

Urban expansion threatens the current and future production of food.

CHAPTER 5

# Challenges to food production

## 5.1 Overview

### 5.1.1 Introduction

Food needs sunlight, water, land and good soil to be able to grow. Easy, right? The increasing scarcity of water, and demands on land for housing and other fuel, as well as climate change, have all made the production of food both today and in the future increasingly complex.

#### Starter questions

- 1 How long has it been since you had anything to eat?
- 2 How many different food items have you eaten today?
- 3 How many of these did your family grow?
- 4 Do you know when and where your next meal is coming from?
- 5 Do you feel secure in knowing that you have food in your home?
- 6 Why do you think we have so many people hungry when there is enough food produced in the world?
- 7 How will the world feed its future population?

#### Inquiry sequence

#### Syllabus outcomes

| Inquiry sequence  | Syllabus outcomes   |
|---|---------------------|
| 5.1 Overview  |                     |
| 5.2 How does water security affect food production?                                       | GE5-1, GE5-3        |
| 5.3 How does pollution affect food production?  | GE5-1, GE5-3        |
| 5.4 <b>SkillBuilder:</b> Constructing and describing complex choropleth maps              | GE5-2, GE5-3        |
| 5.5 How does land degradation affect food production?                                     | GE5-2, GE5-3        |
| 5.6 How does a famine develop?  | GE5-2, GE5-3        |
| 5.7 How does land use affect food production?   | GE5-2, GE5-3        |
| 5.8 <b>SkillBuilder:</b> Interpreting satellite images to show change over time           | GE5-3, GE5-7        |
| 5.9 How is Sydney expanding?  | GE5-2, GE5-3        |
| 5.10 How does climate change affect food production?                                      | GE5-3, GE5-5        |
| 5.11 <b>Investigating topographic maps:</b> What can we eat from Yarra Yarra Creek Basin? | GE5-3, GE5-7        |
| 5.12 <b>Review</b>  | GE5-2, GE5-3, GE5-5 |
| <b>Key terms</b>  |                     |



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Food for thought

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## 5.2 How does water security affect food production?

### 5.2.1 Are we running dry?

There is no substitute for water. Without water there is no food, and agriculture already consumes 70 per cent of the world's fresh water. Every type of food production — cropping, grazing and

processing — requires water. Thus, a lack of water is possibly the most limiting factor for increasing food production in future.

To feed an additional two billion people by 2050, the world will need to generate more food and use more water. The two main concerns that threaten future water security are water quantity and water quality (see figure 1).

### 5.2.2 Why are we running low on water?

In theory, the world has enough water; it is just not available where we want it or when we want it, and it is not easy to move from place to place. We already use the most accessible surface water, and now we are looking for it beneath our feet. Underground aquifers hold 100 times more water than surface rivers and lakes. However, groundwater is not always used at a sustainable rate, with extraction exceeding natural recharge, or filling.

This occurs in many of the world's major food-producing places, in countries such as the United States, China and India.

Water insecurity is connected with food insecurity. An area is experiencing **water stress** when water supplies drop below 1700 m<sup>3</sup> per person per year. When annual water supplies drop below 1000 m<sup>3</sup> per person the population faces water scarcity, and below 500 m<sup>3</sup> 'absolute scarcity'. According to the United Nations, approximately 700 million people currently suffer from water scarcity (2016). It is expected that by 2025, 1.8 billion people will be living in conditions of absolute water scarcity and that 67 per cent of people will be experiencing water stress. By 2030, it is projected that half of the world's population will experience high water stress conditions. Figure 2, which shows an interconnection between increased demand for water and predicted climate change, population increase and greater industrialisation in the 2050s.

When water availability drops below 1.5 million litres per person per year, a country needs to start importing food, although that makes the country susceptible to changes in global prices. Developing countries that experience water stress cannot afford to import food. They are also more vulnerable

to environmental disasters. Seventy per cent of food emergencies in developing countries are brought on by drought.

- *Food production.* It is estimated that an additional 6000 cubic kilometres of fresh water will be needed for irrigation to meet future food demand. Changes in diet, especially increased meat consumption, require more water to grow the crops and pasture that feed the animals. A typical meat eater's diet requires double the amount of water that a vegetarian diet requires.

**FIGURE 1** Water scarcity is a serious threat to food security.



**water stress** situation that occurs when water demand exceeds the amount available or when poor quality restricts its use

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##### Interactivity

##### The last drop

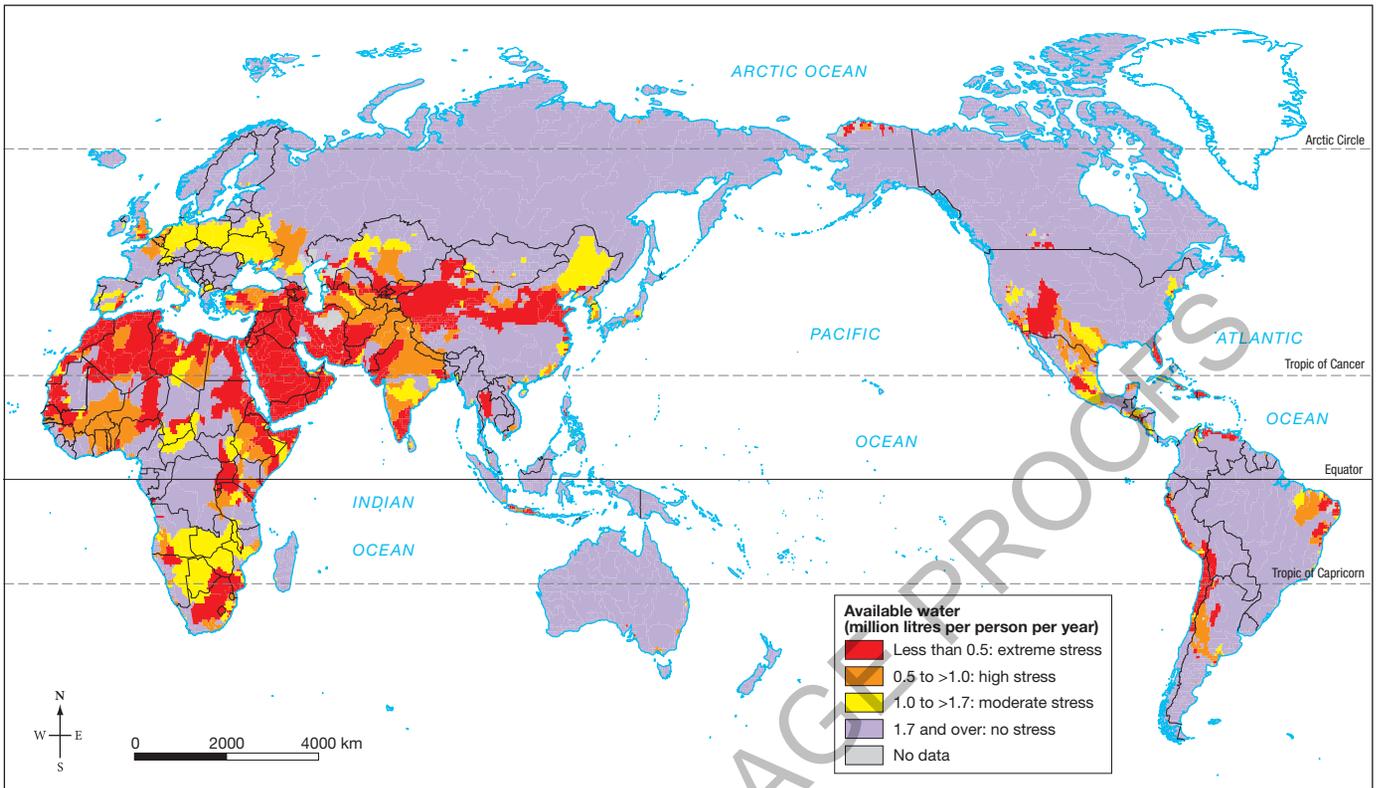
Use this interactivity to further your understanding of the reasons for growing water shortages.

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**FIGURE 2** An increasing number of people around the world will face water stress and water scarcity



**FIGURE 3** How water availability may change with temperature, population and industrialisation increase, 2050s



Source: Spatial Vision

### FOCUS ON FIELDWORK

Fieldwork involves investigation: to determine the importance of water in the production of food you can conduct an investigation of the food found in your kitchen and determine how much water is required in its production. Firstly, you must determine what the raw ingredients are,

for example a packet of chips (depending on the type) is made up of potatoes, vegetable oil and salt. Secondly, conduct research online to determine how much water is needed to produce each of the raw materials. Construct a table to show which foods use the most water.

### eBookplus

#### Weblinks

- Water use
- Water availability

### ACTIVITIES

#### IDENTIFY

- Describe the difference between water scarcity and water stress.
  - With reference to data, describe the projected changes in the numbers of people affected by water shortages (both scarcity and stress) over the period from now until 2030.
- If a country has an average of 0.5 to <1.0 million litres of water per person, per year, would they be considered to be water stressed? Why?

#### EXPLAIN

- Refer to figure 2. Describe those *places* in the world that are predicted to be in high to extreme water stress in the 2050s.
  - Compare your answer with a map of world average rainfall. Are areas that are predicted to be suffering high to extreme stress by 2050 also areas of low rainfall?

#### INVESTIGATE

- Use the **Water use** weblink in your eBookPLUS to select a country and find out more about its water usage. Using the data on this website, construct a table to compare water usage for four countries — one from each continent of Europe, Africa, Asia and South America. (Try to select different countries from those chosen by other students.) Write a paragraph to summarise your findings.

#### PREDICT

- Use the **Water availability** weblink in your eBookPLUS and scroll to the 2020s map. Compare this with the map for 2050. What are the three most significant **changes** you can see?

#### APPLY

- What do you think water managers could do to help prevent water scarcity affecting future food security?

## 5.3 How does pollution affect food production?

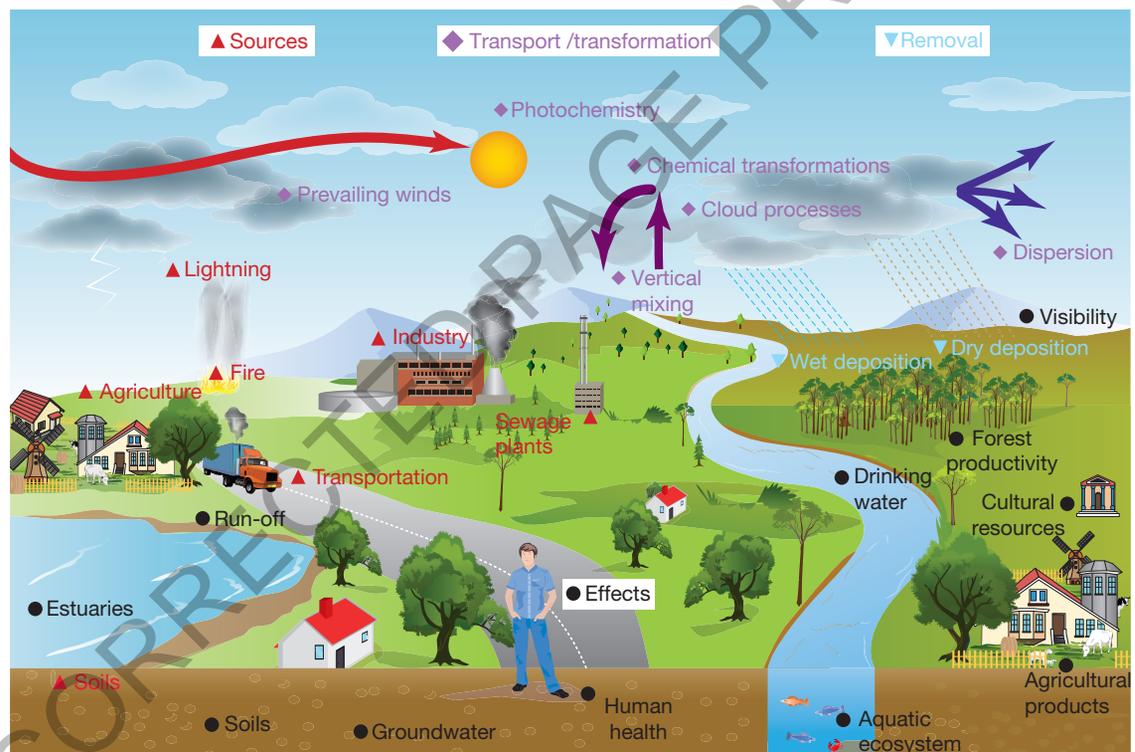
### 5.3.1 What are the impacts of pollution on food production?

Pollution affects agricultural activity, or food production, almost as much as does water scarcity. In fact, pollution of air and water poses one of the greatest threats to the production of food. The irony is that much of the pollution in the water comes from agricultural processes themselves.

Agriculture is a major contributor to water pollution. Excess nutrients, pesticides, sediment and other pollutants can run off farmland or leach into soils and groundwater. Excessive irrigation can cause waterlogging or soil salinity. This salty water not only poisons the soil but also drains into river systems. Industrial waste, untreated sewage and urban run-off also pollute water that may be used to irrigate farmland. Food that is irrigated with polluted water can actually pass on diseases to people. Pollution is an important contributor to the scarcity of clean, **potable** water.

**potable** drinkable;  
safe to drink

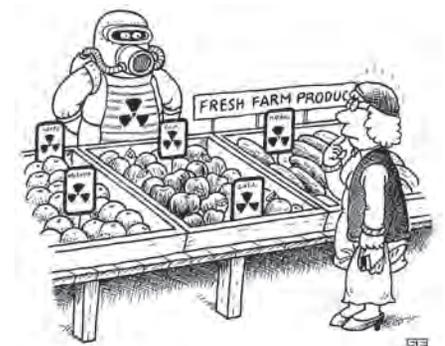
**FIGURE 1** Global pollutants circuit



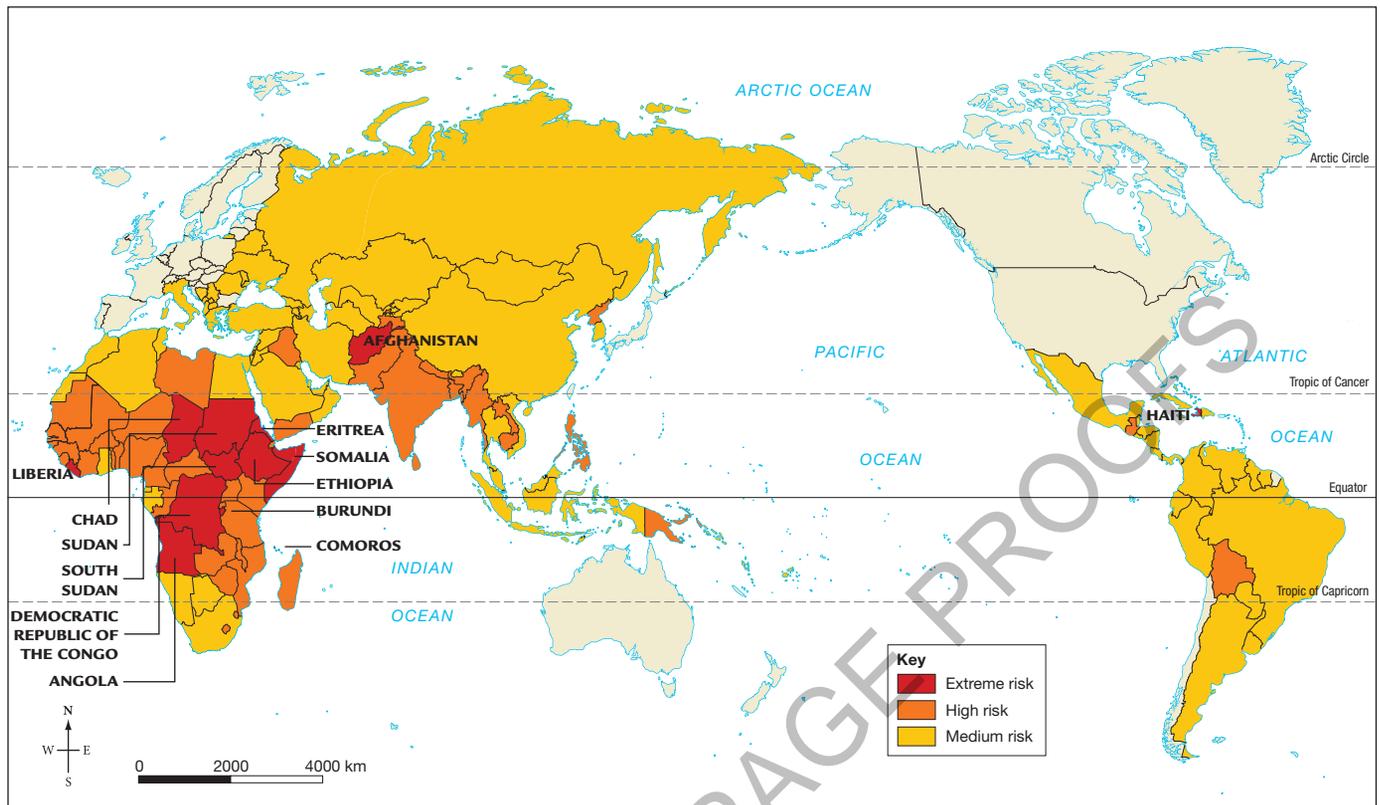
### 5.3.2 Air pollution

Figure 1 demonstrates the variety of ways in which the sources of air pollution can be transported or transformed into harmful effects. These can have a considerable impact on our food production, not only in a direct manner in the form of agricultural products (bottom right) but also indirectly through some of the other effects (shown with black dots in figure 1).

**FIGURE 2** An apple a day may not keep the doctor away.



**FIGURE 3** Countries with medium to extreme risk of food insecurity



Source: maplecroft.com

**TABLE 1** Countries with high or extreme risk of food insecurity

| Rank | Country     | Category | Rank | Country                  | Category |
|------|-------------|----------|------|--------------------------|----------|
| 1    | DR Congo    | Extreme  | 11   | Comoros                  | Extreme  |
| 1    | Somalia     | Extreme  | 12   | Sudan                    | Extreme  |
| 3    | Burundi     | Extreme  | 13   | Central African Republic | High     |
| 4    | Eritrea     | Extreme  | 14   | Djibouti                 | High     |
| 5    | Angola      | Extreme  | 15   | Zimbabwe                 | High     |
| 6    | Chad        | Extreme  | 16   | Yemen                    | High     |
| 7    | Ethiopia    | Extreme  | 17   | Sierra Leone             | High     |
| 7    | Haiti       | Extreme  | 18   | Mozambique               | High     |
| 9    | Afghanistan | Extreme  | 19   | North Korea              | High     |
| 9    | Liberia     | Extreme  | 20   | Kenya                    | High     |

### 5.3.3 What happens when people do not have food security?

For the 800 million people who do not have enough to eat, the issue of finding sufficient and nutritious food must be faced daily. At least 75 per cent of the world's people are **undernourished**, with diets that are minimal or below the level of sustenance. People who do not have a regular and healthy diet often have shortened life expectancy and an increased risk of disease. Children are especially vulnerable to poor diet, and their growth, weight, physical and mental development suffer. Almost 50 per cent of India's children are **malnourished**, and it is estimated that there are 146 million children in the world suffering chronic hunger.

This is often referred to as the 'double burden' of disease. This means that those who are most at risk of having poor diets are more likely to suffer from the effects of disease. Once a disease has been contracted it has an impact on the health and functioning of those individuals.

**undernourished** describes someone who is not getting enough calories in their diet; that is, not enough to eat

**malnourished** describes someone who is not getting the right amount of the vitamins, minerals and other nutrients to maintain healthy tissues and organ function

## ACTIVITIES

### EXPLAIN

- a** Examine figure 1 and make a list of the sources of pollution and factors that remove pollution.
  - b** Compare the two and suggest what happens as a result of the unevenness of the two lists
- What are some of the effects that pollution can have on food production?
  - Why is agriculture both a contributor to and victim of water pollution?

### INVESTIGATE

- Select one of the countries identified in figure 3 and find out more about its

agricultural production. Does agriculture contribute to pollution as well as suffering from it?

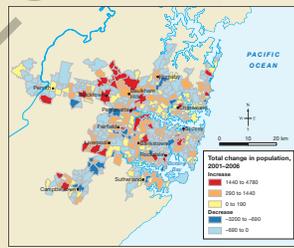
### APPLY

- What does figure 2 suggest about the potential for pollutants to affect food production?
- Draw your own cartoon indicating one of the issues that pollutants cause in agriculture.
- Looking at figure 3 and table 1, what trends can you identify in the location of countries at risk of food insecurity?

## 5.4 SkillBuilder: Constructing and describing complex choropleth maps

### What is a complex choropleth map?

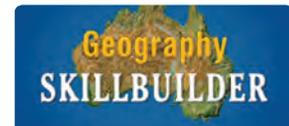
A complex choropleth map is a map that is shaded or coloured to show the average density or concentration of a particular feature or variable, and it shows an area in detail. The least dense or lowest concentration is usually the lightest shade. Average values are attached to the colour shadings in the key or legend. A complex choropleth map is used to show values in a pictorial way.



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### eLesson

Watch this video to learn how to construct and describe complex choropleth maps.



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### Interactivity

Try this interactivity to learn how to construct and describe complex choropleth maps.



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## 5.5 How does land degradation affect food production?

To access this subtopic, go to your eBookPLUS at [www.jacplus.com.au](http://www.jacplus.com.au).

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## 5.6 How does a famine develop?

### 5.6.1 Why did Somalia have a famine?

While many countries across the globe face food insecurity, it is rare for a country or region to be officially declared in **famine**. At the same time that countries in the Horn of Africa were suffering drought, much of southern Australia was similarly affected. Yet we did not suffer from food insecurity, nor was a famine declared. Why is there such a difference?

**famine** a drastic, widespread food shortage

Somalia is located in the Horn of Africa. It is an arid place with less than 2 per cent **arable** land. For 20 years, the country suffered almost continual hardship. A *combination* of political, economic and environmental factors combined to create an acute food crisis. The United Nations declared a famine in two parts of southern Somalia in July 2011, and a month later the famine spread to four more regions. Figures 2 and 3 show the progression of the famine across the country. In all, 42 per cent of the population needed emergency life-saving assistance over the six months of the declared famine.

**arable** land that can be used for growing crops

**FIGURE 1** Famine in Somalia, May 2011



#### What contributed to the famine?

- The country experienced the worst drought in 60 years, which led to failed harvests.
- Prices of both local and imported foods soared; cereal prices increased up to 190 per cent.
- Since the 1990s, there have been 14 failed attempts to achieve peace and reconciliation within the country.
- The militant Islamist al-Shabaab group banned most Western aid agencies and expelled the Red Cross from areas it controlled.
- Somalia has not had a functioning central government for more than 20 years.
- Conflict and a shortage of food caused people to flee rural areas, creating large-scale displacement.
- Half of all food aid sent to Somalia is stolen.
- Somalia is dependent on imports for over 60 per cent of its food supply (mostly rice and wheat flour).
- The country lacks good road and rail infrastructure, so food cannot be moved around and delivered easily. Frequent militia-run checkpoints make travel dangerous.
- Shipping has been affected by increased pirate attacks in the Gulf of Aden. This has further increased the shortage and cost of imported foods.
- The main port can only deal with small ships. Larger ships have to offload into smaller ones in Dubai or Oman, which increases the costs of food items.

## What were the impacts of famine?

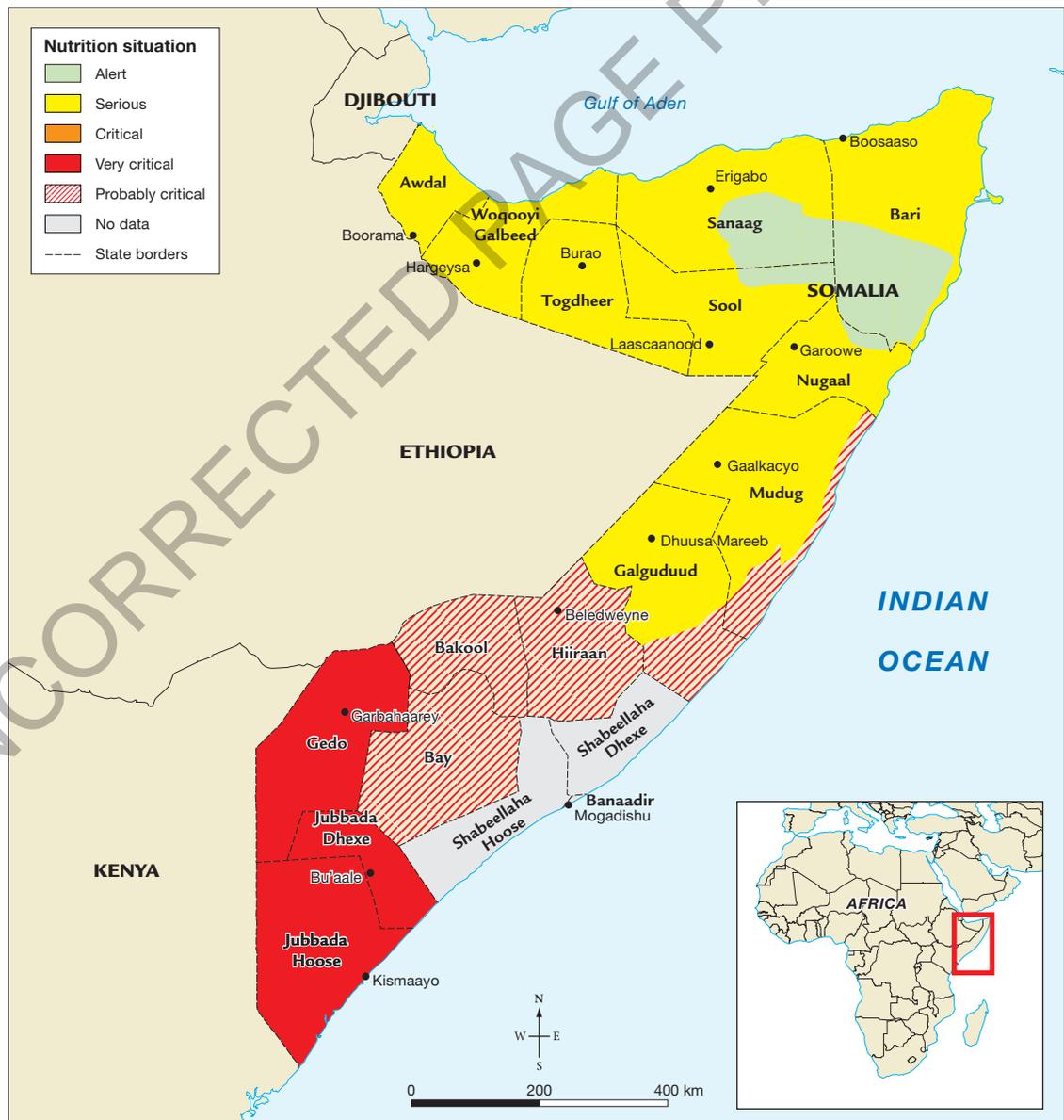
- Approximately 30 000 children died in just four months, from April to July 2011.
- Three million people in southern Somalia became food insecure.
- Along with displaced people, around 25 per cent of urban populations were affected by high food costs and food shortages.
- The United Nations estimated that over 1.4 million people became IDPs (internally displaced persons). Over 900 000 became refugees, fleeing to Ethiopia and Kenya in search of food.
- Livestock were decimated.
- Due to the high costs of purchasing food, diets were reduced to fewer than four food groups per day, mostly grain and oil, and the number of meals per day was reduced.

**humanitarian aid**  
assistance provided in response to a human crisis caused by natural or man-made disasters, in order to save lives and alleviate suffering

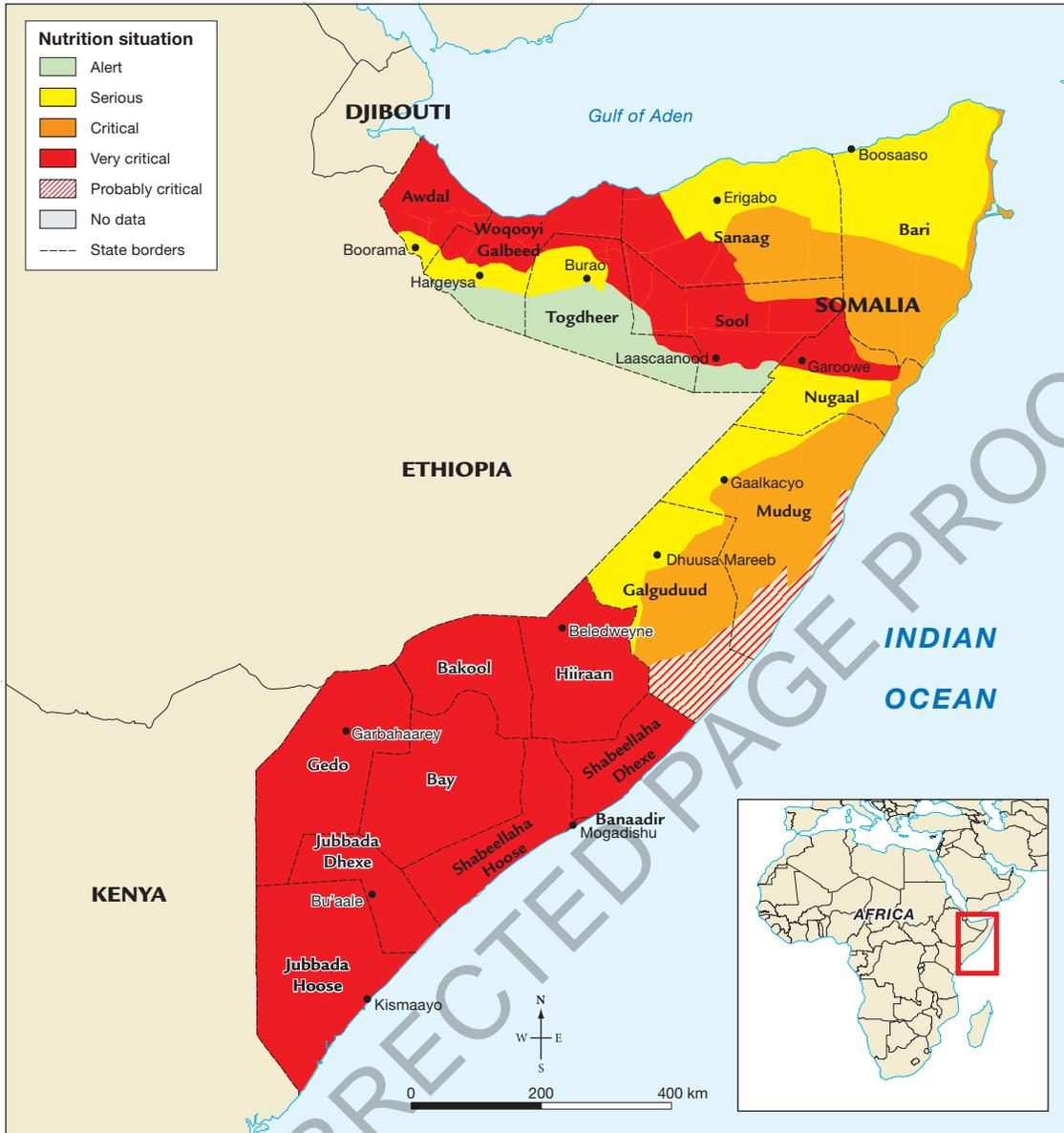
## What is happening now?

The famine was officially declared over by February 2012. This was due to a combination of good rainfall (allowing crop harvests to double that of the previous 17 years' average) and large-scale **humanitarian aid**. Twelve months later, however, 3.8 million people still needed emergency support in the form of food, clean water, shelter, and help in restocking their land with seeds and grazing animals. Other assistance included drilling more water bores, supplying irrigation pumps, and providing cash-for-work projects to upgrade irrigation channels.

**FIGURE 2** Somalia's nutrition situation, January 2011



**FIGURE 3** Somalia's nutrition situation, August 2011



Source: Data from FAO, Food Security and Nutrition Analysis Unit.

**ACTIVITIES**

**IDENTIFY**

1 When does a food crisis become a famine?

**INVESTIGATE**

2 Refer to figures 2 and 3.

a Construct a table to compare the approximate percentages of the country classified as: on alert, serious, critical, very critical, and likely critical.

b Describe the **changes** over time in the spread of the famine.

3 With the help of your atlas, identify the direction and countries that most refugees will flee to.

4 Refer to figure 1 and use the **Fleeing Somalia's drought** weblink in your eBookPLUS to watch a slideshow on the Somali famine.

a Make a list of all of the belongings of the family in figure 1 in the refugee camp.

b Describe the **environment** around the camp and the living conditions there.

5 List the difficulties that aid agencies might have when faced with getting aid to people.

**PREDICT**

6 a What might happen when you get a relatively sudden and large-scale movement of people fleeing from one country and crossing the border into another?

a What happens to the refugees? What can the new host country do?

**APPLY**

7 Much of Australia was in an extended period of drought for over ten years, yet we did not experience food insecurity. Why?

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**Weblink**

Fleeing Somalia's drought

## 5.7 How does land use affect food production?

### 5.7.1 Competition for land

**urban expansion** the increasing size of urban areas

**Urban expansion**, industrialisation and energy production is taking over land once used to produce food. This is a major global issue that affects the future production of our food.

There has been a growing global trend to convert valuable cropland to other uses. Urban expansion, industrialisation and energy production all require land. For example, in less than 16 years, China lost more than 14.5 billion hectares of arable land to other uses. This land no longer produces food, which then puts pressure on existing land resources to make up the loss.

**biofuel** refers to fuel which has been produced from renewable resources, such as plants and vegetable oils, and treated municipal and industrial wastes

### 5.7.2 Biofuel

**Biofuel** refers to fuel that has been produced from renewable resources, such as plants and vegetable oils, and treated municipal and industrial wastes.

Traditionally, the main forms of biofuel have been wood and charcoal. Almost 90 per cent of wood harvested in Africa and 40 per cent harvested in Asia is used for heating and cooking. Today, people are seeking more renewable energy sources and wanting to reduce CO<sub>2</sub> emissions associated with deforestation, so there is greater demand for alternative energy sources. Consequently, the use of agricultural crops to produce biofuels is increasing. Ethanol (mostly used as a substitute for petrol) is extracted from crops such as corn, sugar cane and cassava. Biodiesel is derived from plantation crops such as palm oil, soya beans and **jatropha**.

**jatropha** any plant of the genus *Jatropha*, but particularly *Jatropha curcas* which is used as a biofuel

**FIGURE 1** Jatropha



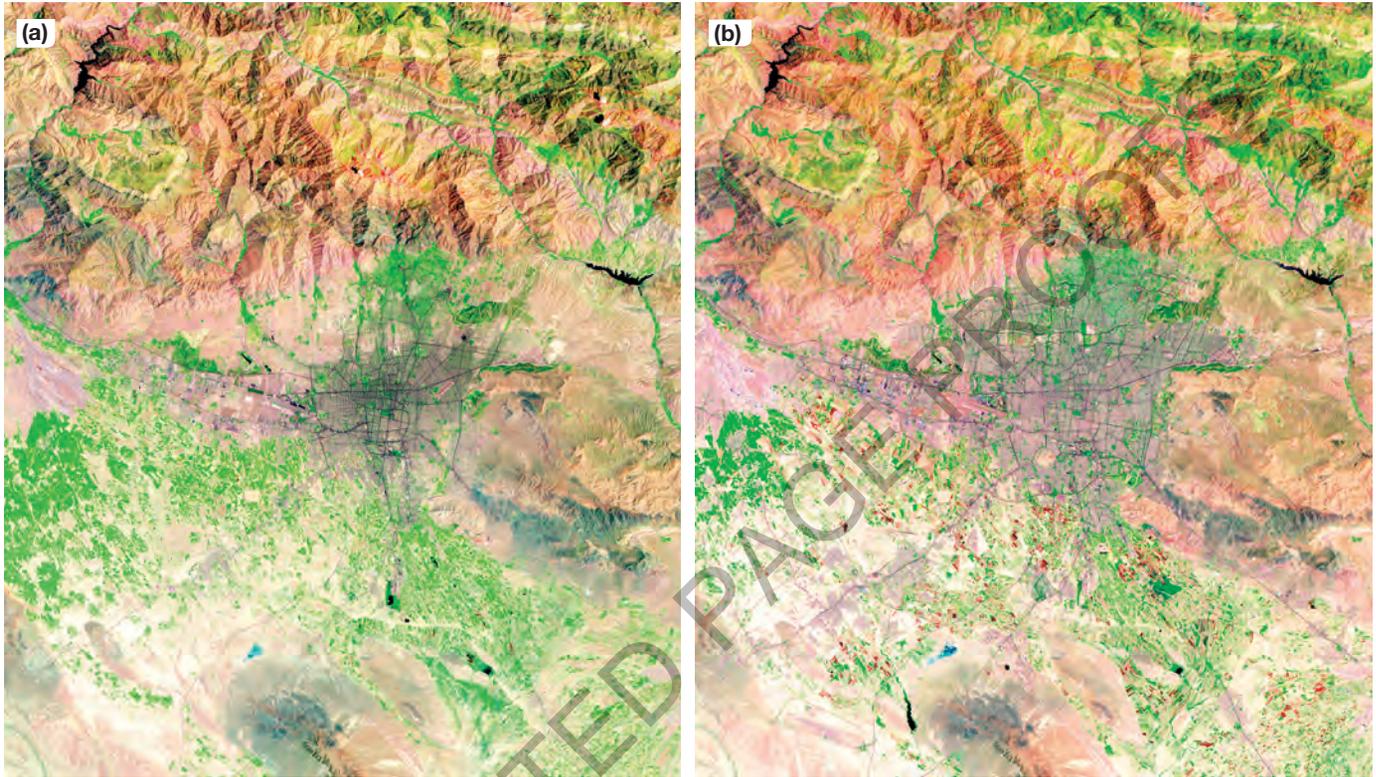
The growth of the biofuel industry has the potential to threaten future food security by:

- changing food crops to fuel crops, so less food is produced and crops have to be grown on marginal land rather than arable land
- increasing prices, which makes staple foods too expensive for people to purchase
- forcing disadvantaged groups, such as women and the landless poor, to compete against the might of the biofuel industry.

### 5.7.3 Urban expansion

Cities tend to develop in or near places that are agriculturally productive. However, as they expand due to population growth, the city encroaches on valuable farmland. This farmland is then converted into housing and infrastructure to support the population. Additional pressure is placed on farmers to produce more food for the increasing number of people on less arable land.

**FIGURE 2** Satellite image of the city of Tehran (a) in 1985; (b) in 2009 — the expansion of the city has taken over valuable arable land.



### 5.7.4 Land grabs

A growing threat to world food security is the purchase or lease of land in developing nations by resource-poor but wealthy nations or companies. According to Oxfam, more than 60 per cent of crops grown on land bought by foreign investors in developing countries are intended for export, instead of feeding local communities. There are many international groups such as Oxfam campaigning against **land grabs** with some success.

Poor and war-ravaged Liberia, in Western Africa, has sold or leased 57.5 per cent of its land to countries, such as Malaysia, for oil palm plantations. Around 80 million hectares of its land (equivalent to all the farmland in Britain, France, Germany and Italy) is used to grow food or fuel crops for the owner country or corporation. In Mozambique, where one-third of the population suffers food insecurity, less than 10 per cent of land sold for overseas agricultural investment is for food crops. Figure 3 shows the global scale of 'land grabs'.

The dramatic rise in land acquisitions across the globe is in response to the 'triple-F' crisis — food, fuel and finance.

- Food crisis — large increases in world food prices in 2007 and 2008 emphasised the need for food importing countries, such as Saudi Arabia and China, to improve their food security by obtaining land in other countries.
- Fuel crisis — rising and fluctuating oil prices between 2007 and 2009 created an incentive for countries to acquire land for the production of biofuel crops as a substitute for oil (see figure 4).
- Financial crisis — the global financial meltdown in late 2009 saw organisations switch from investing in stocks and shares to investing in land in overseas countries, especially land that could be used for food and fuel crops.

#### land grabs

large-scale buying or leasing of land by governments or companies

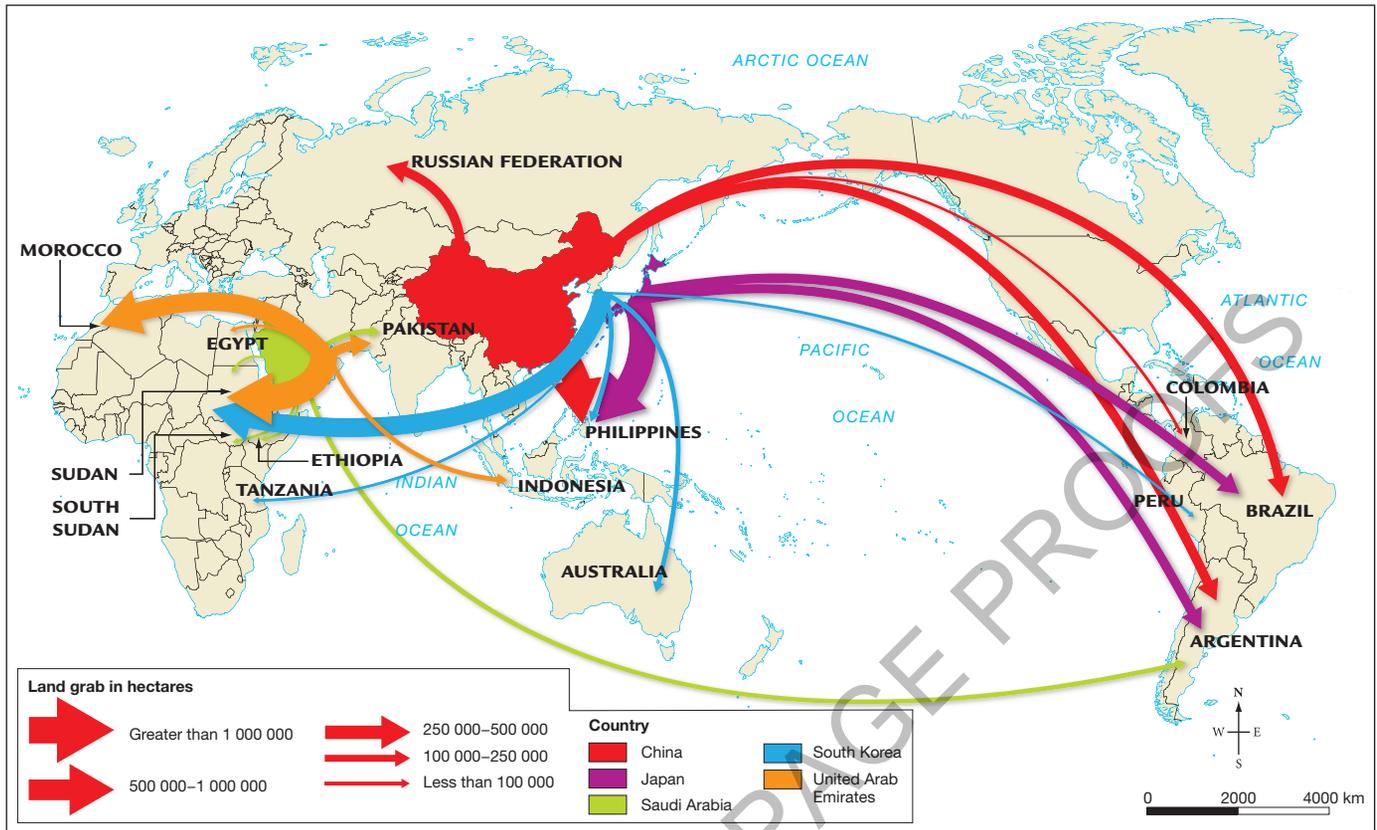
#### eBook plus

#### Interactivity Who is grabbing land?

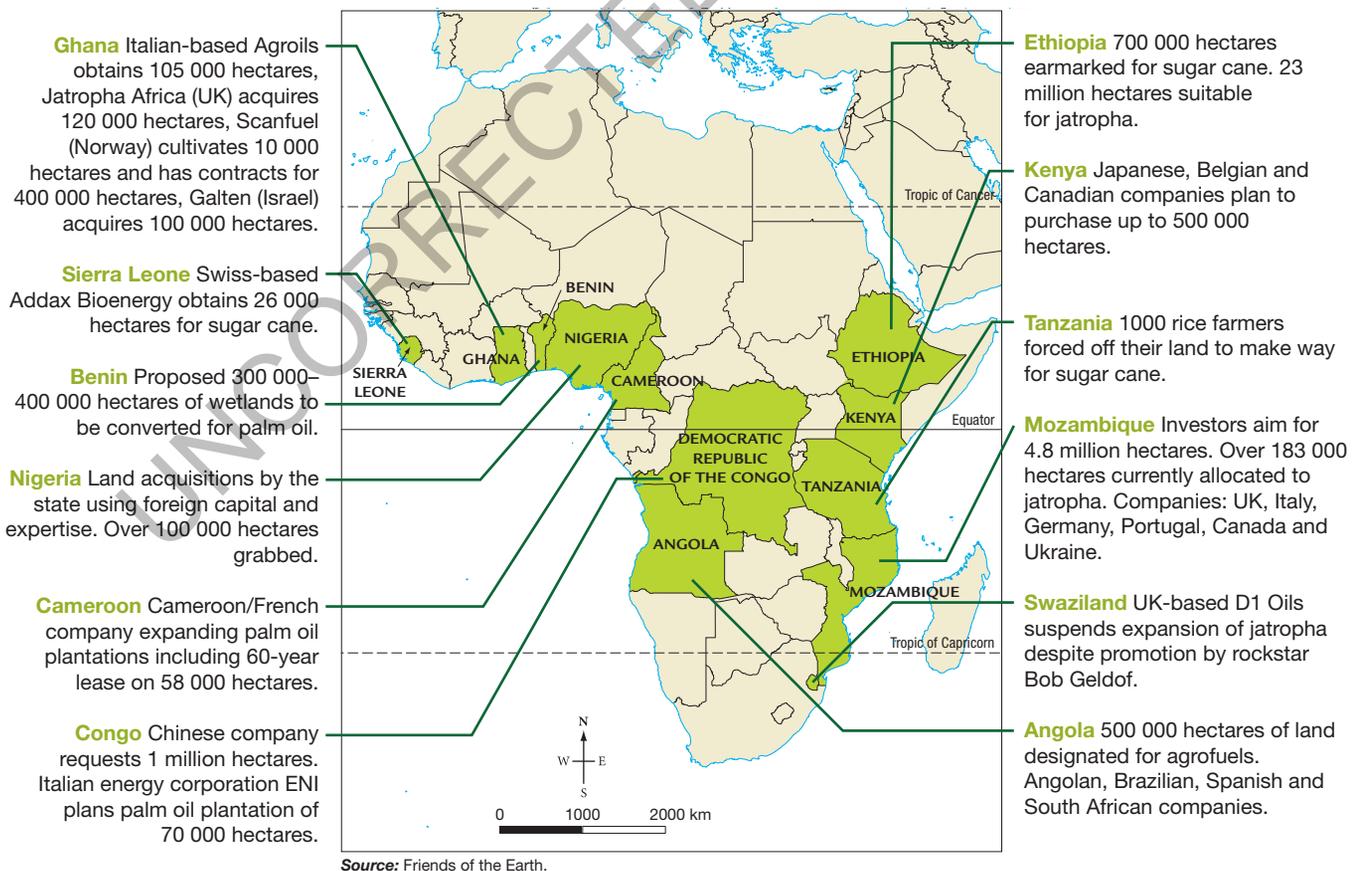
Use this interactivity to further your understanding of key countries involved in land grabs.

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**FIGURE 3** Who is buying land and where



**FIGURE 4** Countries in Africa where land is being bought by other nations for biofuel crops



### 5.7.5 The risk to food security

Investors in farmland are, understandably, seeking land that has fertile soils and good rainfall or access to irrigation water. With land comes the right to withdraw the water linked to it, and this can deny local people access to water for fishing, farming and watering animals. There may also be negative effects downstream when water is reduced in rivers. The Niger River, West Africa's largest river, flows through three countries and sustains over 100 million people, so any water reductions in it would have enormous effects. Mali is one country through which the Niger flows. There, by the end of 2010, around 500 000 hectares of fertile land had been leased by foreign companies and countries. Despite Mali having limited arable land, and 15 per cent of its children suffering malnutrition, a high percentage of land bought by foreign owners will be used for biofuel crops. Land that is purchased in other countries is usually already occupied and used by small-scale farmers—often women who do not always benefit from any compensation. Prices for land are usually very low, and there is frequently corruption, with much money going to local and government officials. Promised jobs do not always materialise. There are risks associated with monoculture farming and loss of biodiversity in the region.

#### ACTIVITIES

##### IDENTIFY

- 1 Why is the use of corn as a biofuel a threat to food security?
- 2 What is meant by the term *land grab*?

##### EXPLAIN

- 3 Compare the advantages and disadvantages of using biofuels, such as wood and charcoal, instead of oil and gas in developing and developed nations.
- 4 Refer to figure 3.
  - a Which three countries are the largest purchasers of overseas land? Use figures in your answer.
  - b Why do you think South Korea has invested in so many countries in such different *places*?

##### APPLY

- 5 What is jatropha? What are the benefits of growing this rather than corn and other biofuels?

##### PREDICT

- 6 Do you think Australia will need to purchase farmland overseas? Give reasons for your answer.

##### INVESTIGATE

- 7 Are land grabs an effective solution for establishing a country's food security? Discuss your point of view.
- 8 What is happening in Australia? Investigate which foreign companies own farmland here, what they are using it for and where it is located.

## 5.8 SkillBuilder: Interpreting satellite images to show change over time

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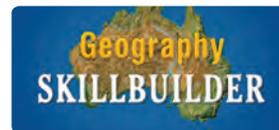
### What is a satellite image?

A satellite image is an image taken from a satellite orbiting the Earth. Satellite images allow us to see very large areas — much larger than those that can be visualised using vertical aerial photography. A satellite image often does not use the natural colours that we expect. This is referred to as using false colours, and these are applied in the computer processing of the images in order to highlight spatial patterns more clearly. You will gain a lot of information from a satellite image that cannot be gained from a topographic map or aerial photograph, so your knowledge of an environment is enhanced.



### eLesson

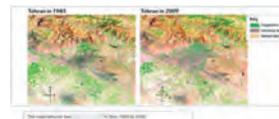
Watch this video to learn how to interpret satellite images to show change over time.



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### Interactivity

Try this interactivity to learn how to interpret satellite images to show change over time.



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## 5.9 How is Sydney expanding?

### 5.9.1 Is Sydney expanding?

Sydney's population reached 5 million in 2015 and it is still growing. Due to urban expansion, Sydney's once farmland is being transformed into housing. Food once grown in Sydney is now grown interstate and transported to the markets.

**FIGURE 1** The Sydney Royal Botanic Gardens is the oldest botanic garden and scientific institution in Australia. Covering 30 hectares near the CBD, it is protected from urban expansion and sprawl and provides open spaces for people to enjoy.



Sydney is Australia's largest city. By 2055, it is estimated that more than 8 million people will call Sydney home. Challenges come with living in the city such as the cost of living, cost of housing, traffic and commute times and employment opportunities. The State and Federal Governments have to plan sustainably to support the needs of the whole community whilst supporting economic growth and environmental concerns.

The Institute for Sustainable Futures assesses the changes in the Greater Sydney Metropolitan area. Currently, the Sydney Basin produces approximately 500 000 tonnes of food, including eggs, fruit, vegetables, meat and dairy. This supports about 20 per cent of the Sydney population. If current development trends continue, by 2031, Sydney will lose 60 per cent of its total food production. The Sydney basin will produce about 220 000 tonnes of food by 2031. Areas that will experience a decline in food production will see an increase in urbanisation. Housing developments in the Wollondilly, Liverpool, Penrith and Hawkesbury areas are expected to rise to support a growing Sydney population.

The New South Wales Government is planning to improve outdoor spaces, housing affordability and job opportunities throughout the Greater Sydney Metropolitan area. By 2020, the Parramatta CBD would offer over 100 000 jobs that support health, education, retail and finance sectors. Marsden Park, Campbelltown and Penrith are developing a high-value economic zone especially for business and industrial activities.

### 5.9.2 How is the landscape changing?

#### eBook plus

##### Weblink

Urban sprawl eats into Sydney's farmland

#### Urban sprawl eats into Sydney's farmland

Despite his family growing peaches and lemons on the fringes of Sydney for nearly 50 years, Warren Rowles says the farming tradition will end with him. 'It's never been so tough,' said Mr Rowles, 59, from his Glenorie farm near the Hawkesbury River on the outskirts of the Hills district. 'I'm waiting for a developer to give me an offer. My two daughters have city jobs and they aren't interested.' Mr Rowles is part of Sydney's shrinking pool of farmers sending fresh fruits and vegetables to the Sydney Markets at Flemington, which now draws two-thirds of produce from interstate.

Victorian growers sent 28 per cent and Queensland 21 per cent of the 860 000 tonnes of

fruit and vegetables sold at the markets in 2010, a study by the University of Western Sydney found.

More than 97 per cent of fruit and vegetables were grown beyond a 150-kilometre radius of the market, which serves greengrocers, supermarkets and restaurants weekdays and the public on weekends.

Supplies of local produce had become 'disappointingly insignificant', said Professor Phillip O'Neill, who worked on the study. 'Sydney farms are disappearing but now we know it's fallen below any levels of significance,' he said. The study found that more than 93 per cent of leafy and stem vegetables such as spinach and celery — the category dominated by producers in the Sydney basin — came from Victoria.

Sydney's urban sprawl had wiped out market gardens on peripheral land since first settlement, said Professor O'Neill. 'The problem now is Sydney's expansion has reached the last phase, where in 20 to 50 years the sprawl will eradicate unprotected farms,' he said. NSW growers had excelled in producing mushrooms, with most less than 50 kilometres from the market. They also contributed three-quarters of citrus fruit and melons sold at the market. The study found 75 per cent of produce travelled between 500 and 2000 kilometres, while tomatoes from Perth came 3041 kilometres.

The chief executive of Sydney Markets, Brad Latham, said produce travelled vast distances because it was cultivated in the most ideal regions. 'Victoria is great for leafy greens. It's feeding NSW and Australia,' he said. 'Northern Queensland's climate is fantastic for bananas and mangoes. The diversity is great.'

Colin Gray, chief executive of NSW Chamber of Fruit and Vegetable Industries, said wholesale and retail prices were determined by supply and demand. 'A good tomato from 20 kilometres away can be more expensive than poor quality

ones 3000 kilometres away,' he said. 'The transport cost is absorbed by the grower in most cases.'

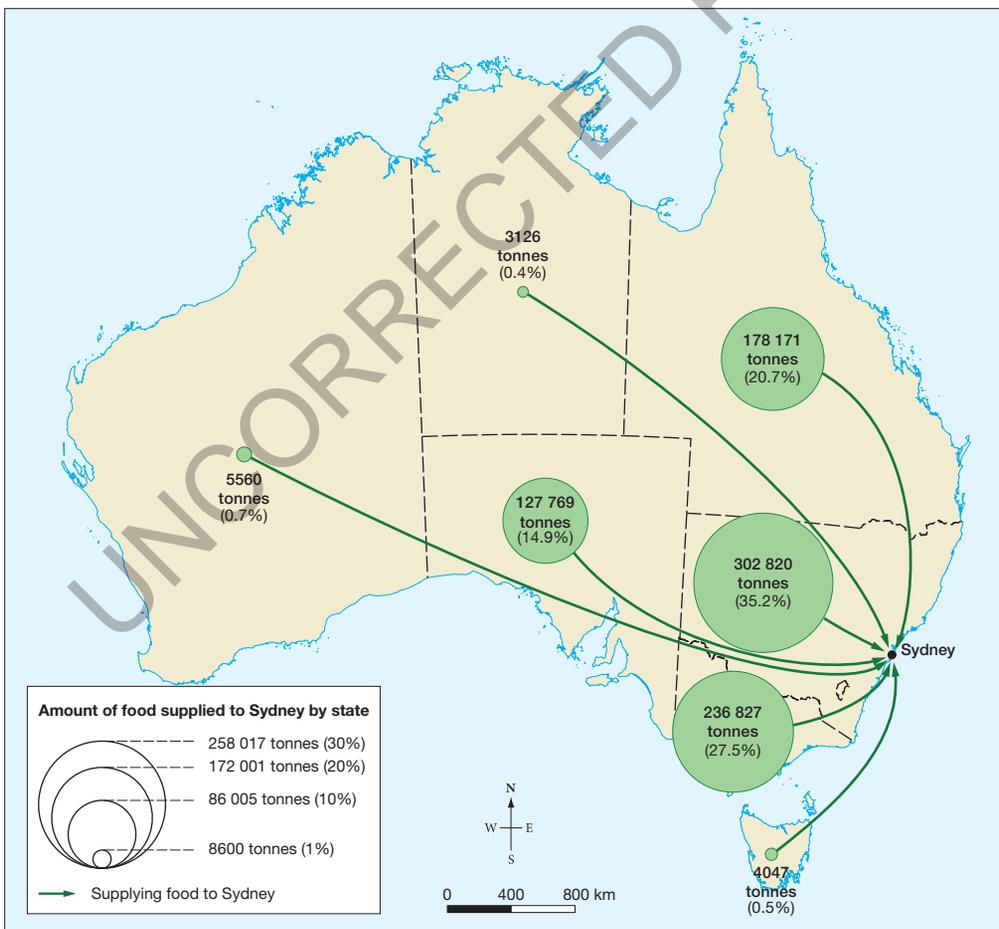
The level of specialisation in agricultural regions, such as stone fruits in northern Victoria and leafy vegetables in the south, surprised Professor O'Neill. 'We felt the impact of this during the Black Saturday bushfires in Victoria. The leaves absorbed the smoke and couldn't be eaten. The industry was severely hit and prices rocketed.'

Julian Lee, founder of Sydney Food Connect, said flaws of the central market system were exposed during natural disasters and revealed the need for various food supply chains such as farmers markets.

At his farm, Mr Rowles reflected on the impact of the urban sprawl on his family. His parents grew peaches and plums in Carlingford in the 1960s but were pushed out by housing constructions. They moved to Glenorie, where he lives today. 'Getting fruits from interstate is part of the progression of things, fuelled by reliability of weather and affordability of farming land. I get it,' he said.

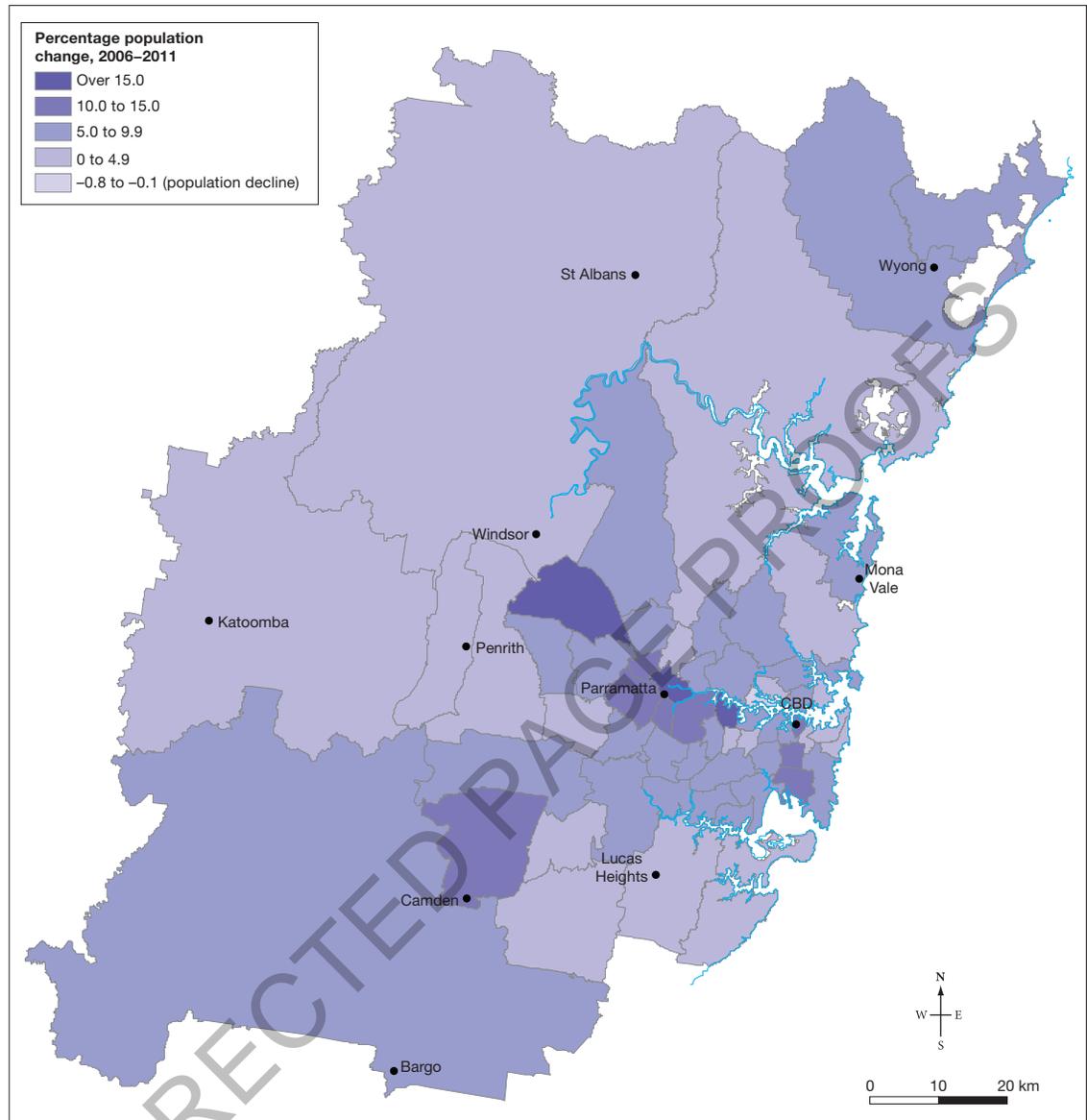
Source: Esther Han, *Sydney Morning Herald*, 28 July 2013

**FIGURE 2** Sydney's Food Footprint; where our fresh fruit and vegetables come from.



Source: Urban Research Centre, University of Western Sydney.

**FIGURE 3** Urban growth in Sydney



Source: Spatial Vision

### ACTIVITIES

#### IDENTIFY

- 1 a How much food is transported interstate to Flemington markets?  
b Where does the food come from?
- 2 State reasons food has to be transported to Flemington markets.
- 3 Which fruits and vegetables have to travel the furthest to reach Flemington markets?
- 4 Why was agricultural land replaced?

#### EXPLAIN

- 5 Refer to figure 3. Study the map.
  - a Explain the history of urban expansion in Sydney.
  - b Describe some problems associated with urban expansion.

- c State some benefits of fruit coming from interstate.

#### APPLY

- 6 Why is there a declining number of farmers sending fruit to Flemington?

#### PREDICT

- 7 With such limited agricultural land, there is a lot of pressure placed on farmers to feed people. As the Australian population continues to grow in urban areas, less agricultural land is available. Suggest some solutions to meet the food requirements. Consider what individuals, groups and the government could do to assist.

## 5.10 How does climate change affect food production?

### 5.10.1 How will food security be affected by climate change?

The impacts of climate change on future world food security are a case of give and take. Some regions of the world will benefit from increases in temperature and rainfall, while others will face the threat of greater climatic uncertainty, lower rainfall and more frequent drought. In either case, food production will be affected.

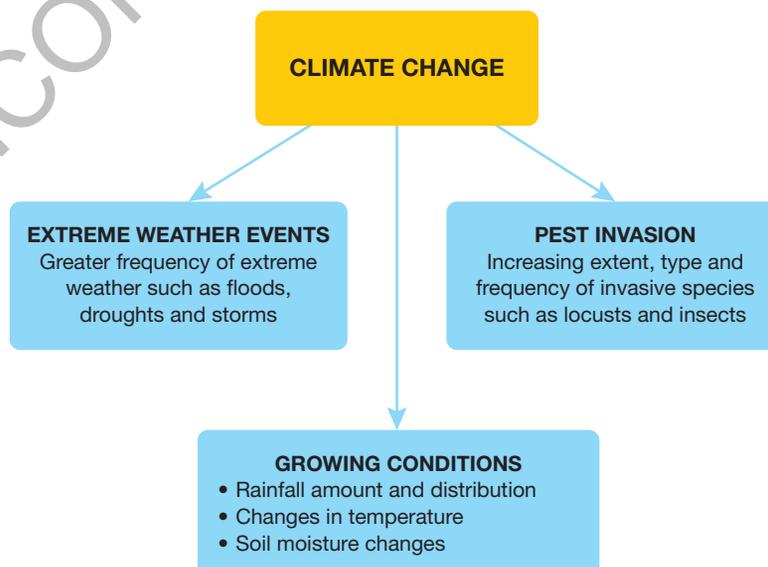
Agriculture is important for food security, because it provides people with food to survive. It is also the main source of employment and income for 36 per cent of the world's workforce. In heavily populated countries in Asia, between 40 and 50 per cent of the workforce is engaged in food production, and this figure increases to over 63 per cent in sub-Saharan Africa.

**FIGURE 1** The majority of the workforce in sub-Saharan Africa are employed in the agriculture industry.



It is difficult to predict the likely impacts of climate change, because there are many environmental and human factors involved (see figure 2), as well as different predictions from scientists (see figure 3). Use the **How to feed the world in 2050** weblink in your eBookPLUS to find out more about this topic.

**FIGURE 2** Possible impacts of climate change on food production

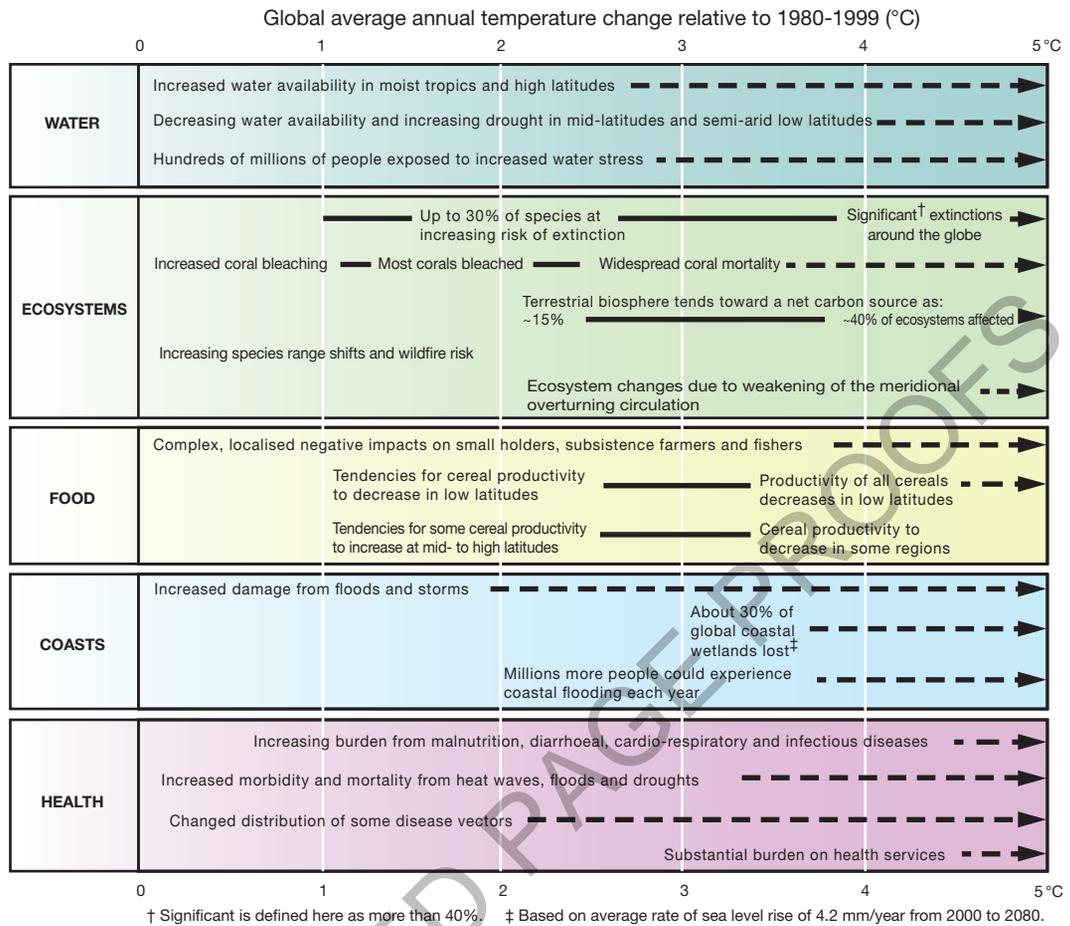


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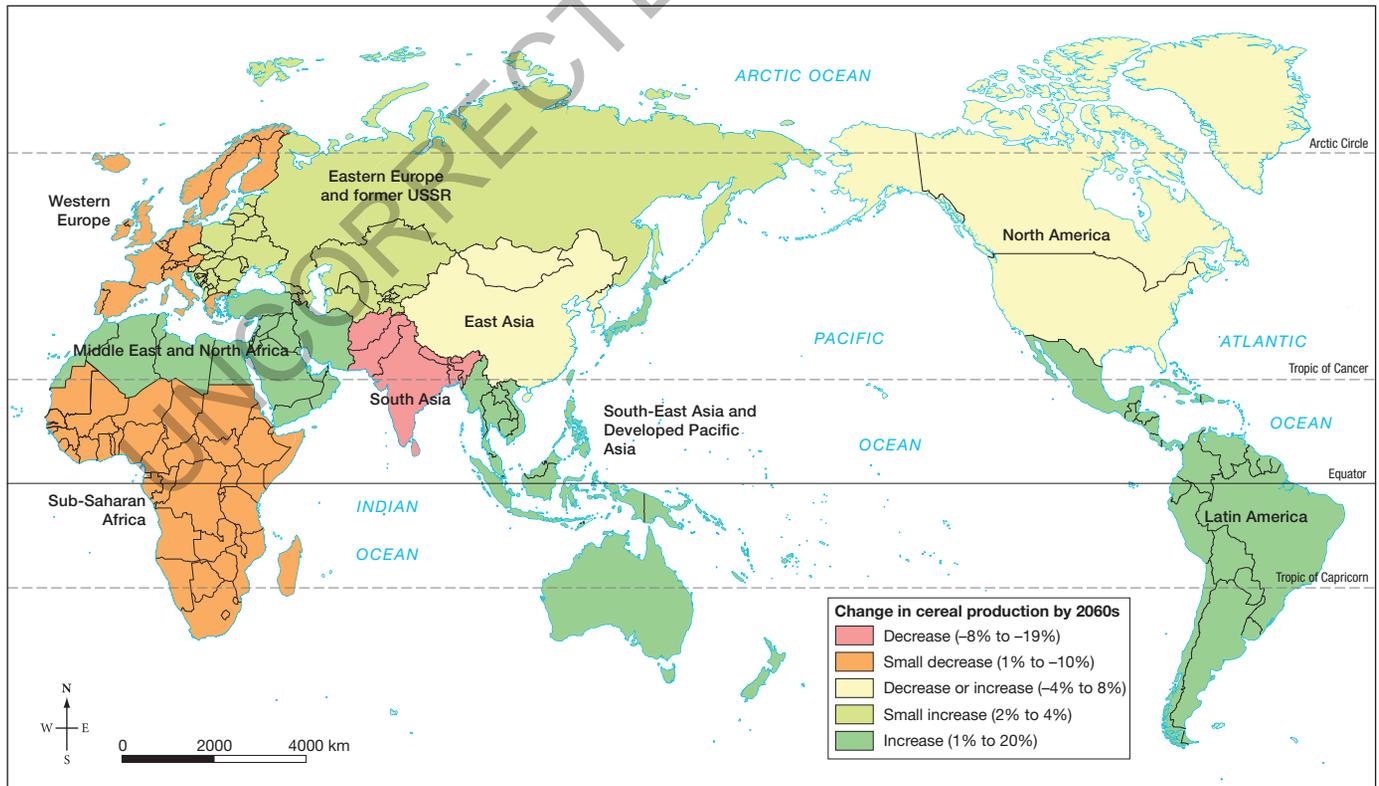
**Weblink**

How to feed the world in 2050

**FIGURE 3** Projected consequences of climate change



**FIGURE 4** Predicted regional effects of climate change on cereal production, 2050s–2080s



Source: Spatial Vision

There is a wide range of possible impacts of climate change. Sea-level rises may cause flooding and the loss of productive land in low-lying coastal areas, such as the Bangladesh and Nile River deltas. Changes in temperatures and rainfall may cause an increase in pests and plant diseases. However, agriculture is adaptable. Crops can be planted and harvested at different times, and new types of seeds and plants, or more tolerant species, can be used. Low-lying land may be lost, but higher elevations, such as mountain slopes, may become more suitable. The loss in productivity in some places may be balanced by increased production in other places. Figure 4 demonstrates the effects of climate change on cereal crops, while figure 5 shows the range of potential impacts across the European Union.

Essentially, hundreds of millions of people are at risk of increased food insecurity if they have to become more dependent on imported food. This will be evident in the poorer countries of Asia and Sub-Saharan Africa, where agriculture dominates their economy. There is also a risk of greater numbers of **environmental refugees** or people fleeing places of food insecurity.

**FIGURE 5** Examples of potential consequences of climate change in the European Union



**environmental refugees** people who are forced to flee their home region due to environmental changes (such as drought, desertification, sea-level rise or monsoons) that affect their wellbeing or livelihood

## ACTIVITIES

### IDENTIFY

- 1 Refer to figure 3 and decide whether the following statements are true or false.
  - a If temperatures increase by 3°C, you would expect to see crop yields rising around the equator.
  - b **Changes** in extreme weather events are unlikely unless temperatures increase by at least 1°C.
  - c Food insecurity will be felt greatly in developing regions if temperatures rise by more than 4°C.
  - d **Places** that are likely to experience decreasing crop yields will be found in the higher latitudes.

### EXPLAIN

- 2 a Refer to figure 4. Which **places** have the potential to be grain exporters and which **places** are likely to become dependent on grain imports? Use data in your answer.
  - b What are the economic and social implications of this for countries in these regions?

- 3 a Refer to figure 5. Which countries of Europe will benefit from climate **change** in terms of food production and which countries are likely to suffer negative outcomes?
  - b Would increased irrigation be a **sustainable** solution to growing food in Spain? Explain your answer.
- 4 Describe the **interconnection** between **environmental** refugees and climate **change**.

### INVESTIGATE

- 5 Research potential impacts of climate **change** on Australia. Create an annotated map to illustrate your findings.

### PREDICT

- 6 How might a country such as Australia best prepare its food production systems to cope with potential **changes** in climate?

### APPLY

- 7 How might food be shared more equitably around the world? Discuss with a group and report your suggestions back to the class.

## 5.11 What can we eat from Yarra Yarra Creek Basin?

### improved pasture

pasture that has been specially selected and sown, which is usually more productive than the local native pasture

**fodder** food such as hay or straw for cattle and other livestock

### 5.11.1 Yarra Yarra Creek Basin (near Holbrook), NSW

The Yarra Yarra Creek Basin is renowned for producing high-quality beef and sheep meat. The Yarra Yarra Basin is located east of Holbrook, a small agricultural town with a population of approximately 1300. Holbrook is located 492 kilometres south-west of Sydney along the Hume Highway between Melbourne and Sydney.



The Yarra Yarra Basin is in a high-rainfall region at the foothills of the Great Dividing Range. Many small creeks feed water into the Yarra Yarra Creek (AR 3951). The high levels of beef and lamb production in the Basin are due to good water resources and the use of **improved pasture**. Crops such as oats, triticale and canola are grown mostly for livestock grazing and sometimes harvested for hay and grain for **fodder**. Farms in the basin are relatively large, in the range of 800–1200 hectares.

**FIGURE 1** Silos, tall cylindrical structures that store grain, are used in the Yarra Yarra Creek Basin to store fodder.

### ACTIVITIES

#### IDENTIFY

- What is the contour interval of the map?
 

|                      |                      |
|----------------------|----------------------|
| <b>A</b> 1 : 100 000 | <b>B</b> 1 : 20      |
| <b>C</b> 20 metres   | <b>D</b> 1 kilometre |
- What is the area reference for the spot height of 538 metres on Morgans Ridge?
 

|                  |                  |
|------------------|------------------|
| <b>A</b> AR 3547 | <b>B</b> AR 4735 |
| <b>C</b> AR 3443 | <b>D</b> AR 4334 |
- What is the aspect of the slope of the spot height 538m (from question 2)?
 

|                     |                     |
|---------------------|---------------------|
| <b>A</b> South east | <b>B</b> South west |
| <b>C</b> North east | <b>D</b> North west |
- Which of the following is the NOT the correct scale of the map?
 

|                                      |
|--------------------------------------|
| <b>A</b> 1/100 000                   |
| <b>B</b> 1 : 100 000                 |
| <b>C</b> 1 cm represents 1000 metres |
| <b>D</b> 1 cm equals 1000 metres     |

- In which general direction would you need to drive to get from Holbrook to Yarra Yarra Junction?

|                |                |
|----------------|----------------|
| <b>A</b> West  | <b>B</b> East  |
| <b>C</b> North | <b>D</b> South |

- What is the major vegetation type on top of Morgans Ridge?

|                  |                   |
|------------------|-------------------|
| <b>A</b> Swamp   | <b>B</b> Mangrove |
| <b>C</b> Orchard | <b>D</b> Dense    |

#### EXPLAIN

- Which area is more likely to produce food – AR3054 or AR3547? Justify your answer.

#### APPLY

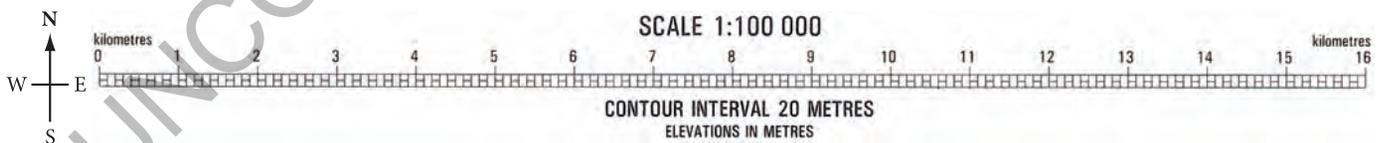
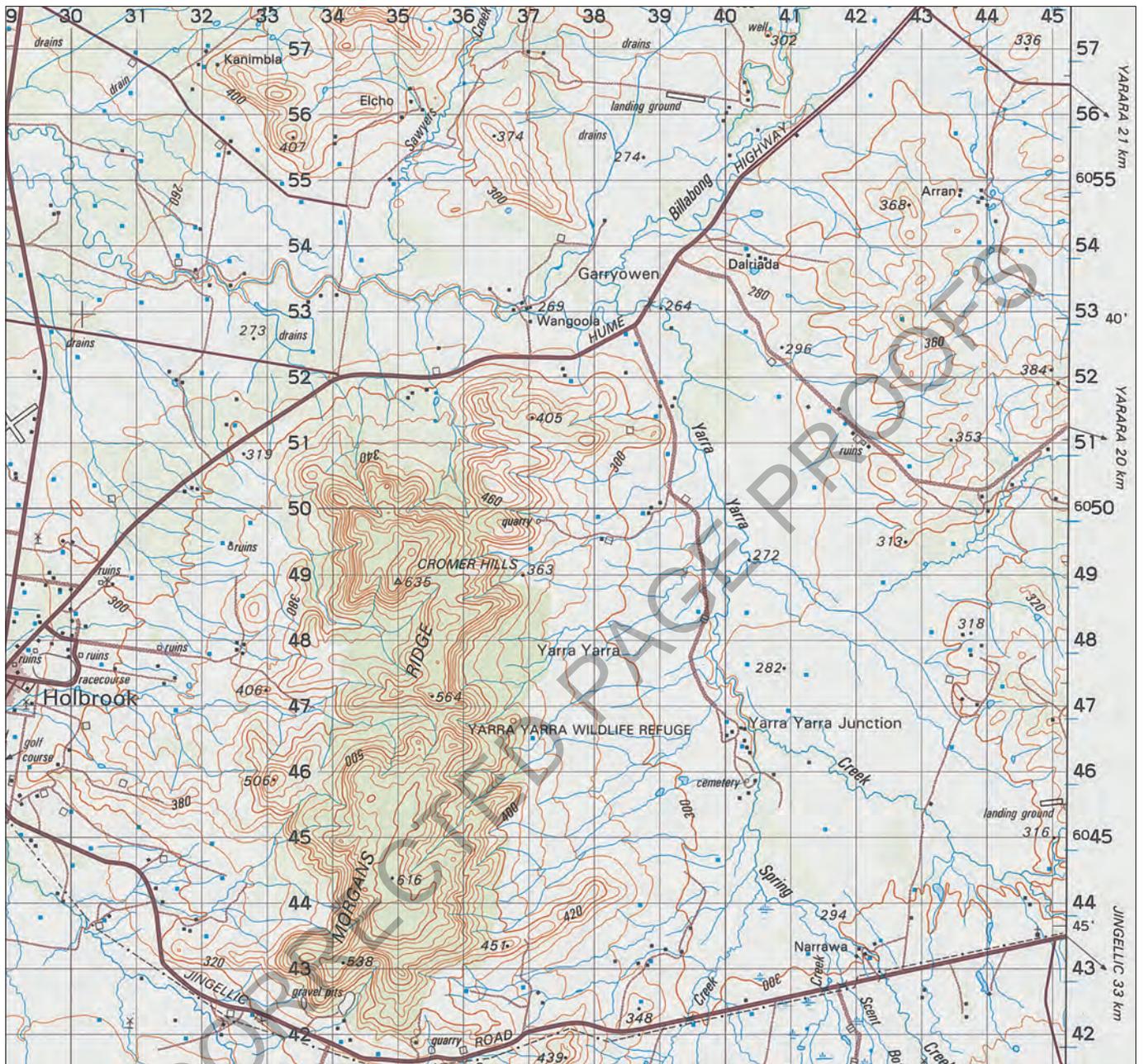
- How might climate change affect water security of the Yarra Yarra Creek Basin in the future?
  - Discuss how this could influence food production.
  - What steps could be taken to ensure food production levels are maintained?

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## 5.12 Review

To access this resource, go to your eBookPLUS at [www.jacplus.com.au](http://www.jacplus.com.au).

**FIGURE 2** Topographic map of the Yarra Yarra Creek Basin



|   |  |   |
|---|--|---|
| Built-up area; Divided highway; Metropolitan route marker | High voltage transmission line                   | Mangrove swamp; Area subject to inundation            |
| Recreation reserve with oval; Drive-in theatre; Underpass | Fence; Prominent telephone line                  | Swamp; Swamp definite boundary                        |
| Sealed road two or more lanes; National route marker      | Mine; Windmill; Church; Building; Yard           | Perennial lake; Watercourse                           |
| Sealed road one lane; Embankment                          | Horizontal control point; Spot elevation         | Intermittent lake; Watercourse                        |
| Unsealed road two or more lanes                           | Contour with value; Supplementary contour        | Mainly dry lake; Watercourse                          |
| Unsealed road one lane; Cutting                           | Depression contour; Sand; Distorted surface      | Tank or small dam; Perennial waterhole                |
| Vehicle track; Road bridge; Gate; Stock grid              | Levee, bank or sand ridge; Joint or rock fissure | Saline coastal flat; Intertidal flat                  |
| Foot track; Foot bridge                                   | High cliff; Escarpment                           | Navigation light; Intertidal ledge or reef            |
| Multiple track railway; Station                           | Vegetation; Dense, medium, scattered             | Pier; Exposed wreck; Prominent submerged wreck        |
| Single track railway; Light railway                       | Vegetation distinctive; Distinctive grass        | Prominent submerged reef, rock                        |
| Railway tunnel, bridge, underpass                         | Orchard or vineyard; Line of trees or windbreak  | Indefinite watercourse, shoreline; Rock bare or awash |

Source: Spatial Vision