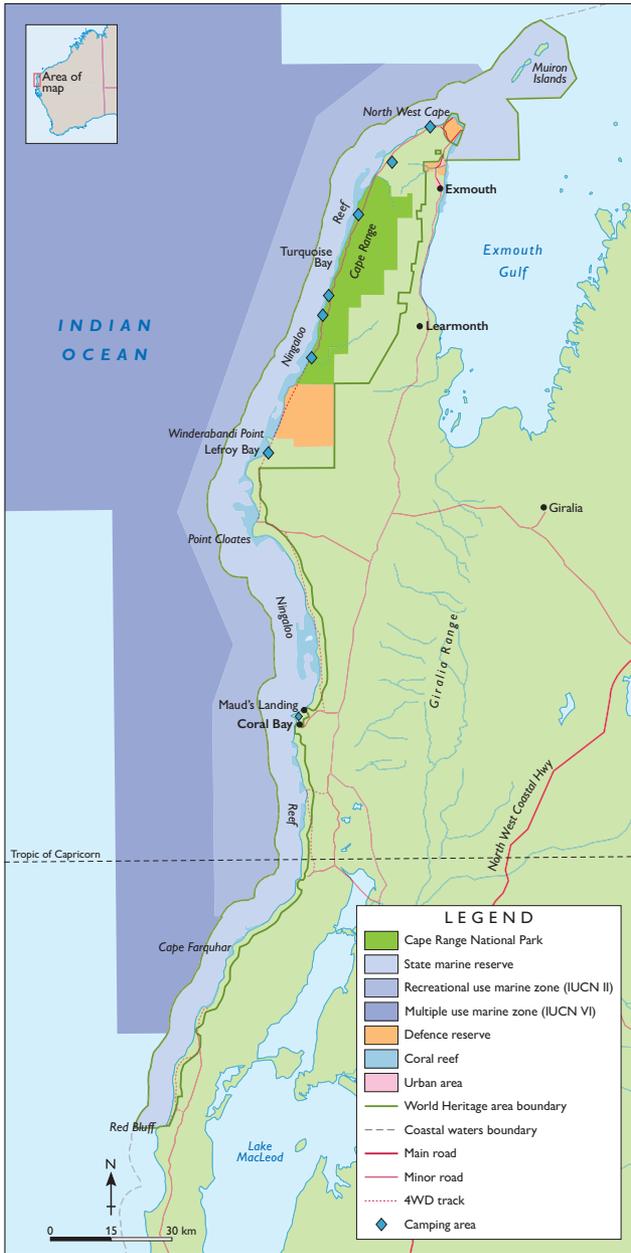
Look at the map of Ningaloo Marine Reserve (Source 7.54).

- 1 Find the symbol for multiple use marine zones in the legend and then locate these areas on the map. Describe the concentration of these areas.
- 2 What relationship is there between the multiple use marine zones and the location of recreational use areas?
- 3 Describe the location of the Ningaloo World Heritage area.



**Source 7.53** The small town of Coral Bay is used as a launching point for whale watching and fishing boats.

## NINGALOO MARINE RESERVE AREAS



Source 7.54

Source: Oxford University Press

### Processing geographical information

Do some further reading on the internet to complete the following tasks.

- 4 Research Ningaloo's World Heritage listing.
  - a What does World Heritage mean?
  - b Why are sites placed on this list?
  - c Why was the Ningaloo Coast added to the list?
- 5 In the early 2000s, a large resort and marina called Coral Coast Resort was planned for the coastal area to the north of Coral Bay known as Maud's Landing. Try and find out more about these plans and suggest reasons why the resort was not built.

### Case study 2: Gulf of Mexico oil spill

The Gulf of Mexico lies between the United States, Mexico and Cuba and contains one of the world's busiest oilfields. There are almost 4000 active oil wells in the Gulf along with a further 27 000 abandoned wells.

In April 2010, an active oil well operated by British Petroleum (BP), known as the Deepwater Horizon, exploded and sank to the sea floor, 1500 metres below the surface. Oil gushed from the well for three months while BP and American authorities tried desperately to plug the hole. The results were catastrophic. An oil slick covering 1500 square kilometres started moving towards the American coastline. Thousands of sea birds, fish, dolphins and turtles were covered in oil and died. Other animals along the shoreline such as crabs and molluscs were also badly affected. Local industries such as fishing and tourism collapsed, and many people lost their livelihoods.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Space, Environment, Interconnection, Sustainability, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Maps, Spatial technologies, Visual representations

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

**Acquiring geographical information**

- Using Source 7.55, analyse the causes and effects of the Gulf of Mexico oil spill. Once you have completed your

analysis, fill in the table below as a way of organising your results. An example has been done for you.

Geographic factor	Possible contributing feature	Description of feature
Physical environment	Shape of the coastline	The Gulf of Mexico is an extensive broad bay that opens to the Atlantic Ocean and Caribbean Sea in the east.
	Features of the seabed	
	Location of coastal marshes	
Natural processes	Ocean currents in the gulf	
Demographics	Distribution of towns and cities	
	Location of oil refineries and oil rigs	

**GULF OF MEXICO: EXTENT OF OIL SPILL FROM DEEPWATER HORIZON, 2010**



Source 7.55

Source: Oxford University Press

In addition to complex maps, geographers use information from a range of additional sources to explain how the impacts of the accident progressed and to look at the more long-term impacts on the environment. Research the Gulf of Mexico oil spill on the internet before answering the following questions.

- Can you identify any contributing factors to the accident that are not shown on Source 7.55 (for example any economic or technological factors). What was their role in the accident? Add these factors to the table provided.

Contributing factors	Possible contributing feature	Description of feature
Economic factors	Level of development of USA	
	Importance of oil in USA economy	
	Tourism and fishing industries	
Technological factors	Operation of oil refineries and oil rigs	
	Technical failure of oil rig	

### Processing geographical information

- Since 2000, more oil wells have been drilled in much deeper water than in the past. Some experts believe that this was an important factor in this disaster. Why do you think wells are now being drilled in much deeper water?
- Conduct research into the most recent findings on the disaster and what measures BP has been forced to undertake to 'fix' the ongoing environmental concerns for the area. Do you think they have done enough? Why / why not?



Source 7.56 The fire on the Deepwater Horizon

### Communicating geographical information

You are to choose ONE coastal management site as a case study. You may select one of these or any other highlighted in this chapter or elsewhere (check with your teacher first). Once you have thoroughly completed your research answer the following questions.

- Define the issue (what is the issue about)?
- Define the spatial dimension (where is the issue occurring)?

- Define the ecological dimension (how are humans a part of it)?
- What has caused the activity to become a problem?
- What is being done to minimise/reduce/eliminate its impact?
- What future possibilities can you think of to help?

Present your findings in the format of a report, poster or visual presentation.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Space, Environment, Interconnection, Sustainability, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Maps, Spatial technologies, Visual representations

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT



4

HUMAN WELLBEING



## GEOGRAPHIES OF HUMAN WELLBEING

# 8

CHAPTER

## IMPROVING INEQUALITIES IN WELLBEING

# 9

CHAPTER

Human wellbeing is about living well in every aspect – health, happiness, shelter and possessions, relationships and access to education and work. Every human on Earth should have the opportunity to live well. Factors that negatively impact on wellbeing are varied and include war, climate, poverty and malnutrition, access to resources, gender, sexual or racial inequality and access to education and healthcare. Shown here is a ‘floating school’ in Bangladesh – a solar-powered school on a boat providing basic education for children up to Grade 5.

## CHAPTER

# 8



**Source 8.1** An apartment building with a pool and tennis court shares a fence with one of São Paulo's largest favelas (a shanty town or slum), Paraisópolis (meaning 'Paradise City'), home to about 100 000 people. This scene starkly illustrates the inequalities in wellbeing worldwide.

## GEOGRAPHIES OF HUMAN WELLBEING

The city of São Paulo in Brazil is home to more than 11 million people. Like many cities around the world today, there are huge differences between the way people in some parts of the city live compared with others. The access they have to food and fresh water, the types of houses in which they live, their levels of education, access to health care and levels of employment vary enormously. Geographers are interested in measuring these variations and exploring the reasons why they exist. Studying the links between all of these factors gives geographers an idea of the level of wellbeing and development in different populations. Wellbeing is an overall measure of the ability of human beings to access the things they need in order to live happy and healthy lives.



# 8.1

## HUMAN WELLBEING AND DEVELOPMENT

WHAT MAKES HUMAN WELLBEING A GEOGRAPHICAL ISSUE?

Geographers define wellbeing as the ability of people to access the things they need in order to live happy, healthy and contented lives. Whether a person is born in a refugee camp in Tanzania, a megacity in China, a rural town in France or a coastal city in Australia their basic requirements for life are the same. The primary requirements include fresh water, a secure food supply, shelter, clothing and safety. Once these primary needs have been met, secondary needs, such as good health, the ability to make a decent living and access to education, become important in determining an individual's level of wellbeing.

The ability to meet these needs varies a great deal within communities, within countries and between countries. Many people around the world struggle simply to find enough food to eat or enough water to drink every day. Other people lack access to good health care or the ability to send their children to school. These experiences lead to a wide range of variations in human wellbeing. Geographers are interested in describing these variations and exploring possible reasons for them. They are also interested in analysing any strategies introduced to improve wellbeing and offering possible responses to resulting problems.

Traditionally, human wellbeing has been expressed as a measure of development, defined by the rate of economic growth. The more developed a country was the more goods and services it produced, the greater the wealth, quality of life and human wellbeing possible. Countries were described as developed, underdeveloped or developing. Today, the labelling of development on the basis of just the single criterion of economic activity is not considered to be enough to accurately represent the human wellbeing of a country. In order to provide a more complete measurement of human wellbeing and development we now use a number of global indicators and benchmarks including Gross Domestic Product (GDP), literacy rates, **life expectancy** and hunger. These will be investigated in this unit.

Three of the most important variables that influence these global indicators are wealth, health and education.

### Wealth

Our access to the basic necessities of life (and other wants we may have) is determined largely by our degree of wealth and our ability to earn a living. Wealth is generated by producing and selling things, earning income from work, making investments or owning assets. If we have enough wealth, we can use it to access a wide variety of goods and services. If we do not, we may struggle to buy things such as food, medicine and tools that we could use to generate more wealth. There are huge variations in wealth across the globe. It is estimated, for example, that the wealthiest 1 per cent of adults own 50 per cent of the world's assets and that the three richest people in the world are wealthier than the world's 48 poorest countries combined.

### Health

Human health is affected by a wide range of factors. Clean air, clean water and a secure supply of nutritious food are all vital but other factors are also important. These include the ability of a community to treat and control the spread of diseases, provide health

#### STRANGE BUT TRUE

'Our estimates suggest that the lower half of the global population possesses barely 1 per cent of global wealth, while the richest 10 per cent of adults own 87.7 per cent of all wealth, and the top 1 per cent account for 50 per cent of the total.'

Credit Suisse Global Wealth Report, 2015



care when individuals are sick or injured, care for the vulnerable such as babies and the aged, and provide emergency services in times of crisis. Access to health care is vital during natural disasters such as a drought or disasters caused by humans such as war, which can limit supplies of food and water. People living in war-torn countries often struggle to find the basic requirements needed for a healthy life.

## Education

Access to a formal education is viewed by many people as the key to improving wellbeing. Being able to read and write gives people access to a greater number of services and provides a range of options that can lead to better jobs, higher wages and improved standards of living. Education also increases people's self-esteem and allows them to have more control over their future.

In many communities, education is difficult to obtain. In many countries, poverty and conflict are the two major reasons why children do not attend school. Education can be especially difficult for girls to obtain because in many cultures educating boys is seen as more worthwhile. While parents may work hard to send their sons to school, they prefer to have their daughters helping out at home.

Despite these obstacles, rates of schooling and literacy (the ability to read and write) are increasing around the world. In Sub-Saharan Africa, for example, the enrolment rates of children in primary school rose from 65 per cent in 1990 to 73 per cent in 2015. This means that 44 million more children received a primary education in the region by 2015. In wealthy countries, such as Australia, New Zealand and the United States, education is seen as so valuable that it is made compulsory, free and universal.



**Source 8.2** People in Singapore enjoy one of the world's best healthcare systems. A baby born in Singapore is 45 times more likely to survive their first year of life than a baby born in Afghanistan.



**Source 8.3** In 2015 about 63 per cent of Indian adults could read and write. This compares with a rate of just 12 per cent in 1947. Despite this dramatic improvement, India is home to the world's largest number of illiterates. A particularly dire aspect of India's illiteracy problem is the large gap between male and female literacy. About 75 per cent of Indian men have at least a basic level of literacy – 24 percentage points higher than the 51 per cent literacy rate for women.

### REVIEW 8.1.1

#### Remember and understand

- 1 Define the term 'human wellbeing' in your own words.
- 2 Why is access to education seen by many as the key to improving wellbeing?

#### Apply and analyse

- 3 Identify some of the ways in which a person's wellbeing could be measured.
- 4 Why do you think survival rates of babies are so poor in Afghanistan? Make a list of possible

reasons. Explain why the survival rates of babies are so much better in Singapore.

#### Investigate and create

- 5 Conduct some research in order to describe wellbeing in Australia. Use the headings of wealth, health and education to guide your description.
- 6 Find a visual representation that best shows what wellbeing means to you. Justify your choice.

# MEASURING WELLBEING

The way in which we define wellbeing and development is dependent on a large number of factors. These include our values, beliefs, history, environment, level of education, language and culture. People from different environments and cultures often view wellbeing in vastly different ways. For example, owning your own home might be considered a factor that increases wellbeing but in many Indigenous Australian communities, guardianship of the land is considered more important to wellbeing than individual ownership.

## Common indicators of wellbeing

Geographers often rely on a range of **quantitative data** to measure and compare levels of wellbeing around the world. Two of the most common measures used today include **Gross Domestic Product (GDP)** and **literacy rates**. These measures are referred to as universal indicators because, while they are not perfect, the data they provide is easily obtained and allows geographers to make basic international comparisons.

GDP provides a measure of the total market value (i.e. the monetary value) of all the goods and services produced in a country in a given year. By dividing the GDP of a country by the total number of people living there, the GDP per capita can be calculated. This gives an approximation of the value of goods and services produced per person in the country each year. This data is then used to assess the average productivity and wealth of individuals.

Another universal indicator used to measure and compare wellbeing around the world is literacy rates. Literacy rates give an indication of the number of people in a population who are able to read and write. Data relating to literacy is often used as a measure of educational results in different countries. In general, low levels of literacy and education can impede the economic development of a country and affect wellbeing.

Although universal indicators such as GDP and literacy rates are commonly used by geographers, they do not provide an objective and complete picture of the situation. For example, relying only on GDP to measure wellbeing assumes that feelings of wellbeing in a population are based exclusively on how much money people have. In the same way, using only literacy rates assumes that feelings of wellbeing are linked exclusively to people's level of education. From our own experiences we know that it's just not that simple. These quantitative measures do not take into account the many different attitudes and values of people within a population, nor do they give an indication of how satisfied individuals may feel with their place in society. In order to give a more complete picture, a range of additional data – known as **qualitative data** – needs to be taken into account. Qualitative data about wellbeing is often more difficult and time consuming to collect because it is gathered from surveys and interviews.

Over the course of this unit we will be looking more closely at a range of different indicators of wellbeing.

## Wellbeing for Indigenous Australians

Many Indigenous Australians have a view of wellbeing based on traditional beliefs of inter-relationships between individuals, their community and the land. Wellbeing is achieved when the relationships between these factors work together in harmony. This is often described as a holistic view of wellbeing. Importantly, ill-health will arise and persist when



**Source 8.4** For Indigenous Australians wellbeing is partly determined by connection to the land.

the harmony of these relationships is disrupted.

It can therefore be difficult to measure the wellbeing of Indigenous Australians using only the common universal indicators. The Australian Bureau of Statistics has recently attempted to develop a model that takes into account Indigenous values when considering wellbeing levels. As well as using measures of health, literacy and wealth, this new model includes wellbeing measures related to an individual's connection to their community, ancestry, cultural traditions and identity, land and spirituality.

There is more to life than the cold numbers of GDP and economic statistics – This Index allows you to compare well-being across countries, based on 11 topics the OECD has identified as essential, in the areas of material living conditions and quality of life.

Source: OECD, (2014), *How's Life? 2015: Measuring Well-being*.

The **Organisation for Economic Cooperation and Development (OECD)** Better Life Initiative, launched in 2011, focuses on the aspects of life that matter to people and that shape the quality of their lives. The initiative comprises a set of regularly updated wellbeing indicators and an in-depth analysis of specific topics, published in the *How's Life?* reports. It also includes an interactive web application, the Better Life Index (see Source 8.5), and a number of methodological and research projects to improve the information base towards a better understanding of wellbeing trends and their drivers.

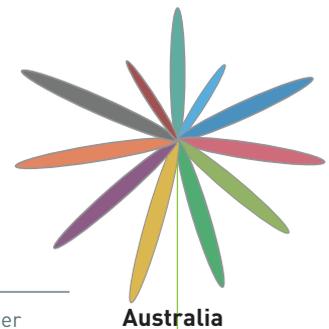
The OECD Better Life Initiative:

- helps to inform policy makers to improve quality of life
- connects policies to people's lives
- generates support for needed policy measures
- improves civic engagement by encouraging the public to create their own Better Life Index and share their preferences about what matters most for wellbeing
- empowers the public by improving their understanding of policy making.

**Source 8.5** OECD Better Life Index. What is your recipe for a better life – a good education, clean air, nice home, money? How does it compare with Australia's index (pictured here).

## CASE STUDY

### OECD Better Life Index



## REVIEW 8.1.2

### Remember and understand

- 1 What is Gross Domestic Product (GDP) an indicator of? Why is it often used as a measure of wellbeing?
- 2 Why is it difficult to measure the wellbeing of Indigenous Australians using only the common universal indicators?

### Apply and analyse

- 3 Rate the topics in the OECD Better Life Index according to their importance to you.
- 4 The OECD maintains that education empowers girls and young women, in particular, by increasing their chances of getting jobs, staying healthy and

participating fully in society – and it boosts their children's chances of leading healthy lives. Explain their reasoning in a diagram.

### Investigate and create

- 5 Go to the OECD Better Life Index web application ([www.oecdbetterlifeindex.org](http://www.oecdbetterlifeindex.org)) and account for the shape and dimensions of Australia's better life index shown in Source 8.5.
- 6 Compare and contrast Australia's performance in the Better Life Index with one of the other 33 member countries of the OECD.

# MAPPING WELLBEING

Geographers often use a range of maps to explore the spatial patterns in wellbeing within and between countries. Maps can be used to show variations in wellbeing around the world using specific indicators, such as the **Human Development Index (HDI)** or levels of poverty. By using a range of different mapping techniques, geographers can easily identify if countries with a high proportion of people living in poverty are clustered together or spread across the globe. They can then use this information to make comparisons and draw conclusions about the level of wellbeing in these places.

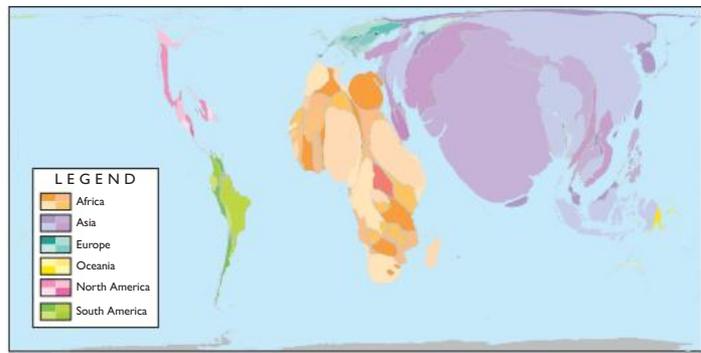
WORLD: HUMAN DEVELOPMENT INDEX RATINGS



Source 8.6

Source: Oxford University Press

WORLD: PROPORTION OF POPULATION LIVING IN POVERTY



Source 8.7

Source: Oxford University Press

## Choropleth maps

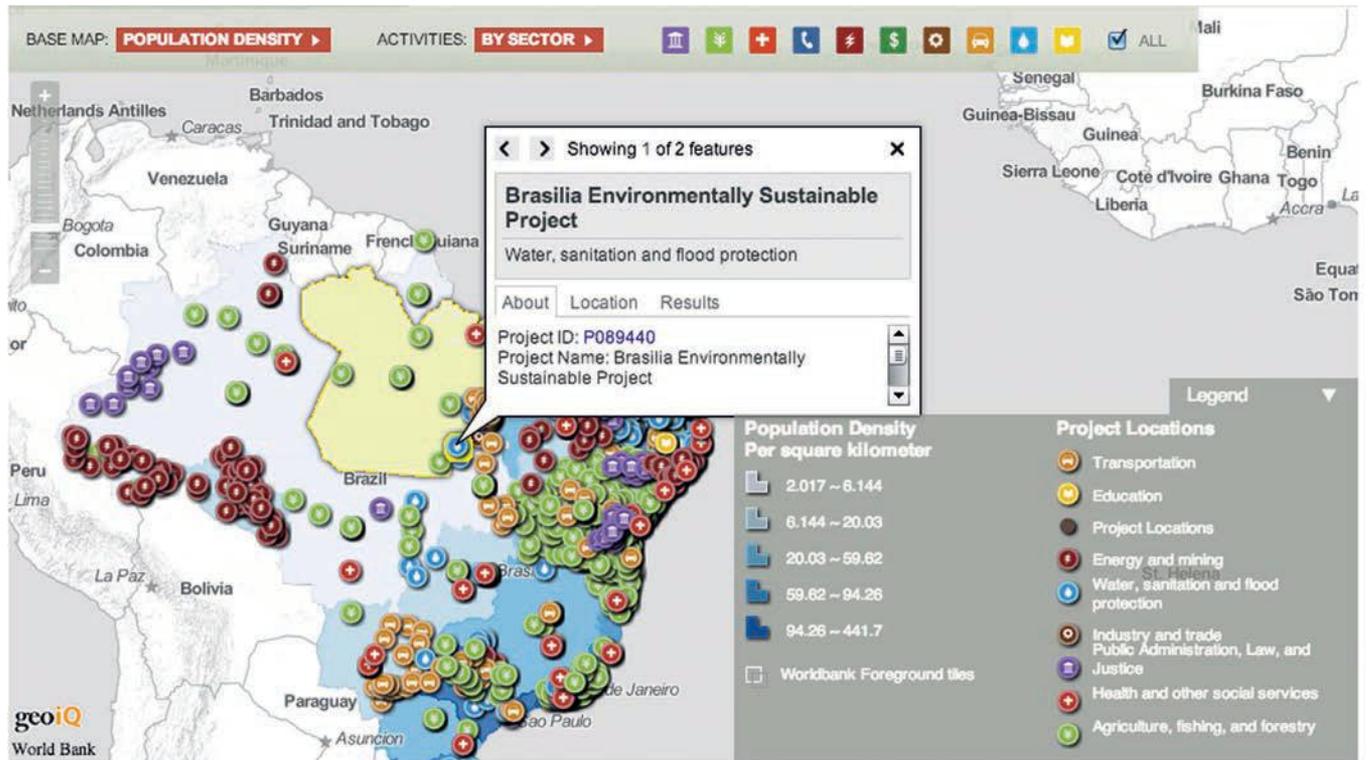
**Choropleth maps** give a quick impression of a spatial pattern by using dark and light shades of the same or similar colours. Darker shades usually show ‘the most’ and lighter shades show ‘the least’. In Source 8.6, for example, countries are shaded according to their HDI rating. This measure, developed by the United Nations, combines several indicators into a single measure. The world’s countries are ranked using indicators of health (life expectancy), education (literacy) and income (GDP). This ranking is then used to place the world’s countries into four categories ranging from very high HDI to low HDI. The United Nations uses the same measure each year in its annual *Human Development Report* so that a country’s scores, rankings and categories are regularly updated.

## Cartograms

A **cartogram** is a type of map that displays countries in roughly their correct geographic locations but the size of countries is determined by the variable being mapped. For example, in Source 8.7 the size of each country is determined by the proportion of the world population that is living in poverty within that country. The larger the country is shown on this map, the greater the number of people living in poverty in that country. The smaller the country is shown on the map, the fewer the number of people living in poverty. The colours are added to the map to divide the world into geographic regions so that different cartograms can be easily compared.

## GIS maps

**Geographic Information Systems (GIS)** maps display data as a series of layers of digital information. Each layer of the map focuses on a different aspect of the environment, such as poverty, population, roads, settlements or land relief. When using a GIS program, geographers can switch layers on and off, allowing them to compare different aspects of the environment and look for interconnections between them. International organisations such as the World Bank are increasingly using GIS technology to map their activities and projects.



Source 8.8 Screenshot of a World Bank GIS map showing a range of projects recently undertaken to improve sustainability and wellbeing in Brazil

### REVIEW 8.1.3

#### Remember and understand

- 1 What is the HDI and what is it used for?
- 2 What is a cartogram?

#### Apply and analyse

- 3 Do you think cartograms or choropleth maps are more useful for investigating variations in patterns of wellbeing? Give some reasons for your answer.
- 4 Describe the patterns of World Bank-sponsored projects that you notice in Brazil on the GIS map.

#### Investigate and create

- 5 Use the World Bank open data website to complete this task.
  - a In groups of three, each research a different indicator of wellbeing in South America: GDP, literacy rates and life expectancy.
  - b With your data, each create a choropleth map for the countries of South America. Use the same colours or shades for all of the maps.
  - c Place the maps on the classroom wall beside each other so that you can easily compare them. What similarities do you notice? What are some of the key differences?

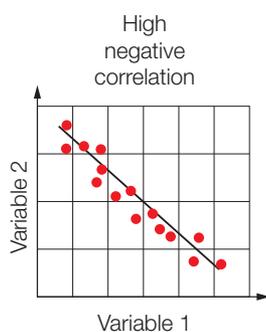
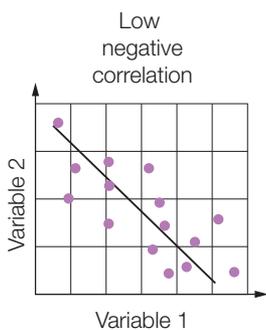
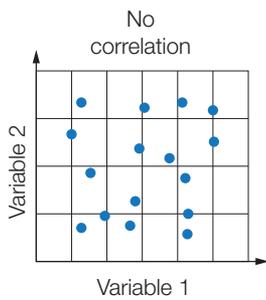
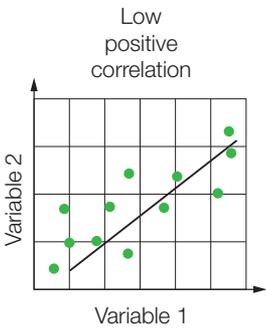
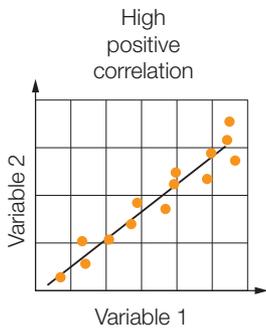
# EXPLORING LINKS BETWEEN WELLBEING

Aspects of wellbeing such as health, wealth and education are usually closely related. A change in one aspect of a person's wellbeing usually affects other aspects of their wellbeing. For example, children who attend school tend to have better health than those who do not. Links such as these can be seen at the national scale as well as at the local scale. One of the most useful tools when exploring these links is a special type of graph known as a **scatter plot**.

## Scatter plots

Scatter plots are similar to line graphs in that they are used to display data plotted against two variables. Scatter plots are used by geographers to show the degree to which one of the variables shown on the graph is related to the other. This relationship is known as the **correlation**. Commonly, scatter graphs show data for a number of countries, each of which is represented by a dot on the graph. When the dots come close to forming a straight line, they are closely related and therefore are said to have a high correlation. When the dots do not come close to forming a straight line, they are not closely related and therefore are said to have a low correlation. When the trend is increasing, the correlation is positive. When the trend is decreasing, the correlation is negative. A trend line is often added to a scatter plot to demonstrate the strength of the relationship between the two variables. Source 8.9 shows a selection of the most common trends that can be represented on a scatter plot.

With the introduction of digital graphing tools, it has been possible to add more data to make scatter plots even more useful. Three variables can now be graphed to create a three-dimensional scatter plot. By animating graphs, it is also possible to show changes in variables and their correlation over time. In Source 8.10 the size of each dot is determined by the size of the population of the country. The graph is able to show life expectancy in each country as well as **fertility rates**.



**Source 8.9** Simple scatter plots showing different types of correlation



**Source 8.10** This scatter plot, taken from the Gapminder website, is exploring the correlation between life expectancy and fertility rates (children per woman) worldwide.

## Constructing scatter plots using Microsoft Excel

You can use a computer program such as Microsoft Excel to construct a scatter plot and show the correlation between two variables. Note: These instructions may vary a little depending on the version of the program you are using.

- Step 1** Enter the data into an Excel spreadsheet. The first indicator goes into column A and the second into column B. The data for each country must go into a separate box, known as a cell, on the spreadsheet.
- Step 2** Highlight all of the cells containing data.
- Step 3** Using the menu at the top of the spreadsheet select insert → scatter → the first scatter plot. This will convert your data into a scatter plot.
- Step 4** The vertical axis usually defaults to begin at zero but the correlation is often easier to see if it begins slightly less than the lowest value being graphed. Look at your graph and decide

what you would like as the lowest value on the vertical axis. Use layout → axes → primary vertical axis → more primary vertical axis options → change minimum auto to minimum fixed and enter the value you have decided on. Close the menu.

- Step 5** Right click on one of the dots on the graph and select add trendline → linear.
- Step 6** Use the chart tools menu 'layout' to turn off the gridlines and the legend. Add a title and label the axes.

### Apply the skill

Use the World Bank website to find the life expectancy and GDP rates for all the countries of Oceania. With this data, construct a scatter plot exploring the links between life expectancy and GDP per person for the countries of Oceania.



**Source 8.11** A scatter plot showing the correlation between life expectancy and GDP per person for South American countries

### REVIEW 8.1.4

#### Remember and understand

- 1 What is the purpose of scatter plots?
- 2 What does the word 'correlation' mean?

#### Apply and analyse

- 3 Describe the relationship between life expectancy and children per woman as shown in Source 8.10. Describe what this means in your words.
- 4 Describe the relationship between life expectancy and GDP per person as shown in Source 8.11. Why do you think this correlation exists?
  - a Scatter plots often contain one or two countries that do not conform to the general pattern and sit apart from most other countries on the graph.

These are called outliers. How many outliers can you identify in Source 8.10?

- b Why do you think these countries do not conform to the general pattern?

#### Investigate and create

- 5 Visit the Gapminder website ([www.gapminder.org](http://www.gapminder.org)) and download Gapminder World. Click the play button to see how countries have changed over time. Explore the graphs on this website by selecting different indicators for each axis and watching the ways in which their correlation changes.

# TRENDS IN WEALTH

By any measure, the world's wealth is unevenly distributed (see Source 8.13). The richest 1 per cent of the world's population (47.7 million people) has approximately the same amount of wealth as the other 99 per cent of the world's population (4.7 billion people). All 10 of the world's poorest countries are in Africa.

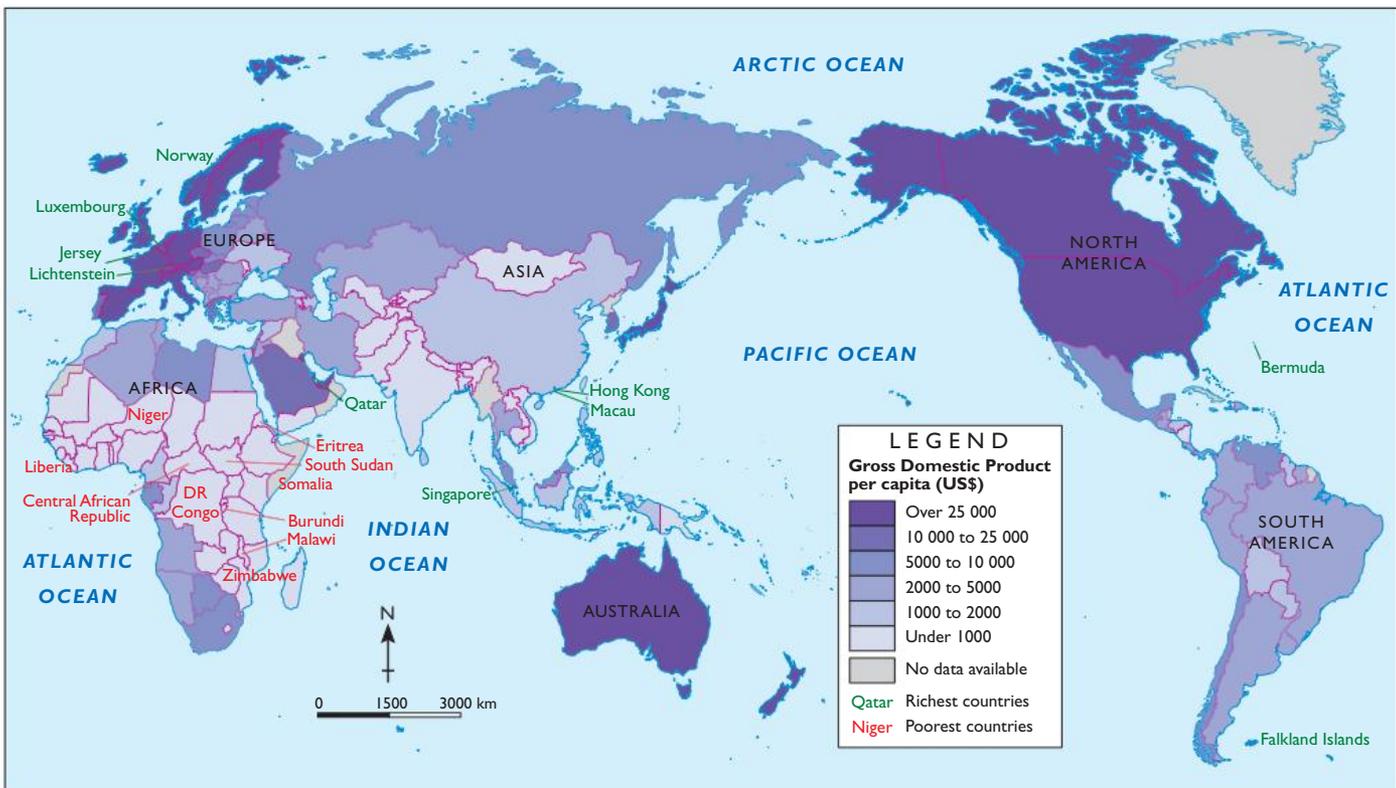
## Measuring wealth: Gross Domestic Product

A country's Gross Domestic Product (GDP) is one way to measure wealth. This is done by calculating the size of a country's economy by adding the total value of all goods and services produced during a year. To make meaningful comparisons between countries, the total GDP is divided by the size of the population to produce a measure known as GDP per capita. Source 8.12 shows the GDP of countries worldwide, together with a listing of the world's 10 richest countries and the world's 10 poorest countries.

In 2015, the GDP per capita of Qatar, the world's richest country, was US\$78 829 and the GDP per capita of the Democratic Republic of the Congo, the world's poorest country, was US\$478. Australia's GDP was \$51 642.

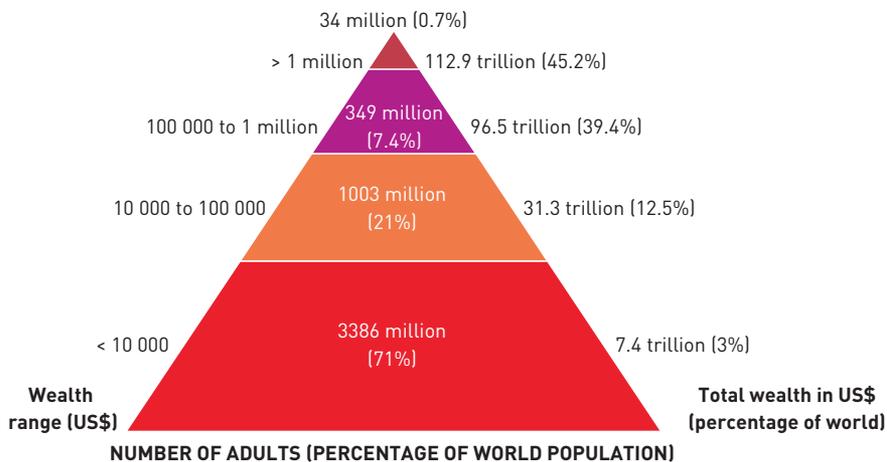


### WORLD: GROSS DOMESTIC PRODUCT



Source 8.12

Source: Oxford University Press



**Source 8.13** The global wealth pyramid  
Source: Credit Suisse Global Wealth Databook, 2015

**Source 8.14** Indian and Nepalese window-washers abseil down a skyscraper in Doha, the capital city of Qatar.

As mentioned, the residents of Qatar are, on average, the wealthiest people on Earth. Qatar's two million people earn an average of US\$78 829 each year (compared with the global average of US\$10 721). Qatar is a tiny country (slightly smaller than the Sydney metropolitan area) with vast reserves of oil and gas. The wealth generated from developing and exporting these resources has been used to increase the state of wellbeing for many Qatari residents. The country boasts one of the world's best healthcare systems, while water, gas, electricity and even food are partially paid for by the state. The employment opportunities in Qatar attract many migrants from other Middle Eastern countries as well as from South and South-East Asia, particularly India, Nepal and the Philippines. More than half of the population is made up of foreign workers (the highest migration rate in the world).

## CASE STUDY

### Levels of wealth in Qatar

#### REVIEW 8.1.5

##### Remember and understand

- 1 Where are the world's 10 poorest countries?
- 2 Consider Source 8.14. Why do you think these men have travelled from Nepal to Doha to do this work?

##### Apply and analyse

- 3 When GDP per capita is calculated, small countries with a low population are often at an advantage over countries with large populations. Explain why this is the case.
- 4 Consider Source 8.12. In a carefully worded paragraph, describe the global distribution of wealth using the PQE method. For more

information on the PQE method, refer to section GT.2 of 'The geographer's toolkit'. Refer to specific regions and countries in your description.

##### Investigate and create

- 5 Identify factors that might help to explain why global wealth is so unevenly distributed (see Source 8.13). Why are people in some countries, such as Qatar, the United States and Australia, wealthy while people in other places are not. Present your findings as a visual representation; for example, a **Levin's Force Field** analysis.

# TRENDS IN HEALTH

In some countries, people struggle to obtain the most basic healthcare services and doctors work in hospitals that are old and poorly equipped. In other countries, hospitals have state-of-the-art facilities and access to the newest treatments and drugs. While it is easy to see how unevenly distributed health services are worldwide, the level of health and its contribution to the wellbeing of a community or country is a complex concept. There are many other variables that can affect the health of people, including diet and other lifestyle factors.

For these reasons, geographers rely on indicators of health such as life expectancy and the **infant mortality** rates to measure and compare the health of individuals within countries. Other indicators such as the number of doctors per 1000 people and access to reliable water can also be used to examine the reasons why health differs between countries.

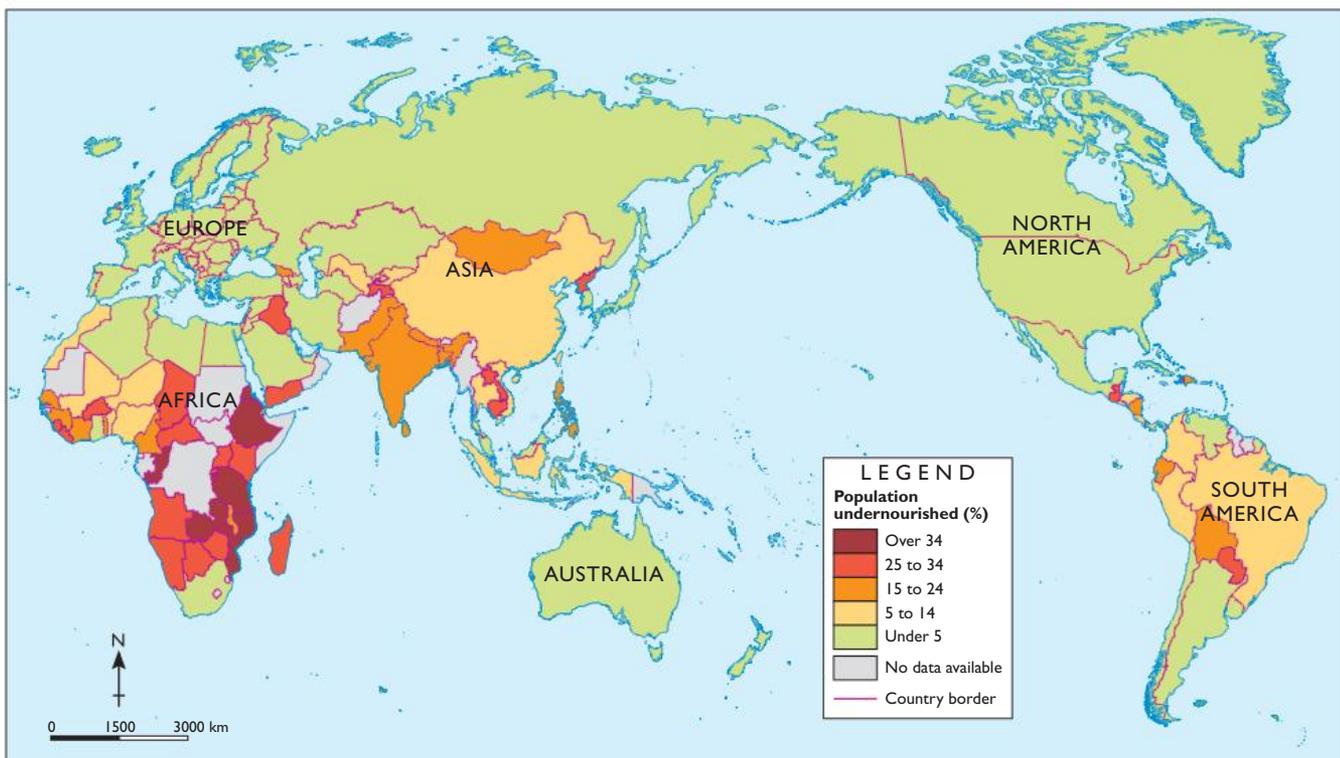


## Thirst and hunger

The greatest threat to good health in the world today is hunger. The simplest way to improve the health of people around the world is to provide them all with enough clean water to drink and enough food to eat. One in eight people worldwide are undernourished (see Source 8.15), making them more susceptible to disease, less productive in their work and more likely to die young. Hunger is often the result of a range of factors including conflict, natural disaster, poverty and environmental degradation.

Dirty water causes health problems as well, including diarrhoea, and carries diseases such as cholera and typhoid. Around 780 million people around the world do not have access to clean water, and 345 million of these live in Africa. The importance of clean water cannot be under-estimated. More than 3.4 million people die each year from diseases caused by dirty water or a lack of sanitation, including thousands of children every day.

### WORLD: HUNGER LEVELS

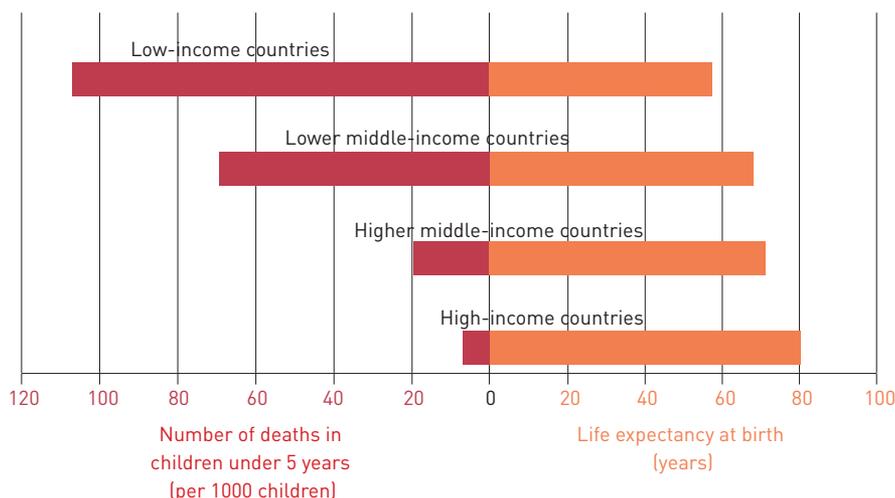


Source 8.15

Source: Oxford University Press

## Life expectancy

Life expectancy is the average number of years that a person can expect to live. For people in developing countries, life expectancy is generally shorter than for people in developed countries. A child born in Sub-Saharan Africa in 2013, for example, can expect to live for 55 years, while a child born on the same day in the United States can expect to live for 79 years – 24 years longer. The lower life expectancy in Sub-Saharan Africa is due to a wide range of factors including the presence of diseases such as malaria and HIV AIDS, poor water and **food security** and poor access to health care. Source 8.16 clearly shows the relationship between the wealth of a country and the life expectancy of its citizens.



Source 8.16 The links between a country's wealth, child deaths and life expectancy

## Infant mortality

In the same way that life expectancy varies greatly between the developing and the developed world, infant mortality rates (the proportion of children who die in their first year) are also strikingly different (see Source 8.16). A child born today in Sub-Saharan Africa is 12 times more likely to die in their first year of life than a child born in the United States.

Studies of infant mortality in developing countries have discovered some specific factors that put children at higher levels of risk. Children and their mothers are much more vulnerable in rural areas than in cities. Women in cities tend to give birth in hospitals and health clinics, while women in rural areas often give birth at home without a nurse or doctor present. Children born to educated mothers, even those with only a primary school level of education, also have a higher survival rate. In some regions, survival rates can be up to three times greater than for children of uneducated mothers.



Source 8.17 Mali, a country in West Africa, has one of the highest infant mortality rates in the world. Vaccinations against disease and more clinics for mothers and children are seen as crucial steps towards lowering this rate.

### REVIEW 8.1.6

#### Remember and understand

- 1 In your own words, explain the links between poverty and indicators of health such as life expectancy and infant mortality.
- 2 What are some of the effects of hunger?

#### Apply and analyse

- 3 Consider Source 8.15.
  - a In which regions of the world are more than 95 per cent of the population well nourished?
  - b In which regions of the world are more than 25 per cent undernourished?
  - c Compare this map with other world maps

in this chapter. What links can you identify between hunger and other factors such as Gross Domestic Product (Source 8.12) and literacy rates (Source 8.19)?

#### Investigate and create

- 4 World leaders gathered at the United Nations Headquarters in New York, September 2015 to adopt the 2030 Agenda for Sustainable Development. The MDGs were replaced by 17 Sustainable Development Goals aiming to finish the work begun by the MDGs by 2030. Research what the 17 new goals are.

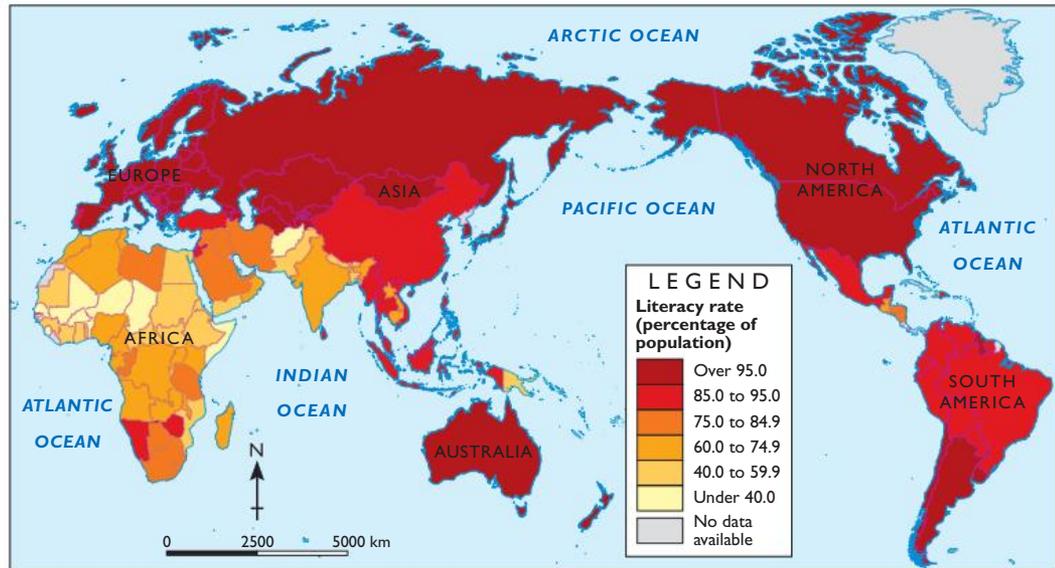
# TRENDS IN EDUCATION



Education provides much more than the opportunity to read, write and count. It is seen by many international aid agencies and experts in the field as the key to helping people, communities and nations lift themselves out of poverty. Education provides individuals with opportunities to become more engaged with society, to have a range of skills and tools to better care for themselves and their children, to participate in the workforce and improve their country's economy, to live healthier lives, to combat poverty and to reduce inequalities in wellbeing.

**Source 8.18** The number of Sub-Saharan African children enrolled in primary school rose by 75 per cent between 1999 and 2012 to 144 million. Despite this improvement, 30 million children still receive no schooling.

## WORLD: LITERACY RATES



**Source 8.19**

Source: Oxford University Press

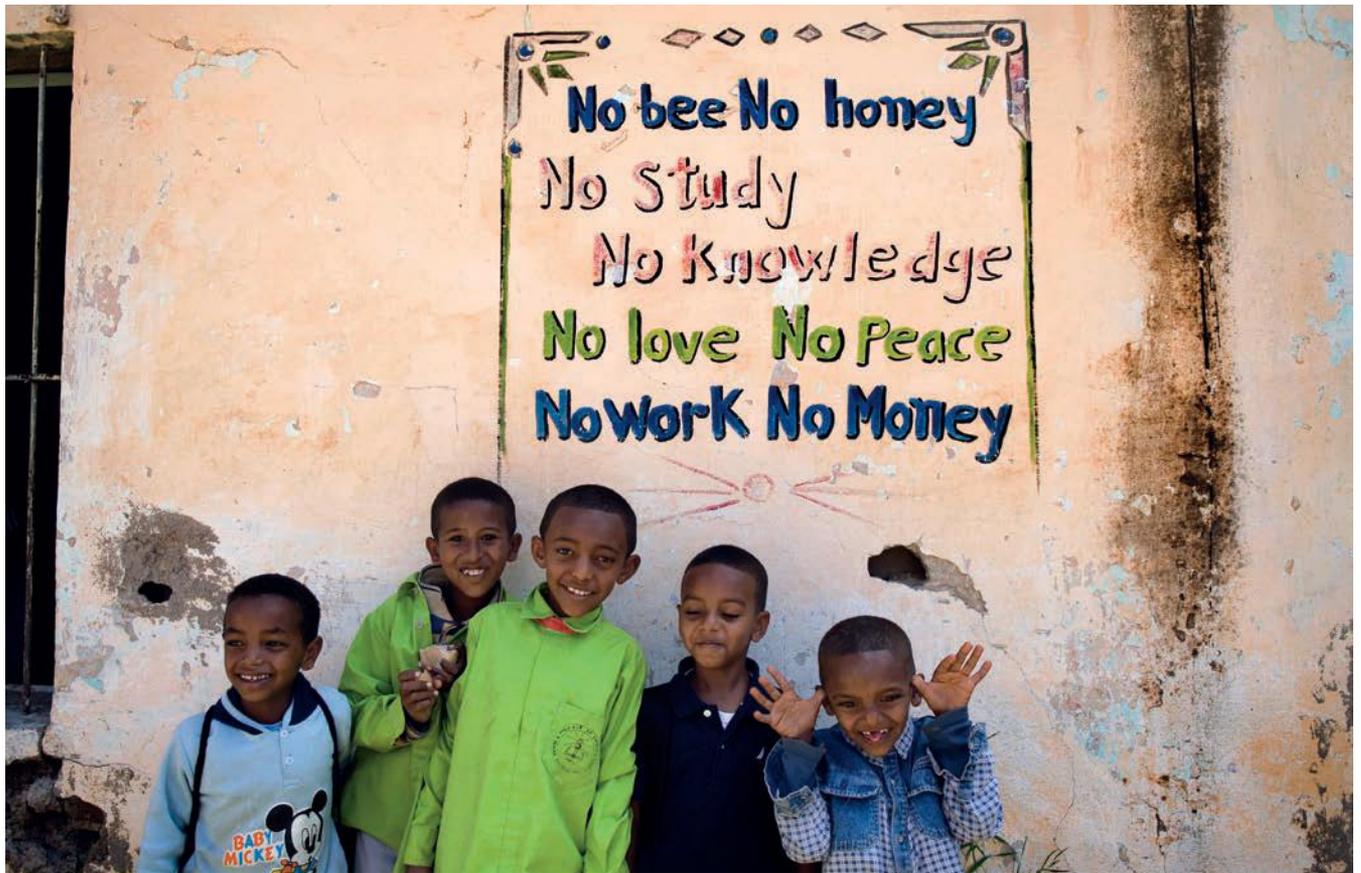
## Literacy rates

Literacy rates measure the percentage of adults who can read and write and are often used as an indicator of education levels within countries. Literacy rates can be difficult to calculate, however, as many countries do not keep accurate data. It is also important to be aware of potential variations in literacy within countries. In many countries, for example, people in rural areas have lower literacy levels than city dwellers. In other countries, girls are not given the same educational opportunities as boys.

## Barriers to successful education

Access to education varies widely across the globe. In developed countries such as Australia, Britain, Germany and France, about 99 per cent of all school-aged children are enrolled in schools. In developing countries such as Mali, Ethiopia and Niger, it is only 90 per cent. While the enrolment rate has improved markedly over the last two decades, a 90 per cent participation rate means that 61 million children of primary school age are not receiving an education. More than half of these children are in Sub-Saharan Africa. A further one-fifth are in South Asia.





There are many factors that determine whether or not a child will attend school. These include:

- system barriers – such as a lack of trained teachers, classrooms and educational materials including books
- attendance barriers – such as school fees, distance to school, poor transport networks and the concern of many parents about the safety of their children; many children also work to help support their families
- social barriers – such as variations in language, religion and conflict within countries; conflict is one of the greatest barriers with children in war-torn nations such as Somalia and Syria much less likely to attend school.

**Source 8.20** Eritrea has one of the lowest primary school enrolment rates. This is due to a number of factors, including school fees, poor infrastructure and the role of many children as workers on subsistence farms.

## REVIEW 8.1.7

### Remember and understand

- 1 Why do you think Sub-Saharan African children are less likely to attend school than children in other regions of the world?
- 2 Identify three social barriers that may determine whether or not a child attends school.

### Apply and analyse

- 3 Consider Source 8.20. Who do you think has painted this sign on the school wall? What is the purpose of the sign?
- 4 Compare Source 8.19, the world map of literacy levels, with Source 8.12, the world map of Gross

Domestic Product. Comment on the relationships you see between these two indicators.

- 5 What is the literacy rate in Eritrea (refer to the World Bank website)? Compare this with the literacy rate in Australia. Suggest reasons to account for the differences in literacy between these two countries.

### Investigate and create

- 6 Which of the barriers to education discussed here do you think would be the most difficult to overcome? Give some reasons for your answer.

# 8.1

## CHECKPOINT

### WHAT MAKES HUMAN WELLBEING A GEOGRAPHICAL ISSUE?

- Investigate ways of measuring and mapping human wellbeing and development.
- 1 What is meant by the terms 'human wellbeing' and 'development'? [6 marks]
  - 2 Why are geographers interested in measuring and mapping human wellbeing and development? [6 marks]
  - 3 Identify four factors that influence human health. [4 marks]
  - 4 What are universal indicators? Why do we use them? [4 marks]
  - 5 Explain the role that qualitative data plays in a wellbeing index. [3 marks]
  - 6 Identify three mapping techniques used to illustrate global wellbeing. [3 marks]
  - 7 Why do we need to take the size of the population into account when measuring wellbeing and development? [4 marks]
  - 8 Explain why poverty is more than just a lack of money. [5 marks]
  - 9 Why does life expectancy vary so much across the world? Identify five variables that can affect the health of people. [5 marks]
  - 10 What are the possible consequences of 61 million children worldwide not attending school? [5 marks]

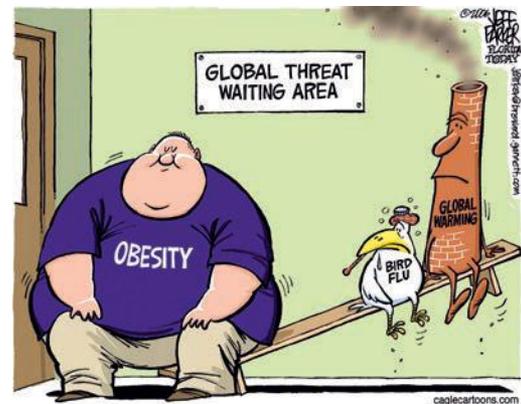
TOTAL MARKS [ /45]

### RICH TASK

#### Developing geographical question from media reports

One growing public health crisis is obesity. Once only a problem in developed countries, obesity has now spread to developing nations such as Mexico, China, India and Brazil. The World Health Organization (WHO) estimates that more than 1.4 billion people in these countries are overweight with 500 million obese.

Excessive body weight and obesity are linked to heart disease, stroke, arthritis, diabetes and some cancers. Obesity is a leading cause of premature death and drains public health resources. Many experts describe it as the global obesity epidemic.



Source 8.21 'Global threat waiting room'

Source 8.22

#### OBESITY EPIDEMIC SPREADS TO DEVELOPING WORLD

The world is getting very fat, very fast and now the obesity epidemic has spread from rich countries to poor and developing countries. It is likely 1 billion people will be obese by 2030.

Fat is being called the new tobacco.

Body weight is not just about vanity, it is about life and death, with obesity increasing the risk of heart disease, type-2 diabetes and some forms of cancer.

So how and why did the problem of obesity explode in places that, not so long ago, counted malnutrition and even famine as major health concerns?

Well it's about increasing wealth, changing diets, genetic programming and aggressive marketing by international food companies.

The most perplexing problem in emerging economies is how they are going to deal with a tidal wave of obesity with relatively scant health resources.

We've canvassed opinion from notable authorities on diet, nutrition and fat issues, and met people in these countries struggling with the consequences of obesity.

It's an eye-opening, sometimes shocking journey.

First stop: Mexico. The biggest killer here is diabetes. In the past 30 years this country has gone from dealing with widespread malnutrition to coping with two thirds of the population growing overweight or obese. One of the main culprits is the super-pervasive spread of soft drinks: Mexicans drink more carbonated beverages per head of population than anyone else in the world. In a country where running water isn't guaranteed and bottled water is expensive, these soft drinks have become a daily dietary staple for everyone from infants to the elderly.

Next is Brazil, where global food giants are moving into every corner of the country, from the big cities to the remote reaches of the Amazon to sell their highly processed products readily and cheaply. Profits and market share are soaring and so is obesity, with another 1 percentage point of Brazil's population

joining the ranks of the obese every year.

In India, as incomes have risen so too has weight. But the effects here are even more dramatic than elsewhere because the Indian body type magnifies the effects of obesity. Many have a genetic predisposition to diabetes and heart disease. The situation is so dire that health experts warn a staggering one in two babies born in India today will get type-2 diabetes, delivering future generations the real possibility of widespread disability and early death. India is bracing for an estimated 100 million type-2 diabetes patients.

The final stop on our Globesity tour is China – where the rapid transformation of the economy has been mirrored by massive changes to the consumption of food. Not just the sort of things Chinese are eating but the way they eat. Snacking was a rarity not so long ago. Now it abounds. Thirty years ago the Chinese ate only small amounts of sugar and oil – today they are a big part of the diet and a big part of the reason more and more Chinese are getting bigger and bigger.

'Obesity epidemic spreads to developing world'  
from *ABC News*, 24 July 2012

### Acquiring geographical information

Much of our understanding about events and trends around the world comes through media reports – in newspapers and magazines, television and radio reports, or the internet and mobile phones. By learning a few simple techniques you can use the news to generate geographical questions.

**Step 1** Check the source of the news article for reliability and possible bias. Find out who wrote the article and the news organisation that published it. Mainstream media organisations are generally more reliable than smaller ones but this may not always be the case. Use the news company website to investigate possible bias.

**Step 2** Work out what type of report you are watching, reading or hearing. Is the information presented being reported as fact or is it an opinion piece? Both are valuable but it is important to know the difference.

**Step 3** What is the reporter's main contention or key point?

**Step 4** What information and arguments support the reporter's contention?

**Step 5** What evidence does the reporter use to support these arguments? What is the source of this evidence?

**Step 6** Look closely at any images or graphics. How do they support the reporter's arguments?

**Step 7** What further questions does this article raise for you? Use question starters such as 'How many', 'Where does', 'Why does', 'Who is affected', 'What changes does' and 'How should people'.

### Processing geographical information

- 1 Use the steps provided to analyse and develop questions about Source 8.22.
- 2 Share your geographical questions with your classmates and build up a class list.
- 3 Examine closely Source 8.21. What point is the cartoonist making about obesity?

### Communicating geographical information

- 1 Select one of the geographic questions from the class analysis of the article. Use this as a starting point for research into the global obesity epidemic. Report back to the class.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Space, Interconnection, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Cartoon interpretation, Media article reliability/bias

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

# 8.2 INEQUALITIES IN WELLBEING

HOW CAN THE SPATIAL VARIATIONS IN HUMAN WELLBEING AND DEVELOPMENT BE MEASURED AND EXPLAINED?

There are many reasons for the inequalities in wellbeing that exist between countries. The environment and climate can make a difference, affecting access to fresh water and the ability to grow food. The presence of natural resources such as oil and minerals is an important source of wealth for countries that influences levels of wellbeing.

The political, economic and social organisation of a country can also have a big impact on its wellbeing. Important factors include the make-up of the population, the levels of gender equality and access to technology. One of the most significant factors affecting wellbeing, however, is conflict.



## CASE STUDY

### Syria

In 2011 fighting between rebels and government troops broke out in Syria, destroying more than half of the country's hospitals as well as other vital infrastructure such as roads, electricity, communication networks and factories. Food production fell dramatically and, in some areas, clean water supplies were reduced to one-third of their pre-war levels. All of these factors have resulted in enormous falls in wellbeing.

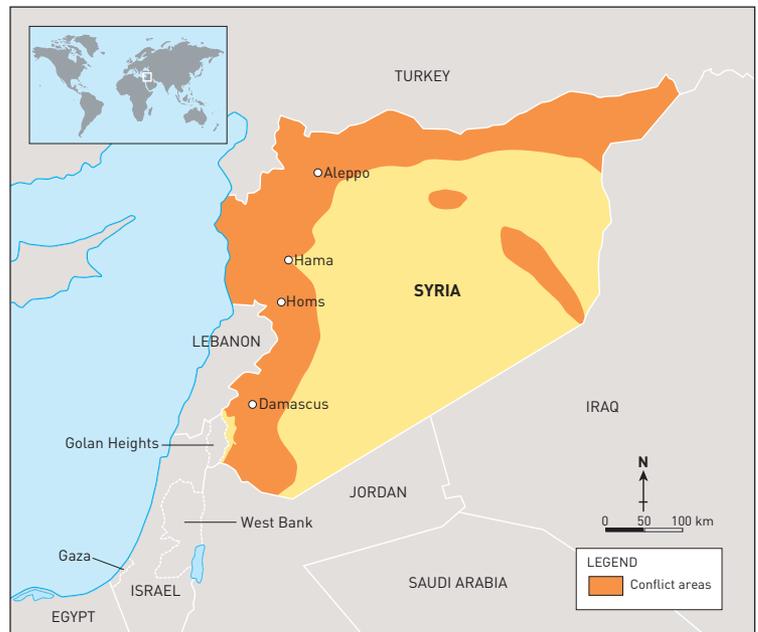


**Source 8.23** A Syrian refugee carries her infant with her to wash the family clothes at Zaatari refugee camp in Jordan. She is one of more than four million who have fled the country after five years of civil war.

It has also resulted in one of the largest refugee exoduses in recent history. Neighbouring countries have borne the brunt of the refugee crisis, with Lebanon, Jordan and Turkey struggling to accommodate the flood of new arrivals. The exodus accelerated dramatically in 2013, as conditions in Syria deteriorated.

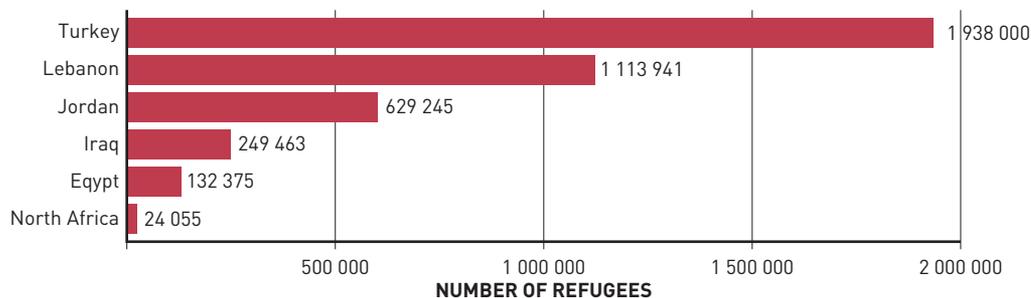
A further 7.6 million Syrians have been internally displaced within the country, bringing the total number forced to flee their homes to more than 11 million – half the country's pre-crisis population. Overall, an estimated 12.2 million are in need of humanitarian assistance inside Syria, including 5.6 million children, according to the United Nations.

## SYRIA: CONFLICT AREAS 2015



Source 8.24

Source: Oxford University Press



Source 8.25 A report published by the United Nations in March 2015 estimated the total economic loss since the start of the conflict to be US\$202 billion and that four in every five Syrians were now living in poverty – 30 per cent of them in abject poverty. Syria's education, health and social welfare systems are also in a state of collapse.

### REVIEW 8.2.1

#### Remember and understand

- 1 Identify five possible reasons for the inequalities in wellbeing that exist between countries.
- 2 How many Syrians have been affected by the civil war conflict there?
- 3 Examine Source 8.24. What is the relationship between the conflict areas and the destinations refugees are fleeing to?

#### Apply and analyse

- 4 Refugee camps are often located in regions close to national borders where it can be difficult to maintain a high level of wellbeing. What does Source 8.23 tell you about the natural environment of this place?

- 5 Which organisation has responded to the plight of Syria's refugees in Source 8.23? What assistance does this woman need to help her maintain her wellbeing and that of her children?
- 6 What problems will the woman in Source 8.23 face when the conflict in Syria comes to an end?

#### Investigate and create

- 7 Identify the causes of the Syrian civil war and discuss how this conflict is likely to have affected the wellbeing of individuals and communities in both Syria and Turkey. Summarise your findings and present them in a table. Use the column headings 'Effects on the wellbeing of individuals' and 'Effects on the wellbeing of communities'.

# WHY WELLBEING VARIES: CAUSES, ISSUES AND CONSEQUENCES



**Source 8.26** Norway regularly tops the world ranking in the annual Human Development Index.

As you have learned, wellbeing varies a great deal within and between countries. The causes behind these variations are complex but can be broken up into five main groups: environmental, social, economic, historic and political.

Environmental causes that impact on wellbeing include the suitability of the land for agriculture, the climate and whether there are any natural resources present in the landscape. In some places, good growing conditions ensure that food is plentiful and minerals in the ground bring wealth and industry. In other places, poor soils or unreliable rainfall are the key factors that limit people's wellbeing.

Social, economic, historic and political causes are all examples of human factors. Human factors that affect wellbeing include things such

as population size, cultural norms, laws and rules regulating business and trade, historical events, political systems and wars. In some places, long periods of stability have allowed for great improvements in living conditions. In other places, the wellbeing of people has been impacted by ongoing conflict and decades of corruption and persecution. In these cases, people's access to resources such as water, food and health care is limited, affecting their quality of life.

Every region and country around the world has its own unique set of inter-related causes, issues and consequences that determine the wellbeing of the people who live there. The key causes that determine a country's level of wellbeing are outlined in Source 8.27.

**Source 8.27** Causes of spatial variation in human wellbeing

Environmental causes	Climate Land quality and availability of fresh water Natural resources Relative location
Social causes	Population size and growth Cultural norms such as gender roles
Economic causes	Trade laws Access to trade routes
Historic causes	Colonial past Past conflicts
Political causes	Political stability Level of corruption Wars and civil conflict

## KEY CONCEPT: PLACE

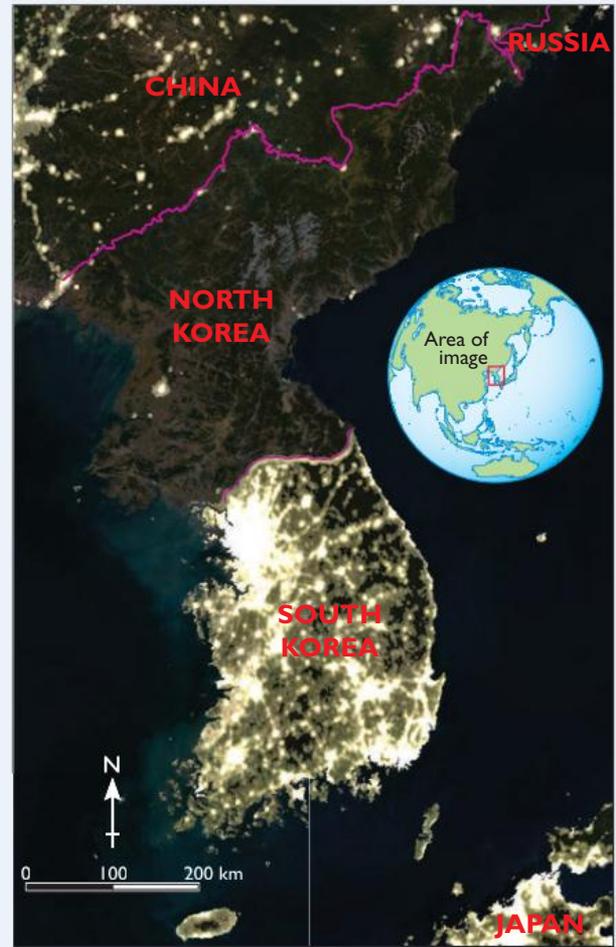
### The two Koreas: A study in wellbeing

The Korean Peninsula is shared by two countries – South Korea and the Democratic People’s Republic of Korea (more commonly known as North Korea). Due to their proximity to each other they have similar climates, soils, topography and mineral resources. And yet South Korea is rated as the country with the 12th highest level of wellbeing in the world, while North Korea is 63 places lower at 75th. South Koreans live, on average, 10 years longer and have a GDP 18 times higher than their northern counterparts.

These differences cannot be explained by differences in resources but in the ways in which these countries are governed and their resources managed. South Korea is a democracy with a market-driven economy. It has a strong economy with high exports and imports, is highly industrialised with a large urban population and is technologically advanced. South Korea also has relatively low levels of corruption and a free media.

North Korea is a totalitarian state, meaning there is only one political party and no elections. It has little to do with the rest of the world and the economy is strictly controlled by the central government. The population is still largely rural and farming methods are technologically backwards. The North Korean Government places a great emphasis on having a strong military and up to one-third of the country’s budget goes towards maintaining it. North Korea also has very high levels of corruption and no freedom of the press.

For more information on the key concept of place, refer to section GT.1 of ‘The geographer’s toolkit’.



Source 8.28 The Korean Peninsula at night

## REVIEW 8.2.2

### Remember and understand

- 1 What are some of the environmental causes of spatial variation in wellbeing? Explain the influence that each of these may have on an individual’s wellbeing.

### Apply and analyse

- 2 Using Source 8.26, describe the environmental causes that help to explain Norway’s high levels of wellbeing.
- 3 Using Source 8.27, explain why Australia has high levels of wellbeing.
- 4 Examine Source 8.28. Describe the pattern shown in this satellite photograph and explain it in relation to wellbeing.

### Investigate and create

- 5 Use the internet to complete some research to answer the following tasks.
  - a ‘Levels of human wellbeing are mainly the result of human factors rather than natural ones.’ Evaluate this statement with reference to some specific examples.
  - b Find and research a similar example to the Korean Peninsula, where neighbouring countries have very different levels of wellbeing – for example, Haiti and the Dominican Republic. Outline the reasons for this with reference to the five causes shown in Source 8.27. Present your findings in a table format.

# ENVIRONMENTAL CAUSES OF SPATIAL VARIATIONS IN WELLBEING

The natural environment provides us with the necessities of life – fresh air, fresh water and food. However, there are wide variations in the availability of these vital resources around the world. Climate also affects the suitability of the environment for sustaining wellbeing.

## Variations in water and food security

The most important environmental factors are those that provide us with a reliable supply of clean water and the resources required to grow food. Clean water is provided by regular rainfall and is usually carried along rivers where it is accessed by communities in villages, towns and cities. Fresh water is also used by farmers to irrigate their crops in the production of food.

Because there are natural variations in rainfall, temperature, soil fertility and river flows, food and water security vary widely. To get the best crops farmers rely on fertile soils, warm temperatures and other important ecosystem services such as insects and birds to pollinate plants and control pests. The products of human ingenuity such as water pipelines and dams, fertilisers and greenhouses have overcome many of the limitations set by these natural variations but they are costly to build and maintain. The growth in the world's population, particularly in the last 50 years, has placed a strain on the ability of the environment to provide food and water security.

In some places the land has become degraded by human activities such as overgrazing and the unsustainable use of water. This is now affecting the food and water security of millions of people (see Source 8.29).

**Source 8.29** This girl in Chad sets out from her village on her daily walk to collect water. She lives in the Sahel on the southern fringe of the Sahara Desert where wellbeing is threatened by unreliable rains, infertile soil and a rapidly expanding population.



## CASE STUDY

### Food security in India

In some environments, the inability to grow enough food to meet the needs of the population has a major impact on wellbeing. India has a population of about 1.2 billion but across much of the country, environmental conditions are unsuitable for growing food.

These environmental conditions, together with a lack of agricultural technology and poor irrigation, have led to frequent famines. In 2013, a severe drought in the western Indian state of Maharashtra became the worst the region had experienced in four decades. As reservoirs ran out of water, farmers were unable to produce food. Shortages meant people went without.



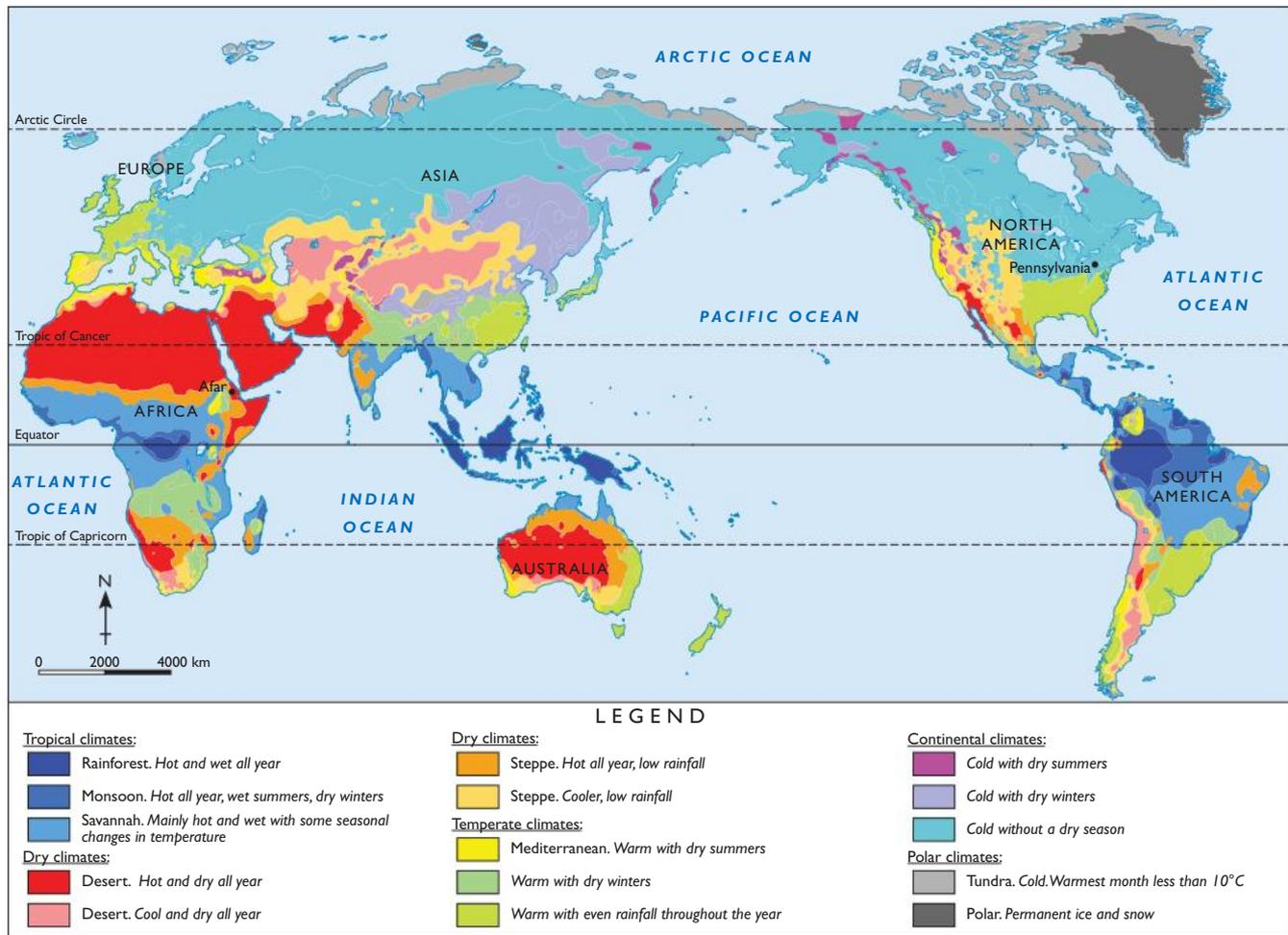
# THE INFLUENCE OF CLIMATE

On a global scale, climate has largely determined where people have lived. Areas that are too cold, too hot or too dry have tended to be sparsely populated, while those with mild temperatures and reliable rainfall have tended to be more densely populated.

As the world's population has increased, however, more and more people have moved into marginal climate regions that were previously considered unsuitable for farming and settlement. By using technology such as irrigation in dry places, these marginal regions have been transformed to support human populations.

Researchers have developed two theories based on these trends in an attempt to explain how climate affects wellbeing.

## WORLD: CLIMATIC ZONES



Source 8.32

Source: Oxford University Press

## Theories of how climate impacts wellbeing

**Theory 1** – Human wellbeing is highest in regions where the climate is neither too extreme nor too comfortable. Supporters of this theory believe that populations living in regions where the challenges presented by climates that are not too severe or too comfortable lead to advances in technology that improve wellbeing overall. According to this theory, people in rainforest climates where rainfall and temperature are both perfect for growing crops have

lower levels of development because there are few major challenges to their survival and no incentive to change. By comparison, people living in climates that present a number of mid-range challenges will have higher levels of development because they are encouraged to solve these challenges through innovation.

**Theory 2** – People who live in marginal climate regions have lower levels of wellbeing because of the difficulties faced in growing enough food or finding enough fresh water. These activities take so much time and effort; for example, spending hours each day collecting water from the nearest water source, that there is no time left to develop ways to move beyond simple survival. Supporters of this theory point to desert regions in Northern Africa and Central Asia as evidence to support their case.



**Source 8.33** Farming for food usually requires reliable rainfall and mild temperatures such as here in Pennsylvania, north-east United States.

**Source 8.34** In Afar, northern Ethiopia, people are nomadic and live from livestock farming. Girls are responsible for herding sheep, goats and camels to pastures while men provide protection.

## REVIEW 8.2.4

### Remember and understand

- 1 Why are human populations clustered in certain areas rather than evenly distributed across the world?
- 2 Use Sources 8.33 and 8.34 to describe the very different climates of Afar and Pennsylvania.

### Apply and analyse

- 3 Use data from the World Bank website to compare levels of wellbeing in Ethiopia and the United States. To what extent do you believe these differences are due to climatic differences?
- 4 Why are more people moving to areas that have previously been considered unsuitable for human habitation? Which causes do you think would be most important to drive people to move to an inhospitable area?

### Investigate and create

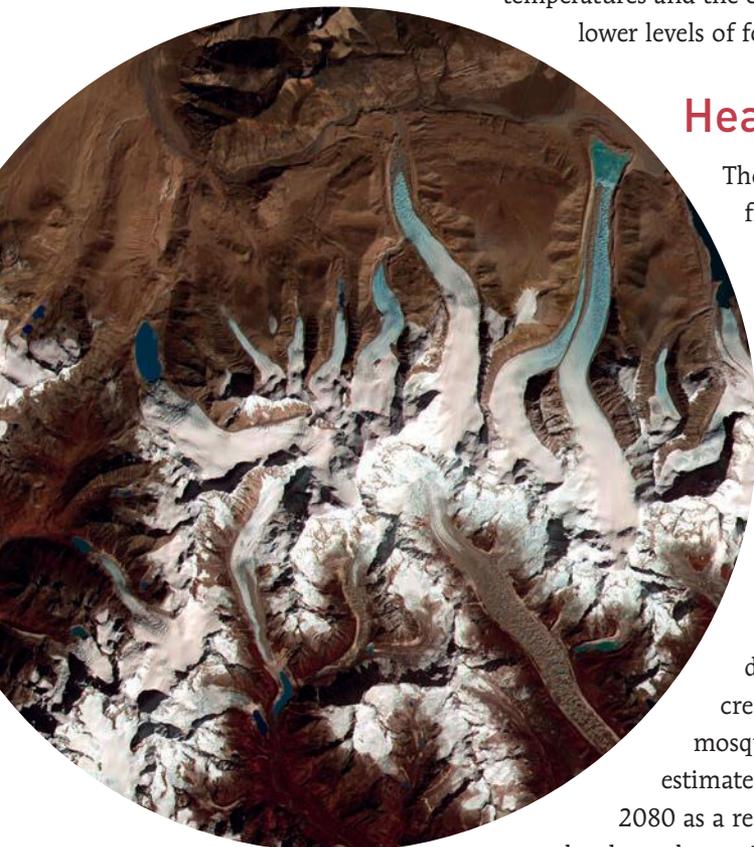
- 5 Copy and complete the following table in your notebook. Use the internet to get the latest HDI figures to complete column 2. Then use Source 8.32 to complete column 3.

Region	HDI ranking 201_	Main climate zone
Northern Africa: Morocco		
Southern Africa: South Africa		
North America: Canada		
South America: Brazil		
Oceania: Australia		
Europe: Germany		
Central Asia: Mongolia		
North Asia: Russia		
South Asia: Pakistan		
South-East Asia: Indonesia		

- 6 Use the information that you have collected in this table to evaluate the theory that levels of wellbeing are highest in regions where the climate is neither too extreme nor too comfortable.

# THE ISSUE OF CLIMATE CHANGE

Many regions of the world have seen a dramatic improvement in human wellbeing over the last few decades. Infant survival, literacy rates and life expectancy have all increased. **Climate change**, however, threatens to stall and even reverse many of the gains made in these areas. The main threats from climate change are the greater risks posed to people's health from rising temperatures and the expected fall in food production which may, in turn, lead to lower levels of food security.



**Source 8.35** A NASA satellite image of glaciers in the Himalayas. The lakes at the end of each glacier are increasing in size as the glaciers reduce in size.

## Health threats

The most direct consequence of rising temperatures is more frequent heatwaves and more cases of associated heat stress.

Heatwaves are already Australia's deadliest natural disaster, with older people in urban areas most at risk. In 2009, during a heatwave that hit south-east Australia, there were more than 400 heat-related deaths in Melbourne and Adelaide alone. Researchers expect the death toll from heatwaves in Australia to increase fourfold by 2050. Increasing temperatures bring other threats too, with more frequent extreme weather events such as bushfires, droughts, cyclones and floods.

The other major health concern with rising temperatures, and potentially the most catastrophic, is the spread of serious diseases such as malaria and dengue fever. Rising temperatures create suitable living environments for disease-carrying mosquitoes in areas that were previously too cold. Some research estimates that 300 million more people will be affected by malaria by 2080 as a result. In recent years, the numbers of people dying from malaria has been decreasing, thanks to better preventative measures and greater access to treatment. But increasing numbers of victims could overwhelm health systems in poorer countries where they are less able to prepare and recover from health epidemics.

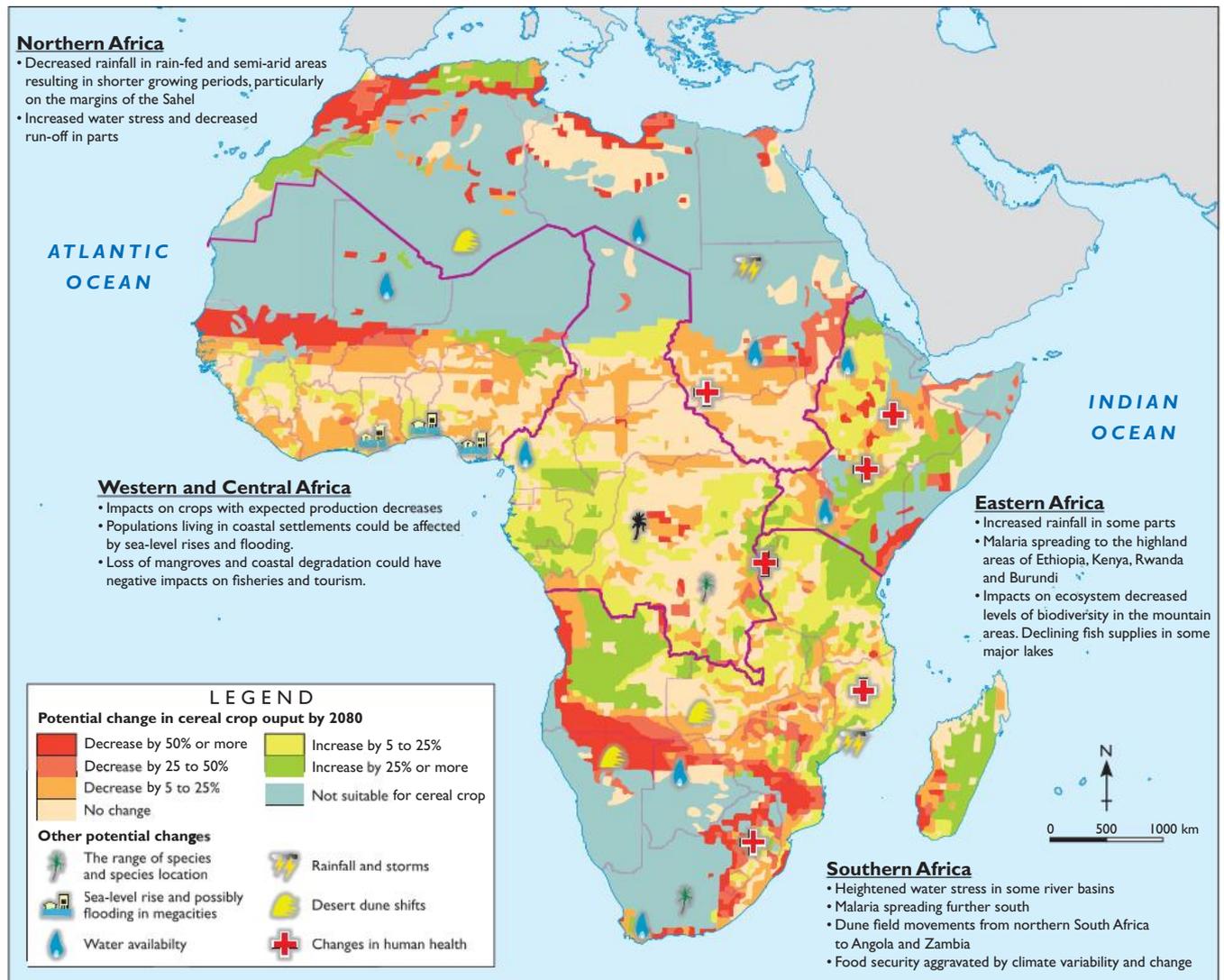
## Food security threats

As temperatures rise and rainfall patterns change so will growing conditions. This will affect food security as communities in some regions become unable to produce enough food. Farming areas that are already in dry, warm regions, such as areas surrounding the Sahara and Kalahari deserts in Africa, are expected to see a massive reduction in food production (see Source 8.36). Worldwide, reductions in grain production are also expected, at a time when world population figures continue to grow. This will send prices for grains higher, making it increasingly difficult for the poor to feed themselves.

The impacts on food security will also be multiplied by changes in water supply. The glaciers of the Himalayas and the Andes supply water to over one billion people in cities and on farms. As the glaciers disappear, the water supply for these people will become less reliable, reducing the ability of farmers to use this supply to irrigate their crops (see Source 8.35).

Farmland in coastal regions will also be affected. Rising sea levels are expected to flood low-lying land making it unsuitable for farming and causing salt water to intrude further inland.

## AFRICA: CURRENT AND POSSIBLE FUTURE CONSEQUENCES OF CLIMATE CHANGE



Source 8.36

Source: Oxford University Press

### REVIEW 8.2.5

#### Remember and understand

- 1 Identify the ways in which rising temperatures impact on people's health.
- 2 Name two climatic factors that threaten food security.
- 3 Why should we be worried about the melting of glaciers?

#### Apply and analyse

- 4 Analyse Source 8.36.
  - a Which areas of Africa are likely to see the greatest reduction in cereal crop output by 2080?

- b Which areas are likely to see an increase in cereal crop output?
- c What might this mean for the distribution of populations in Africa?
- d What might this mean for food security?

#### Investigate and create

- 5 Which of the consequences of climate change shown in Source 8.32 do you consider to be the greatest threat to wellbeing? Give some reasons for your answer, supporting your argument with data gathered from at least two secondary sources.

# THE INFLUENCE OF NATURAL RESOURCES ON SPATIAL VARIATIONS IN HUMAN WELLBEING

Natural resources include a country's mineral, petroleum, timber and hydropower reserves along with any other resources that can be used commercially to improve the wealth of the country and the wellbeing of the country's population. Fossil fuels such as oil, and minerals such as iron ore, copper and diamonds are often in demand around the world. The money raised from the sale of these resources can then be used to improve wellbeing. This is what has happened in the oil-rich nations of the Middle East who now enjoy very high levels of wellbeing.

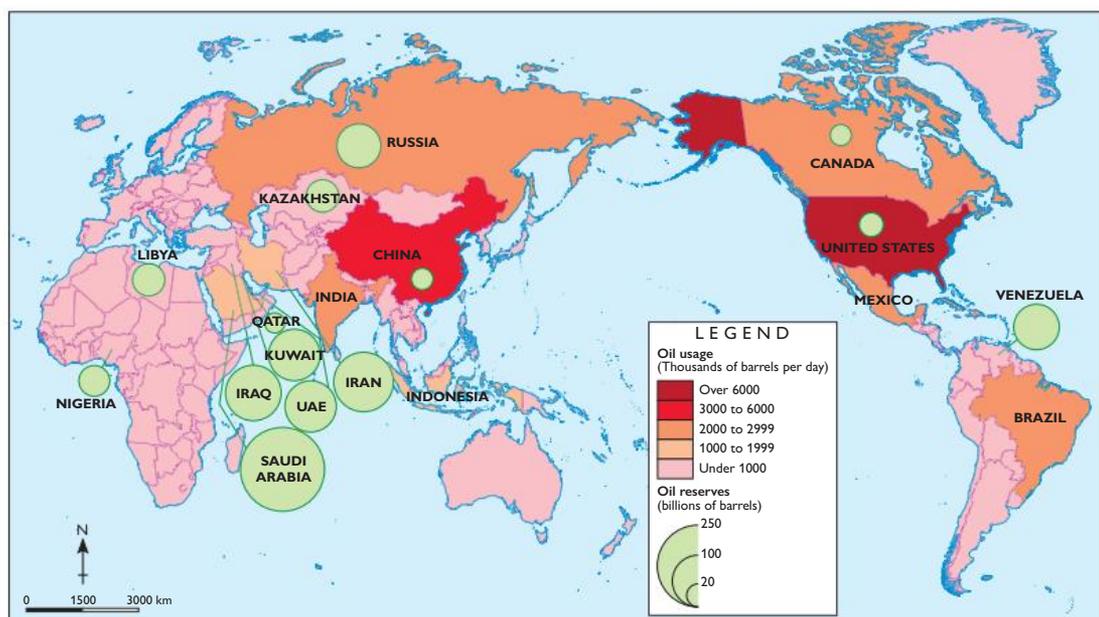
## Variations in mineral wealth

Throughout human history, different minerals have provided people with the means to increase their wellbeing. Ancient people used bronze and iron to make tools and weapons with which they could hunt large prey and increase their food security. In today's world, oil is a vital commodity. It is used by billions of people for transport, manufacturing, heating and cooking. Oil is found in only a few places on Earth but often in vast quantities.

Those countries that have reserves of oil are able to mine, refine and sell it to those who do not, thereby giving them an opportunity to generate wealth and increase their wellbeing. Source 8.37 shows the distribution of oil reserves throughout the world using proportional circles to show the oil reserves available to each country. You can see from this map that the majority of oil reserves are concentrated in a relatively small number of countries. The colour of each country in Source 8.37 indicates how much oil it uses. If a country needs oil but does not have any oil reserves, they have to buy it from a country that does.

Natural resources are considered of such high value that throughout history, access to them has been a common cause of conflict between countries.

WORLD: THE LOCATION OF OIL AND THE RATE OF OIL USE



Source 8.37  
Source: Oxford University Press

## KEY CONCEPT: INTERCONNECTION

### Natural resources and colonisation

As Western nations developed and their populations grew in the 16th and 17th centuries, their need for resources increased beyond what could be provided within their national borders. European powers such as Spain, England, Portugal and the Netherlands sent explorers out to the unknown regions of the world in the hope of finding resources and riches that they could use. They colonised vast areas of the Americas, Africa and the Pacific, often taking the wealth of the countries they colonised to increase their own wellbeing. In many cases, this had devastating results for the Indigenous people in these colonies.

Millions were taken as slaves or put to work extracting minerals and other natural resources from the ground. Countless others were killed in conflicts or died from Western diseases against which they had no natural immunity. Valuable resources such as timber and minerals were taken, and the Indigenous social and political systems were destroyed.

Some people would argue that a form of colonisation still continues today, as companies from wealthy countries develop and sell the resources of poorer nations. Thanks to profits from oil, Nigeria now has Africa's second-largest economy. Much of this wealth comes from multinational companies such as Royal Dutch Shell extracting Nigeria's oil. Shell currently produces 21 per cent of Nigeria's exported oil.

For those living near Shell's oil plants in the Niger Delta, there have been more negatives than positives as a result of the oil industry. Oil spills, loss of agricultural land and environmental degradation have left those in surrounding villages poorer than ever.

For more information on the key concept of interconnection, refer to section GT.1 of 'The geographer's toolkit'.



**Source 8.38** Royal Dutch Shell's oil plant in Bonny, Nigeria. Shell began operations in Nigeria in 1937. Today more than 1000 Nigerian wells operated by Shell produce more than 739 000 barrels of oil a day, virtually all of it exported.

## REVIEW 8.2.6

### Remember and understand

- 1 What do individuals and communities use oil for?
- 2 How can natural resources influence a country's wellbeing?

### Apply and analyse

- 3 Consider 8.37.
  - a Which 10 countries have the world's largest oil reserves?
  - b Use data from the World Bank website to order the 10 countries with the largest oil reserves according to their HDI rankings.
  - c Can you see a direct relationship between large reserves of oil and high levels of wellbeing as shown by the HDI rankings? Write a paragraph describing this relationship.
  - d Discuss why access to important natural resources such as oil does not always lead to improved levels of wellbeing.

- 4 What is colonisation? How does this help to explain variations in human wellbeing?

### Investigate and create

- 5 Use Google Earth to explore the town of Bonny in Nigeria.
  - a Find the location of the photograph in Source 8.38.
  - b Comment on the variations in buildings in this town and the conclusions that can be drawn about relative wealth and wellbeing.
  - c Use the ruler function to estimate the size of the oil and gas plant.
  - d What evidence can you find of environmental change as a result of this plant?

# THE INFLUENCE OF LOCATION ON SPATIAL VARIATIONS

## STRANGE BUT TRUE

When ships are caught in storms, they often lose cargo to the oceans. The following are just a few of the strange items that have washed up on shores:

- In 1990, five shipping containers of Nike sneakers and work boots were lost to the Pacific Ocean in a storm. People in Washington and Oregon snatched up the shoes on shore, holding swap meets to find matched pairs to wear or sell.
- In 1992, rubber duckies floated in the Pacific Ocean when a ship lost tens of thousands of bathtub toys. The ducks were accompanied by turtles, beavers and frogs.



### Source 8.39

Source: Oxford University Press

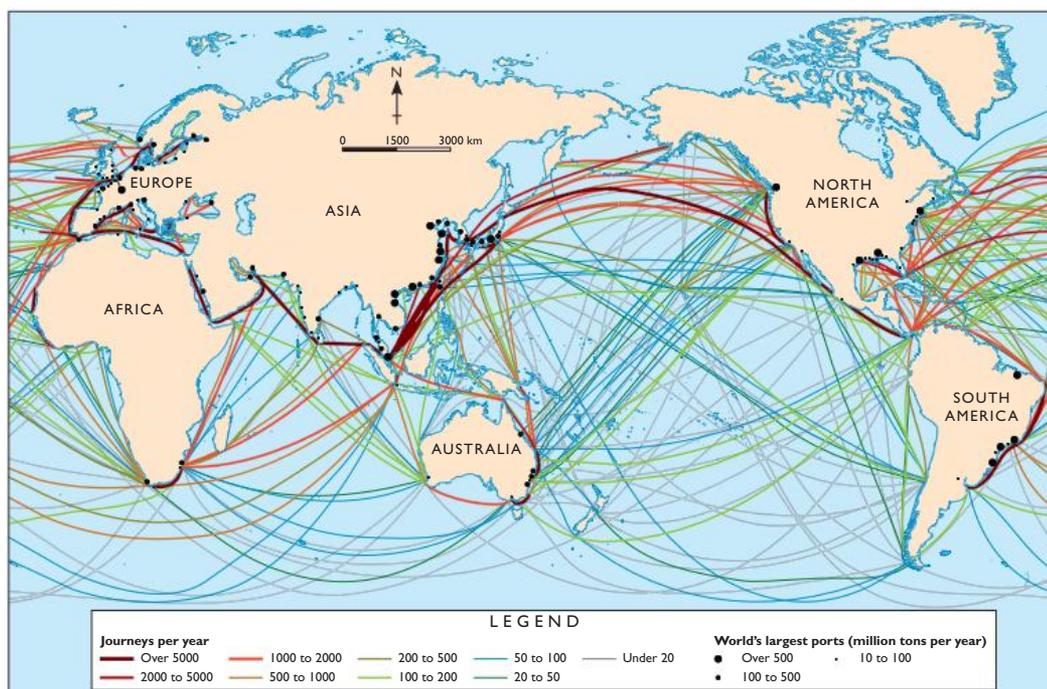
Differences in human wellbeing cannot be explained by variations in climate and the distribution of natural resources alone. While control over reserves of natural resources was the main source of wealth and power hundreds of years ago, it tends to be less of a factor in today's world. In our increasingly globalised world, vast quantities of goods, services, people, finances and ideas move quickly between countries. As a result, countries with few natural resources can increase their wellbeing by engaging in these flows of goods and services.

Some of the highest levels of wellbeing are enjoyed by people living in places without natural resources such as large areas of land suitable for agriculture or vast mineral reserves. For these people, their location and ability to trade are the key to their wellbeing.

## Access to trade routes

All of the world's great empires were built partly on their ability to transport goods and people. Large volumes of goods were usually transported by water. Ancient Egyptians used the Nile River, the Greeks and Romans used the Mediterranean Sea, and the British used the oceans of the world for trade. Countries and empires with ports close to major shipping routes had a natural advantage. Little has changed in the ways goods are transported today. The United States, for example, has been able to maintain high levels of wellbeing for centuries through its ability to trade from large ports on its west, east and south coasts. China, one of the world's fastest-growing economies, is the world's largest exporter and second-largest importer. Six of the world's eight busiest ports are located in China and an estimated 121 million shipping containers pass through them every year. China is using trade from its many ports as a way to improve the wellbeing of hundreds of millions of its citizens.

### WORLD: MAIN SHIPPING ROUTES AND LARGEST CONTAINER PORTS



## KEY CONCEPT: INTERCONNECTION

### Singapore and the importance of location

Singapore is one of the world's smallest countries with few natural resources. Most of the land area is used for urban development, so little remains for food production; there are no significant rivers and no mineral reserves. And yet, Singapore has one of the world's highest levels of wellbeing with an average life expectancy of over 84 years and one of the world's highest levels of GDP per person. Singapore's wealth is based largely on its geographic location at the tip of the Malay Peninsula.

Ships moving between the world's major exporters and importers have used the port of Singapore as a trading centre for hundreds of years. The Port of

Singapore is connected through shipping to more than 600 ports in 123 countries around the world, making it the 'gateway to Asia'. This central location has enabled Singapore to thrive in other global industries. Singapore also imports raw materials, which it turns into valuable commodities such as electronic and telecommunication goods for export. Lastly, the country is home to major oil refineries and other mineral treatment plants and is a major centre of finance.

For more information on the key concept of interconnection, refer to section GT.1 of 'The geographer's toolkit'.



Source 8.40 An oblique aerial photograph showing part of the Port of Singapore

## REVIEW 8.2.7

### Remember and understand

- 1 How does Singapore's location help to explain the high levels of wellbeing there?
- 2 How can countries with little in the way of natural resources work to improve their wellbeing?

### Apply and analyse

- 3 Use the World Bank website to describe the overall levels of wellbeing in Singapore.
- 4 Consider Source 8.39.
  - a Describe the location of the busiest shipping routes.
  - b Design the course of a container ship that travels from Beijing, around the world, and back to Beijing following the busiest shipping routes. Use

an atlas to make a list of the ports and countries where your ship would dock.

- c Use the World Bank website to explore the levels of wellbeing in the countries where your ship would dock.
- d What does this map tell you about the advantages of coastal nations in accessing trade?
- e How does this map help to explain the high levels of wellbeing in the United States, China and Singapore?

### Investigate and create

- 5 Create a PowerPoint presentation, or similar, to highlight all of the ways in which location influences a country's wellbeing.

# HUMAN CAUSES OF SPATIAL VARIATIONS IN WELLBEING

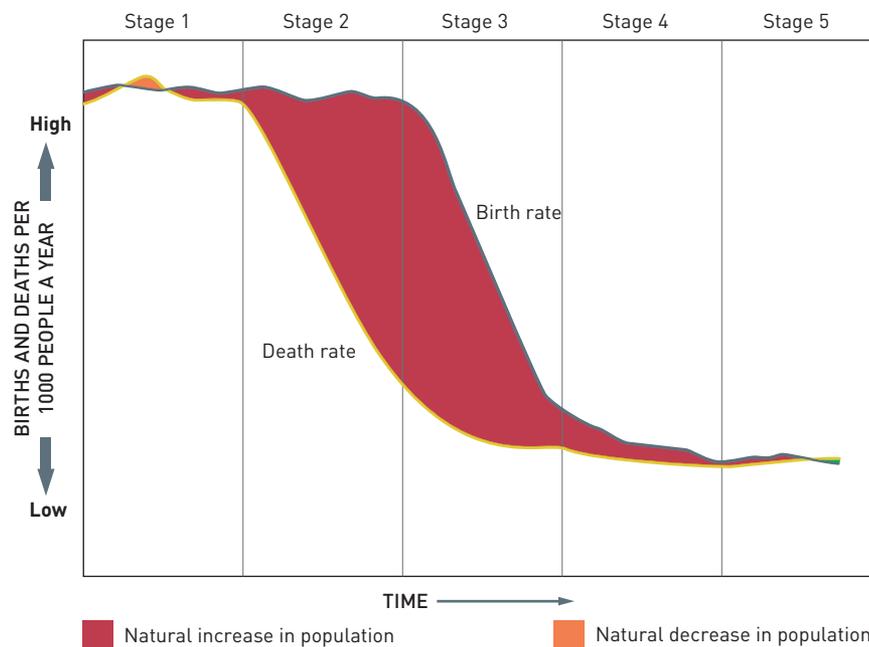
Human causes are a combination of different social, economic, historical and political factors. Changes in the size of populations, inequalities between different groups in society, political instability and conflict are all examples of human causes that affect wellbeing.

## Demographics and changes in population

The number of people living in a country is always changing. In some countries the population is growing rapidly and in others it is declining. The rate at which populations change is largely related to changes in wellbeing.

**Demographics** is a term used by geographers to describe the quantifiable statistics of a population (or smaller groups within it). Looking at statistical data on population can help to identify trends in population patterns and predict future trends that could affect wellbeing within a country.

Countries tend to pass through a series of stages in terms of population change. By observing these changes in many countries over a long period, geographers were able to develop the **demographic transition model** (Source 8.41).



## Looking at population trends

Many developing countries around the world today, particularly in Africa and Asia, are currently in stage 2 according to the demographic transition model. Death rates have fallen dramatically as better health care, sanitation and the provision of fresh water have improved the health and life expectancy of millions of people. Improvements have also been made in the care offered to women giving birth and their newly born children. Millions more babies are now surviving into adulthood as a result of these improvements.

While these improvements have led to people enjoying longer, healthier lives, they have also created a problem. In these countries, there is currently a gap (or lag) between the fall

in the death rate and a fall in the birth rate, so populations are growing rapidly (see Source 8.41). As a result, the population of Africa, for example, is expected to double in the next 40 years to more than two billion.

In contrast, many developed countries in regions such as North America and Western Europe have reached stages 4 and 5 in their demographic transition. Birth rates have now fallen to such an extent that some of these countries are facing an overall decline in their populations. The reasons for this fall differ between countries but there are some common factors. A general improvement in living conditions, high use of contraception and other family planning methods, high rates of education and work participation among females and a movement from rural living to large cities all seem to be contributing factors to the falling birth rates.

Perhaps the most famous attempt by a country to reduce its birth rate was China's 'one-child policy'. Introduced in 1979, and abandoned in 2015, its aim was to reduce the rate of population growth in the world's most populous country. Couples in China were encouraged to have only one child, although the policy had been unevenly applied across the country. One-child families were given better access to education, health care, jobs and houses while those who had more children were fined and lost access to important social services.

The policy was successful in reducing China's growth rate and resulted in 300 million fewer births since it was implemented in 1979. But there were also a range of unintended consequences, which caused concern and resulted in the abandonment of this policy.

In China, people preferred to have sons rather than daughters, as boys traditionally supported their parents in their old age. As parents could only have one child, many were ensuring that this was a boy. In some cases, this involved using an ultrasound machine to determine the sex of the foetus, and abortion of the pregnancy if it was a girl. In other cases, baby girls were abandoned or sent to orphanages. This led to a large imbalance between the sexes in some parts of China with 13 males born to every 10 females.

## CASE STUDY

### China's one-child policy



Source 8.42 A mother in Shaoyang plays with her son in front of a family planning poster.

## REVIEW 8.2.8

### Remember and understand

- 1 Why can it be useful to analyse statistical data on population?
- 2 Why have death rates fallen in many developing countries over recent times?

### Apply and analyse

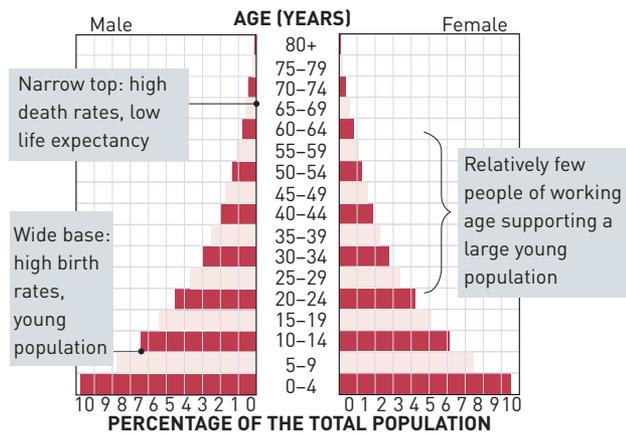
- 3 In what ways would the demographic transition model be useful for geographers studying population trends?
- 4 Use the World Bank website to find the birth and death rates for Australia, Afghanistan, Italy and Timor-Leste.
  - a Which of these countries would you describe as having a rapidly expanding population, which is relatively stable and which has a declining population? Explain your answers.

- b In which stage of demographic transition is each of these countries? What challenges do planners in Italy and Timor-Leste face?
- 5 What was China's one-child policy designed to do? Describe its results in terms of the demographic transition model.

### Investigate and create

- 6
  - a What messages do you think are being communicated on the billboard shown in Source 8.42?
  - b Make a list of the unintended consequences, giving examples from the media, of China's one-child policy, which ultimately led to its abandonment in 2015.

# CHANGES IN POPULATION STRUCTURE



Source 8.43 The population pyramid for Niger, an example of a growing population

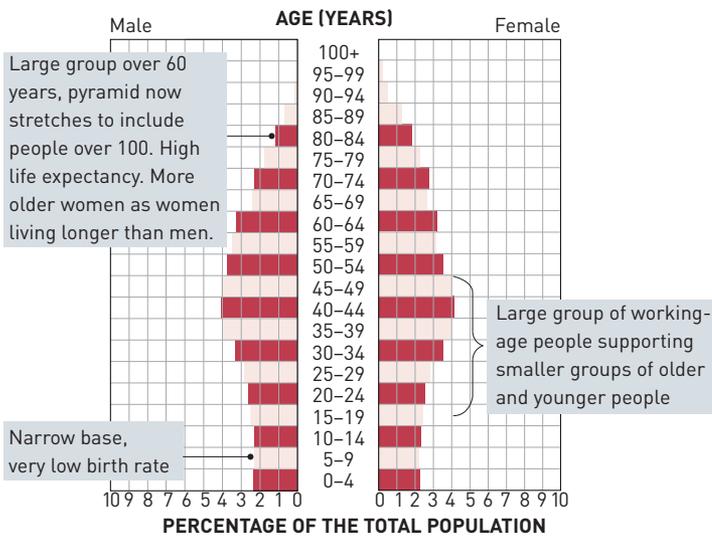
## How population affects wellbeing

Population structure is a term used to describe the different groups in society that together make up the total population. Geographers often identify groups according to their age and sex. One of the most useful tools that geographers use to study a country's population structure is called a **population pyramid**. Population pyramids graph the population of a country in age segments (shown in the central axis). Males and females are shown separately – males are always shown on the left of the pyramid and females on the right.

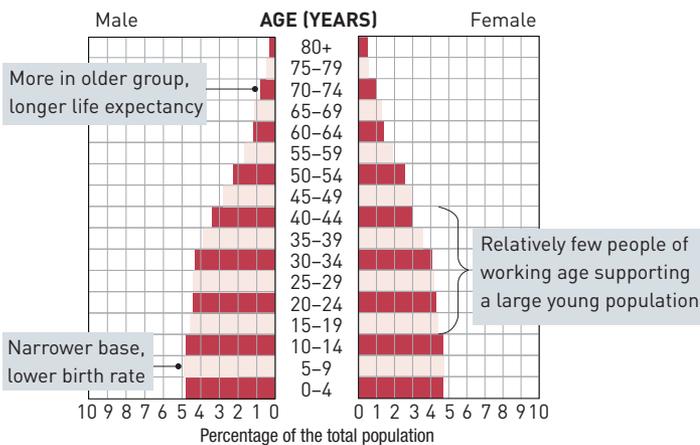
Population pyramids help geographers to identify trends in populations. The overall shape of the pyramid can indicate whether a country's population is growing, contracting or remaining relatively stable. Countries with a rapidly growing population tend to have pyramids that are wide at their base and narrow at their top (Source 8.43).

Countries with a population that is growing slowly have a different-shaped pyramid (Source 8.44). The base is much narrower because birth rates and fertility rates are lower. In these countries, much of the population is of working age.

Countries with a declining population tend to have a population pyramid that looks like an inverted pyramid (Source 8.45). In these countries, the birth rate is low so the base of the pyramid is very narrow. There is usually a large group of people over 60 years of age as life expectancy is high and death rates are low.



Source 8.44 The population pyramid for Indonesia, an example of a slowly growing population



Source 8.45 The population pyramid for Italy, an example of a declining population



Source 8.46 The population of Italy is ageing and declining due to a very low birth rate.

## Constructing a population pyramid

You can construct your own population pyramid by following these steps. Population pyramids are fairly simple to construct but accuracy is very important so take your time. For more information on population pyramids, refer to section GT.3 of 'The geographer's toolkit'.

- Step 1** Draw the horizontal axis (the x-axis), which will show the percentage of the population. Leave a gap in the centre similar to the population pyramids shown in Sources 8.43–8.45. Your age ranges will go in this space.
- Step 2** Add the scale 0 to 10 on each side, working from the centre outwards. Label your x-axis 'Percentage of the total population'.
- Step 3** Add the centre axes (the y-axes) as per the population graph in Source 8.43. Label the y-axes 'Age (years)'. Remember that males are always shown on the left and females on the right, label the left side 'Male' and the right side 'Female'.
- Step 4** Mark the scale on the y-axes. You will need to allow for 20 rows.
- Step 5** Add the labels for each age group span in the centre space. Start with 0–4 at the bottom and increase in intervals of four years until you reach 100+.
- Step 6** Transfer information from your data set onto your population pyramid. Draw bars in for each age group's data. Use a ruler and sharp pencil. Make sure that each bar is exactly the same width.
- Step 7** Lightly shade each bar using two alternating colours so the graph is easy to read. Add a title.

**Source 8.47** The population of Australia, 2015 (ABS)

Age	Males (%)	Females (%)
0–4	3.3	3.2
5–9	3.3	3.1
10–14	3.1	2.9
15–19	3.2	3.0
20–24	3.6	3.4
25–29	3.7	3.7
30–34	3.7	3.7
35–39	3.3	3.3
40–44	3.5	3.5
45–49	3.3	3.3
50–54	3.2	3.3
55–59	3.0	3.1
60–64	2.7	2.8
65–69	2.4	2.5
70–74	1.8	1.8
75–79	1.3	1.4
80–84	0.8	1.1
85+	0.6	1.2

### Apply the skill

- Construct a population pyramid for Australia in 2015 using the data from Source 8.47.
- Add three labels to your Australian population pyramid, similar in style to those on the three population pyramids shown in Sources 8.43–8.45, describing three key features of the structure of Australia's population.

Note: You could use Microsoft Excel, or similar, if you would like to construct a digital version.

## REVIEW 8.2.9

### Remember and understand

- Describe the appearance of a population pyramid for a rapidly growing population.
- Which of the population pyramids shown on these pages represents the most rapidly growing population?

### Apply and analyse

- Use the World Bank website to list the fertility rates in Niger (Source 8.43), Indonesia (Source 8.44),

Italy (Source 8.45) and Australia. What link can you make between the shape of the pyramids of these countries and their fertility rates?

### Investigate and create

- Using the four population pyramids (Italy, Niger, Indonesia and Australia) as a guide, match each country with its current position in the demographic transition model (Source 8.41).

# POPULATION GROWTH AND SPATIAL VARIATIONS IN WELLBEING

The countries in which poverty levels are the highest are generally those that have the most rapid increases in population and the highest fertility levels.

United Nations Population Fund



**Source 8.48** Niger is the only country in the world where the average number of children born to each woman (known as the fertility rate) is greater than seven. Of the 15 countries with the highest fertility rates, 14 are in Sub-Saharan Africa. The other country is Afghanistan.

The populations of most countries around the world are increasing. In some countries, such as Australia and the United States, the population is growing slowly, and in other countries, such as Niger and Uganda, it is growing rapidly. Populations grow when the number of arrivals from births and immigration is greater than the number of departures from deaths and emigration. In most cases, the growth of a country's population is largely determined by the fertility rate.

Many people living in countries with a rapidly growing population experience difficulties accessing vital services. These include access to education, food, safe drinking water, electricity, communications and transportation. Access to health services such as hospitals, doctors and medicines is also much lower than in countries with slowly growing or declining populations. Infant mortality and maternal mortality (mothers dying due to pregnancy or childbirth problems) are also much higher in rapidly growing populations. This is largely because many births in these countries are not attended by health professionals.



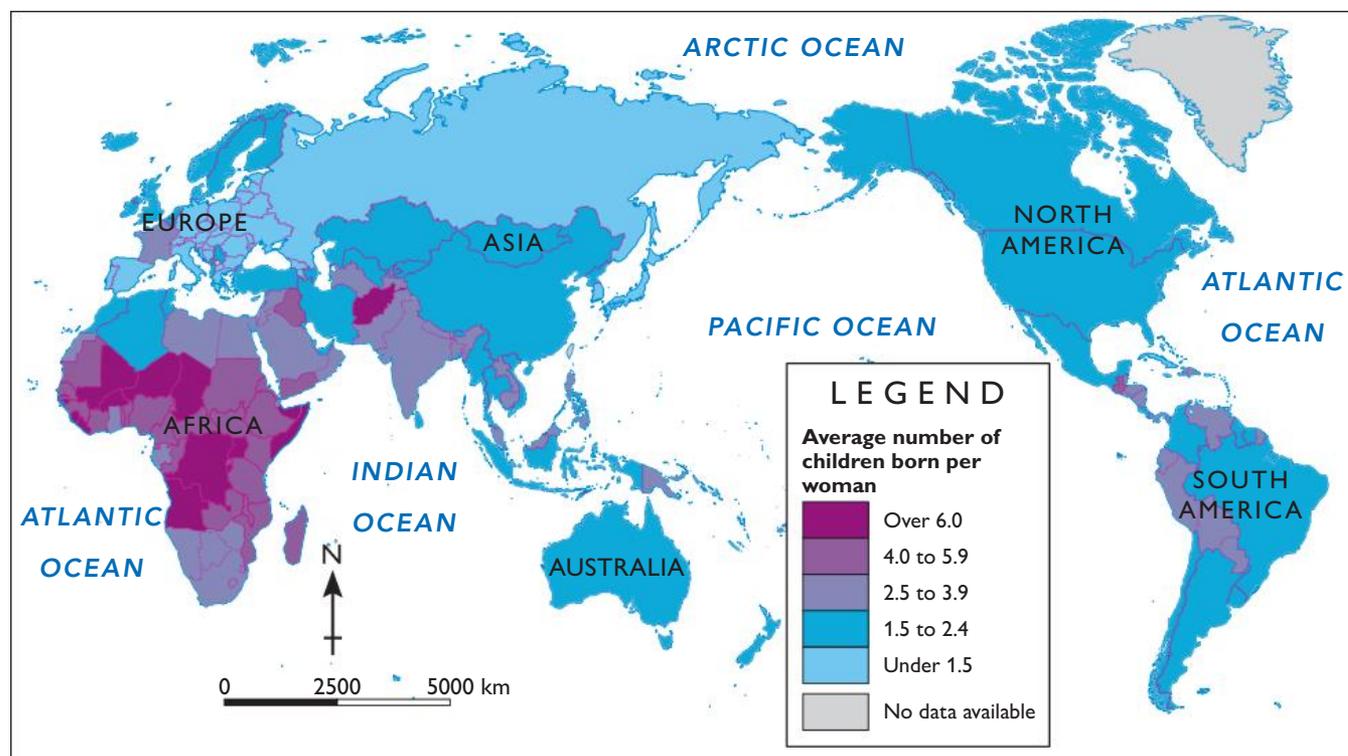
**Source 8.49** The adult literacy rate for Yemen is 43 per cent for females and 79 per cent for males.

## Gender inequality and fertility rates

Gender inequality fuels population growth. Where women are denied full legal, social and economic rights, such as education, secure livelihoods, property ownership and credit, they are forced to rely on childbearing for survival, status and security.

Lakshmi Puri, Assistant Secretary-General of UN Women

## WORLD: TOTAL FERTILITY RATES



Source 8.50

Source: Oxford University Press

Many researchers believe that the lower status of women, particularly in developing countries, contributes to higher fertility rates as women with lower levels of education tend to have more babies. In turn, higher fertility and larger families make it even more difficult for women to attend school or to participate in the workforce and in government.

Inequality between women and men is both a cause of inequality in wellbeing and one of its effects. Societies in which women have a lower status in education, employment and government tend to have lower levels of wellbeing than those with less or no gender discrimination.

### REVIEW 8.2.10

#### Remember and understand

- 1 Define what is meant by maternal mortality.
- 2 What might be the cause of higher rates of infant and maternal mortality in countries with rapidly growing populations?
- 3 What is the fertility rate in Australia? Name three other countries with a similar fertility rate.
- 4 Explain the links between gender inequality and population growth in your own words.
- 5 What sorts of services are difficult to access in countries with rapidly growing populations?

#### Apply and analyse

- 6 Consider Source 8.49.
  - a Estimate the proportion of girls and boys in this school in Yemen.

- b How does this help to explain the gap in literacy levels between males and females in Yemen?

#### Investigate and create

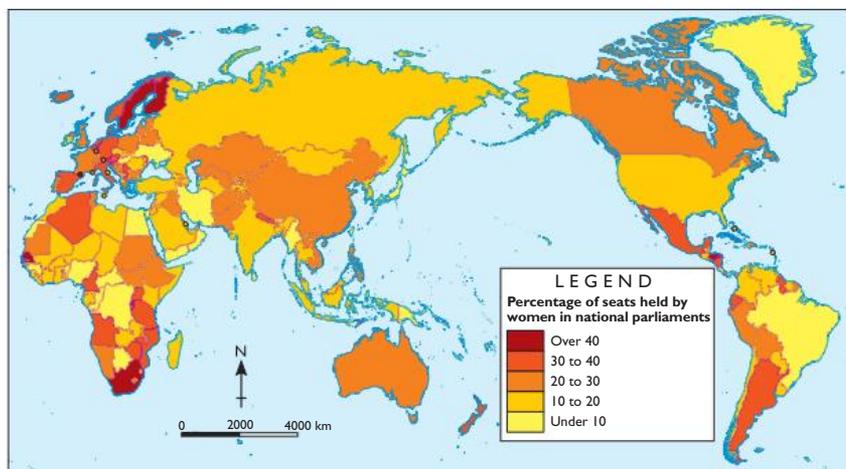
- 7 Examine Source 8.50.
  - a Use the PQE method to describe the pattern shown on this map.
  - b Compare this map to the world maps showing the proportion of populations living in poverty (Source 8.8), GDP per capita (Source 8.12), hunger levels (Source 8.15) and literacy rates (Source 8.18). For each map summarise in one sentence the similarities that you notice.
  - c Based on your responses to **a** and **b**, what is the most significant link between fertility rates and human wellbeing?

# GENDER AND SPATIAL VARIATIONS IN WELLBEING

Throughout much of the world today there are **gender inequalities**. For example, if you are a woman, you are more likely to be living in poverty and unable to read or write. You are more likely to be a refugee and subject to gender-based violence. You are also less likely to be in government, to be employed or to own property.

As we have learned, there are certain key indicators that can be used to measure wellbeing. Three important ways to assess gender equality in a country are by measuring women's participation in education, the workforce and government. It is these three things that are essential to raising the status of women and providing opportunities for better jobs, higher levels of wealth and female-friendly government policies.

WORLD: GENDER PARITY FOR ENROLMENTS IN PRIMARY AND SECONDARY EDUCATION



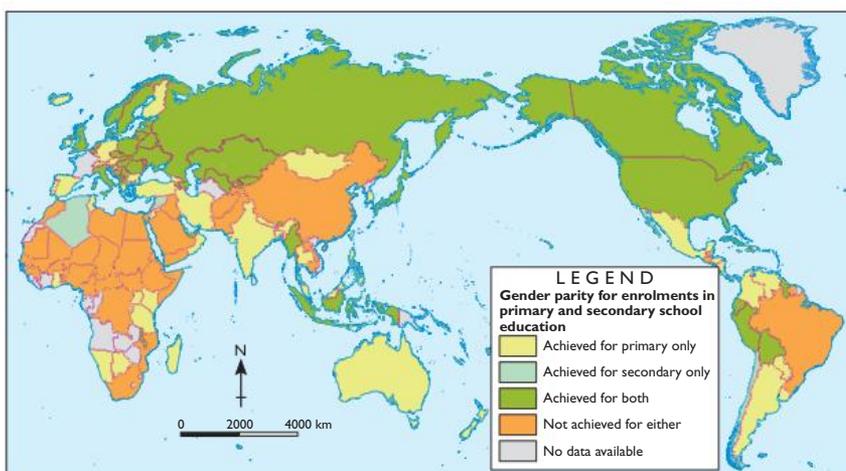
Source 8.51

Source: Oxford University Press

## Gender inequality in education

In many countries around the world, boys outnumber girls in schools particularly at secondary school level (see Source 8.51). The gap is wide throughout South Asia, for example, where the number of girls attending secondary schools is low compared with boys – only 75 girls for every 100 boys. This gap is a reflection of gender-based discrimination in societies where sons are often considered more important than daughters. Poverty also has an effect on this inequality. In India, for example, girls from poorer families who do attend school, attend inferior schools that teach nothing more than basic literacy and numeracy. Higher levels of schooling cost money and poor families are more willing to invest in their sons than their daughters.

WORLD: PERCENTAGE OF WOMEN IN NATIONAL GOVERNMENTS



Source 8.52

Source: Oxford University Press

## Gender inequality in government

In every country of the world, less than half of the representatives in national parliaments are women (see Source 8.52). Globally, women make up only 18 per cent of the world's elected officials. The Scandinavian countries and Iceland have the highest number of women in government, with Spain, South Africa and Argentina also having better-than-average numbers. Low levels of representation in government can make it difficult for gender equality laws such as universal education to be discussed and enacted.

# EXTREME POVERTY AND WOMEN

Worldwide, there are about a billion people living in extreme poverty. They do not earn enough to feed, clothe, and shelter their families each day. They are forced to make impossible choices between necessities like medicine and school fees and are often marginalized or excluded from society. Because women and girls face distinct challenges that increase their vulnerability to extreme poverty, addressing gender inequalities is vital to ending poverty.

## THE PROBLEM



In almost **90%** of 143 countries studied, at least one law impedes women's economic opportunities. 28 countries have ten or more legal differences.<sup>1</sup>



The **vast majority** of women workers in developing countries are employed in informal work and are overrepresented in the least-secure and lowest paying jobs.<sup>2</sup>

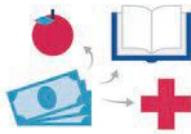


Around the world, **62 million girls** are out of school, compared to 53 million boys, inhibiting their ability to find good employment opportunities.<sup>3</sup>



Many developing countries **limit women's access to land** and other types of property by law or cultural practice, restricting their ability to move out of poverty.<sup>4</sup>

## THE POSSIBILITIES



Women are **more likely** to reinvest their earnings back into their families to improve education, nutrition, and health, helping to break the cycle of poverty.<sup>5</sup>



For each additional year of schooling, a woman's globally averaged labor earnings increase by **nearly 12%**.<sup>6</sup>



If women had the same access to productive resources as men, they could increase their farm yields by **20-30%**, feeding an additional 150 million people.<sup>7</sup>



When more women work, **economies grow**. An increase in women's share of labor force participation results in faster economic growth.<sup>8</sup>

**Source 8.53** Worldwide, there are about one billion people living in extreme poverty. They do not earn enough to feed, clothe and shelter their families each day. They are forced to make impossible choices between necessities such as medicine and school fees and are often marginalised or excluded from society. Because women and girls face distinct challenges that increase their vulnerability to extreme poverty, addressing gender inequalities is vital to ending poverty.

Source: www.usaid.gov

## Gender inequality and job opportunities

Women own about 1 per cent of the world's resources and earn one-tenth of the world's income. In many places around the world their participation rates in the paid workforce are much lower than men's. The Middle East and North Africa have the lowest levels of female participation in the workforce. Even in the developed world, where women's participation is high, women earn less than men and occupy lower-level positions.

In many of the places where women have low participation rates in the paid workforce, they are instead doing unpaid agricultural work. Approximately 60 per cent of women in developing countries work in farming. These women work long hours every day on family farms that produce just enough food to support their families. They also perform most of the domestic chores such as collecting wood and water, caring for children and preparing food.

### REVIEW 8.2.11

#### Remember and understand

1 Define 'gender inequality' in your own words.

#### Apply and analyse

2 Examine Source 8.51.

- Which regions have parity (equal numbers) of male and female students for both primary and secondary education?
- Use Source 8.50 to comment on the fertility rates in the regions you identified in a.
- What relationships can you see between education parity and fertility?

3 Use the sources provided to compare the regions of Europe and Sub-Saharan African in terms of:

- parity in education
- the percentage of women in government.

#### Investigate and create

- Research the sources from the USAID infograph (Source 8.53) and outline two programs that are addressing gender inequality and job opportunities for women.
- Outline the current situation in Australia. Focus on issues such as employment, wage levels, number of seats in parliament and education.

# TECHNOLOGY AND SPATIAL VARIATIONS IN WELLBEING

Technology is a very broad term used to describe a range of different tools, machinery, techniques and systems to solve a problem or achieve a goal. From the times of earliest human societies, people have strived to find new and better ways of growing food, accessing water, treating medical problems and improving sanitation. All of these technological developments were designed to improve wellbeing. Over the last 200 years, there have been many significant advances in technology that have fundamentally changed the way we live and work. These advances have had enormous impacts on societies. Some of the biggest changes were during the Agricultural Revolution of the 18th century and the Industrial Revolution of the 19th century.

These revolutions, however, were concentrated in Europe and the United States and their impacts were greatest in the parts of the world now known as the developed world. The people of Europe may have been living with the benefits of these revolutions for generations but in many Asian and African countries, they are still using farming methods not seen on Europe's farms for hundreds of years.

## CASE STUDY

### Differences in dairy farming technology

Differences in the availability and use of technology between the developed world and the developing world can be seen clearly in these examples of dairy farming in Laos and New Zealand.

The woman shown in Source 8.54 is a farmer in Laos. She is bringing her herd of four cows to a small shed leaning against her house. She will spend the next hour or so milking the cows by hand into a bucket. This will provide enough milk for her family to be able to make their evening and morning meals. The cows will stay in the shed overnight and be milked in the early morning. During the day they will be able to wander across the countryside but will be accompanied by one of the children of the family whose daily task is to make sure the cows are fed, keeping the child out of school. Their droppings will be collected and used for fertiliser, fuel for the cooking fire or mixed with straw and used for mud bricks. On some days, the larger cow will be used to plough the family rice field, pulling a plough through the mud.

The farm in Source 8.55 is also a dairy farm. The family ride motorbikes to herd the cows into a mechanised milking shed. Suction cups are attached to the cows' udders and the milk is pumped into large storage tanks ready for collection by a refrigerated milk tanker later in the day. Because the milking is mechanised, the farmer and one other worker are able to milk 1200 cows twice a day, producing much more milk than the farmer and his family can consume. The milk is sold to the local dairy factory where it is treated and used to supply the needs of the people in towns and cities throughout the South Island of New Zealand.



Source 8.54 A dairy farm in Laos



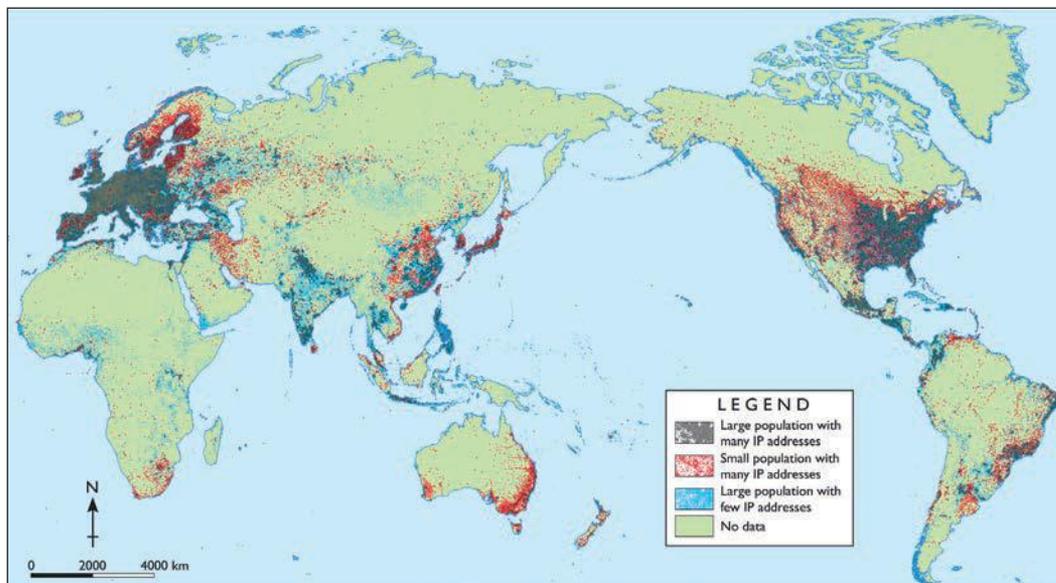
Source 8.55 A dairy farm in New Zealand

# Information and communications technology and wellbeing

Technology is always moving forwards. We are currently experiencing a kind of information revolution in which the growth and spread of ideas and knowledge are occurring much more rapidly than at any time in the past. To a large degree this is being fuelled by advances in information and communications technologies (ICT).

ICT has the potential to improve the wellbeing of people throughout the world. Already, the Information Revolution has made it easier for businesses on opposite sides of the world to work with each other. It has also allowed Western companies to access cheaper labour in developing countries by outsourcing jobs overseas. The outsourcing of jobs in call centres and IT services, for example, has provided new employment opportunities and increased wellbeing in countries such as India and the Philippines. The spread and influence of the Information Revolution throughout the world, though, remain uneven (Source 8.56).

## WORLD: INTERNET USE AND POPULATION



Source 8.56

Source: Oxford University Press

### REVIEW 8.2.12

#### Remember and understand

- 1 What is technology?
- 2 In which areas do humans seek to improve wellbeing through the use of technology?
- 3 How has the outsourcing of jobs by Western countries improved wellbeing in India and the Philippines?

#### Apply and analyse

- 4 Compare Sources 8.54 and 8.55.
  - a Comment on the level of technology used by dairy farmers in these two places.
  - b Use the World Bank website to compare levels of wellbeing in these two countries.

- 5 Consider Source 8.56.

- a Describe the general pattern of internet use on this map.
- b Compare the map to Source 8.6 showing HDI rankings around the world. What links do you notice between the HDI rankings and the internet traffic?
- c Account for these links.

#### Investigate and create

- 6 How can the National Broadband Network (NBN) connect communities and contribute to reducing spatial variations in human wellbeing in Australia.

# POLITICS AND SPATIAL VARIATIONS IN WELLBEING



Politics is a term used to describe all of the activities associated with governing a country or region. Thomas Jefferson (1743–1826), third President of the United States and principal author of the Declaration of Independence, was a gifted politician. According to Jefferson, good governments were those that protected the rights of individuals, encouraged economic freedom, promoted happiness and listened to the will of the people. Although Jefferson died almost 200 years ago, his beliefs still hold true. Governments wield enormous power over their citizens. Some are good, while others are bad. Regardless of this, they are all responsible for influencing levels of wellbeing among their citizens.

## The Universal Declaration of Human Rights

On 10 December 1948, the United Nations General Assembly adopted the Universal Declaration of Human Rights. After World War II, the newly formed United Nations, set an international agreement of basic human rights that should be made available to all. The idea was that those in power would be responsible for ensuring that the human rights of their citizens were protected to the best of their government's ability.

This was the first time in history that the nations of the world had listed the basic human rights to which all human beings are entitled. The declaration now underpins many laws to protect basic human rights all around the world. These rights include:

- the right to equality, life, freedom, security, equality before the law, a fair public hearing, be presumed innocent until proven guilty, move freely, seek asylum in another country, marriage, family, own property, freedom of opinion, peaceful assembly, free elections, social security, desirable work, rest, adequate living standards, education and to share in scientific advancements
- freedom from discrimination, slavery, torture, arbitrary arrest, interference with privacy, religious persecution, state or personal interference in the above rights.

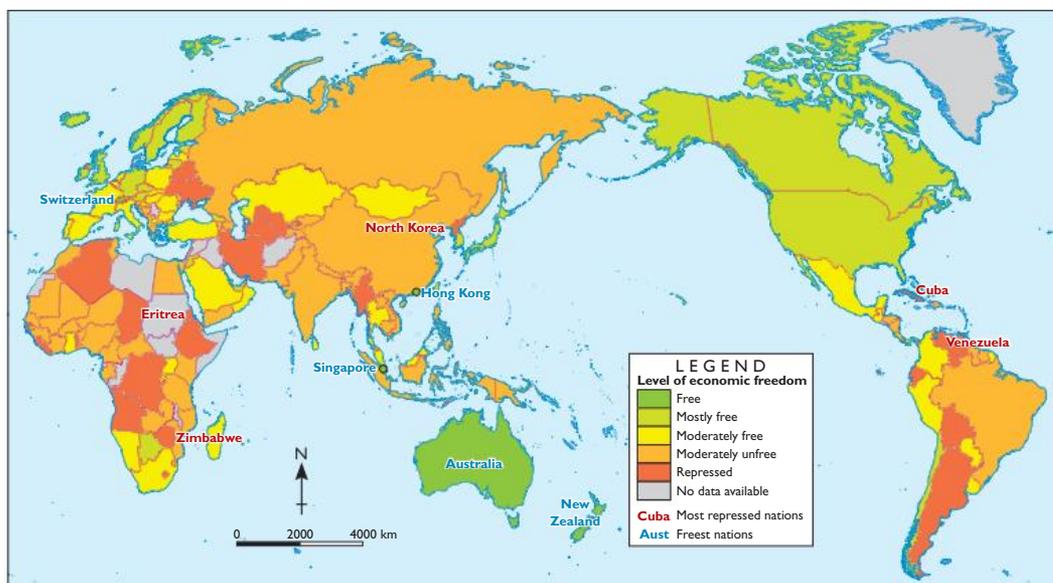
## Government corruption

Many researchers believe that the abuse of political power is the leading cause of poverty and inequality in the world today. In particular, they point to the corruption that exists in many developing nations where those in power use their position for their own benefit rather than the benefit of the country. Source 8.58 ranks the countries of the world according to the level of economic freedom. This data is compiled by scoring nations on various indicators including the level of corruption, labour freedoms and property rights.

Government corruption usually leads to the repression or punishment of any individual or group that speaks out against the government. In some cases, the struggle between different political groups within a country can result in civil war and ongoing conflict, an example of this is the current civil war in Syria. Along with environmental degradation, corruption and conflict are the two factors most likely to halt or reverse upward trends in improved wellbeing, affecting people's health, education and economic activity.

**Source 8.57** In some countries, such as Myanmar (Burma), children are forced into conflict and become child soldiers. Some groups, including Amnesty International, argue that 'the right to refuse to kill' should be added to the list of basic human rights.

## WORLD: ECONOMIC FREEDOM AND REPRESSION



Source 8.58

Source: Oxford University Press



**Source 8.59** North Korea is one of the world's most repressed nations. It is very difficult to access data for North Korea but it is estimated that more than one-quarter of North Koreans live below the poverty line. Despite this, it is believed that up to one-third of the annual budget is spent on the military under a policy known as 'songun' or putting the military first.

### REVIEW 8.2.13

#### Remember and understand

- 1 Describe Jefferson's idea of good government.
- 2 How can corruption and conflict within a country affect the wellbeing of its people?

#### Apply and analyse

- 3 In which regions of the world are the people most repressed?
- 4 In which regions are people most free of repression?

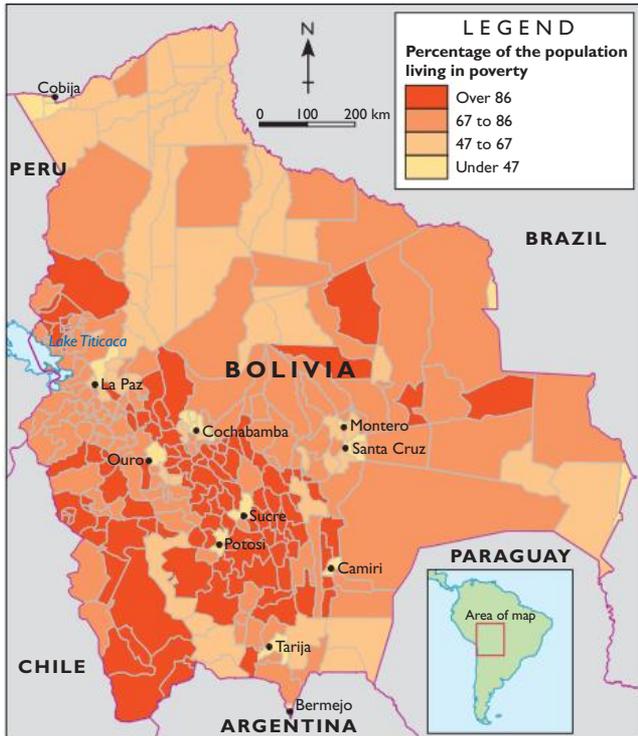
- 5 Access the full list of 30 rights and freedoms outlined in the Universal Declaration of Human Rights online. If these rights were adopted as law in every country how would they influence wellbeing?

#### Investigate and create

- 6 Using Source 8.58 and an atlas, select four countries from each level of the five levels of economic freedom. Use the World Bank website to research the HDI ranking of each of these 20 countries. Construct a scatter plot comparing the level of economic freedom in each country with its HDI ranking. Describe the spatial pattern shown.

# WELLBEING IN BOLIVIA

## BOLIVIA: POPULATION LIVING BELOW THE POVERTY LINE



Source 8.60

Source: Oxford University Press

By most measures, Bolivia has one of the lowest levels of wellbeing in South America. In the 2015 United Nations Human Development Report, Bolivia is ranked at number 119 in the world in terms of the HDI. This places Bolivia in a group of countries described as having medium human development. Even so, 60 per cent of Bolivians live below the poverty line, and more than half of these people are described as living in extreme poverty.

## Patterns of poverty

Taking a more detailed look at Bolivia's poor, it becomes clear that people in some areas are more likely to be living in poverty than in other areas. As in India, poverty tends to be concentrated in rural areas, where two-thirds of the population is in extreme poverty. In these areas people grow just enough food to feed themselves and their families, with little left to sell. Poverty is also higher among the Indigenous population. Source 8.60 shows the percentage of the population in each region of Bolivia living below the poverty line. This poverty is due to a number of factors, including different levels of employment and availability of resources, varying quality of infrastructure such as roads, schools, hospitals and electricity and high levels of land degradation.



Source 8.61 In rural Bolivia there tends to be low levels of technology, poor infrastructure such as roads, a lack of job opportunities, and less access to services such as schools, doctors and sanitation than in the nation's urban centres.

## Education

Bolivia spends almost one-quarter of its national income on education. This is one of the highest rates of education spending in Latin America. Despite this, about one million Bolivian adults are illiterate and approximately one in five children never complete primary school.

Most of the children who do not attend school live in rural areas where they are needed to work with their parents to help support their families. The result of this is that rural children do not gain the education and skills that could help to pull their families out of poverty. Many Indigenous children also drop out of school due to language difficulties. They grow up speaking their Indigenous language but when they attend school all the classes are taught in Spanish.



**Source 8.62** Around one in five Bolivian children do not complete primary school.

## Health

Many Bolivians face chronic health problems linked to food insecurity. Farm productivity in Bolivia is among the lowest in South America and is still declining in some regions. This is due to a wide range of environmental problems including land degradation, regular flooding and droughts, outdated farming technology and a lack of investment.

Poor harvests have led to widespread malnutrition and almost five million people struggle to meet their daily food requirements. Pregnant women and young children are the hardest hit by malnutrition, resulting in underweight children and iron deficiencies. Infant mortality rates are falling as health care gradually improves but they are still the highest in South America.

Rates of diseases such as tuberculosis, malaria and yellow fever are high. This can further lower farm productivity as ill farmers and workers are less able to work to produce food. HIV/AIDS rates are relatively low but increasing.



**Source 8.63** These two boys are among the lucky few Bolivians in rural areas who have access to an improved water source.



**Source 8.64** An example of an NGO project in Bolivia aimed at improving wellbeing through providing access to clean drinking water.

## Improvements to wellbeing

The Bolivian Government and people are working hard to improve their wellbeing. The country has experienced times of political uncertainty and corrupt government but is now in a period of stability. This has encouraged aid organisations such as the World Bank and UNICEF to support the government in its efforts to implement reforms designed to improve wellbeing.

## Helping the disadvantaged

Small **non-government organisations (NGOs)** are also making a difference in Bolivia. One example of this is the Foundation for Sustainable Development (FSD) that works with local community organisations in Cochabamba, a city in central Bolivia. FSD volunteers and interns help these organisations to improve health and education services, particularly for disadvantaged groups such as the rural poor, Indigenous people and women. Some examples of the initiatives supported by FSD include a literature and reading group for children and programs to combat malnutrition by training adults in health and cleanliness, nutrition, agriculture and microfinance.

### KEY CONCEPT: SCALE

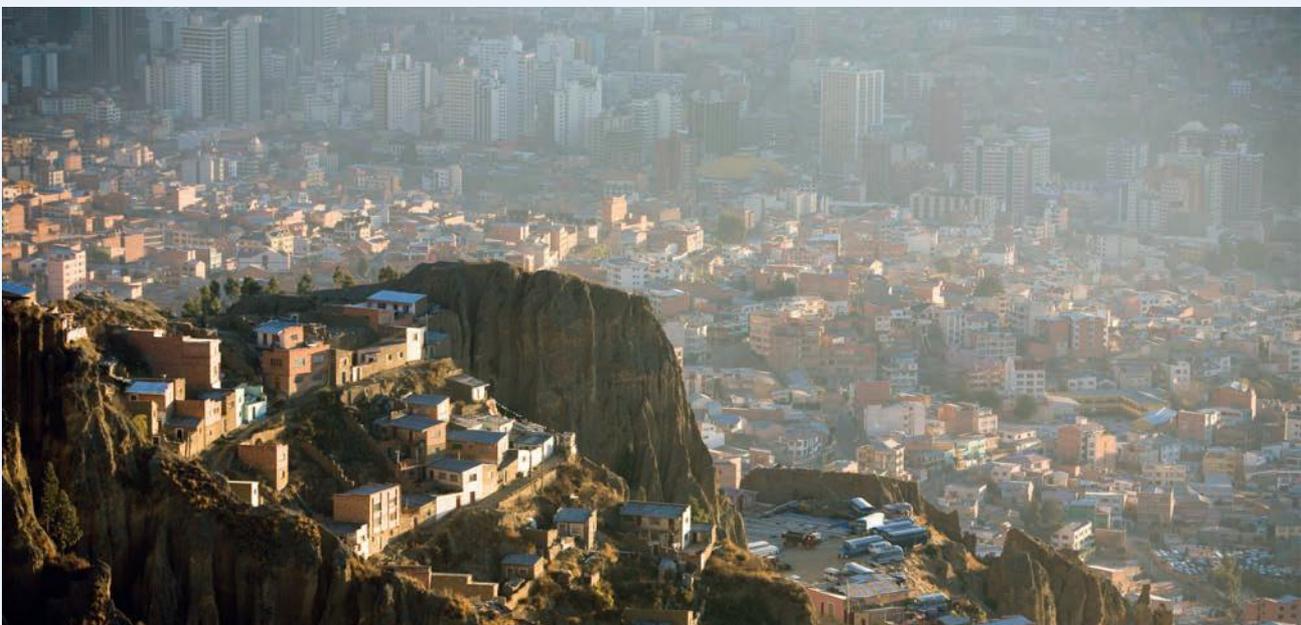
#### Life in Bolivia's cities

Variations in wellbeing can be observed at a range of scales including at the global, national, regional and local scale. An example of a global variation is the classifying of countries according to their level of economic development (see Source 8.12). National and regional variations can be seen in the map of poverty in Bolivia (Source 8.60). Local variations are those that occur in small areas such as individual suburbs and cities.

La Paz, Bolivia's capital city, has a population of about 2364000. The highest capital in the world, La Paz is a

spectacular city sitting within a canyon on the Altiplano (also known as the Andean Plateau). Tall, modern office buildings crowd the city centre, while vast urban slums cling precariously to the mountain slopes on the city's edges (see Source 8.65). These slums are home to up to one million people, many of them migrants from the poverty-stricken countryside. About 42 per cent of La Paz's population lives below the poverty line.

For more information on the key concept of scale, refer to section GT.1 of 'The geographer's toolkit'.



**Source 8.65** La Paz valley showing the houses of the poor built on the hillsides and the central business district below

## Creating multiple-line graphs

Multiple-line graphs are useful tools because they allow geographers to observe and compare changes in data over time. This enables geographers to more easily identify trends and changes in different sets of data gathered in different locations.

**Step 1** Construct a set of axes. The years are placed on the horizontal *x*-axis. The years must be evenly spaced out; for example, 1 centimetre for every five years. The data being graphed is placed on the vertical *y*-axis and should extend slightly higher than the highest figure being graphed. Once again, the scale must be even; for example, 1 centimetre for every 10.

**Step 2** Plot the first set of data with a series of small neat dots and join these with a smooth coloured line. Add a label at the end of the line describing the indicator you have graphed.

**Step 3** Repeat step 2 for the remaining sets of data. Use a different colour for each line.

**Step 4** Add a title and label each axis.

### Apply the skill

**1** Construct a multiple-line graph to show the changes in wellbeing in Bolivia between 1970 and 2010 using the selected key indicators listed in Source 8.66.

**Source 8.66** Changes in wellbeing in Bolivia between 1970 and 2015 using selected key indicators

Key indicator	1970	1975	1976	1980	1985	1990	1992	1995	2000	2005	2010	2015
Adult literacy (%)	—	—	63	—	—	—	79	—	86	—	91	92
Infant mortality rate (per 1000 people)	141	123	—	108	97	82	—	70	59	49	40	39
Life expectancy at birth	45	48	—	52	56	59	—	61	63	65	66	69
Urban population with clean water (%)	—	—	—	—	—	92	—	93	94	95	96	96
Rural population with clean water (%)	—	—	—	—	—	43	—	48	55	62	69	72
Urban population with sanitation (%)	—	—	—	—	—	28	—	30	31	33	35	58
Rural population with sanitation (%)	—	—	—	—	—	6	—	7	8	9	10	24

## REVIEW 8.2.14

### Remember and understand

- Use the data in Source 8.66 to comment on the level of wellbeing in Bolivia from 1970 to 2015.
- What are NGOs and what role do they play in Bolivia?
- Why do people move from the countryside to the cities of Bolivia? What impact does this migration have on cities?

### Apply and analyse

- Examine the multiple-line graph that you constructed in the skill drill.
  - What general trend do you observe in this graph?
  - Comment on the spatial variations in rural and urban wellbeing shown on your graph.
  - Comment on the usefulness of the multiple-line graph for showing the links between the two sets of data.

**5** Consider Source 8.60.

- Describe the pattern of poverty at the national scale.
- Suggest a reason to explain the pattern you have described.

### Investigate and create

- Use the photographs on these pages to describe the inequalities in wellbeing in Bolivia. Which photograph best shows these inequalities? Write a caption for the photo that you have chosen briefly describing the situation.
- Research one indicator, such as education, that contributes to Bolivia's level of wellbeing. Create an infographic that explains how it affects the wellbeing of the Bolivian people.

# 8.2

## CHECKPOINT

### HOW CAN THE SPATIAL VARIATIONS IN HUMAN WELLBEING AND DEVELOPMENT BE MEASURED AND EXPLAINED?

- Investigate causes, issues and consequences of spatial variations in human wellbeing.
- 1 Identify the five main causes of spatial variation in human wellbeing. [5 marks]
  - 2 Use one contemporary example to show how these causes are often linked in their impact on places and people. [5 marks]
  - 3 How does climate change influence human wellbeing in some places more than others? [5 marks]
  - 4 Sub-Saharan Africa performs poorly on most wellbeing indicators yet has considerable natural resources:
    - Democratic Republic of the Congo – Africa’s biggest copper producer
    - Sierra Leone – iron ore
    - Angola, Mozambique and Tanzania – oil and gas.What factors are limiting this region’s growth potential? [5 marks]
  - 5 Explain how gender inequality can restrict human wellbeing. [5 marks]
  - 6 In what ways can improvements in technology impact on wellbeing? [5 marks]
  - 7 Many researchers believe that the abuse of political power is the leading cause of poverty and inequality in the world today. Explain their reasoning. [10 marks]
  - 8 Are spatial variations in wellbeing and development inevitable in every country? What are the main consequences? [10 marks]

TOTAL MARKS [ /50]

### RICH TASK

#### The lasting consequences of conflict

Conflict at any scale and any intensity almost always has wide-ranging and long-term impacts on human wellbeing. Countries can take decades to recover from the impacts of war, preventing people from accessing opportunities to improve their wellbeing. Source 8.67 lists some of the common consequences of high-intensity conflicts.

#### Conflict and refugees

##### 1951 UN Refugee Convention

protects refugees from being returned to countries when they risk persecution.

##### Article 14 of the Universal Declaration of Human Rights

states that everyone has the right to seek and enjoy asylum from persecution in other countries.

Wars, conflicts and persecution have forced more people than at any time since records began to flee their homes and seek refuge and safety elsewhere (see Source 4.32

in Chapter 4). If they cross into another country they are referred to as **refugees**. If they remain within their home country but away from where they live, they are referred to as **internally displaced persons (IDP)**.

The number of refugees and IDPs around the world changes constantly depending on the number of places involved in conflicts. Worldwide displacement is at the highest level ever recorded with almost 60 million people being forced to leave home because they feared for their safety. The war in Syria has been the single largest driver of displacement with 7.6 million IDPs and 3.88 million refugees.

#### Acquiring geographical information

- 1 Compile a one-page fact file on the Syrian crisis.

#### Processing geographical information

- 2 Why are Syrians fleeing their homes? Identify, at least, three reasons.
- 3 What are the refugees’ greatest needs?
- 4 Where are the refugees living?



#### Impacts at the personal scale:

- reduced quality of life
- reduced ability to make choices about lifestyle
- loss of life
- impact on personal dignity and human rights
- impact on health and a reduced ability to access appropriate care
- loss of connection to other people in other regions
- individuals forced to fight
- targeted attacks on schools reduce the opportunity to have an education
- greater incidence of sexual violence.

#### Impacts at local and regional scales:

- decreased access to land, leading to food insecurity
- collapse of systems such as transport, food supply and local government
- fewer job opportunities
- breakdown in transport and communication networks
- displaced people put stress on infrastructure such as water and health systems in neighbouring places
- unsustainable use of natural resources to fund the conflict
- loss of productivity due to labour shortages.

#### Impacts at the national scale:

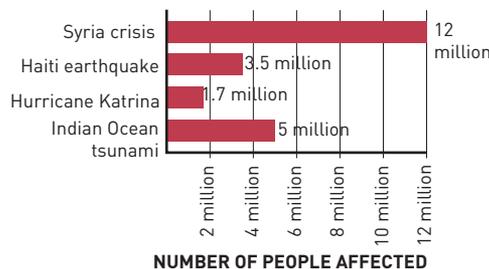
- environmental degradation, e.g. forest clearing and landmines
- food insecurity and dependency on aid
- refugees flee to other countries
- decline in national economy and less public spending as money is spent on conflict
- neighbouring nations often increase their military spending
- less spending on education (21 developing countries spend more on arms than on education)
- military spending results in less financial aid for developing countries.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Scale, Interconnection, Space, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Line drawing, Themed maps, Data tables

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

**Source 8.67** Impacts of conflict at the personal, local, regional and national scales



**Source 8.68** Syria's civil war is the worst humanitarian crisis of our time. Half the country's pre-war population – more than 12 million people – have been killed or forced to flee their homes. This is more people than affected by Hurricane Katrina, the Haiti earthquake and the Indian Ocean tsunami combined.

### Communicating geographical information

**5** Design a refugee camp, on an A3 page, that could accommodate 20 000 people (approximately 0.5 per cent of the current [2016] Syrian refugee population) Some things to consider:

- What buildings and services are required?
- How will people move through the camp?
- What will they do during the day?

Plan and sketch it out by thinking of the camp as a hierarchy of different interlocking spaces that the built

structures are part of. Some of these spaces will be absolutely private (e.g. family plot/shelter) and some of them absolutely public (e.g. schools, medical clinics) and many of them will contain a combination of the two.

(Note: The average lifespan of a refugee camp is close to seven years, with some camps for Palestinian refugees still on their original sites after more than 60 years.)

Some useful references include UNHCR, The Sphere Project, Mercy Corps and Amnesty International.

# CHECKPOINT

## CHAPTER

# 9



**Source 9.1** Globally, one in ten people lack access to safe water. Here, people gather to get water from a huge well in a village in the western Indian state of Gujarat.

## IMPROVING INEQUALITIES IN WELLBEING

Inequality is often the consequence of unequal progress between countries as well as within countries. Despite more than two decades of strong economic growth, the world's prosperity has not been evenly shared, with income and wealth becoming more concentrated in the hands of fewer people. The OECD has warned that growing inequality is divisive. It polarises societies, splits regions, and carves up nations between rich and poor. It reduces equality of opportunity, stifles upward mobility between generations, increases social tensions, harms the economy and reduces economic growth. It is something we cannot ignore.

All over the world, the wellbeing of millions of people is slowly improving. From local projects (such as the Australian Government's Close the Gap campaign) to global initiatives (such as the United Nations Sustainable Development Goals), the inequalities between rich and poor in many areas are being addressed.



# 9.1

## HUMAN WELLBEING IN AUSTRALIA

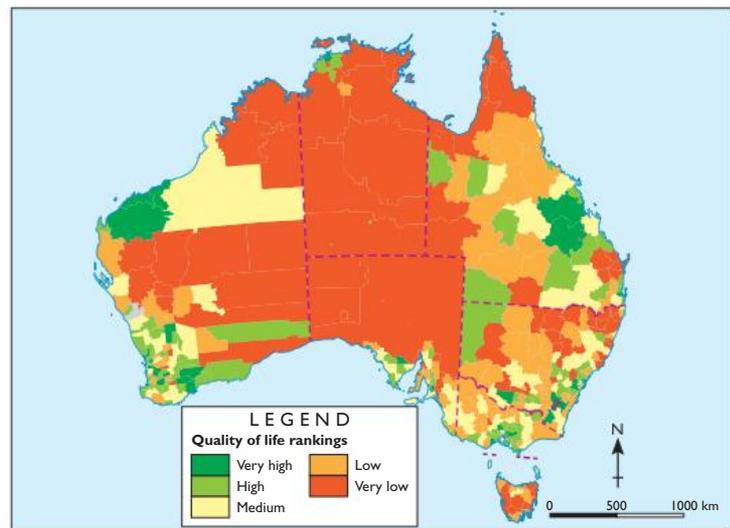
WHAT ARE THE ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACTS OF VARIATIONS IN DEVELOPMENT AND WELLBEING?

Australia is one of the world's wealthiest nations. In the 2015 United Nations Human Development Report, Australia was placed second in the world in the Human Development Index (HDI) rankings. As with all countries, however, there are variations in wellbeing within Australia.

Some places provide better access to reliable medical and educational facilities, a range of occupations and affordable housing. Other places have limited access to some or all of these services or facilities. These variations can be difficult to measure at a regional or local scale using common indicators such as life expectancy and literacy rates. These are generally only measured at the national scale. So, how do we know how all people are doing? Are their lives getting better? If not, then what can be done about it?

There are no datasets in Australia that are able to provide estimates of subjective wellbeing for small areas. However, there are other objective sources of information that can help geographers measure wellbeing at the regional and local scale. Australia's five-yearly census gives us a great deal of information about living in Australia, such as the areas with the highest and lowest quality of life (see Source 9.2).

AUSTRALIA: QUALITY OF LIFE RANKINGS BASED ON CENSUS DATA



Source 9.2

Source: Oxford University Press



### Quality of life studies

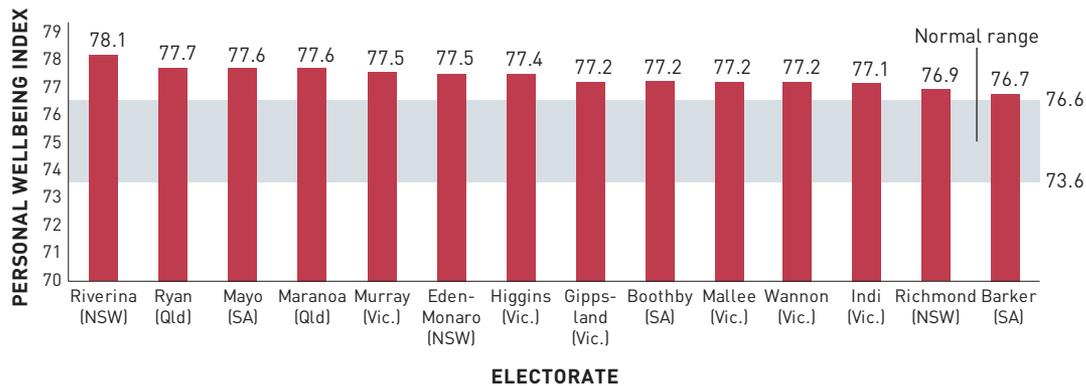
In 2008 Bankwest (a bank based in Perth, Western Australia) conducted its own quality-of-life study to rank 590 local government areas (LGAs) using indicators such as access to health, education and employment services, home ownership, house size, internet access, income and rates of crime. The study found the Sydney suburb of Ku-ring-gai to have the highest quality of life. Virtually all of the top 25 LGAs were suburbs in our capital cities, particularly Sydney, Melbourne and Perth. The Western Australian town of Hall's Creek was found to have the lowest quality of life. Of the bottom 25 LGAs, 23 were in remote and regional areas.

### Subjective studies

Other studies have created their own indexes measuring how Australians feel about their lives. Notable among them is the Australian Unity Wellbeing Index (2001–15) produced by Deakin University for Australian Unity Ltd and, since 2013, adopted by both the World

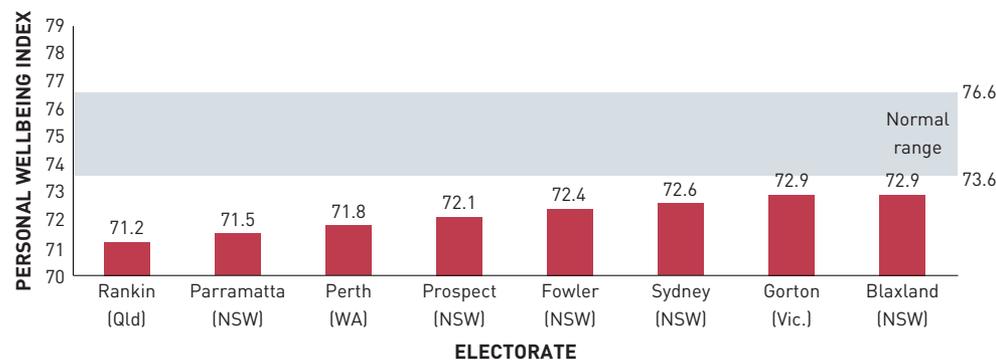
**Source 9.3** Part of the Sydney suburb of Ku-ring-gai, rated Australia's most liveable suburb by the Bankwest Quality of Life Index

Health Organization (WHO) and the Organisation for Economic Development and Cooperation (OECD) as their instrument to measure subjective wellbeing. This index incorporates feelings about personal health, relationships, safety, standard of living, achievements, community involvement and future security. Sources 9.5 and 9.6 display the Australian federal electorate areas that were reliably above and reliably below the normal range, shown by the grey band, of personal satisfaction with their lives using this index.



**Source 9.4** Hall's Creek, a remote Western Australian town, was rated as the least liveable place in Australia.

**Source 9.5** Highest Personal Wellbeing Index (PWI) electorates



**Source 9.6** Lowest Personal Wellbeing Index (PWI) electorates

## REVIEW 9.1.1

### Remember and understand

- 1 Why is it difficult to measure, rank and map variations in wellbeing within countries?
- 2 Use examples to distinguish between objective and subject indicators of human wellbeing.

### Apply and analyse

- 3 Consider Source 9.2.
  - a Which regions of Australia have the highest quality of life?
  - b Which regions of Australia have the lowest quality of life?
  - c In a carefully worded paragraph, describe the distribution of regions in Australia according to their quality of life rankings using the

PQE method. For more information on the PQE method, refer to section GT.2 of 'The geographer's toolkit'.

- 4 Locate Riverina and Parramatta on a map of Australia and then find them on Source 9.2. How consistent is the subjective indicator of personal wellbeing for the electorates of Riverina and Parramatta with the objective census quality-of-life ranking? Do they match? Why/why not?

### Investigate and create

- 5 Sydney rates as seventh in the top 10 liveable cities in the world yet Source 9.6 identifies the Sydney electorate as having one of the lowest Personal Wellbeing Index ratings in the country. How is this possible?

# INVESTIGATING WELLBEING AT THE LOCAL SCALE



**Source 9.7** There are significant variations in wellbeing in central Sydney.

Most studies of wellbeing focus on differences and variations between nations. But there are also variations at the local scale. A census aims to find out about people within a country by asking all members of a community on a particular evening to fill out the same questionnaire. The census is held in Australia every five years and the results are processed and published by the Australian Bureau of Statistics (ABS). Geographers often use this information to map data and trends across an area.

To discover more about your own community you can use census data to collect and map information about wellbeing in your local area. Based on your completed research and maps, you can then explore some possible reasons for the variations in wellbeing at the local scale so to better understand how human wellbeing is influenced by where people live in Australia.

## SKILL DRILL

### Collecting and mapping census data

Using the census data, you can collect data about your local area and map it by following these steps:

- Step 1** Access the ABS website at [www.abs.gov.au](http://www.abs.gov.au). Click on the 'Census' tab at the top of the home page. Then select the 'Data & Analysis' tab on the left, then 'Community Profiles'.
- Step 2** This page allows you to access the census data at a wide range of scales, including at the local level. A useful way of working at the local scale for this study is by using postcodes. To access the data for your suburb, enter your four-digit postcode in the 'Community Profiles Search' tool. If more than one option is displayed, choose POA. Click 'Go'.
- Step 3** This should open a map of your postcode and allow you to choose one of two spreadsheets. Select 'Basic Community Profile' and open or save this spreadsheet.
- Step 4** Use the tabs at the bottom of the spreadsheet to access the 'List of Tables'. This will give you a breakdown of the kind of information available. Select a category you would like to map.



**Source 9.8** A screenshot of the postcode map on the ABS census website



**Source 9.9** A screenshot from the Australian Postcode Finder website

**Step 5** Click on the category you have decided and record the data for your suburb. Access the same data for your neighbouring postcodes by typing the area or postcode in the field above the map. You can find out what your neighbouring postcodes are by using the interactive map at the Australian Postcode Finder website ([www.aus-emaps.com/postcode\\_finder.php](http://www.aus-emaps.com/postcode_finder.php)). Simply enter your four-digit postcode into the search tool at the top of the page and it will zoom into this area. Click on the neighbouring postal areas to find their postcodes and then use the ABS website to access and record data for these postcodes.

**Step 6** Once you have collected the data you can map it by constructing a choropleth map. Print out a map of your area. You can use one you have or print the one from the ABS site. Trace a copy showing only the postcode boundaries.

**Step 7** Use the data collected from the census to construct a choropleth legend for your map.

Divide your data into four or five categories. Use darker shades of a colour for higher values and lighter shades for lower values. For example, your suburb might have fewer people per household (if that was what you chose to map) than the neighbouring suburb. So, you would colour your suburb a lighter shade and your neighbouring suburb a darker shade.

**Step 8** Shade your map according to the legend you created in Step 7.

**Step 9** Complete your map with BOLTSS.

### Apply the skill

Complete a choropleth map of variations in median household income in your local area (include at least six suburbs) by collecting information from the ABS website. You can find this data under table B02, *Median Household Income*. Follow the steps to gather your data and map the information.

## REVIEW 9.1.2

### Apply and analyse

- 1 Describe the pattern shown on your completed map from the skill drill.
- 2 Explore and evaluate possible reasons for the variations shown on your map. These will vary from place to place but here are some possibilities:
  - distance from the centre of a large city
  - presence of employment opportunities such as factories and shopping centres
  - presence of higher educational opportunities such as universities
  - presence of transport networks such as railway stations and major roads
  - presence of large shared accommodation areas such as aged-care facilities or school hostels
  - presence of geographic features such as a coastline or large park.

### Investigate and create

- 3 Collect information from the ABS website and examine variations in another indicator of wellbeing. Do this for the same suburbs you investigated earlier. You could choose the number of motor vehicles per dwelling, highest year of schooling completed or percentage of people unemployed, for example.
- 4 Use the census data to explore levels of wellbeing in communities that are not located close to each other. Follow Step 1 in the skill drill to access the census data and then enter the names of communities in the 'Communities Profiles Search' tool. There may be a few options given as the ABS collects data at a range of scales. The Local Government Area (LGA) is a useful scale when comparing suburbs or country towns but you can compare wellbeing at many scales.
  - a Use the Quick Stats to compare wellbeing in Halls Creek, Ku-ring-gai and the LGA in which you live.
  - b What have you learned about variations in wellbeing within Australia?
  - c What are the advantages and disadvantages in using census data to describe and compare wellbeing?

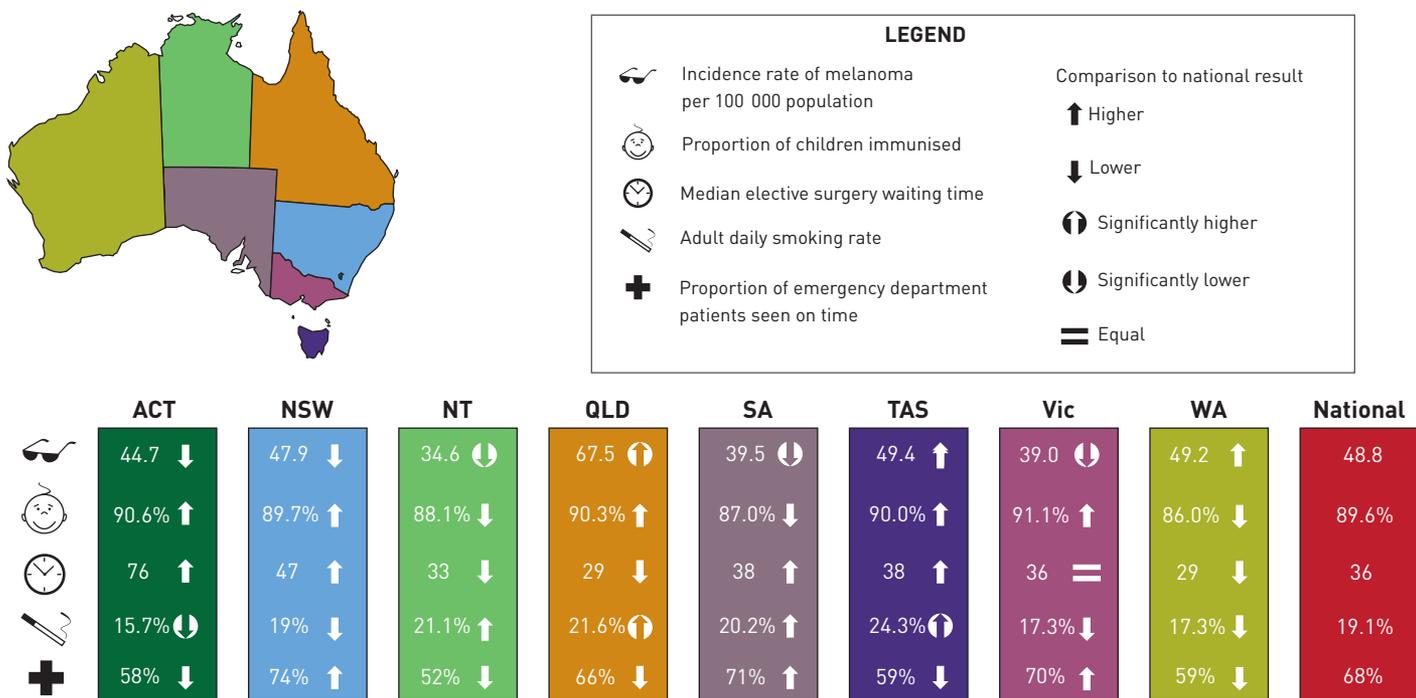


# WELLBEING IN AUSTRALIA

Australians can expect to go to school for longer and to live longer, healthier lives than virtually any other nationality. However, there are significant variations in wellbeing, for example, between rural and urban Australia and between Indigenous and non-Indigenous Australians.

## Inequalities in health

Studies show that there are significant differences in the health of different groups of Australians. People from poorer households are less likely to be physically active, to visit a dentist or medical specialist, or to have a medical test such as a skin cancer check or mammogram to detect breast cancer. They are more likely to smoke and to be obese or overweight. As well as inequalities due to income, studies have also found health inequalities relating to location, ethnicity and age.



Source 9.10 Health inequalities exist between states in Australia.

## Inequalities in education

There are similar trends in education to those exhibited in health areas. Children from poorer households are less likely to attend early childhood education and less likely to go to university than children from wealthier households. They also have less access to information technology, particularly in rural and remote regions.

## The rural–urban divide

In many areas of wellbeing in Australia there is a rural–urban divide. People in rural areas have fewer education and employment opportunities and less access to health services and medical care. They are more likely to suffer from chronic health conditions such as diabetes and heart disease and die earlier than those living in towns and cities. They are also at a higher risk of injury from work and car accidents. This pattern is repeated in other developed countries around the world.

# Reducing inequality

Governments have tried to reduce these inequalities in wellbeing in Australia in two main ways:

- targeted programs that focus on a particular problem or issue; for example, campaigns to reduce smoking or to encourage people to have health checks
- general programs to maintain and lift the wellbeing of the entire community; the National Disability Insurance Scheme and Medicare, which ensure people can access care regardless of their financial situation, are examples of these.

There are many people working in a range of fields to improve wellbeing in Australia. One of these groups is the non-profit organisation the Royal Flying Doctor Service (RFDS), one of the largest aeromedical organisations in the world. The mission of the RFDS is 'to provide excellence in aeromedical and primary health care across Australia'. The RFDS delivers primary health care and 24-hour emergency services to people living, working or travelling in rural and remote Australia, where there are often few health services available. The primary health care is provided by regular fly-in fly-out GP, nursing and allied health clinics. In New South Wales alone, the clinic program takes around 5000 clinics to more than 20 remote communities each year – including doctors, nurses, dentists, mental health team-members and specialists.



Source 9.11 The Royal Flying Doctor Service.

## CASE STUDY

### Royal Flying Doctor Service

#### STRANGE BUT TRUE

In 2015 the RFDS fleet of 66 aircraft flew 26 847 325 kilometres. That's equivalent to 34 trips to the Moon and back, or more than 600 flights around the Earth.

## REVIEW 9.1.3

### Remember and understand

- 1 In what ways do people in rural areas have lower levels of wellbeing than people in urban areas?
- 2 Identify three health concerns that are more serious for Australians living in rural areas than for those living in urban areas.
- 3 What is the Royal Flying Doctor Service (RFDS) doing to help reduce these inequalities?

### Apply and analyse

- 4 Consider Source 9.10.
  - a List the seven statistics that are significantly lower or higher than the national average.

- b Describe the results of this survey for New South Wales. What two priority areas should be targeted?
- 5 What barriers do you think exist that make it difficult to improve wellbeing in rural and regional areas of Australia? What could be done to improve wellbeing in those areas?

### Investigate and create

- 6 Rank the states and territories of Australia from those that performed best in the health survey in Source 9.10 to those that performed worst.
- 7 One of the difficulties for governments in reducing inequalities in wellbeing is being able to evaluate the effectiveness of individual programs. How could the effectiveness of the RFDS be evaluated?

# WELLBEING FOR THE AGED



**Source 9.12** An ageing population means more people will require care and support. Much of it will be provided informally by family but, increasingly, it will take the shape of formal aged care.

Today's older Australians live longer lives than previous generations. Girls born today can expect to live to 84 and boys to 80 years. For the individual older Australian an increased lifespan is a positive outcome. However, there are negatives. Older Australians will need more savings, superannuation and/or access to welfare assistance to be able to support themselves financially. Conditions such as arthritis, dementia and hearing loss become more common as people get older.

In Australia, the proportion of total population aged 65 years and older is projected to increase quickly over the next decade as the baby boomers reach retirement age. Australia's ageing population has many implications for our national wellbeing including:

- the need to provide increased specialist health services for the aged
- a decrease in the size of the working-age population as more people retire
- the need to provide appropriate housing for an ageing population
- increased demand for skilled labour as more and more people retire
- potential strains on the capacity of the economy to provide the aged pension 'safety net' and other benefits for those who have not had the opportunity to save and/or participate in the superannuation system (the compulsory superannuation guarantee was only introduced in Australia in 1992).

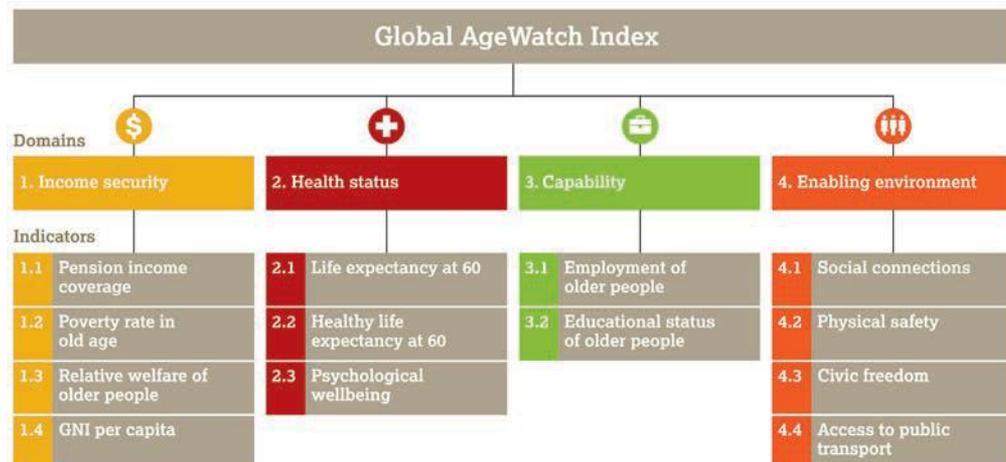
## Measuring wellbeing of our older generations

People accumulate life experiences that variously affect their wellbeing, health and quality of life. For example, the current population of older Australians are the last group to have had their lives shaped by the hardships of the Great Depression of the 1930s and World War II. In contrast, the youngest members of this population are the baby boomers, the first generation to experience a 'third age' with its unprecedented expectation of a decade or two of relatively healthy life after retirement. Their needs, relationships, financial control and sense of purpose vary and so too does their wellbeing and satisfaction with life.

## Global AgeWatch Index

The Global AgeWatch Index measures four key domains of wellbeing for older people (see Source 9.13) and ranks countries according to their social and economic wellbeing. In the 2015 index, Switzerland, with 24% of their population over 60, ranked first with its range of policies and programs on active ageing, and Afghanistan, with 4% of their population over

**Source 9.13** Australia ranked highest in the health domain (5), with values above the regional average on all health indicators; high in the capability domain (8) due to high levels of educational attainment (85.4%) and a high employment rate (60.5%) among older people; high in the enabling environment domain (26), with above the regional average social connectedness (92%) and civic freedom (94%); lowest in its region in the income security domain (62), due to a high old age poverty rate (33.4%) and a pension income coverage (83%) below the regional average.

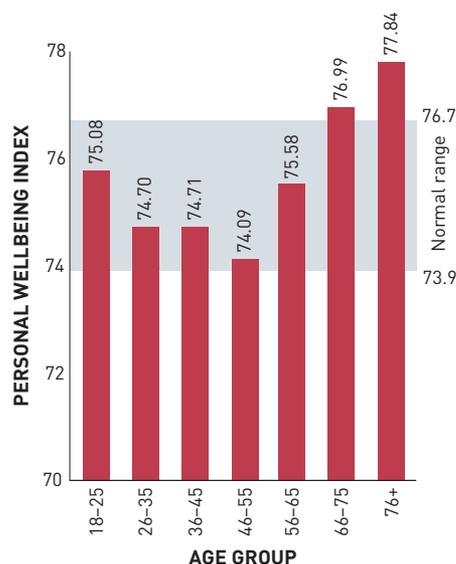


60, remained at the bottom, ranked 96th, with few local or national policies to promote wellbeing of older people. Australia was 17th, behind both New Zealand and Canada and down four places from last year.

## Australian Unity Wellbeing Index

Most Australians are satisfied with their lives (see Source 9.14). The surprise is that personal wellbeing consistently trends upwards with our older Australians through to retirement and into old age. Those aged 76 and over reported the highest average wellbeing score of any group.

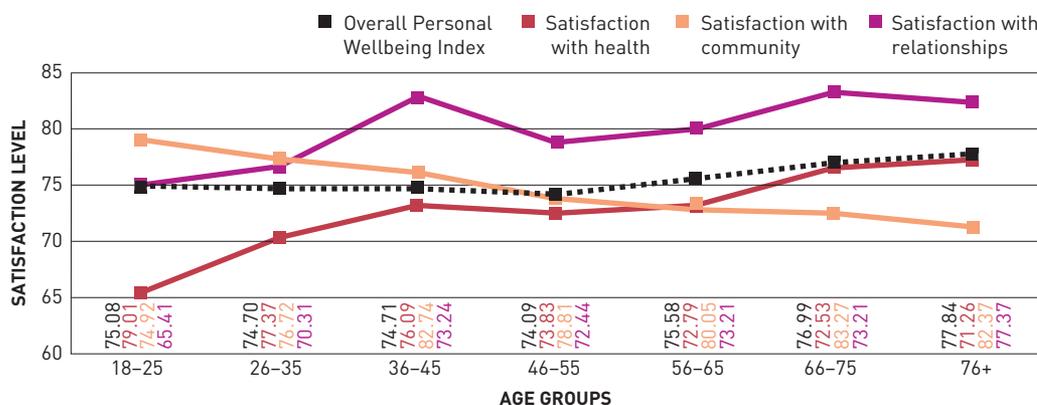
The Australian Unity wellbeing surveys have been going for 15 years. Looking at their results and the factors that drive wellbeing for older Australians, it is clear that overall personal wellbeing means more than simply good health (see Source 9.15).



**Source 9.15** Australian Unity Wellbeing Index 2015 comparison across age groups in Australia. Satisfaction with health does drop as people grow older but that is offset by a positive correlation between getting older and higher satisfaction with standard of living, relationships and community.

## STRANGE BUT TRUE

Over the past two decades, the number of centenarians (people aged 100 years and over) increased by 271 per cent, compared with a 31 per cent increase in the general population over the same period. Australia has produced 23 verified super centenarians (aged 110 years or older). The oldest was Christina Cock, who died in 2002 aged 114 years.



**Source 9.14** Wellbeing by age. 'We are reasonably happy when we are young and our lives stretch out before us but happiest when we are in our sunset years.' (Australian Unity wellbeing report, 2015)

### REVIEW 9.1.4

#### Remember and understand

- 1 Explain why life expectancy has increased in Australia.
- 2 Why should Australia be concerned about an ageing population?

#### Apply and analyse

- 3 What are the greatest barriers to improving the wellbeing of older Australians? What could be done to improve wellbeing in those areas?
- 4 Identify the main difference between the Global AgeWatch Index and the Australian Unity Wellbeing Index. Are both indexes equally useful for understanding older Australians?

- 5 What are the reasons for and consequences of differences in human wellbeing?

#### Investigate and create

- 6 Australia is not the only country with a declining and ageing population. What are the similarities and differences between Australia and Japan in terms of:
  - a fertility
  - b population over 60 years of age
  - c the reasons for the population change
  - d Global AgeWatch Index ranking.

# 9.1

## CHECKPOINT

### WHAT ARE THE ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACTS OF VARIATIONS IN DEVELOPMENT AND HUMAN WELLBEING?

- Investigate the reasons for and consequences of spatial variations in human wellbeing in Australia.

- 1 Why would you classify Australia as a wealthy country? [5 marks]
- 2 Describe how the wellbeing of Australians is linked to where they live. [5 marks]
- 3 Explain what is meant by the term 'rural–urban divide'. [5 marks]
- 4 Describe the effects of remoteness on wellbeing. [5 marks]
- 5 ABS statistics show that 80 per cent of older Australians rely on receiving the aged pension yet 30 per cent of people aged 60 and over are reportedly living below the poverty line. How is this possible? [10 marks]
- 6 Identify one economic, one social and one environmental impact of spatial variation in wellbeing in your local area. [10 marks]

TOTAL MARKS [ /40]

### RICH TASK

#### Closing the gap for Indigenous Australian communities

By most measures there are significant differences in wellbeing between Indigenous and non-Indigenous communities around Australia. Indigenous children are twice as likely to be born underweight and twice as likely to die before their fifth birthday than non-Indigenous children. They are also less likely to attend pre-school and much less likely to reach minimum standards in literacy and numeracy while at school. Although almost nine out of every 10 non-Indigenous young adults complete Year 12, it is closer to five out of 10 for Indigenous young adults. The pattern is similar with employment. Only 46 per cent of Indigenous adults are in employment, compared with 72 per cent of their non-Indigenous counterparts. Perhaps the most alarming statistic is that an Indigenous boy born this year can expect to live 11.5 years less than a non-Indigenous boy. For girls, the figure is 9.7 years.

In 2008, the Australian Prime Minister, Kevin Rudd, apologised to Aborigines and Torres Strait Islanders affected by the official government policies that separated Indigenous children from their families, a group known as the Stolen Generation. As part of this apology, Prime Minister Rudd also gave a promise 'to close the gap between Indigenous and non-Indigenous Australians on life expectancy, educational achievement and employment opportunities'.

The government's targets were to:

- close the gap in life-expectancy by 2031
- halve the gap in mortality rates for Indigenous children under five by 2018
- ensure access to early childhood education for all Indigenous four year olds in remote communities by 2013
- halve the gap in reading, writing and numeracy achievements for Indigenous children by 2018
- halve the gap in Indigenous Year 12 achievement by 2020
- halve the gap in employment outcomes between Indigenous and non-Indigenous Australians by 2018.

By 2013, the early childhood education target had been met and progress had been made in the other areas. However, progress is generally slower than is needed to meet all targets by their set dates. The gap is closing, but slowly.

## HOW BIG IS THE GAP NOW?

### Acquiring geographical information

This task involves you conducting research to access the latest statistics and information available in order to quantify and qualify how big the gap is between the wellbeing of a vulnerable group of people in our Australian society compared with the average Australian's wellbeing. Choose from one of the following:

- Indigenous Australians
- the unemployed
- a cultural group
- the homeless
- young people
- people with disabilities.

### Processing geographical information

- 1 Start by describing the characteristics of your chosen group to build a profile that you can compare with the average Australian. Include population size (percentage of total Australian population) and geographic location (where do they live, are they found in particular places more often than others and why?).
- 2 Build a table with three columns – Social, Economic and Environmental – to describe the nature of their disadvantage. Use as many facts as you can. Make sure you reference the source of your information.

### Communicating geographical information

- 3 List the consequences of your chosen group's disadvantage.
- 4 Recommend actions to address their gap in wellbeing.
- 5 Consider the following question, and then write a one-page answer in response: 'If disadvantage was the norm among your family, and had been for generations, what is the likelihood that you could imagine a better future for yourself?'



**Source 9.16** Ntaria school in Hermannsburg, outside Alice Springs in the Northern Territory. Increased government funding has allowed remote schools to offer longer pre-school programs. This has resulted in improved literacy and numeracy as well as improved health as the children are also given healthy lunches.



**Source 9.17** On any given night in Australia one in 200 people are homeless.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Space, Interconnection, Change
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Data tables, Statistics to find patterns and trends, Maps to identify location and resources

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

# 9.2

## IMPROVING WELLBEING AND DEVELOPMENT

HOW DO GOVERNMENTS, GROUPS AND INDIVIDUALS RESPOND TO INEQUALITIES IN DEVELOPMENT AND HUMAN WELLBEING FOR A SUSTAINABLE FUTURE?

On 1 January 2016, the 17 Sustainable Development Goals (SDGs) of the 2030 Agenda for Sustainable Development – adopted by world leaders in September 2015 at an historic UN Summit – officially came into force. Over the next 15 years, countries will target efforts to end all forms of poverty, fight inequalities and tackle climate change, while ensuring that no one is left behind. The SDGs build on the success of the Millennium Development Goals (MDGs) and aim to go further to end all forms of poverty.

The new goals are unique in that they call for action by all countries – poor, rich and middle-income – to promote prosperity while still protecting the planet. They recognise that ending poverty must go hand-in-hand with strategies for economic growth and address a range of social needs including education, health, social protection and job opportunities, while tackling climate change and environmental protection. While the SDGs are not legally binding, governments are expected to establish national programs for the achievement of the 17 goals.

### The Millennium Development Goals

At a meeting of the United Nations in 2000, representatives of all the 193 countries present agreed to a set of goals designed to end poverty and improve wellbeing across the globe by 2015. Eight goals, known as the Millennium Development Goals (MDGs), were created and agreed to by all of the world's countries and leading development institutions. The MDGs showed the world that goals mattered. They helped all countries to focus on specific issues, such as extreme poverty, HIV/AIDS and school retention rates.

By the end of 2015, progress had been made but not all goals had been reached (see Source 9.18). For example, progress was made in reducing the number of Africans living on less than \$1.25 a day but more than one-third of the world's extreme poor still live in Sub-Saharan Africa. However, the goals did motivate significant action and global cooperation, paving the way for the 2030 Agenda for Sustainable Development. Many countries, including Australia, used these goals as a framework for allocating funds to their overseas aid programs.

### The Sustainable Development Goals

The 17 Sustainable Development Goals (SDGs) have 169 targets. They are both broader in scope and go further than the MDGs, aiming to address the root causes of poverty and the need for development that works for all countries. The goals cover the three dimensions of sustainable development: economic growth, social inclusion and environmental protection.

Building on the success and momentum of the MDGs, the new global goals aim to address inequalities, economic growth, decent jobs, cities and human settlements, industrialisation, oceans, ecosystems, energy, climate change, sustainable consumption and production, peace and justice.



Goals and Targets	Africa		Asia				Oceania	Latin America and the Caribbean	Caucasus and Central Asia
	Northern	Sub-Saharan	Eastern	South-Eastern	Southern	Western			

### GOAL 1 | Eradicate extreme poverty and hunger

Reduce extreme poverty by half	low poverty	very high poverty	low poverty	moderate poverty	high poverty	low poverty	—	low poverty	low poverty
Productive and decent employment	large deficit	very large deficit	moderate deficit	large deficit	large deficit	large deficit	very large deficit	moderate deficit	small deficit
Reduce hunger by half	low hunger	high hunger	moderate hunger	moderate hunger	high hunger	moderate hunger	moderate hunger	moderate hunger	moderate hunger

### GOAL 2 | Achieve universal primary education

Universal primary schooling	high enrolment	moderate enrolment	high enrolment						
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### GOAL 3 | Promote gender equality and empower women

Equal girls' enrolment in primary school	close to parity	close to parity	parity	parity	parity	close to parity	close to parity	parity	parity
Women's share of paid employment	low share	medium share	high share	medium share	low share	low share	medium share	high share	high share
Women's equal representation in national parliaments	moderate representation	moderate representation	moderate representation	low representation	low representation	low representation	very low representation	moderate representation	low representation

### GOAL 4 | Reduce child mortality

Reduce mortality of under-five-year-olds by two thirds	low mortality	high mortality	low mortality	low mortality	moderate mortality	low mortality	moderate mortality	low mortality	low mortality
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### GOAL 5 | Improve maternal health

Reduce maternal mortality by three quarters	low mortality	high mortality	low mortality	moderate mortality	moderate mortality	low mortality	moderate mortality	low mortality	low mortality
Access to reproductive health	moderate access	low access	high access	moderate access	moderate access	moderate access	low access	high access	moderate access

### GOAL 6 | Combat HIV/AIDS, malaria and other diseases

Halt and begin to reverse the spread of HIV/AIDS	low incidence	high incidence	low incidence	low incidence	low incidence	low incidence	low incidence	low incidence	low incidence
Halt and reverse the spread of tuberculosis	low mortality	high mortality	low mortality	moderate mortality	moderate mortality	low mortality	moderate mortality	low mortality	moderate mortality

### GOAL 7 | Ensure environmental sustainability

Halve proportion of population without improved drinking water	high coverage	low coverage	high coverage	high coverage	high coverage	high coverage	low coverage	high coverage	moderate coverage
Halve proportion of population without sanitation	moderate coverage	very low coverage	moderate coverage	low coverage	very low coverage	high coverage	very low coverage	moderate coverage	high coverage
Improve the lives of slum-dwellers	low proportion of slum-dwellers	very high proportion of slum-dwellers	moderate proportion of slum-dwellers	—					

### GOAL 8 | Develop a global partnership for development

Internet users	moderate usage	low usage	high usage	moderate usage	low usage	high usage	low usage	high usage	high usage
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The progress chart operates on two levels. The text in each box indicates the present level of development. The colours show progress made towards the target according to the legend below:

Target met or excellent progress.	Poor progress or deterioration.
Good progress.	Missing or insufficient data.
Fair progress.	

Source 9.18 This chart presents the final assessment of progress towards selected key targets relating to each Millennium Development Goal.

Source: United Nations

## REVIEW 9.2.1

### Remember and understand

- Describe the aim behind the creation of the MDGs.
- What do countries like Australia use these goals for?

### Apply and analyse

- Examine Source 9.18.
  - Which targets were the closest to being achieved?
  - Which targets were the furthest?

c Why do you think this is?

d How do Oceania and Sub-Saharan Africa compare in achieving their MDGs?

### Investigate and create

- Research the SDGs to find out more about them. Using a series of boxes and arrows, explain how five or more of the SDGs are linked to each other.

# IMPROVING WELLBEING FOR WOMEN AND GIRLS



The SDGs continue the strong emphasis on improving the wellbeing of women and girls started with the MDGs. Despite making some progress towards gender equality and women's empowerment under the MDGs (including equal access to primary education for girls and boys), women and girls continue to suffer discrimination and violence in every part of the world. Women and children are also particularly at risk from the effects of poverty as their status in many societies is lower than that of men.

**Source 9.19** Providing women and girls with equal access to education, health care, decent work and representation in political and economic decision-making processes will fuel sustainable economies and benefit societies and humanity at large.

**Source 9.20** The benefits of family planning

## Some of the key benefits of effective family planning

- Smaller families mean better health and education for each child.
- Higher rates of condom use reduce the likelihood of individuals contracting HIV/AIDS.
- Average income increases as smaller families share their income between fewer people.
- Women with fewer children have greater education and employment outcomes.
- Smaller families have higher rates of infant survival and healthier, better nourished children.
- Fewer pregnancies mean fewer deaths due to pregnancy and birth complications and fewer unsafe abortions.
- The cost of social services is reduced, particularly the cost of health care and infrastructure such as water provision and schools.

## Family planning

Two goals of the MDGs focused on women and children were to improve maternal health and reduce **child mortality**. One way to do this is to reduce the number of times a woman goes through childbirth. This is referred to as family planning. Fewer children means more resources for those children who are born, leading to improved health (see Source 9.20). In countries where the central government develops a program of family planning – often with external aid and help from non-government organisations (NGOs) – a falling birth rate has tended to follow.

While talking about reproduction has long been a taboo subject in some societies, these barriers are gradually being broken down. At thousands of clinics across the developing world, mothers are educated about proper infant nutrition, babies are weighed and immunised, women are counselled about having their first babies later and then spacing subsequent births further apart, and contraceptive options are provided. Educating women about using condoms has been particularly important, as their use can also stop the spread of diseases such as HIV/AIDS.



## Violence against women

The United Nations defines violence against women as 'any act of gender-based violence that results in, or is likely to result in, physical, sexual or mental harm or suffering to women, including threats of such acts, coercion or arbitrary deprivation of liberty, whether occurring in public or in private life'. For women in

**Source 9.21** A family planning clinic in a busy Kenyan marketplace

many parts of the world, violence is a leading cause of injury and disability, as well as a risk factor for other physical, mental, sexual and reproductive health problems. Violence has long-term consequences for these women and their children, as well as social and economic costs for all society.

Many international agreements, including the United Nations Universal Declaration of Human Rights and the Declaration on the Elimination of Violence against Women, have recognised women's fundamental human right to live free from violence. The challenge is to get countries to implement laws for women's protection and to provide them with access to safety and justice.

Forced marriage, child brides, genital mutilation and slave labour are some examples of the continued mistreatment of women and girls in the world today.

## Child brides

Child marriage is a human rights violation and a product of gender inequality. Worldwide, more than 700 million women alive today were married as children. More than one in three of these child brides were married before they turned 15. This often destines the young bride to a life of isolation and limited opportunity for either education or employment. Addressing child marriage requires recognition of the various factors that contribute to the continuation of the practice:

- economic factors (e.g. the need to support many children, paying a lower dowry)
- structural factors (e.g. lack of educational opportunities)
- social factors (e.g. sense of tradition and social obligation, risk of pregnancy out of wedlock, avoiding criticism whereby older unmarried girls may be considered impure).

Child marriage is entrenched in many cultures but governments and communities are working to change attitudes and reduce the occurrence of child brides. In fact, often the parents of the girls themselves would prefer to delay the marriage but lack the options to do so. Actions taken by governments and communities include:

- awareness-raising campaigns focused on the negative consequences of child marriage
- programs for girls to provide them with alternatives to marriage
- stricter enforcement of laws against child marriage.



**Source 9.22** Nujood Ali was married off by her father at age 9 for a dowry of a little more than \$750.

### REVIEW 9.2.2

#### Remember and understand

- 1 Explain what is meant by violence against women.
- 2 In what ways does family planning help to improve human wellbeing?

#### Apply and analyse

- 3 Use the key concept of scale to think about the benefits of family planning shown in Source 9.20. Categorise these benefits in order from the personal scale to the global scale.
- 4 Write a paragraph explaining how an effective family-planning program can help to reduce infant deaths in a country.

#### Investigate and create

- 5 Consider Source 9.21. It shows a family planning clinic in Kenya set up by Marie Stopes International. Use the internet to research this organisation.

What do they do? In which regions and nations are they most active? What are some of their success stories?

- 6 Use a search engine to find National Geographic online. Then go to the photogallery 'Too young to wed'. Choose one of the photographs in this series and use it to complete the following activities.
  - a Write an account from the father of the bride's perspective of the reasons this wedding took place.
  - b Create a list, from the child bride's perspective, of all of her losses both present and future that may result from this wedding.

# IMPROVING ACCESS TO EDUCATION



Education has been included as a standalone goal in the 2030 Agenda for Sustainable Development, following the positive work begun with the MDGs 2000–15 and the United Nations Global Education Initiative launched in 2012. Sustainable Development Goal 4 is to ensure inclusive and quality education for all and promote lifelong learning. Obtaining a quality education is seen as the foundation to improving the living conditions and future wellbeing of millions of children.

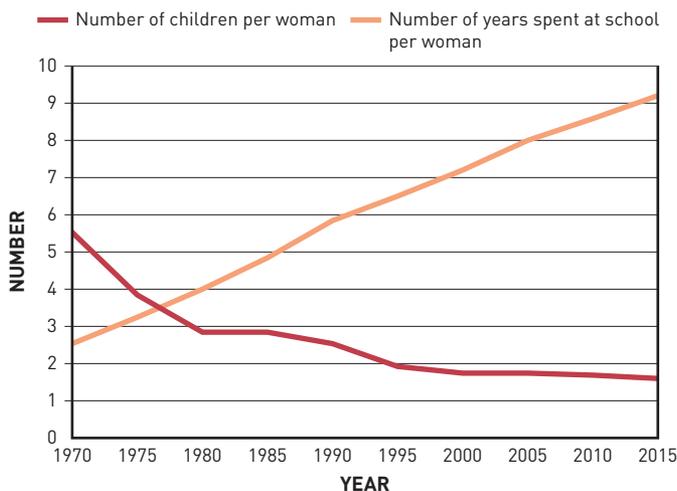
## The benefits of education

Many social researchers believe that the key to improving human wellbeing around the world, particularly in poorer communities, is to improve participation rates in education. Their studies show that education allows individuals to break the cycle of poverty and live healthier, longer lives.

The benefits to society are multiplied when girls are able to access an education at the same rate and level as boys. Studies show that mothers who have attended school have a lowered risk of their babies falling victim to infant mortality, have fewer children and earn more than mothers who are less educated. Children born to these women are 50 per cent more likely to live past the age of five and have much lower rates of HIV infection than children born to less educated mothers.

Over the past 40 years the Chinese Government has made a real effort to get more children into education for longer periods. This push has included increasing the education levels of girls. Educating girls has had many benefits for Chinese society. Educated women generally want smaller families and make better use of reproductive health and family planning services to achieve their desired family size (see Source 9.24). Educated women contribute more to the economy and help increase economic growth. With China's booming economy, China now has 68 per cent of women in paid employment. This is a higher rate than Australia (which has 59 per cent).

**Source 9.23** Major progress has been made towards increasing access to education at all levels and increasing enrolment rates in schools, particularly for women and girls. Basic literacy skills have improved tremendously but greater efforts are needed to get closer to universal education targets. For example, the world has achieved equality in primary education between girls and boys but few countries have achieved that target at all levels of education.



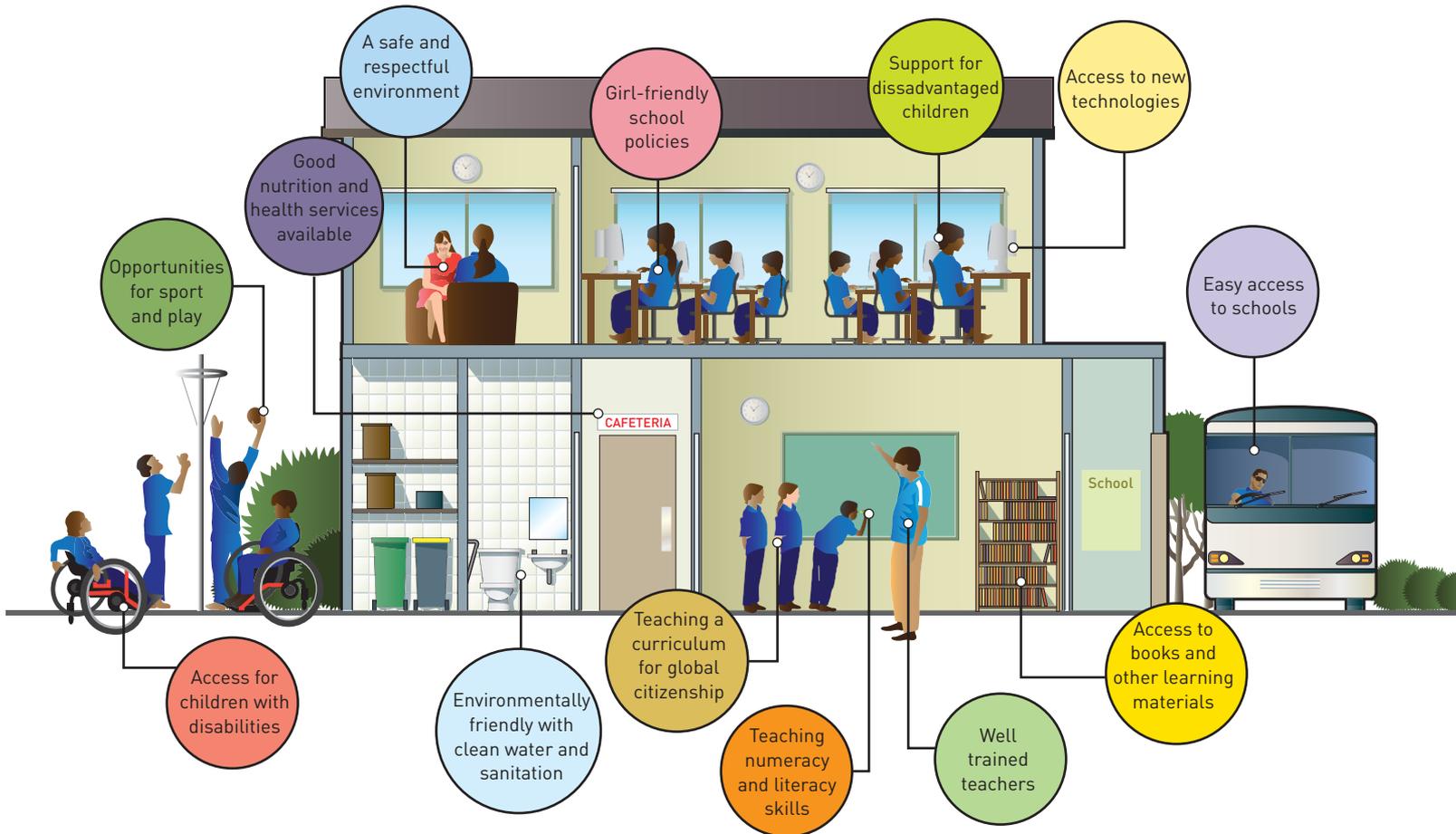
**Source 9.24** Education levels and fertility rates for women in China aged between 15 and 44



**Source 9.25** A Chinese Government poster from the 1970s encourages girls to 'Learn science and build the country'.

## Successful schools

As well as getting all children into schools, the United Nations Global Education First Initiative is also interested in improving the standard of schooling that children receive and creating a positive school environment. Too many schools in the developing world currently have poorly trained teachers and not enough books or other resources to teach with. Too many children are also going to school hungry, which is affecting their ability to learn. Source 9.26 shows the standards and features that the United Nations would like all schools worldwide to achieve.



**Source 9.26** The main features of successful schools according to the United Nations Global Education First Initiative

### REVIEW 9.2.3

#### Remember and understand

- 1 What are some of the links between education and wellbeing?
- 2 Explain why educating girls can improve wellbeing for everyone in a community.

#### Apply and analyse

- 3 'Education provides much more than the opportunity to read, write and count.' Explain this statement using examples from Source 9.26.
- 4 Examine Source 9.24.
  - a Describe the change in the education of women between 1970 and 2015.
  - b How is this linked to the poster in Source 9.25?

- c How has the fertility rate changed over this time?
- d How is this linked to the one-child policy?

#### Investigate and create

- 5 Using Source 9.26 as a guide, design an advertisement that promotes one of the advantages of gaining an education.
- 6 Malala Yousafzai is the youngest person to have received the Nobel Peace Prize for her work as an advocate for education for girls. She told the UN that 'One child, one teacher, one pen and one book can change the world'. What do you think she meant by this? Do you agree? Research Malala's work and write a 500-word expression of your thoughts.

# IMPROVING THE WELLBEING OF INDIGENOUS AUSTRALIANS

As you have learned, studies show that the wellbeing of Aboriginal and Torres Strait Islander Peoples is well below that of other Australians. A United Nations official described the standard of health in Indigenous communities in Australia in some respects as being worse than in developing countries. A range of government and non-government groups are working to close the gap between Indigenous and non-Indigenous Australians in a range of important areas.

## Improvements in health

Chronic diseases such as heart attacks and diabetes are responsible for about 70 per cent of the health gap between Indigenous and non-Indigenous Australians. The federal government, in partnership with local health services, is working to:

- encourage Indigenous people to have regular health checks
- train health workers in the techniques of managing chronic diseases such as diabetes and arthritis; this includes giving advice on such things as the health benefits of increased physical activity and stopping smoking (see Source 9.27)
- make medicines and treatments more affordable to Indigenous patients
- increase the number of Indigenous Australians working in the health sector
- build more hospitals and health centres in Indigenous communities
- improve the quality and range of foods available in the shops in Indigenous communities
- provide mobile health facilities that visit remote communities and target dental, eye and ear problems
- change the type of fuel sold in many remote petrol stations to make it unsuitable for sniffing to reduce the rates of this type of substance abuse

Advertisement

**Quit for you.  
Quit for two.**

When a baby's on the way, it's twice as important to get the support you need to quit smoking. Phone Quitline and ask about Quit for you Quit for two.

They can help you beat the cravings, with tips like these:

- **Delay:** Delay for a few minutes – the urge will pass
- **Deep breathe:** Breathe slowly and deeply
- **Do something else:** Ring a friend or practise your prenatal exercises
- **Drink water:** Take 'time out' and sip slowly

When you choose to quit, you lower the risk of:

- miscarriage
- premature labour
- ectopic pregnancy
- AIDS

And you'll save money.

Download the free app  
Go to the App Store or  
Android Market now to download  
Quit for you Quit for two for free.

**Quitline**  
137848  
australia.gov.au/quitnow

Australian Government

**Source 9.27** Rates of smoking for Indigenous Australians are twice that of non-Indigenous Australians. Anti-smoking campaigns aim to reduce these rates. Similar campaigns aim to reduce alcohol use during pregnancy.

- improve the mental health of Indigenous people; one initiative is called Link Up, which helps Indigenous people trace and contact those family members who were forced to move as part of the Stolen Generation
- increase participation of Indigenous children in sport and recreation
- strengthen cultural ties within communities through the support of language and the arts
- upgrade and maintain airstrips in remote communities to provide better access to emergency health care.

The responses outlined here are targeted at improving the health of Indigenous Australians. There are also responses aimed at the other six key areas that are seen as vital

to closing the gap between Indigenous and non-Indigenous Australians: early childhood, schooling, healthy homes, economic participation, safe communities and leadership.

Responses to wellbeing issues often involve a partnership between governments and non-government organisations (NGOs). One such response is the work being done by the Cathy Freeman Foundation to improve the wellbeing of children on Palm Island. Olympic champion Freeman established the foundation in 2007 to help address some of the key problems facing this remote Indigenous community. These problems include high unemployment, low literacy and life expectancy rates and very high rates of ear disease and hearing loss. As nearly two-thirds of the population is under the age of 20, the foundation focuses on education, particularly reducing the truancy rate, which can be as high as 55 per cent.

Key components of the foundation's strategy are public recognition of children who attend school and achieve good outcomes, sport and recreation programs that encourage children to attend school, increased numbers of teacher's aides, school camps to the mainland for those children who attend school regularly, and scholarships to students to attend private schools in mainland Queensland. The foundation has had great success in reducing truancy, improving literacy levels and improving the future employment prospects of hundreds of Indigenous children.

## CASE STUDY

### Cathy Freeman Foundation



**Source 9.28** Cathy Freeman helps Craig Evers ride his new bike on Palm Island. The bike was donated by the Cathy Freeman Foundation.

## REVIEW 9.2.4

### Remember and understand

- 1 Explain what the Cathy Freeman Foundation is doing to improve the wellbeing of Palm islanders.
- 2 What did a United Nations official have to say about Indigenous health in Australia? Why do you think he made this comment?

### Apply and analyse

- 3 Select one of the strategies aimed to improve the health of Indigenous Australians and explain:
  - a the aims of the strategy
  - b how the effectiveness of the strategy could be measured.

- 4 Cathy Freeman is not the first celebrity to become involved in projects aimed at improving wellbeing. Angelina Jolie, Bob Geldof and Bono are other well-known examples. Why do you think celebrities often become involved in this type of work?
- 5 Use an atlas to describe the location of Palm Island. Describe how the location of this community may help explain the high rates of unemployment.

### Investigate and create

- 6 Visit the Cathy Freeman Foundation website. Prepare a report on one of the five programs that are helping to improve wellbeing.

# ORGANISATIONS WORKING TO IMPROVE WELLBEING

As we have learned, the United Nations (UN) has a huge interest in improving wellbeing across the globe with its Sustainable Development Goals. But the UN does not work alone. It works with individual governments and not-for-profit organisations, each of which set their own goals and develops their own programs. In this section, we will investigate the work of the UN and a range of other organisations working to improve wellbeing.



**Source 9.29** The UN peacekeepers pass groups of people fleeing conflict in the Democratic Republic of the Congo.

## STRANGE BUT TRUE

Diarrhoea and pneumonia together kill more children in the world than HIV/AIDS, malaria and tuberculosis combined. The sad part is that these are preventable, treatable illnesses that no one should have to die from.



## The role of the United Nations

The UN was founded at the end of World War II, in 1945, to encourage countries to work together and maintain peace. Since that time it has grown into a vast organisation with multiple agencies working towards the key goals of ‘maintaining international peace and security, developing friendly relations among nations and promoting social progress, better living standards and human rights’.

The UN has 193 member countries. These countries provide the funding to operate the UN’s agencies and programs. Four key areas for the UN are peace and security, development, human rights and humanitarian aid.

### Peace and security

The UN has continued with its initial aim of promoting peace and security among the nations of the world. It provides assistance in areas such as disarmament, mine clearance, counter-terrorism and peacekeeping forces as well as encouraging nations and communities in conflict to work towards a peaceful resolution.

### Development

UN programs throughout the developing world are aimed at reducing poverty and improving the wellbeing of billions of people. In terms of promoting economic development, the UN works with countries to promote trade between countries and to build stable governments.

## Human rights

The UN seeks to uphold the values of the Universal Declaration of Human Rights throughout the world. Since the creation of the Universal Declaration of Human Rights in 1948, the UN has adopted several further declarations. These include conventions aimed at ending discrimination against women (in 1979) and further protecting the rights of children (in 1989). In 2006, the rights of Indigenous people were described in a further declaration. This aims to allow Indigenous groups to protect and strengthen their cultural identity.

The UN works towards ending violence against children, human trafficking and the use of sexual violence as a weapon of war. It also promotes the freedom of Indigenous people to determine their own futures. The UN believes that every child has the right to an education.

## Humanitarian aid

In those regions where food security is an issue, the UN works to improve farm productivity and provide food in times of famine. It also provides refuge for millions of people fleeing conflict in refugee camps and aid to those suffering from the impacts of disasters.



**Source 9.30** The UN works to provide free universal education, particularly among groups who have found this difficult to access. This includes the young girls of Pakistan.



**Source 9.31** The World Food Programme provides aid to almost 100 million people a year in over 70 countries.

### REVIEW 9.2.5

#### Remember and understand

- 1 What was the initial aim of the UN?
- 2 What types of discrimination is the UN now dedicated to eliminating?

#### Apply and analyse

- 3 Construct a four-column table in your notebook. Add the title 'Who is working to improve wellbeing?'
  - a In the first column, titled 'United Nations', list all of the goals and programs of the UN identified here. For example, disarmament is the first one listed.
  - b Title the second column, 'Other government organisations'. In a small group, brainstorm to identify a list of government organisations also working on these goals and programs. For example, NATO (North Atlantic Treaty Organisation) has a long-standing commitment to arms control, disarmament and non-proliferation of nuclear weapons.
  - c In the third column, titled 'Non-government organisations', identify as many NGOs as

you can think of who work in each area. For example, ControlArms.org campaigns to regulate the arms trade.

- d In the fourth column, titled 'Individuals', identify people who support any of these goals through significant donations, being spokespersons or champions who raise public awareness, voluntary work or academic study. For example, Mahatma Gandhi strove for peace through non-violence.

#### Investigate and create

- 4 Research to find out more about the World Food Programme to complete the following questions.
  - a Which areas received assistance from the World Food Programme this year?
  - b How many children received special nutritional support this year?
  - c Who are the top five donor countries that support the World Food Programme?

# GOVERNMENT AND FOREIGN AID

In the 2015–16 Budget, the Australian Government provided \$4 billion in overseas aid. Most of Australia’s aid is spent on countries in the Asia–Pacific region, particularly Papua New Guinea, Indonesia and the small island nations in the Pacific.

Aid is given to poorer countries to improve the lives of those living in poverty and to make the countries in the Asia–Pacific region more stable. Not only does this aid help improve wellbeing in the region, it also supports Australia’s economic and security interests by helping to build stronger, healthier countries in our region.

**Source 9.32** Where we give aid – top 25 recipients 2015–16.

Country	Australian ODA \$(million) (2015–16)	Human Development Index value 2015
Papua New Guinea	554.5	0.505
Indonesia	375.7	0.684
Solomon Islands	175.9	0.566
Pacific Regional Programs	120.0	–
Sub-Saharan Africa	95.9	0.475 (average)
Timor–Leste	95.3	0.595
Vietnam	89.6	0.666
Cambodia	89.0	0.555
Afghanistan	84.6	0.465
Philippines	83.0	0.668
East-Asia Regional Programs	66.0	–
Myanmar (Burma)	62.8	0.536
Vanuatu	60.5	0.594
Bangladesh	59.8	0.57
Fiji	57.8	0.727
Pakistan	55.7	0.538
Middle East & North African Programs	47.1	–
Palestinian Territories	42.8	0.677
Laos	37.9	0.575
Samoa	36.8	0.702
Southern & Western Asian Programs	32.8	–
Nepal	31.4	0.548
Tonga	30.2	0.602
Sri Lanka	28.9	0.757
Kiribati	27.9	0.59

Aid is also given to countries outside the Asia–Pacific region when there is a humanitarian disaster such as famine or war or a natural disaster such as an earthquake or cyclone. Source 9.32 shows the top recipients of Official Development assistance from Australia in 2015–16.

## What does foreign aid do?

Aid is delivered to these countries in a number of ways:

- Money is given to aid organisations, such as World Vision, that do work at the community level.
- Emergency aid, such as that provided after the Nepal earthquake, is often provided in the form of food supplies, fresh water and medical teams.
- The Australian Government works with other governments to assist in the delivery of important services such as policing and hospitals.

The sorts of aid programs that receive funding from the government are wide-ranging. There are programs that are directly improving the health of communities and saving lives. These include providing safe water and sanitation where it is not available, maternal and child health services and disease prevention (see Source 9.33).



**Source 9.33** These women are registering their children for health checks at an Australian-funded clinic in East Timor.

There are programs that address inequalities by increasing access to education, helping people with disabilities and empowering women (see Source 9.34).

There are programs that support sustainable economic development, improve food security and employment and reduce the negative impacts of environmental change (see Source 9.35).

There are programs that help other governments to improve their security, justice and human rights (see Source 9.36).

There are also humanitarian aid and disaster response programs for communities impacted by crisis situations and natural disasters (see Source 9.37).



**Source 9.34** Australia provides funding for schools throughout the Asia-Pacific region including here at Laos.



**Source 9.35** This organic farm in the Philippines is supported by Australian aid.



**Source 9.36** An Australian electoral officer helps the Solomon Islands police force provide security in a general election.



**Source 9.37** A Queensland fire and rescue team inspect an earthquake-damaged building in Pandang, Indonesia.

## REVIEW 9.2.6

### Remember and understand

- 1 Why does Australia provide aid to overseas communities and countries?
- 2 Name three concerns that are addressed by aid programs.

### Apply and analyse

- 3 Why do you think that the Australian Government does not simply send money to the leaders of each country?
- 4 Select one of the photographs showing Australian aid at work. Imagine that you are one of the people receiving assistance. Describe the ways in which the aid you received has improved your wellbeing.

### Investigate and create

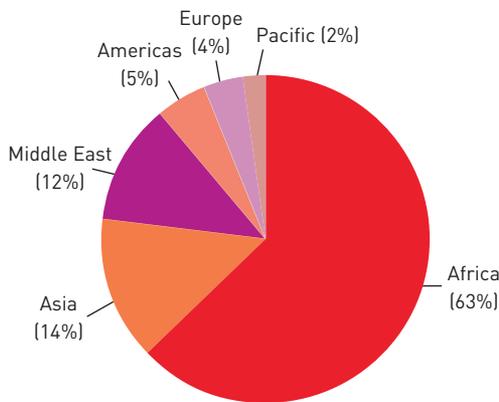
- 5 Construct a scatter plot using the data provided in Source 9.32. It shows the amount of ODA given to each country and the HDI value for each of these countries. Use your completed scatter plot to test the theory that Australia gives the most aid to the poorest countries.
- 6 Construct a choropleth map of the aid recipients in Source 9.32. Use your completed map to test the theory that Australia gives more aid to countries in our region than those further away.

# THE CONTRIBUTION OF NGOS

While governments are important sources of aid that help to improve wellbeing, there are also hundreds of **non-government organisations (NGOs)** with a similar aim. NGOs range from vast international groups such as World Vision and the Red Cross to very small NGOs with only a few members working to make a difference in a single community. What NGOs do have in common, however, is that they are non-profit organisations, meaning all their money goes to support their work, and they all depend on donations from governments or private individuals and companies to fund their work.

Here we look at two organisations:

- *Médecins Sans Frontières* – an organisation that responds to emergency situations with medical assistance
- Bangladesh Rural Advancement Committee – an organisation that works to reduce the causes of inequalities in wellbeing around the world.



**Source 9.38** The programs of *Médecins Sans Frontières* in 2014, by location and percentage of expenditure

## *Médecins Sans Frontières* (Doctors Without Borders)

*Médecins Sans Frontières* (MSF) was founded by 13 French doctors in 1971 to deliver ‘emergency aid to people affected by armed conflict, epidemics, exclusion from health care and natural disasters’. They are currently active in 77 countries, many of them with unstable governments. In 2014, MSF took part in 384 programs, of these 240 were in Africa (see Source 9.38). MSF believes strongly in drawing attention to human rights violations and the lack of adequate responses to emergencies by governments in the areas in which they work. This does not always make them popular and means that virtually all of their funding must come from individual donations, 5.7 million donors in 2014, rather than from governments.

**Source 9.39** Top 10 countries with the largest MSF programs, 2014

	Country	Type of emergency
1	South Sudan	Armed conflict, refugees
2	Democratic Republic of the Congo	Armed conflict, epidemic (malaria)
3	Central African Republic	Armed conflict, refugees
4	Haiti	Natural disaster, epidemic (cholera)
5	Sierra Leone	Epidemic (ebola)
6	Afghanistan	Post-conflict, emergency health
7	Niger	Hunger, epidemic (malaria)
8	Liberia	Epidemic (ebola)
9	Ethiopia	Armed conflict, refugees, epidemic (tuberculosis)
10	Iraq	Post-conflict, refugees

Three years of non-stop surgery under tough circumstances – I have maxed out. I've had enough of scenes of misery. I was on the phone recently with my surgery professor and he said: 'Regardless of the operating conditions, your work during these three years matches my whole 30 years' experience as a doctor. You have reached retirement in just three years.' And indeed, every moment of every day I feel I have had enough, but we have no other choice. People here need us. They are in desperate need of all kinds of medical care, from the most simple to the most complicated. We cannot add another reason for the deterioration of this already disastrous situation. Today, I am almost certain that, when the war is over, I will quit medicine. Any human being would make that decision after living through what I have lived through. I look forward to the end of the war. It has to stop, one day. Then, I can choose what to do. Only then will we be truly alive again.

Dr S – a young surgeon working in an MSF-supported hospital in the east of Damascus

**Source 9.40** MSF work to improve the wellbeing of people whose survival is threatened by violence – as shown in this story from a staff member.

## Bangladesh Rural Advancement Committee

The Bangladesh Rural Advancement Committee (BRAC) was founded in 1972 to alleviate poverty by providing micro-credit to the poor of Bangladesh. Micro-credit allows the poor to access small loans – as small as \$20 – to allow individuals to finance projects such as machinery repair, hiring a new labourer, purchasing a sewing machine or shoe-repair kit so that they can start their own small businesses. The loan is then repaid with minimum interest.

From these small beginnings, BRAC is now the world's largest NGO. It has over 100 000 employees and helps to improve the wellbeing of around 126 million people, mainly in Bangladesh but also in 10 other countries in Asia and Africa. In addition to offering micro-loans, BRAC now also provides education to millions of children, public health programs aimed at reducing child mortality, services for the disabled, disaster relief and internet connections to thousands of rural communities.



**Source 9.41** MSF volunteers often work in dangerous conditions.



**Source 9.42** BRAC works to improve opportunities for women in Bangladesh and throughout the world. The volunteer is training local women to act as nurses and health advocates for their villages.

### REVIEW 9.2.7

#### Remember and understand

- 1 What are the aims of *Médecins Sans Frontières* (MSF)? Why do they receive very little funding from governments?
- 2 What is micro-credit and how does it help the poor?

#### Apply and analyse

- 3 Examine Source 9.39.
  - a Describe the location of the countries listed.
  - b Select one of the top 10 countries supported by MSF. Use the World Bank website to prepare a report on wellbeing levels in this country.

- c Suggest how MSF could help address some of the wellbeing issues in this country.

#### Investigate and create

- 4 Visit the MSF website and use the international activity report page to research the type of assistance given by MSF in the country you selected in question 3.
- 5 Visit the BRAC website. Use the 'Where we work' tab to explore the countries in which BRAC is active and the types of assistance they provide in each country. Summarise your findings and present them in a format you think is most effective.

# CHARITY AND THE CONTRIBUTION OF INDIVIDUALS



Many NGOs, including those you have learned about in this chapter, are funded by donations from individuals and private companies. Donations vary from place to place depending on a wide range of variables including income. Of course, giving money to help other people is only one type of charity. Many people also give their time as volunteers. This can be of great assistance to others and can help to increase their level of wellbeing. Most of the doctors who work with MSF, for example, donate their time to work in areas where they are needed. Source 9.48 shows the percentage of the population who donate money to charity in 20 selected countries.

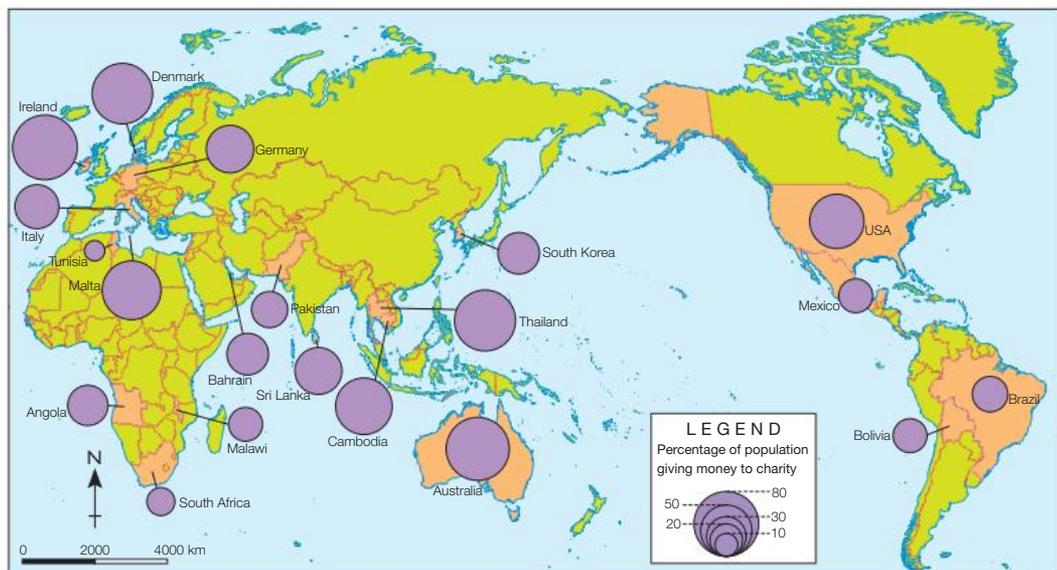
## Charity in Australia

There are more than 54 000 registered charities and not-for-profit organisations in Australia. With almost nine out of 10 Australians giving to charity annually there is clearly widespread generosity. But with so many causes asking for support, how can you make sure that what you give actually makes a difference? Australia's leading consumer advocacy group, CHOICE, suggests that the most effective donations are when you:

- give directly to the causes that matter to you most
- volunteer for the organisation; more than 30 per cent of Australian adults volunteer, giving an average of 56 hours of their time per year.

**Source 9.43** One of the world's largest charity organisations was started by Microsoft founder Bill Gates, one of the world's wealthiest men. The Bill and Melinda Gates Foundation has donated more than \$33 billion to improve the wellbeing of people around the world. In this photograph, Bill and Melinda Gates are chatting to Tatomkhulu-Xhosa, a South African man who is living with tuberculosis.

## WORLD: CHARITABLE GIVING INDEX MAP



**Source 9.44**

Source: Oxford University Press

## The wellbeing of refugees in Australia

Refugees and asylum seekers often have low levels of wellbeing. The process of fleeing their home country and waiting for resettlement has prevented them from receiving full health care and education. They may have suffered trauma in their home countries, and may experience culture shock on their arrival in Australia.

Issues of wellbeing for refugees arriving in Australia include:

- Many face difficulty accessing appropriate health care and other public services. Language barriers also often require the use of interpreters.
- Many newly arrived refugees lack family and friends in Australia and face isolation in their new communities.
- Refugees may need specialised torture and trauma counselling for long periods of time as a result of their experiences.
- Before coming to Australia, many refugees have lived for years with only limited access to food, both in terms of amount and variety, leading to poor nutrition.

There are many large organisations in Australia working tirelessly in support of the wellbeing of refugees including Red Cross, Amnesty International, Save the Children, MSF, Oxfam and CARE Australia. There are also some many smaller initiatives with innovative programs from dedicated individuals that are interesting to consider:

- Asylum Seekers Centre provides practical and personal support to asylum seekers in Newtown, Sydney. As a not-for-profit organisation it relies on the generosity of private donors and volunteers to provide a range of services including accommodation, financial relief, health care and counselling, employment assistance, education, advocacy, food and recreational activities. All are aimed to make it possible for asylum seekers to rebuild their lives as worthy members of the community.
- West Welcome Wagon supports asylum seekers in the local community of West Melbourne by providing good-quality donations of furniture, emergency food relief, neighbour-to-neighbour social support as well as special projects such as in-house English support and community engagement.



**Source 9.45** This is one of 39 portraits of refugees and asylum seekers created by Australian artist Wendy Sharpe to support the Asylum Seekers Centre. The portraits are drawn from life while the subjects share their stories about why they came to Australia, their hopes and dreams for the future, and their personal interests.

## REVIEW 9.2.7

### Remember and understand

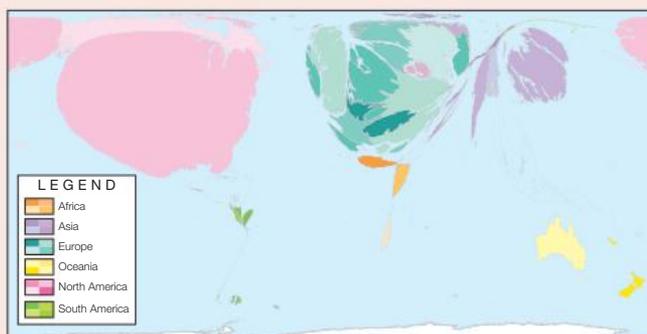
- 1 Explain what is meant by 'charity' in your own words.
- 2 How can you be sure that your donations reach the people who need them?

### Apply and analyse

- 3 Construct a proportional circles map (like the one in Source 9.44) using the data provided in 9.32 relating to the amount of aid given to the countries by the Australian Government in 2015–16.
- 4 Examine Source 9.44.
  - a List the 10 countries on this map with the largest percentage of population who give money to charity.
  - b Compare this map to the GDP world map in Source 8.12. Describe any links that you can find between charitable giving and GDP.
  - c In a recent study of charitable behaviours, Australia ranked 2nd for donating money, 12th for volunteering and 10th for helping a stranger. Do you find these rankings surprising? Give some reasons for your answer.

- 5 Source 9.46 shows another technique that relies on the size of features to communicate a message. What similarities and differences do you notice between the two patterns shown on these maps?

### WORLD: INTERNATIONAL FOOD AID



**Source 9.46**

Source: Oxford University Press

### Investigate and create

- 6 Use the internet to research the Bill and Melinda Gates Foundation. Select one of the areas where this aid organisation helps and describe what the foundation does in this area.

# 9.2

## CHECKPOINT

### HOW DO GOVERNMENTS, GROUPS AND INDIVIDUALS RESPOND TO INEQUALITIES IN DEVELOPMENT AND HUMAN WELLBEING FOR A SUSTAINABLE FUTURE?

- Investigate initiatives to improve human wellbeing in Australia and other countries.

- 1 What is the 2030 Sustainable Development Agenda? [5 marks]
- 2 How many Sustainable Development Goals and targets are there? [5 marks]
- 3 Mahatma Gandhi, a leader of the Indian Nationalist movement in the early 20th century once said, 'Educate one man, you educate one person, but educate a woman and you educate a whole civilisation.' What do you think he meant by this? [5 marks]
- 4 List 10 improvements in health that are required to work towards Closing the Gap for Indigenous Australians. [10 marks]
- 5 Explain how the United Nations contributes to improve human wellbeing. [5 marks]
- 6 Where in the world is Australia's Official Development Assistance (ODA) directed? Why is this the case? [5 marks]
- 7 Identify five Australian programs that target improving wellbeing in Australia or overseas. [5 marks]
- 8 Describe how technology and banks can help to reduce poverty. [5 marks]
- 9 Why are private donations a major source of aid? [5 marks]

TOTAL MARKS [ /50]

### RICH TASK

#### Evaluating aid

Never doubt that a small group of thoughtful, committed citizens can change the world; indeed, it's the only thing that ever has.

Margaret Mead (1901–78)



**Source 9.47** Globally overseas aid has contributed to preventing 45 million child deaths since 1990.

Wealthy nations such as Australia give overseas aid to developing countries to help them overcome extreme poverty. The Australian Government provides aid assistance to 75 countries. The most money goes to our nearest neighbours – Papua New Guinea, Indonesia, Timor–Leste and the Pacific Islands – but also to countries in South Asia, Africa and parts of the Middle East. This assistance is provided in a number of ways:

- direct to developing country governments
- through international organisations such as the World Bank or World Health Organization
- through non-government organisations such as World Vision

Complete the following questions to prepare a presentation on an evaluation of the Australian aid given to a country of your choice.

### Acquiring geographical information

- 1 Select one of the top 25 recipients of Australian Government aid (see Source 9.32).
- 2 Consult the CIA World Factbook, or similar, to compile a brief overview of your selected country. Include total population, median age of population, life expectancy, fertility rate, GDP/capita, economy, exports, export partners, imports and import partners.

### Processing geographical information

- 3 Consult the website [www.dfat.gov.au](http://www.dfat.gov.au) to compile a brief overview of the Official Development Assistance (ODA) given to your country.
  - How has the ODA been directed? Has it been directed to any particular programs?
  - Which of the Sustainable Development Goals have been addressed with this aid? Identify both the goal and the target(s).
  - Evaluate the performance of this aid program.
  - Identify the challenges for the future.
  - Is this level of aid from Australia likely to continue? Why/why not?
  - List the non-government organisations working in this country.

### Communicating geographical information

- 4 Add some images to your presentation and then share it with your class.



**Source 9.48** Illness from drinking dirty water and the time lost gathering it robs entire communities of their futures. Here, a Pacific islander collects clean water from a tank funded by AusAID.

In this Checkpoint and Rich Task, you will be learning and applying the following geographical concepts, inquiry skills and tools:

- » Concepts: Scale, Sustainability, Interconnection
- » Inquiry skills: Acquiring geographical information, Processing geographical information, Communicating geographical information
- » Tools: Statistics, Data tables, Infographs, Photographs

For more information about these concepts, skills and tools, refer to 'The geographer's toolkit'.

# CHECKPOINT

# GLOSSARY

## A

### abiotic

non-living components of an environment, such as temperature, rainfall, humidity, wind speed and direction, sand, clay and rock

### Agricultural Revolution

period of gradual change to the agricultural system that began in Britain in the 18th century, and included the introduction of new techniques and machinery in farming

### annotate

to add notes that explain, comment or clarify

### aquatic biome

features, plants and animals that make up water environments such as oceans, freshwater lakes, coral reefs and wetlands

### aquifer

underground water supply consisting of a layer of rock or other permeable materials that hold water

### arid

term used to describe land and climate conditions that are too dry to support vegetation

### atmosphere

all of the gases that surround the Earth

## B

### bar graph

graph that shows information as a series of horizontal bars

### biodiversity

variety of living organisms (i.e. plants, animals, bacteria and fungi) found in an environment

### biological pollutant

term used to describe the negative effects of invasive species (such as bacteria, parasites and invasive plants and animals) that do harm to an environment

### biome

large area of the Earth that is home to similar plant and animal communities that have adapted to a particular environment over time (e.g. desert, forest, grassland)

### biosphere

all living things on Earth (i.e. plants, animals, humans and other organisms)

### biotic

living components of an environment, such as the animals, plants, bacteria and fungi

### bore

(also called an Artesian well) drilled well that brings water up from deep in the ground

### boreal

(adjective) refers to the north, or the northern regions

### boreal forest

coniferous forest biome, dominated by fir, spruce and pine trees

### breakwater

wall constructed out into the sea to help prevent waves from reaching the coastline and causing erosion

## C

### calorie

unit used to measure the energy in food

### carbon cycle

series of processes by which carbon compounds are interconverted in the environment, involving the incorporation of carbon dioxide into living tissue by photosynthesis and its return to the atmosphere through respiration, the decay of dead organisms, and the burning of fossil fuels

### carbon emissions

carbon dioxide released into the atmosphere as a result of burning fossil fuels and gas

### cartogram

type of map that is distorted to show a representation of statistical data (e.g. access to water, rates of obesity) rather than land area

### census

'head count' or audit of the number of people living in a particular place at a particular time; information collected during a census can often include age, occupation, income, etc.

### change

key concept in geography: the dynamic nature of all processes on Earth, whether slow or fast, small or large

### chemical pollutants

term used to describe a range of heavy metals, oils, pesticides, industrial chemicals and salts that do harm to the environment

### child mortality rates

measure of the number of deaths among children under five years per 1000 children born

### choropleth map

map that shows changes in particular data or characteristics across an area (e.g. population density, GDP per capita) by using shades of the same colour (e.g. light green through to dark green)

### climate change

change in global or regional climate patterns; in particular, a change apparent from the mid to late 20th century onwards and attributed largely to the increased levels of atmospheric carbon dioxide produced by the use of fossil fuels

### climate graph

combination bar and line graph that shows the rainfall and temperature of a given place; also known as a climograph

### column graph

graph showing information as a series of vertical

### columns

community in terms of an environment, populations of different species that interact with each other in a particular area

### community

in terms of environments, groups of different species interacting with each other

### complex map

type of map that displays more than one set of data or information

### compound column graph

type of column graph that features two or more sets of related data at the same time so that they can be compared; information provided in each column is sub-divided for further comparison

### confluence

place or junction where two rivers meet

### coniferous

relates to trees or shrubs that bear cones and have needle-like leaves, like pine trees

### coniferous forest

type of forest comprised of conifer trees, sometimes called a boreal forest

### consumers

animals that eat either plants or other animals

### contour line

line on a map (e.g. topographic map) joining points of equal height above or below sea level; contour lines can also be used to show the steepness of the land on a map

### correlation

statistical measure that indicates the extent to which two or more variables are related or interlinked

### culture

term used to describe the shared characteristics (e.g. language, food, religion, beliefs) of a population or group of people

## D

### deforestation

removal of trees and other plant life from a forested area, either by cutting down or burning; usually carried out to clear the land for farming

### **demographics**

statistical data of a population or of particular groups within a population, especially those related to average age, gender, income, education level, etc.

### **demographic transition model**

geographical model designed to help explain changes in populations over time, especially the transition from high birth and death rates to low birth and death rates as countries become more developed

### **deposition**

laying down of solid material that has been eroded and transported from another part of the Earth's surface

### **desert**

dry region of the Earth with little vegetation or rainfall, but experiencing extreme temperatures

### **desertification**

the transformation of fertile land into relatively dry desert

### **developed country**

industrialised country with a well-developed economy and relatively high standard of living that is able to support the needs of its citizens (*see also* developing country)

### **desertification**

the transformation of fertile land into relatively dry desert

### **developing country**

non-industrialised (i.e. largely agricultural) country with a relatively fragile economy and low standard of living that is not always able to support the needs of its citizens (*see also* developed country)

### **digital terrain model (DTM)**

topographic illustration (or digital model) that uses a range of data to generate a 3D representation of the Earth's surface

---

## **E**

### **economic**

(adjective) a term used to describe a range of issues relating to employment, income and trade

### **ecosystem**

complex community made up of living organisms that interact with each other and with their environment; an abbreviation for 'ecological system'; made up of biotic and abiotic components

### **ecosystem services**

term used to describe a range of important resources, processes and benefits that healthy ecosystems provide to humans; there are four categories of ecosystem services: 1. **sources** (or provisioning services) such as providing food and materials, 2. **sinks** (or regulating services) such as purifying air and water, 3. **services** (or supporting services) such as seed dispersal and nutrient cycling, 4. **spirituality** (or cultural services) such as spiritual enrichment and recreation

### **ecotourism**

form of responsible and sustainable tourism that involves travel to areas of natural or ecological interest with the goal of conserving the environment and improving the wellbeing of the local people

### **environment**

key concept in geography: a specific place on Earth and all the things, both animate and inanimate, that are there

### **erosion**

wearing away of the Earth's surface by wind, water or ice

### **estuary**

wide tidal mouth of a river

### **ethnicity**

background, nationality or culture of a person or group of people

### **extensive farming**

type of farming that requires large areas of land; for example, dairy farming, which needs to provide grazing land for cattle

### **extinction**

dying out and complete disappearance of a species (e.g. plant or animal)

### **exurb**

area beyond an urban centre and its suburbs, usually separated by areas of farmland

---

## **F**

### **false colour image**

image that depicts an object or area in colours that differ from those seen in nature; false colour images use colours that are different or more exaggerated than those shown in standard photographs, in order to make the thing being shown easier to interpret

### **fertility rate**

statistical measure of the average number of children that all women in a particular area or population will have throughout the course of their lives; expressed as births per 1000 women

### **fieldwork**

geographical study that takes place outside the classroom at the site of inquiry

### **flow diagram**

diagram that shows the sequence or stages in a process

### **food accessibility**

having physical and economic access to enough food that can be reached by those who need it

### **food availability**

state of people having enough food of appropriate quality consistently available

### **food insecurity**

term used to describe a condition in which not all people have access to enough safe nutritious food to sustain a healthy life (*see also* food security)

### **food loss**

reduction in the amount of food from where it is produced to where it reaches the consumer

### **food security**

term used to describe a condition in which all people at all times have access to enough safe nutritious food to sustain a healthy life (*see also* food insecurity)

### **food waste**

food that is thrown out by a retailer or consumer

### **forced migration**

forced movement of people from one place to another because of war, famine or violence

### **fossil fuel**

fuel made from the decomposed (fossilised) remains of plants and animals that lived millions of years ago (e.g. coal, oil, gas)

---

## **G**

### **gender inequality**

unequal treatment of individuals within a society based on their gender, whether male or female

### **genetic modification (GM)**

process by which scientists can change the genes of plants and animals to give them certain desirable traits

### **Geographic information system (GIS)**

software application designed to capture, store, manipulate, analyse, manage and present all kinds of geographical information

### **geographical sketch**

sketch focusing on those parts of the environment relevant to the geographic study; often completed in the field but also from photographs

### **Global Positioning System (GPS)**

device that uses satellites to accurately pinpoint the location of an object on the Earth's surface (e.g. a car, satellite navigation device, mobile phone) and provides data and directions to help with navigation

### **global warming**

gradual increase in the overall temperature of the Earth's atmosphere generally attributed to the release of greenhouse gases such as carbon dioxide, CFCs and other pollutants into the atmosphere

### **grasslands**

biome of wide open spaces, where the vegetation is dominated by grasses; sometimes called a prairie, steppe or savannah

### **Green Revolution**

period of research, development and alteration of agricultural techniques that took place between the 1940s and 1960s, most markedly in the developing world, which saw global increased agricultural production

**greenhouse effect**

gases, such as carbon dioxide, absorb radiation from the Sun's rays trapping heat in the Earth's atmosphere

**Gross Domestic Product (GDP)**

total monetary value of all the goods and services produced by a country over a specific time period (usually a year)

**ground level photograph**

photograph taken from ground level (i.e. the photographer is standing on ground level and camera lens is parallel to the ground)

**groynes**

artificial barrier that juts out from a beach into the water, built to prevent erosion of the beach from the power of destructive waves and longshore drift

---

**H****habitat**

preferred location of an organism because it has the correct water, temperature, minerals and sunlight

**horizons**

layers that are formed in soil over time due to the gradual breaking down of rock into finer particles

**Human Development Index (HDI)**

tool developed by the United Nations to grade and rank the social and economic development of the world's countries in order from most to least developed; used as a measure of human wellbeing

**human environment**

environment that has been built or altered by humans, such as a city, town or farmland

**hydrological (water) cycle**

continuous cycle by which water evaporates from lakes and oceans, condenses into clouds, falls on land as rain, finds its way into rivers (often after human use) and returns to the oceans

**hydrosphere**

all of the water on Earth (i.e. in solid, liquid and gaseous forms)

---

**I****individual**

in terms of an environment, the smallest biotic component – a single organism

**Industrial Revolution**

period of major socioeconomic change during the late 1700s and early 1800s, where agricultural and other manufacturing processes were revolutionised by the use of machinery

**infant mortality**

statistical measure of the proportion of children in an area or population under the age of 12 months who die; expressed as deaths per 1000 live births

**infrastructure**

facilities and services necessary for any community, city or country to function (e.g. buildings, electricity, roads, airports and water supply)

**intensive farming**

kind of farming that can supply large volumes of produce in a relatively small area, such as poultry or vegetable farms

**interconnection**

key concept in geography: the relationship between all things, both animate and inanimate, and all processes, both natural and human

**internal migration**

movement of people within a region or country

**internally displaced person (IDP)**

person who has been forced to flee their home to escape conflict but who remains within their own country's borders

**international migration**

movement of people between countries

**invasive species/invasive alien species (IAS)**

plant, animal or other organism that is not native to an area, and whose introduction has negative effects on its new environment

**irrigate/irrigation**

watering of otherwise dry land by artificial means (e.g. pipes, ditches, sprinkler systems) to help in the growing of crops

---

**L****land degradation**

wearing down of the health of land resources through human actions in ways that threaten their ability to maintain their environmental functions

**landfill**

method used to dispose of rubbish by burying it; also used to describe the place where rubbish is buried

**landform**

natural geographical feature or shape that appears on the Earth's surface (e.g. dune, hill, valley, beach and cave)

**landlocked**

country where all its borders are shared with other countries and there is no coastline

**land reclamation**

process of creating new land from oceans, bays, harbours and estuaries by dumping rocks, silt from the sea bed or other materials into the water

**leaching**

draining away or removal of soluble substances

**Lewin's Force Field model**

model that helps organise and apply weights to the driving forces for and the restraining forces against a decision or change

**life expectancy**

statistical measure of the average number of years a person in an area or population can expect to live; expressed in years

**line graph**

type of graph that displays data as a line

**literacy rate**

statistical measure of the percentage of people in an area or population that can read and write

**lithosphere**

the outer rocky layer of Earth (i.e. crust)

**location**

a place or position on the Earth's surface

**longshore drift**

process that moves sediment in a zigzag pattern along a beach by wash and backwash of waves approaching the shore at an angle

---

**M****map**

simplified plan of an area shown from directly above the area (i.e. plan view)

**megacity**

city with a population of more than 10 million people

**megalopolis**

collection of large cities that are close together and are connected by a network of roads and train lines, effectively forming one continuous urban centre

**Millennium Development Goals (MDGs)**

United Nations eight international targets for 2015 for addressing global extreme poverty; they have been replaced in the 2030 Agenda for Sustainable Development by 17 Sustainable Development Goals

**mountain vegetation**

biome surrounding mountains, where cold conditions determine plant life and animals

**mulch**

decaying organic material such as leaves or compost that is spread over soil to insulate it and keep it warm and moist

---

**N****national park**

a park that is protected by the government

**natural environment**

environment that occurs naturally, such as forests, deserts and coral reefs

**non-government organisation (NGO)**

any not-for-profit organisation independent of the government that is organised and administered on a local, national or international level; NGOs often rely on the support of volunteers

---

**O****oblique aerial photograph**

photograph of an object or area taken from a high point (i.e. a hilltop or aircraft) on an angle that is neither horizontal (see ground level photograph) nor directly above (see vertical aerial photograph)

**ocean acidification**

ongoing decrease in the pH level (a measure of acidity and alkalinity) of the Earth's oceans, caused by the uptake of carbon dioxide from the atmosphere by the water

**Organisation for Economic Cooperation and Development (OECD)**

international economic organisation of 34 countries, set up in 1961 to stimulate economic progress and world trade

**overlay map**

type of map that uses information on a piece of transparent paper or plastic (known as an overlay) placed over a base map; used to show the relationship between features or processes taking place on the Earth's surface

**oxygen cycle**

cycle whereby atmospheric oxygen is converted to carbon dioxide in animal respiration and regenerated by green plants in photosynthesis

---

**P****photolysis**

process of oxygen forming through UV light converting water to oxygen and hydrogen

**photosynthesis**

process by which green plants and some other organisms use sunlight to synthesise nutrients from carbon dioxide and water; photosynthesis in plants generally involves the green pigment chlorophyll and generates oxygen as a by-product

**physical map**

type of map that shows the locations and names of physical features of the Earth, such as mountains and rivers

**physical pollutants**

term used to describe a range of substances (e.g. particles of soil, chemicals, plastic bags, cigarette butts and other rubbish) that do harm to an environment

**pie graph**

graphical way of presenting data; a circle is divided into segments to represent the distribution of data

**place**

key concept in geography: a part of the Earth's surface that is identified and given meaning by people

**polar land**

very cold region that surrounds either the North or South Pole

**pollution**

any substance that is released into the environment that causes damage

**population**

in terms of an environment, group of plants or animals of the same species living in a particular area

**population density**

measurement of the number of individuals per unit area (e.g. 1500 people per square kilometre)

**population pyramid**

type of graph that displays the percentage of males and females in a region or population grouped by age

**precision farming**

system of farming that adapts modern technology to analyse aspects of the environment to bring out better economic and environmental outcomes

**primary data**

data collected first-hand for a geographical inquiry by the person conducting the inquiry (e.g. survey data, hand-drawn maps or photographs)

**producers**

organisms that convert the Sun's energy into food in the form of simple sugars through the process of photosynthesis, such as plants

**pull factor**

positive factor that pulls people to a certain place

**push factor**

negative factor that pushes people away from a certain place

---

**Q****qualitative data**

any information that can be recorded in words (e.g. Uluru is very large)

**quantitative data**

any information that can be recorded as numbers (e.g. Uluru is 3.6 kilometres long)

---

**R****rain shadow**

area of low rainfall on the lee (inland) side of a mountain range

**rainforest**

dense forest area found in tropical regions with warm temperatures and heavy rainfall

**raw material**

basic organic resources from which things are made; often used to refer to the Earth's natural materials such as oil, wood and water

**refugee**

person who travels from one country to another country to escape the effects of a natural disaster or conflict or to avoid persecution

---

**S****salinity**

measure of the amount of salt present in the soil

**satellite image**

image of an object or area taken from a satellite orbiting above the Earth's surface

**savannah**

biome of wide open spaces, where the vegetation is dominated by grasses; sometimes called a prairie, steppe or grassland

**scale**

key concept in geography: the level at which a geographical inquiry take place – personal, local, regional, national or global

**scale (mapping)**

system used to give an indication of distances on a map and the corresponding actual distances in the real world (e.g. line scale, written scale, ratio scale)

**scatter plot**

type of graph that shows two sets of data by plotted points along two axes, the pattern of which shows their correlation; also called a scatter graph or scattergram

**secondary data**

data used for a geographical inquiry not collected by the geographer conducting the inquiry (e.g. textbooks, atlases and government websites)

**semi-arid**

term used to describe land and climate conditions that only receive enough rainfall to support limited vegetation (see *also* arid)

**services**

one of the four categories of ecosystem services (also known as supporting services); processes that take place in the environment that support life (e.g. seed dispersal and absorption of carbon dioxide by trees and oceans)

**sinks**

one of the four categories of ecosystem services (also known as regulating services); processes that take place in the natural environment that absorb waste (e.g. microorganisms in the soil and water breakdown waste from humans and animals)

**soil degradation**

decline in the quality of soil due to human activities

**sources**

one of the four categories of ecosystem services (also known as provisioning services); these are natural products that can be used or converted by humans for use (e.g. wood from trees)

**space**

key concept in geography: the way things are arranged on the Earth's surface

**spatial variation**

term used to describe differences in the way built and natural features (e.g. towns, cities, rivers, mountain ranges, farming regions) are arranged on the Earth's surface

**spirituality**

one of the four categories of ecosystem services (also known as cultural services); a sense of wellbeing and spiritual connection offered by the environment (e.g. aesthetic appreciation of certain landscapes, deep connections to the land)

**spit**

curved build-up of eroded material that forms at the mouth of a river

**subsistence farming**

type of farming whereby the yield of crops grown or raised by a farmer are just enough to cover their household needs

**suburb**

an area beyond a city centre, with medium-density housing

**suburbanisation**

process of growing cities outwards by building new housing estates and businesses away from the central business district

**sustainability**

key concept in geography: the ongoing capacity of Earth to maintain all life

---

**T****tectonic activity**

processes that tend to build up the various features of the Earth's crust (e.g. types of mountain building, volcanic action, folding and faulting)

**temperate forest**

large forest biome that experiences a range of seasonal climate conditions; lies between the tropics and the polar regions

**thematic map**

type of map that shows details of a particular topic or data set (e.g. land use or the distribution of resources)

**tombolo**

deposit of sand linking an island to the mainland (or to another island), formed by longshore drift

**topographic map**

type of map that shows the shape of the land, its relief and landforms

**tropical forest**

biome that lies between the Tropic of Capricorn and the Tropic of Cancer, which has high regular rainfall, high average temperatures and a high level of biodiversity

**tundra**

biome that is characterised by having a vast, treeless environment across the Arctic region of Asia, Europe and North America

---

**U****undernourished**

state of not having enough food to develop or function adequately

**urban**

term used to describe a built-up area such as a city or town

**urban drift**

movement of people from rural areas into cities and towns

**urban heat island (UHI)**

a city that is significantly warmer than surrounding rural areas due to human activities

**urban sprawl**

growth of a city onto productive farming land on the city fringes

**urbanisation**

process of social and economic change that takes place as increasing numbers of people move from rural areas (e.g. farms) to urban areas (e.g. cities)

---

**V****vertical aerial photograph**

photograph taken from a high point directly above the object or area being photographed (i.e. plan view)

**voluntary migration**

movement of people from one place to another of their own free will

---

**W****water scarcity**

term used to describe a lack of sufficient water to meet the demands of an area or population

**water table**

highest underground level at which the rocks and soil in a particular area are completely wet with ground water

**weathering**

wearing away by exposure to the Earth's elements

**wellbeing**

ability of human beings to access the things they need in order to live happy and healthy lives (e.g. food, water, education, safety and security)

# INDEX

## A

abiotic components 194  
acquiring geographical information 12–15  
    fieldwork 34–6  
aerial surveys 80  
Aeta people, Philippines 200  
Afghanistani refugees, case study 180–1  
Africa  
    city growth 164–5  
    consequences of climate change 323  
    grasslands 46  
aged persons 330  
    measuring wellbeing 354–5  
Agricultural Revolution 114, 336  
agriculture  
    changes to vegetation and water for 58–61  
    impacts of 56–7  
    land suitable for 71  
aid  
    charity and the contribution of individuals 372–3  
    distribution, war-torn areas 100  
    evaluating 374  
    foreign aid 368–9  
    from non-government organisations (NGOs) 370–1  
air pollution 175, 214  
Akbar, Ahmad, Afghan refugee 180–1  
Amazon rainforest, clearing of 224  
American cities 142, 146–7  
American mink 226  
American prairie 46, 47  
Americans, why they live where they do 144–5  
annotated field sketches 85  
annotated images 32  
Antarctic food web 194–5  
apartment buildings, New York 146–7  
aquaculture 208  
aquatic biomes 43  
aquifers 59, 72, 79, 230  
armed conflict see conflict  
artificial reefs 275, 276  
Asia  
    climate change impacts 92, 93  
    immigrants from 186–7  
    megacities 132–3  
    steppes 46  
Asia-Pacific region, Australian foreign aid to 368  
Asmara, Eritrea, urban growth 96, 97  
aspect, on topographic maps 52  
Asylum Seekers Centre 373  
Atlantic cod 209  
atmosphere 199, 258  
attitudes to the environment 204–5

Australia  
    biomes 54, 196  
    changing face of 182–5  
    charity in 372–3  
    cities 138, 140, 150–7  
    climate zones 196–7  
    cultural diversity 182, 183  
    desert landscapes 54  
    environments 140, 141  
    food production 78–9, 141  
    grasslands 46  
    Indigenous lands and significant sites 188  
    inequalities 352–3  
    land degradation 221  
    land use 78  
    migration to 178–9, 183–4  
    population density and distribution 138, 139  
    population movements 170–1  
    quality of life rankings 348  
    rainfall 140, 141  
    rainforests 48, 49, 245  
    and refugee wellbeing 372–3  
    rice growing 86  
    sea surface temperature and sea level rise 263  
    soil salinity 62–3  
    soils 77, 79  
    voluntary migration 162–3  
    wellbeing in 348–9, 352–5  
Australian Government  
    foreign aid 368–9  
    migration policy 178, 183–4, 187  
Australian Unity Wellbeing Index 348–9, 355  
Australians  
    ancestry 182  
    residents by country of birth 183  
    where they live 138–9  
    why they live where they do 140–1

## B

Bangladesh  
    integrated coastal zone management 283  
    sea-level rise effects 265, 283  
Bangladesh Rural Advancement Committee (BRAC) 371  
bar graphs 26  
Barangaroo precinct, Sydney Harbour 10, 11, 158  
beach nourishment 275, 276, 277  
bias in data 16  
biodiversity, loss of 210–11, 268–9  
biofuel industry, Brazil 98, 99  
biofuels, as threat to food security 89, 98–9  
biological/physical carbon cycle 198  
biological pollutants 237

biomes 40, 42–9, 54, 196  
    Australia 196  
    and food production 70  
    use and alteration for food production 56–65  
biosphere 199, 258  
Biosphere 1 191, 239  
Biosphere 2 202, 238–9  
biotic components 194, 196  
birth rates 328, 329, 330  
bison 47  
black rat 226  
Bolivia  
    education 341  
    health 341  
    helping the disadvantaged 342  
    patterns of poverty 340  
    wellbeing in 340–2  
boreal forest biome 42, 44  
    threats to 44  
BosNYWash 142  
Brazil  
    biofuel industry 98  
    tropical rainforest clearing 224  
breakwaters 266, 276  
British migrants 178  
built environments 6

## C

Canberra  
    as decentralised city 157  
    residential districts 157  
cane toad 228–9  
carbon cycle 198–9  
carbon dioxide 199, 212, 214, 262  
carbon emissions 244  
caring for Country 246–7  
cartograms 25, 302  
casinos 148  
cassowary 247  
castor oil plant 226  
Cathy Freeman Foundation 365  
cattle farming 79  
census data, collecting and mapping 350  
change(s) 10–11  
    American prairie 47  
    in coastal environments 254–7  
    in environments, causes and consequences 240–1  
    forests 58  
    grasslands 59–60  
    natural environment 56–61  
    rainforests 50  
    water 60–1  
charity  
    in Australia 372  
    world index 372

- chemical pollutants 237
- child brides 361
- children, protecting the rights of 367
- China
  - change in standard of living 174, 175
  - education of girls and women 362
  - manufacturing boom 174–5
  - one-child policy 329
  - population movements 172–3
  - urbanisation 136–7
- Chinese community, Hurstville, Sydney 186–7
- choropleth maps
  - Human Development Index 302
  - interpreting 137
  - patterns 82
- cities
  - advantages of 128–9
  - Africa 164–5
  - Australia 138, 140, 150–7
  - Bolivia 342
  - decentralisation 151, 156–7
  - disadvantages of 130–1
  - growth 126
  - moving to 164–5
  - planning for future cities 150–7
  - pull of 129, 140
  - suburbanisation 150, 152–3
  - United States 142, 146–7, 148–9
  - urban renewal 150, 154–5
  - urban slums 164, 166–7, 342
- clean water 308, 318
- climate 196
  - impact on farm decisions 72
  - impact on farming 74–5
  - impact on wellbeing 320–1
  - impact on where Americans live 144
  - impact on where Australians live 140
- climate change 8, 44, 212–13
  - causes 212
  - and coasts 262–5
  - environmental responses 212–13
  - food security threats 322
  - and frog decline 210–11
  - health threats from 322
  - and human wellbeing 322–3
  - impact on food security 88, 92–3
  - impact on nations 265
  - impacts on Sub-Saharan Africa and Asia 92
  - and predicted changes in food production 93
  - and Saami people 213
- climate graphs 26, 145
- climate zones
  - Australia 196–7
  - world 75, 320
- coastal communities, and sea changers 162–3
- coastal degradation, examples of 254–5
- coastal environments
  - analysis using the four spheres model 258
  - change in 254–5
  - climate change impacts 262–5
  - dynamic equilibrium 256, 257
  - growth and competition for land 267
  - human factors affecting 258
  - human settlement impacts 266
  - loss of biodiversity 268–9
  - natural factors influencing 258
  - new management approaches 276–7
  - population growth impacts 266–7
  - reducing tourism impacts 266, 286–7
  - understanding natural processes in 256–7
  - virtual field trip 261, 273
- coastal erosion 265, 266
- coastal landforms 256
- coastal management
  - Gulf of Mexico oil spill 291–3
  - hard vs soft engineering techniques 274, 276–7
  - integrated coastal zone management 282–3
  - Ningaloo Coast, WA 290–1
  - Rainbow Beach, Qld 280–1
- coastal pollution 270
- coastal squeeze 264–5
- collecting and organising information 14–15
- colonisation and natural resources 325
- coltan mining 216–17
- column graphs 26, 149
- communicating geographical information 22–3
  - fieldwork 34, 36–7
- community 196
- competition for land, impact on food security 89, 96–7
- complex maps
  - analysing 99
  - reading 189
- compound column graphs 26
- conclusions 16, 18, 36, 67
- conflict
  - impact on food security 89, 100–1, 108, 367
  - impacts at personal, local, regional and national scales 345
  - and refugees 344
  - Somalia 100, 101
  - Syria 314–15
- coniferous forest biome 44
- consumers 194, 195
- container ports 326
- contour patterns 24
- copper mining 216
- coral bleaching 8, 264, 269
- coral reefs 269
  - and climate change 263–4
- correlation 304
- counter-migration 168
- crime 131
- crop production
  - in Australia 78, 79
  - improved high-yielding varieties 111
- cultural diversity 129
  - Australia 182, 183
- cultural factors affecting farming 72
- D**
- dairy farming
  - automated milking 81
  - differences in technology use 336
- dams 61, 230, 234–5
  - environmental impacts 234–5
  - removal 235
- data collection and organisation 14–15
- death rates 328, 329, 332
- decentralisation 151, 156–7
  - advantages/disadvantages 156
  - Canberra 157
  - natural 156
  - to regional cities 156
  - to suburbs 156
- Declaration on the Elimination of Violence against Women 361
- decomposers 195
- deforestation 58, 210, 224, 270
  - reversing 244
- Democratic Republic of Congo, coltan mining 216–17
- demographic transition model 328
- demographics 328
- desert landscapes, Australia 54, 141
- desert locusts 95
- desertification 63–4, 220
- deserts
  - greening, Saudi Arabia 59
  - spreading 63–4
- developed countries 106–7
- developing countries 107
- developing geographical questions 12–13, 113, 127
  - from media reports 313
- development role of the UN 366
- Dharavi slum, Mumbai, India 166–7
- dietary changes, environmental impact 66–7
- digital maps 25
- digital terrain modelling (DTM) 278–9
- diseases 308, 309, 341
- domestic cat 226
- donations 372
- downtown (US cities) 142
- drawing conclusions 16, 18, 36, 67
- drones 80
- droughts 8, 64, 92, 93, 108, 169, 318
- dryland salinity 62, 222–3
- dune erosion 275, 280–1
- dynamic equilibrium, coastal environments 256–7
- E**
- Easter Island 218
- eco-bridges 243
- ecological footprint of different food types 66
- economic advantages
  - of cities 128–9
  - of international migrants 184

- economic factors
    - affecting farming 72, 73
    - affecting spatial variation in wellbeing 316
    - affecting where Australians live 140
    - and water scarcity 90
  - economic freedom and repression 338, 339
  - economic growth, and human wellbeing 298–9
  - ecosystem decline 220
    - disappearing forests 224–5
    - invasive species 226–7
  - ecosystem hierarchy 196
  - ecosystem services 230, 268, 269
    - fours S's of 205
    - from forests 244
    - from rainforest plants 49
    - provided by the environment 204–5
  - ecosystems 50, 119, 194, 196
    - response to climate change 212–13
  - ecotourism 247, 286–7
    - definition 287
  - education
    - barriers to 310–11
    - benefits of 362, 363
    - Bolivia 341
    - gender inequality 334
    - and human wellbeing 299
    - improving access to 362–3
    - inequalities, Australia 352
    - and successful schools 363
    - trends in 310–11
  - electronic consumer goods 216–17
  - Elwha River restoration project, USA 235
  - endangered species 43, 130, 153, 209, 217, 242, 243, 247
  - energy flows, rainforest ecosystem 51
  - engineering structures, coastal management 266, 276–7
  - environmental change
    - causes and consequences 240–1
    - Easter Island 218
    - geographers role in managing 274–5
    - industry and mining role 216–17
    - satellite images to analyse 225
    - spatial technology use to predict 278–9
    - topographic maps to explore 229
    - worldview about managing 240–1
  - environmental disadvantages of cities 130
  - environmental factors
    - affecting farming 72
    - affecting spatial variation in wellbeing 316, 318–19
    - affecting water and food security 318–19
    - and water scarcity 90
  - environmental impacts
    - of damming fast-flowing rivers 234–5
    - of dietary changes 66–7
  - environmental issues
    - developing responses to 288–9
    - evaluating responses to 289
  - environmental responses to climate change 212–13
  - environmental wisdom 240
  - environment(s) 6, 192
    - attitudes to the 204–5
    - Australia 140, 141
    - biotic components 196
    - challenges to sustainability 208
    - ecosystem services provided by the 204–5
    - Green Wall of China 65
    - pollution effects 214–15
    - processes 198–9
    - spatial variations 258–9
    - use of the 208–9
    - what makes up an environment? 194–5
    - worldviews about the 206–7
    - see also natural environments
  - epiphytes 43
  - ethics in geography 15
  - ethnicity 182
  - evaluating data 16, 17
  - evaporation 198
  - exceptions (PQE method) 18
  - extensive farming 78
  - extreme weather events 264
  - exurbs 142–3
- 
- F**
- false colour images 21
  - family planning 329, 360
  - family reunions 185
  - famine 68, 319, 367
  - farmers
    - decision making 72–3
    - impact of armed conflict on 101
  - farming 56–7
    - Australia 78–9
    - changes to forests 58
    - changes to grasslands 59–60
    - changes to water 60–1
    - high-tech 80–1
    - impact of climate on 72, 74–5
    - lessons from Indigenous farmers 116–17
    - negative impacts 56, 57
    - practices to improve food security 114–15
  - fertilisers 77, 111, 270
  - fertility rates 330, 332
    - and gender inequality 332–3
    - and life expectancy 304
  - field sketches 30
    - annotated 85
  - field trip, virtual 261, 273
  - fieldwork 33
    - case study 274–5
    - conducting 34
    - example, Lowcroft Vegetable Farm 34–7
    - location and inquiry questions 34
    - skills associated with 33
  - fire 199
  - fishing industry 208
    - sustainability 208–9
  - flood-prone rice 83
  - floods 93, 108, 264
  - flow diagrams 50
  - fluorinated gases 212
  - food, using appropriately 107
  - food accessibility 106–7
  - food aid, distribution, war-torn areas 100
  - food availability 106
  - food chains 194
  - food insecurity 64
    - Bolivia 341
    - Horn of Africa 112
    - and poverty 108
    - world 109
  - food loss 120
  - food production
    - in Australia 78–9, 141
    - and biome changes 56–65
    - challenges to 88–102
    - environmental constraints, India 319
    - factors affecting 108
    - rice 82–6
    - using genetic modification (GM) 118–19
  - food security 64, 68, 106–7, 309
    - climate change threats 322
    - environmental factors affecting 318–19
    - global patterns 108–9
    - how to improve? 114–15
    - and humanitarian aid 367
    - impact of population growth on 110
    - in India 318–19
    - into the future 110–11
    - threats to 88–102, 108
  - food shortages 101, 318
  - food types, ecological footprint 66
  - food waste 120
  - food webs 194–5
  - forced migration 160, 180–1
  - foreign aid
    - from Australian Government 368, 369
    - what's it for? 368–9
  - forests
    - agricultural impacts on 58
    - decline 224
    - management 244–5
  - fossil fuels 92, 199, 208, 213
  - four spheres model 258
  - frog chytrid fungus 210–11, 226
  - frog species decline 210–11
- 
- G**
- gambling 148
  - Ganges River, India 237
  - gender inequality
    - in education 334
    - and fertility rates 332
    - in government 334

and improving wellbeing for women and girls 360–1  
and job opportunities 335  
and poverty 335  
and spatial variations in wellbeing 334–5  
genetically modified (GM) foods 110, 118–19  
in Australia 119  
main benefits 118  
opposition to 119  
geographers role in managing environmental change 274–5  
geographic information systems (GIS) 30, 80, 278, 279  
maps 303  
geographical concepts 4–11  
geographical diagrams 29  
geographical inquiry skills 12–23  
geographical photographs 31  
analysing 20, 200  
collecting and evaluating 31–2  
geographical sketches 30  
geographical tools 24–35  
geological carbon cycle 198, 199  
Gibson, Miranda 206  
girls  
child marriage 361  
improved access to education 362  
improving wellbeing for 360–1  
glacier melting 8, 90, 92, 322  
Glines Canyon Dam, USA 235  
Global AgeWatch Index 354–5  
global positioning systems (GPS) 80, 278  
global scale 8  
global warming 8, 10, 92, 212, 262  
global wealth pyramid 307  
glossary 376–81  
gold rushes, and immigration 178, 187  
government  
corruption 338–9  
gender inequality in 334  
gradient, estimation on topographic maps 52  
graphs 26–8  
interpreting 176  
see also specific types, e.g. column graphs  
grasslands 224  
conversion for agriculture 59–60  
grasslands biome 42, 46–7, 60  
grazing animals 46  
Great Barrier Reef, climate change effects 263–4  
Great Dividing Range, influence on Australia's climate 140, 141  
Great Pacific Garbage Patch 270  
Green Revolution 93, 110, 114  
greenhouse effect 199  
greenhouse gases 212  
Gross Domestic Product (GDP)  
and human wellbeing 298, 300  
as a measure of wealth 306–7  
ground-level photographs 21, 200

groundwater 79, 198  
groynes 266, 276  
Guangxi Province, China, rural life 172–3  
Gulf of Mexico oil spill 291–3

---

**H**

habitat 196  
hard engineering structures  
coastal areas 266  
Old Bar, NSW, case study 274–5  
vs soft engineering, coastal areas 276–7  
health  
Bolivia 341  
and human wellbeing 298–9  
improvements, Indigenous Australians 364–5  
inequalities, Australia 352  
trends in 308–9  
health threats, from climate change 322  
high-tech farming 80–1  
historic factors  
affecting farming 72  
affecting spatial variation in wellbeing 316  
Horn of Africa, food insecurity 112  
housing, land for 96  
Human Development Index 302  
Australia 348  
Bolivia 340  
Indian states 319  
human environments 6, 192  
human factors influencing spatial variations 259  
human-induced changes 10, 11  
to the natural environment 56–65  
human rights 338, 361, 367  
human settlements, impact on coastal areas 266  
human wellbeing see wellbeing  
humanitarian aid 367  
hunger 308  
eradicating extreme 102  
world distribution 109  
hydroelectricity 233  
hydrological cycle 198  
hydrosphere 258

---

**I**

immigrants 178–9, 182, 183, 184, 185, 186–7, 332  
India  
environmental constraints on food production 319  
food security 318–19  
population movements 176  
urban slums, Mumbai 166–7  
Indigenous Australians  
caring for Country 246–7  
closing the wellbeing gap 356, 364–5  
health improvements 364–5  
holistic view of the natural world 248

improving wellbeing for 364–5  
and international migration 188–9  
'living water' 248–9  
wellbeing 300–1  
Indigenous farming practices  
South America 116  
Sub-Saharan Africa 117  
Indigenous lands and sites, Australia 188  
Indigenous peoples, rights of 367  
Indigenous Protected Areas 247–8  
individual organisms 196  
Indonesia, urbanisation 134–5  
Industrial Revolution 114, 336  
inequality  
reducing in Australia 353  
in wellbeing 314–15  
see also gender inequality  
infant mortality 308, 309, 332, 341, 360, 362  
infographics 121  
information and communications technology (ICT) and wellbeing 337  
infrastructure 124, 128  
insect pests, impact on food security 88, 94–5  
insects, as food 107  
integrated coastal zone management (ICZM) 282  
use in Bangladesh 283  
use in the Netherlands 284  
intensive farming 78, 79  
interconnection 7  
Indigenous Australians view of the natural world 248  
natural resources and colonisation 325  
population movements in Somalia 169  
Singapore and the importance of location 327  
internal migration 160, 162, 168  
internally displaced persons (IDPs) 169, 180, 181, 344  
international aid, and food security in war-torn areas 100  
international migration 160  
economic benefits 184  
and Indigenous Australians 188–9  
to Australia 178–9, 183–4  
international scale 8  
Internet use and population 337  
interpreting data 16  
invasive species/invasive alien species 94, 210, 226–9, 268  
irrigated rice 83  
irrigation 59, 60, 61, 62, 72, 115, 222

---

**J**

Jakarta, as megacity 132, 135  
Java, rice growing 84–5  
Jefferson, Thomas, idea of good government 338  
job opportunities, and gender inequality 335

---

**K**

Kokoda Trail, PNG 52–3  
krill 194, 195

**L**

Lake Chad, Africa, decline 231  
land  
    competition for, impact on food security 89, 96–7  
    for housing 96  
    suitability for agriculture 71  
    for tourism and recreation 96–7  
    used for fuel, impact on food security 89, 98–9  
land degradation 220–1, 224  
    repairing, Toolibin Lake, WA 242  
land pollution 215  
land reclamation 267  
land use  
    Australia 78  
    Mekong Basin 91  
land-use patterns, changing 56–7  
landfill 214, 215  
landscapes  
    impact on where Americans live 144  
    impact on where Australians live 140  
language diversity 182  
larger grain borer 94  
Las Vegas, Nevada 148–9  
Lee's migration model 168  
life expectancy 298, 308, 309, 330  
    Australia 354–5  
    and fertility rates 304  
line graphs 26, 149, 343  
literacy rates 310, 332  
    and human wellbeing 298, 299, 300  
lithosphere 199, 258  
little penguins 287  
livestock, in Australia 78  
'living water' (Indigenous Australian perspective) 248–9  
local scale 8  
    studies of wellbeing 350  
location 5  
    and human wellbeing 326–7  
    importance of, Singapore 327  
locust plagues 95  
logging 9, 44, 58  
loss of biodiversity 210  
    causes 210  
    coastal environments 268–9  
    and species extinction 210–11  
Lowcroft Vegetable Farm (fieldwork example) 34–7

**M**

Madagascar, deforestation and poverty levels 58  
malnutrition 341, 342  
managed retreat 275, 276, 277  
Mandingalbay Yidinji Indigenous Protected Area 247  
mangroves 244, 247, 264, 265, 267, 268, 283  
Manhattan Island, New York 5, 146  
manufacturing boom, China 174–5  
mapping wellbeing 302–3

maps 24–5  
    comparing patterns on 73  
    complex 99, 189  
    estimating size of features on 87  
    see also choropleth maps; topographic maps  
marine dead zones 271, 273  
marine pollution 270–1  
maternal mortality rate 332  
Médecins Sans Frontières (MSF) 370–1, 372  
media reports, to develop geographical questions 313  
megacities 124, 126–7, 132  
    Asia 132, 133, 135  
    United States 146–7  
    world 133  
megalopolis 142  
Mekong Basin 91  
Melbourne  
    growth corridors 153  
    population growth 170  
    public transport use 153  
    suburbanisation 152  
Mesopotamian Marshland, Iraq 250  
metal mining, impact on the environment 216–17  
methane 212, 214  
micro-credit 371  
migrant communities in Australia 186–7  
migrants 129, 168, 178, 179, 307  
    categories of 184  
migration 160, 162–3  
    forced 160, 180–1  
    internal 160, 162, 168  
    international 160, 178–9, 183, 186–7, 188–9  
    Lee's migration model 168  
    to Australia 162–3, 178–9, 183–7, 188–9  
    voluntary 162–3  
Millennium Development Goals (MDGs) 102, 358, 359, 362  
mind mapping 105  
mineral wealth, variations in 324  
mobile phones  
    growth worldwide 217  
    raw material components 216–17  
    recycling 241  
Mount Kilimanjaro, Kenya 6, 14, 21, 23, 25, 29, 31, 32  
mountain vegetation biome 42, 43  
moving for safety 180–1  
moving house, and stages of life 162  
moving to cities 164–5  
mulch 77  
multicultural Australia 178–9  
multiple-line graphs, creating 343  
Murray–Darling Basin 104, 141, 215  
    salinity management 232–3  
    water degradation 232–3

**N**

Namche Bazaar, Nepal 4  
national parks 235, 245, 250

national scale 8  
Native Americans 47  
native grasslands, changes 59–60  
native title 247  
natural change 10, 11  
natural decentralisation 156  
natural environments 6, 192  
    human-induced changes 56–65, 208–9  
natural factors influencing spatial variations 258  
natural pest control 115  
natural processes 6, 7  
    in coastal environments 256–7  
    managing, hard vs soft engineering techniques 276–7  
natural resources  
    and colonisation 325  
    influence on a country's wellbeing 324–5  
    use and sustainability 208  
Netherlands, integrated coastal zone management 283  
New Delhi, India, as megacity 127, 132  
New Ecological Paradigm (NEP) scale 206–7  
New York  
    life in 146–7  
    as megacity 146  
Ningaloo Coast, WA 290–1  
nitrous oxide 212  
non-government organisations (NGOs) 342, 360, 365  
    aid to improve wellbeing 370–1  
non-native plants and animals, impact on food security 88, 95–6  
North Korea, wellbeing 317, 339  
northern Australia, farming 79  
nutrients 76, 77

**O**

obesity, as global epidemic 312–13  
objective indicators of wellbeing 300, 348  
oblique aerial photographs 21, 146, 247, 274, 280  
oblique photographs 200  
ocean acidification 264  
OECD Better Life Index 301  
oil reserves and rate of oil use 324  
Old Bar, NSW, coastal issues 274–5  
Oosterscheldekering, Zeeland 285  
oral presentations 103  
organisation (space) 5  
outsourcing of jobs 337  
overfishing 266  
overgrazing 64  
overlay maps, constructing from satellite images 251  
oxygen cycle 199

**P**

Palm Island, Qld, Cathy Freeman Foundation work 365  
paper consumption 44

parasitic plants 43  
 pattern (PQE method) 18  
 patterns in data  
   PQE method 18, 20  
   SHEEPT method 18, 20  
 patterns on maps  
   comparing 73  
   describing 82  
 peace and security, UN role 366  
 Penguin Parade, Phillip Island, Vic 287  
 permanent migrants 184  
 Perth, urban growth 171  
 pest control 115  
 pesticides 60, 111, 214, 269  
 pests, impact on food security 88, 94–5  
 photolysis 199  
 photosynthesis 194, 199  
 physical pollutants 236  
 place 4  
   birth of multicultural Australia 179  
   the two Koreas – a study in wellbeing 317  
 planetary management 240  
 planning a geographical inquiry 14  
   about Mount Kilimanjaro, Kenya 14  
 plastics 216, 270  
 polar lands biome 42, 43  
 Police Lagoons, Qld 249  
 political factors, affecting spatial variation in wellbeing 316, 338–9  
 pollution 60, 130, 175, 214–15, 230  
   see also coastal pollution; water pollution  
 population 196  
 population change  
   Australia 170  
   China 136  
   and wellbeing 328–9  
 population density  
   Australia 138, 139  
   China 137  
   Indonesia 134  
   Manhattan, NY 146  
   United States 143  
 population growth  
   impact on coasts 266–7  
   impact on food security 110  
   and variations in wellbeing 332–3  
 population movements 168  
   in Australia 170–1  
   in China 172–3  
   in India 176  
   push factors/pull factors 168  
   in Somalia 169  
 population pyramids 27, 330  
   constructing 331  
 population structure, changes in 330–1  
 population trends 328–9  
 Port of Sydney 7  
 ports 7, 266, 326

poverty  
   alleviation, Bangladesh 371  
   Bolivia 340  
   China 174  
   and deforestation 58  
   and food insecurity 108  
   and gender inequality 335  
   and hunger 102  
   world 302  
 PowerPoint presentations 22  
 PQE methods 18, 20, 82  
 precipitation 198  
 precision farming 80  
 primary data 14, 20  
 processing geographical information 16–19  
   fieldwork 34, 35  
 producers 194, 195  
 push factors/pull factors 168  
 Pyramid Creek, Vic, salt interception 233  
 Pymont-Ultimo, Sydney, urban renewal 154–5

## Q

Qatar, levels of wealth 307  
 qualitative data 20, 300  
 quality of life rankings, Australia 348  
 quantify (PQE method) 18  
 quantitative data 20, 300  
 questionnaires 113

## R

rabbits 226  
 rain shadows 145  
 Rainbow Beach, Qld, dune erosion 280  
   Coastcare remedial strategies 281  
 rainfall  
   Australia 140, 141  
   United States 145  
 rainfed rice 83  
 rainforest ecosystems 50–1  
 rainforests 48–9  
   Australia 48, 49, 245  
   changes 50  
   clearing for agriculture 58, 224  
   ecosystem services 49  
   energy flows 51  
   management 245  
   species abundance 42–3  
 raw materials, in mobile phones 216–17  
 recycling 241  
 red-tailed phascogale 243  
 reflecting 22  
 refugees 169, 180–1, 185, 315, 344, 367  
   wellbeing in Australia 372–3  
 regional cities, decentralisation to 156  
 regional scale 8  
 reliability of data 16  
   website information 17  
 representing data 16  
 reservoirs 61, 230, 234–5

responding 23  
 revegetation 65  
 rice 82–5  
 rice growing  
   in Australia 86  
   in Java 84–5  
   methods 83  
 rice production, world 82  
 rivers  
   damming of 61, 230, 234–5  
   restoration 235  
 rock weathering 76  
 Royal Flying Doctor Service (RFDS) 353  
 rural life, China 172–3  
 rural population 126  
   impact of China's manufacturing boom on 174–5  
 rural-urban divide 352  
 rural-urban migration 164

## S

Saami people, and climate change 213  
 salinity 62, 63, 215, 222  
   Murray–Darling Basin 232–3  
   Toolibin Lake, WA 242–3  
   in the Western Australian wheat belt 223  
 salt marshes 264, 265, 267, 268, 277  
 sand mining 275, 280  
   Sierra Leone, responses to 288–9  
 Sao Paulo, Brazil, inequality 296  
 satellite images 20, 21  
   constructing overlap maps from 251  
   to analyse environmental change 225  
 Saudi Arabia, greening the desert 59  
 savanna 46, 224  
 scale 8  
   life in Bolivia's cities 342  
 scatter plots (scatter graphs) 28, 304  
   constructing using Microsoft Excel 305  
 schools, successful 363  
 sea change 162  
   effect on coastal communities 162–3  
 sea-level rises 92, 93, 262–3, 264, 272, 322  
 sea temperature rises 263, 264, 269  
 sea walls 275, 276  
 seagrass beds 268  
 secondary data 15, 16, 20  
   analysing 67  
 sediment 269, 270  
 services (ecosystem services) 205  
 sewage discharge 266  
 Shanghai, China, as megacity 133  
 SHEEPT method 18, 20  
 Shenzhen, China, urban life 173  
 shipping routes 326, 327  
 Sierra Leone, sand mining 288–9  
 Singapore, importance of location 327  
 sinks (ecosystem services) 205  
 Snowy Mountain Hydroelectric Scheme 179

social advantages/disadvantages of cities 129, 130–1  
social factors, affecting spatial variation in wellbeing 316  
soft engineering coastal management techniques 276–7  
soil contamination 215  
soil degradation 62, 220, 222–3  
soil erosion 220  
soil horizons 76–7  
soil management 114  
soil properties, impact on farming 72  
soil salinity 62  
    managing 63  
soils 76–7  
    Australia 77, 79  
Somalia  
    armed conflict, food aid and food shortages 100, 101  
    population movements 169  
sources (ecosystem services) 205  
South American traditional Indigenous farming practices 116  
South Korea, wellbeing 317  
Southern Brown Bandicoot 153  
space 5  
    agricultural suitability 71  
spatial distribution 5  
spatial technologies 29–32  
    use to predict environmental change 278–9  
spatial variation in environments, causes 258–9  
spatial variation in wellbeing  
    causes 316–17  
    climate influence 320–1  
    environmental causes 318–19  
    and gender 334–5  
    human causes 328–9  
    influence of location 326–7  
    and the issue of climate change 322–3  
    natural resource influences 324–5  
    and politics 338–9  
    and population growth 332–3  
    and technology 336–7  
species facing extinction 210–11  
spirituality (ecosystem services) 205  
stacked column graph 26  
stage of life, and moving house 162  
stewardship 240  
stored crops, and larger grain borer 94  
Sub-Saharan Africa  
    climate change impacts 92  
    impact of larger grain borer 94  
    infant mortality 309  
    life expectancy 309  
    primary school enrolment rates 310–11  
    traditional Indigenous farming practices 117  
subjective indicators of wellbeing 300, 348–9  
subsistence farmers 94  
subsistence farms 111  
subtropical rainforests 48

suburbanisation 150, 152  
    advantages/disadvantages 152  
    Melbourne 152–3  
suburbs 142  
    decentralisation to 156  
    fastest growing, Australia 171  
supermarket foodstuffs, origins 70  
surface run-off 198  
surveys 113  
sustainability 9  
    Africa's disappearing lake 231  
    challenges to 208  
    fishing industry 208–9  
    greening the desert 59  
    Indigenous Australian perspective 249  
    Penguin Parade, Phillip Island, Vic 287  
    river restoration project 235  
    salinity management 63  
Sustainable Development Goals (SDGs) 102, 358, 360, 362, 366  
Syrian civil war and refugees 314–15

---

**T**  
tables 29  
Tarkine Wildernss Area, Tas. 245  
technological factors affecting farming 72, 73  
technology, and spatial variations in wellbeing 336–7  
temperate forest biome 42, 44–5  
temperate rainforests 48, 49, 245  
temperature variation  
    boreal forest biome 44  
    temperate forest biome 45  
temporary migrants 184  
terrain models 25  
thirst 308  
Tokyo, Japan, as megacity 126, 132  
Tokyo Bay, Japan, land reclamation 267  
Toolibin Lake, WA, repairing degraded land 242–3  
topographic maps 24, 285  
    estimating gradient and aspect 52  
    interpreting 219  
    to explore environmental change 229  
tourism  
    ecotourism 247, 286–7  
    land for 96–7  
    Las Vegas, Nevada 148  
    reducing impacts from, coastal areas 266  
trade 7  
trade routes, access to 326  
traffic congestion 131  
transpiration 198  
tropical cyclones 264  
tropical forest biome 40, 42–3, 48–9, 224  
tropical rainforests 48  
    clearing for agriculture 58, 224  
    ecosystem services 49  
    energy flows 51  
tundra, movement of 213

tundra biome 40, 42, 43  
Tuvalu, sea-level rise effects 264, 265

---

## U

undernourished people 102, 109  
United Nations  
    comments on standard of health in Indigenous Australian communities 364  
    convention aimed at ending discrimination against women 367  
    Declaration on the Elimination of Violence against Women 361  
    development role 366  
    human rights role 367  
    humanitarian aid 367  
    Millennium Development Goals 102, 358, 359, 362  
    peace and security role 366  
    protecting the rights of children 367  
    Refugee Convention 344  
    rights of indigenous peoples 367  
    role of the 366–7  
    Sustainable Development Goals 102, 358, 360, 362, 366  
    Universal Declaration of Human Rights 338, 344, 367  
United Nations Global Education First Initiative 362, 363  
United States  
    megacities 146–7  
    population density 143  
    rainfall 145  
    urban areas 142–3  
    why Americans live where they do 144–5  
Universal Declaration of Human Rights 338, 344, 361, 367  
upland rice 83  
urban areas  
    growth, Perth 170, 171  
    United States 142–3  
urban drift 164  
urban life, China 173  
urban population 126  
    Indonesia 134–5  
urban renewal 150, 154–5  
    advantages/disadvantages 154  
    Barangaroo, Sydney Harbour 158  
    Pyrmont-Ultimo, Sydney 154–5  
urban slums 164, 166–7, 342  
    Dharavi slum, Mumbai, India 166–7  
urban sprawl 96, 97, 143, 153  
urbanisation 124, 126–7  
    China 136  
    Indonesia 134–5  
    see also cities; megacities

---

## V

vertical aerial photographs 21, 285  
    comparing 158  
vertical photographs 200–1

violence against women 360–1  
virtual field trip 261, 273  
visual representations 29–32  
voluntary migrants 162  
voluntary migration 160  
    in Australia 162–3  
volunteers 372

---

## W

water  
    agricultural use 59, 60  
    clean water 308, 318  
    Indigenous Australian perspective 248–9  
water cycle 198  
water degradation 230–1  
    Murray–Darling Basin 232–3  
water flows, changes to 61  
water hyacinth 226  
water management 115  
water pollutants 236  
    biological pollutants 237  
    chemical pollutants 237  
    physical pollutants 236  
water pollution 214, 230  
    from farming 60  
    sources of 236–7  
water resources, Indigenous Australian perspective 248–9  
water scarcity, impact on food security 88, 90–1  
water security, environmental factors affecting 318–19  
water table 62, 63, 215, 222  
water vapour 198  
wealth  
    and human wellbeing 298  
    measuring 306–7  
    Qatar 307  
    trends in 306–7  
weather patterns 8  
weathering 76, 77  
websites, reliability 17

wellbeing 295  
    for the aged, Australia 354–5  
    in Australia 348–9, 352–5  
    in Bolivia 340–2  
    causes of variation in 316–17  
    and climate 320–1  
    and climate change 322–3  
    and development 298–9  
    and education 299, 310–11, 362–3  
    environmental factors affecting 318–19  
    exploring links between 304–5  
    global indicators 298–9, 300  
    and health 298–9, 308–9  
    human factors affecting 328–9  
    improving wellbeing and development 358–9  
    for Indigenous Australians 300–1, 356, 364–5  
    inequalities in 314–15  
    local scale investigations 350–1  
    and location 326–7  
    mapping 302–3  
    measuring 300–1  
    and natural resources 324–5  
    objective and subjective indicators 300, 348–9  
    OECD Better Life Index 301  
    organisations working to improve 366–7  
    and politics 316, 338–9  
    population affect on 330  
    Singapore 327  
    and technology 336–7  
    two Koreas 317  
    and wealth 298, 306–7  
    women and girls 332, 334–5, 360–1  
West Welcome Wagon 373  
Western Australia, dryland salinity 223, 242–3  
wetlands 247, 249, 250  
White Australia Policy 178, 187  
women  
    convention aimed at ending discrimination against 367  
    family planning 329, 360  
    improved access to education 362

improving wellbeing for 360–1  
inequality 332, 334–5  
violence against women 360–1  
world  
    agricultural regions 75  
    biomes 42–3  
    charitable giving index map 372  
    climate zones 75, 320  
    coral reefs at risk 269  
    economic freedom and repression 338, 339  
    fish production 208  
    food insecurity levels 109  
    gender inequality in education 334  
    Gross Domestic Product (GDP) 207  
    Human Development Index ratings 302  
    hunger levels 102, 308  
    Internet use and population 337  
    literacy rates 310  
    marine dead zones 273  
    megacities 133  
    oil reserves and use 324  
    percentage of women in national governments 334  
    pollution distribution 215  
    proportion of population living in poverty 302  
    refugees and internally displaced persons 181  
    rice production 82  
    shipping routes and container ports 326  
    total fertility rates 333  
World Bank GIS maps 303  
worldviews  
    about the environment 206–7  
    about managing environmental change 240–1

---

## Y

Yousafzai, Malala 363

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## Z

Zeeland, Netherlands  
    integrated coastal zone management 284  
    topographic map 285

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**Chapter 4:** **AAP/Wallenius Wilhelmsen**, 4.33; **Airviewonline**, 4.14; **Alamy/David Hancock**, 4.44; **Andrea Benton**, 4.13; **Corbis/Arindam Dey**, 4.10a/Robert Harding World Imagery, 4.10b/imagechina, 4.1, 4.18/James Marshall, 4.6/Frederic Soltan, 4.8, 4.9/Keren Su, 4.21; **FairfaxPhotos/Steve Baccon**, 4.34 (Anh Do)/Drew Ryan, 4.4; **Getty images/John Cantile**, 4.11/Matt Carr, 4.34 (Jessica Mauboy)/Jonas Gratzler, Unit opener/Chris Jackson, 4.34 (Julia Gillard)/Sungin Kim, 4.5/Joosep Matinson, 4.34 (Tim Mannah)/Diana Mayfield, 4.15/STR, 4.17/Dennis Walton, 4.22; **National Library of Australia**, 4.28, 4.30; **Newspix/Stuart McEvoy**, 4.38/Rebecca Michael, 4.39; **Shutterstock**, p. 161, p. 166, p. 168, p. 170, p. 172, p. 186.

**Chapter 5:** **AAP Image/AP Photo/Itsuo Inouye**, 5.10; **Corbis/Gerald & Buff Corsi**, 5.3/Michael S. Yamashita, 5.11; **Getty Images/John Carnemolla**, 5.4/George Lepp, 5.5 (group of zebras)/Whitworth Images, 5.1; **Shutterstock**, 5.5 (zebra, African animals), p. 193, p. 194, p. 197; **SPOT** imagery supplied by Geoimage Pty Ltd (c) CNES 1991, 5.12.

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McKenzie, 6.23; **Shutterstock**, 6.2, 6.30, 6.40, 6.49, 6.59, p. 203, p. 205, p. 212, p. 218, p. 221, p. 224, p. 226, p. 239, p. 240, p. 244, p. 246, p. 248; © **Union of Concerned Scientists**/Justin Bilicki, 6.7; **USGS**, 6.45.

**Chapter 7:** **AAP/AP/NOAA Pacific Islands Fisheries Science Centre**, 7.23 (insert);/Gerald Herbert, 7.56/University of Queensland/Ove Hoegh-Guldberg, 7.12; **Airviewonline**, 7.38; **Alamy**, 7.42/Chris Gomersall, 7.33/Frans Lemmens, 7.32/Suzanne Long, 7.53; **APN**, 7.39; **Commonwealth of Australia**, 7.25; **Corbis**/Ashley Cooper, 7.13/Imaginechina, 7.21/Robert Harding, 7.18/Jerry Lampen, 7.1; **M. Edmiston-Prior**, 7.41, 7.42; **ESRI**, 7.37; **Getty Images**/AFP, 7.5/Chris Jackson, 7.52/Tim Laman, 7.17/Peter Harrison, 7.4 /Frans Lemmens, 7.46/Majority World, 7.22/MIXA, 7.15b/Oilvier Morin, 7.14; **iStockPhoto**/Alysta, 7.15a; **Merrett Survey**, 7.35, 7.36; **NASA**, 7.47; **National Geographic Creative**, 7.16; **Newspix**/David Clark, 7.30 /Greg Cutler, 7.28/John Grainger, 7.9/Greg Noakes, 7.50; **Oceanus**, 7.23; **Ozaerial**, 7.27; **Shutterstock**, 7.19, 7.29, 7.49, 7.8, p. 253, p. 254, p. 258, p. 266, p. 278, p. 280-81, p. 283, p. 286, p. 287, p. 288-9; **UNPD**, 7.44.

**Chapter 8:** **AAP/AP**, 8.23, 8.29; **Alamy**/Paul Gregg, 8.55/Powderkeg Stock, 8.38; **Corbis**/Noah Addis, 8.1/Antoine Gyori 8.49/Imaginechina, 8.42/Ton Koene, 8.34/Alan Nogue, 8.59/Charles Pertwee, 8.40/Anders Ryman, 8.61/Hugh Sitton, 8.18/George Steinmetz, 8.65/Jim Wark, 8.33; **Gapminder**, free material from [www.gapminder.org](http://www.gapminder.org), 8.10; **FSD International**, 8.64; **Getty Images**/Bloomberg, 8.2/Thierry Falise, 8.57/Lynn Gail, 8.4/Sean Gallup, 8.14/Jacques Lange, 8.46/Jane Sweeney, 8.54; **NASA**, 8.35; **Panos**/Rob Huibers, 8.3/Eduardo Martino, 8.63/Giacomo Pirozzi, 8.17/David Rose, 8.48/Dermot Talow, 8.62; **Shutterstock**, 8.26, p. 297, p. 298, p. 308, p. 310, p. 314, p. 322-3, p. 324, p. 326, p. 328, p. 341; **USAID**, 8.53; **World Bank**, 8.8.

**Chapter 9:** **AAP/AP**, 9.43/Ausaid, 9.36; **Airviewonline**, 9.3, 9.7; **Alamy**/Dinodia Photos, 9.1/dpa picture alliance 9.41; **AusAid**, 9.33, 9.34, 9.35, 9.37/Lorrie Graham, 9.48; **Aus-emaps**, 9.9; **Ian Cochrane**/[www.iancochrane.com.au](http://www.iancochrane.com.au), 9.4; **Corbis**/Yahya Arhab, 9.22/Karen Kasmauski, 9.42/Franco Pagetti, 9.31/David Pollack, 9.25/David Turnley, 9.23; **Getty Images**/Walter Astrada, 9.29/Silvia Jansen, 9.12/Ullstein Bild, 9.17; **Global AgeWatch Index 2015**: Insight report, HelpAge International, 9.13; **Newspix**/David Caird, 9.28/Brett Costello, 9.16; **Panos**/Peter Barker, 9.21; **Royal Flying Doctor Service**, 9.11; 'Antoinette'. Portrait by Wendy Sharpe from **Seeking Humanity**, 9.45; **Shutterstock**, p. 347, p. 351, p. 355, p. 358, p. 366; **UN**, 9.18, 9.19; **United Nations Photo Library**, 9.30; **World Vision Australia**, 9.47.

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