14 Food security

14.1 Overview

Numerous **videos** and **interactivities** are embedded just where you need them, at the point of learning, in your learnON title at www.jacplus.com.au. They will help you to learn the content and concepts covered in this topic.

The world produces enough food to feed everyone. So why do hundreds of millions of people go hungry every day? Will there come a time when we don't have enough food to feed everyone?

14.1.1 Introduction

Currently the world produces enough food to adequately feed everyone, but that doesn't mean that everyone is well fed. The food that is produced is far from equally distributed. It is estimated that approximately one in every nine people (around 850 million) are going hungry.

What is preventing everyone getting enough to eat? And if this is the current situation, what will happen in the future, with our population set to rise to nearly 10 billion by 2050? How can we ensure food security for all the people of our ever-growing world population?

If we want to stop the number of hungry people from increasing, we will need improvements in food production, new sources of food, better aid programs, and different attitudes to food consumption and waste.

on Resources

eWorkbook	Customisable worksheets for this topic (ewbk-5851)
Video eLesson	Food for thought (eles-1720)

FIGURE 1 For these children, in a tent camp for people displaced by flooding in northern India, the only hope for food security is humanitarian aid.

14.2 Global food security

LEARNING INTENTION

By the end of this subtopic, you will be able to explain the concept of food security, and understand some of the reasons for food insecurity.

14.2.1 Defining food security

Very few Australians, by choice, would go to bed at night hungry. We live in a country where there is a plentiful supply and wide range of food items available. Our relatively high standard of living enables most of us to afford to purchase, store and prepare food, or even dine out. Most of us are secure in the knowledge that there will be food available at the next mealtime.

According to the United Nations Food and Agriculture Organization, 'Food security exists when all people, at all times, have physical and economic access to enough safe and nutritious food to meet their dietary needs and food preferences for an active and healthy lifestyle.'

Food security for you, as a student, means that your family either grows its own food, has sufficient income to purchase food, or is able to barter or swap food. Similarly, food security for a country means that it is able to grow sufficient food, or it has enough wealth to import food, or it combines the two. Not all people in the world are able to achieve this. Further, access to a wide variety of foods varies from place to place. For example, consider the range of foods available in the two markets in **FIGURES 1 (A)** and **(B)**.

FIGURE 1 Fresh produce market in (a) a developed country and (b) a developing country

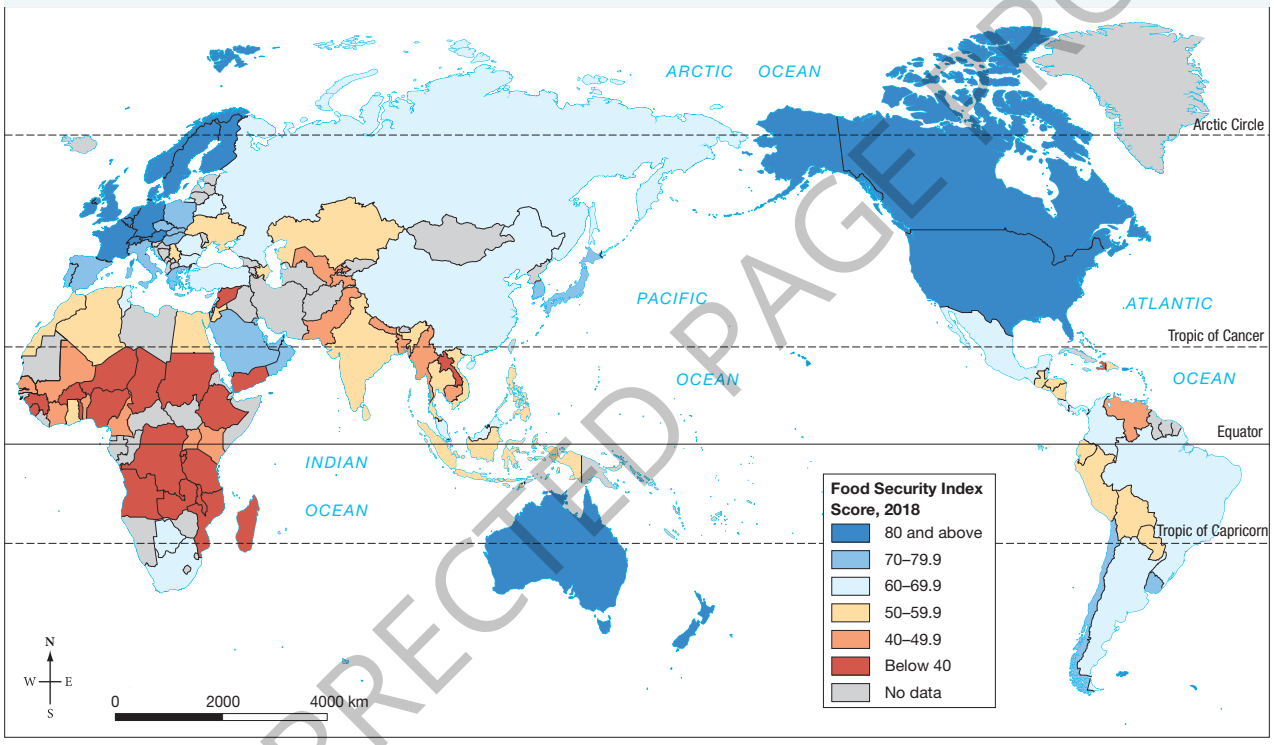
14.2.2 Measuring food security

The **FIGURE 2** map shows the countries of the world, scored according to the Global Food Security Index. This is based on a range of 12 different **indicators**, including the:

- affordability of food
- accessibility of food
- nutritional value of food
- safety of food
- nutritional and health status of the population.

Countries that have a high rating on the index are able to produce more food than they require, so they can export their surplus, or they are able to afford to import all of their food needs, as is the case for Singapore.

FIGURE 2 The Food Security Index, 2018



Source: © 2019 The Economist Intelligence Unit Limited, data from Global Food Security Index. Map drawn by Spatial Vision.

In Australia, we produce three times as much food as we consume. We are a major exporter of both fresh and processed food, and can trade competitively in cereals, oil seeds, beef, lamb, sugar and dairy products. About 90 per cent of our food is grown here in Australia. Of the remaining 10 per cent that we import, many foods are either processed or out of season in Australia; oranges are an example. Global trade is an important component of food security because it is almost impossible to exactly match food production to food demands.

As a country, Australia does not have a lack of food but it has a humanitarian interest in the food security of developing nations. As a major food producer, Australia does face future challenges. There is declining growth in agricultural productivity, the threat of climate change, and increasing competition for land and water.

indicators things that provide a pointer, especially to a trend

14.2.3 Food insecurity

FIGURE 2 also shows those countries that have a low Food Security Index score. It is estimated that more than 850 million people — one in every nine people in the world — are **undernourished**, with diets that are minimal or below the level of sustenance. Poor diet and limited access to food create large-scale food insecurity in many parts of Africa and southern Asia. 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, and physical and mental development suffer. India is home to 24 per cent of the world's **malnourished** and 30 per cent (46.6 million) of the world's children under five with stunted growth due to poor and inadequate diets.

Paradoxically there is also an interconnection between food insecurity and obesity. When fresh food is scarce or expensive, people will choose cheaper food that is often high in kilojoules but low in nutrients. This is quite common in urban areas of middle- and high-income countries. Of the world's population of over 7.7 billion, two billion are now overweight — a condition that contributes to significant health issues such as diabetes and heart disease.

14.2.4 Causes of food insecurity

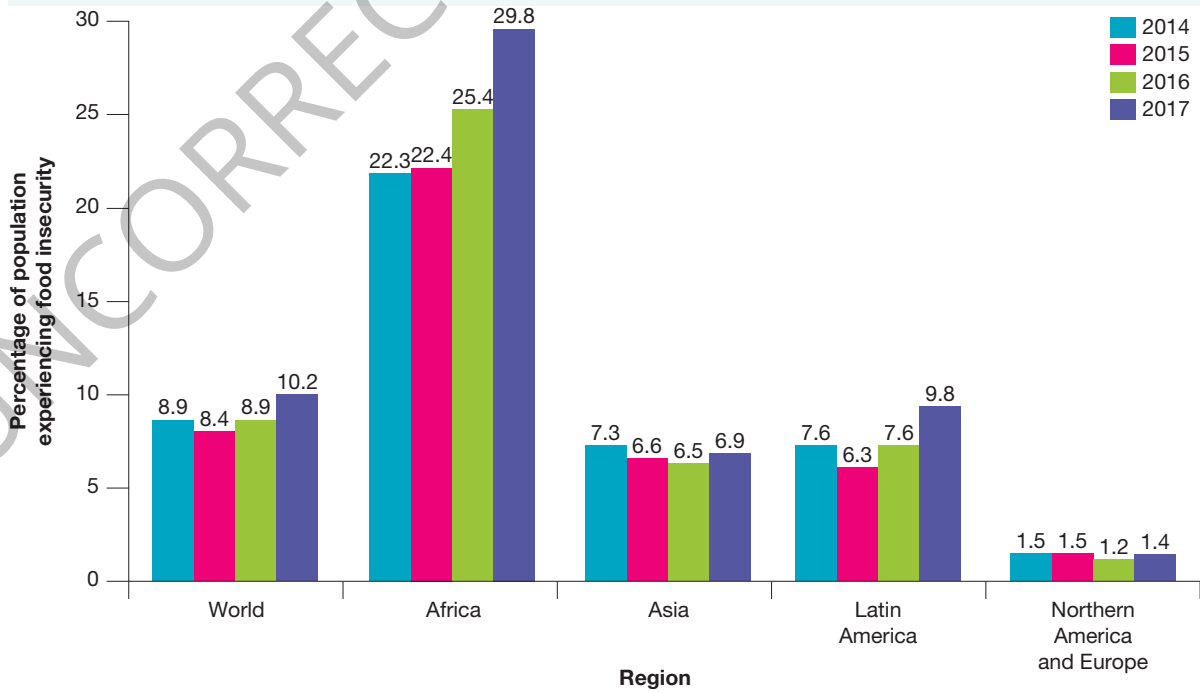
Global food production now provides one-third more calories than are needed to feed the entire world. Since the beginning of this century there has been an increase in production from 2716 to 2904 calories per person per day. Increases from 2083 to 2358 calories have also occurred in the least developed countries. There is, however, unequal access to **arable** land, technology, education and employment opportunities. Improvements in food production and economic development have not always occurred in those places experiencing rapid growth in population. Food is redistributed around the world via trade and aid but neither is a long-term or large-scale solution to food insecurity. Regional variations still occur in the distribution of hunger, as can be seen in **FIGURE 3**. Since 2014, severe food insecurity has actually risen in Africa, Latin America, and the world as a whole.

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

arable describes land that can be used for growing crops

FIGURE 3 Regional food insecurity, 2014–2017



Source: © FAO, 2019. FAO, IFAD, UNICEF, WFP and WHO. 2018. The State of Food Security and Nutrition in the World 2018. Building climate resilience for food security and nutrition. Rome, FAO. Licence: CC BY-NC-SA 3.0 IGO.

Some of the reasons for food insecurity include:

- poverty
- population growth
- weak economy and/or political systems
- conflict
- natural disasters such as drought or a pandemic.

14.2 ACTIVITIES

1. Research the causes and effects of one of the conditions caused by dietary deficiency, such as deficiency in iron, vitamin A or vitamin C.

HASS skills: Questioning and researching

2. Select one of the places mapped in **FIGURE 2** as being at extreme risk of food insecurity. Find out the main factors that contribute to its food insecurity.

HASS skills: Questioning and researching

3. Refer to a map of conflict in your atlas or online. Is there an interconnection between those countries that have a high or extreme risk of food insecurity and those countries that are experiencing conflict? Include country names in your answer.

HASS skills: Analysing

4. Research the impact of COVID-19 on food security. Choose one of the developed countries most effected (for example, the USA or Spain) and examine:
   a. Did the availability of food change?
   b. Did people's ability to access food change?
   c. Did specific segments of the community or country experience greater food insecurity?

Prepare your findings for a class discussion on the factors affecting food security in developed countries.

HASS skills: Questioning and researching
General capability: Personal and social capability

FIGURE 4 (A) Firefighters collect and distribute food for the community in Granada, Spain, in May 2020.

FIGURE 4 (B) People queue to receive emergency food aid in Austin Texas, USA, in April 2020.

14.2 EXERCISE

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
Questions	Questions	Questions
1, 3, 9, 10, 12	2, 4, 7, 11, 13	5, 6, 8, 14

Check your understanding

1. Which of the following is not considered important for food security?
   - **A.** Being able to afford to buy food
   - **B.** That the food is nutritious and healthy
   - **C.** That the food covers all food tastes: sweet, salty and sour
   - **D.** That the food is suitable for people's religious and dietary needs
2. Compare the two photographs in **FIGURE 1(A)** and **1(B)**.
   - **a.** What are the similarities and differences between the two markets?
   - **b.** Do you think all food groups would be available in both markets? Why or why not?
3. Refer to **FIGURE 2**.
   - **a.** Identify three countries that are considered to have low risk of food insecurity.
   - **b.** Which of the following statements applies to people living in countries with low risk of food insecurity?
     - **A.** A variety of food items would rarely be available at affordable prices. There would be day-to-day concerns over the supply or availability of food.
     - **B.** A variety of food items would be easily available at affordable prices. There would be little, if any, day-to-day concerns over the supply or availability of food.
     - **C.** A variety of food items would not be easily available and would be expensive. There would be concerns over availability of food.
     - **D.** All of the above.
4. What does it mean to live in a country with low risk of food insecurity?
5. The Food Security Index was based on evaluating five different indicators: affordability of food, accessibility of food, nutritional value of food, safety of food, and nutritional health value of the population. Why do you think indicators such as accessibility and safety were included?
6. What factors make people vulnerable to food insecurity?
7. Explain the difference between undernutrition and malnutrition.
8. Explain how conflict can lead to food insecurity.

Apply your understanding

9. Suggest two ways in which climate change might affect Australia's food security.
10. What natural or human events could disrupt our food security? Outline two natural and two human events that might affect Australian food security.
11. Refer to **FIGURE 3**.
    - **a.** With the use of dates and percentages, describe the main trend in food security throughout the world for 2014–2017.
    - **b.** Compare the trends in food security for Africa and North America/Europe over time. Use figures in your answer.
12. Suggest five steps you think would reduce a country's risk of food insecurity. Give reasons for your choices.
13. Outline three ways Australia might help another country that is at high risk of having insufficient food for its people.
14. At the turn of the twentieth century, the total worldwide spending on agricultural research was US$23 billion, compared with US$1.5 trillion on weapons. Do we have our priorities right? Write a short letter to the editor outlining your view.

For sample responses to every question, go to www.jacplus.com.au.

14.3 Impacts of land loss on food security

LEARNING INTENTION

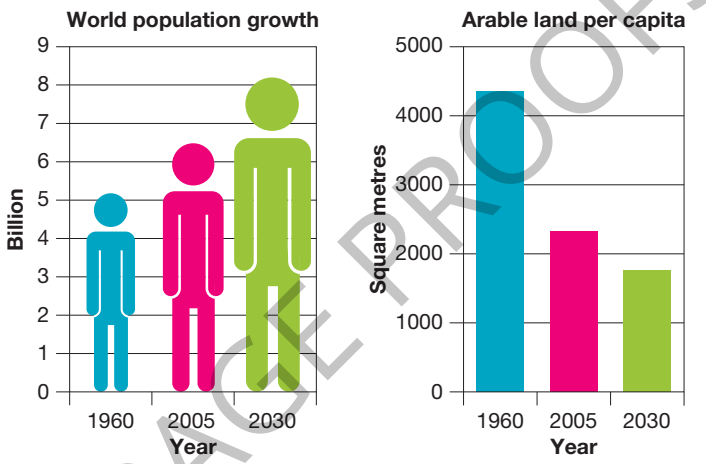
By the end of this subtopic, you will be able to describe the impacts of land degradation and competing demands for land on food security.

14.3.1 Causes of land loss

Land is absolutely essential for food production, and the world has more than enough arable land to meet future demands for food. Nevertheless, we need to find a balance between competing demands for this finite resource.

The loss of productive land has two main causes. First, there is the degradation of land quality through such things as erosion, **desertification** and salinity. Second, there is the competition for land from non-food crops, such as biofuels, and from expanding urban areas. As **FIGURE 1** shows, the growth in world population is inversely proportional to the amount of arable land available. This does not even take into consideration the land that is degraded and no longer suitable for growing food.

FIGURE 1 Comparison of world population growth and arable land per capita



Land degradation

Although there have been significant improvements in crop yields, seeds, fertilisers and irrigation, they have come at a cost. Environmental degradation of water and land resources places future food production at risk.

The main forms of land degradation are:

- erosion by wind and water
- salinity
- pest invasion
- loss of biodiversity
- desertification.

Land degradation occurs in all food-producing biomes across the globe. Some degradation occurs naturally; for example, a heavy rainstorm can easily wash away topsoil. However, the most extensive degradation is caused by overcultivation, overgrazing, overwatering, overloading with chemicals and overclearing (see **FIGURE 2**). More than 75 per cent of the planet's land is considered degraded, impacting on the lives of more than 3 billion people. In China, erosion affects over 40 per cent of the land area; up to 10 million hectares are contaminated by pollutants.

FIGURE 2 Land degradation caused by deforestation in Madagascar

desertification the transformation of arable land into desert, which can result from climate change or from human practices such as deforestation and overgrazing

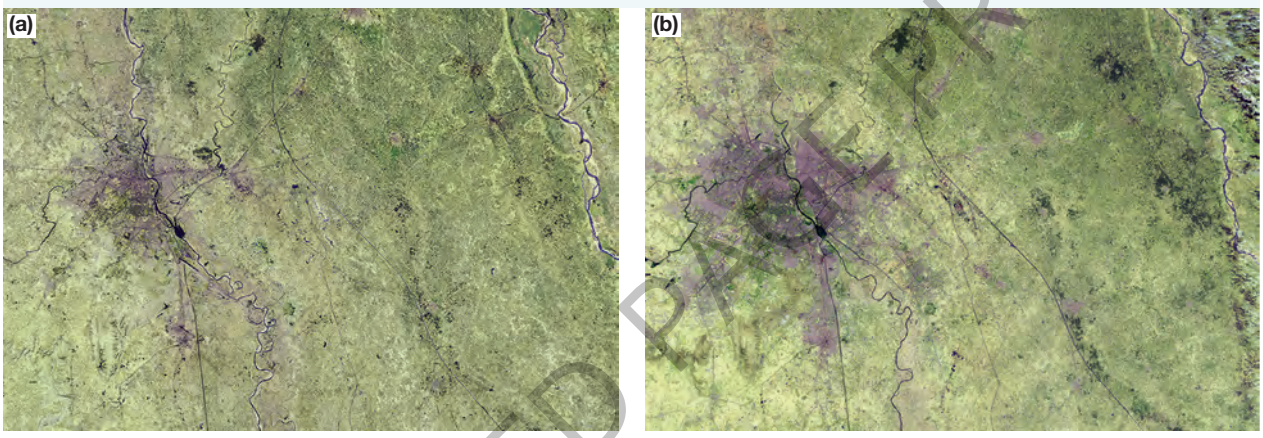
Competition for land

There has been a growing global trend to convert valuable cropland to other uses. Urban growth, industrialisation and energy production all require land. Melbourne currently produces enough food to supply 41 per cent its needs. With an estimated population of 7–8 million and the consequent growth in city size by the year 2050, the city will need 60 per cent more food. The capacity of current farmland will provide only 18 per cent of the city's needs.

Creeping cities

Cities tend to develop in places that are agriculturally productive. However, as they expand, they encroach on valuable farmland. Approximately 3 per cent of the world's land areas are urbanised, but this is expected to increase to 4–5 per cent by 2050.

FIGURE 3 Satellite image of New Delhi, India, in (a) 1989 and (b) 2018 — the expansion of the city has taken over valuable arable land.



Growing fuel

Traditionally, the main forms of biofuel have been wood and charcoal. Almost 90 per cent of the wood harvested in Africa and 40 per cent of that harvested in Asia is used for heating and cooking. Today, people are seeking more renewable energy sources and they want to reduce CO_2 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**. 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.

Land grabs

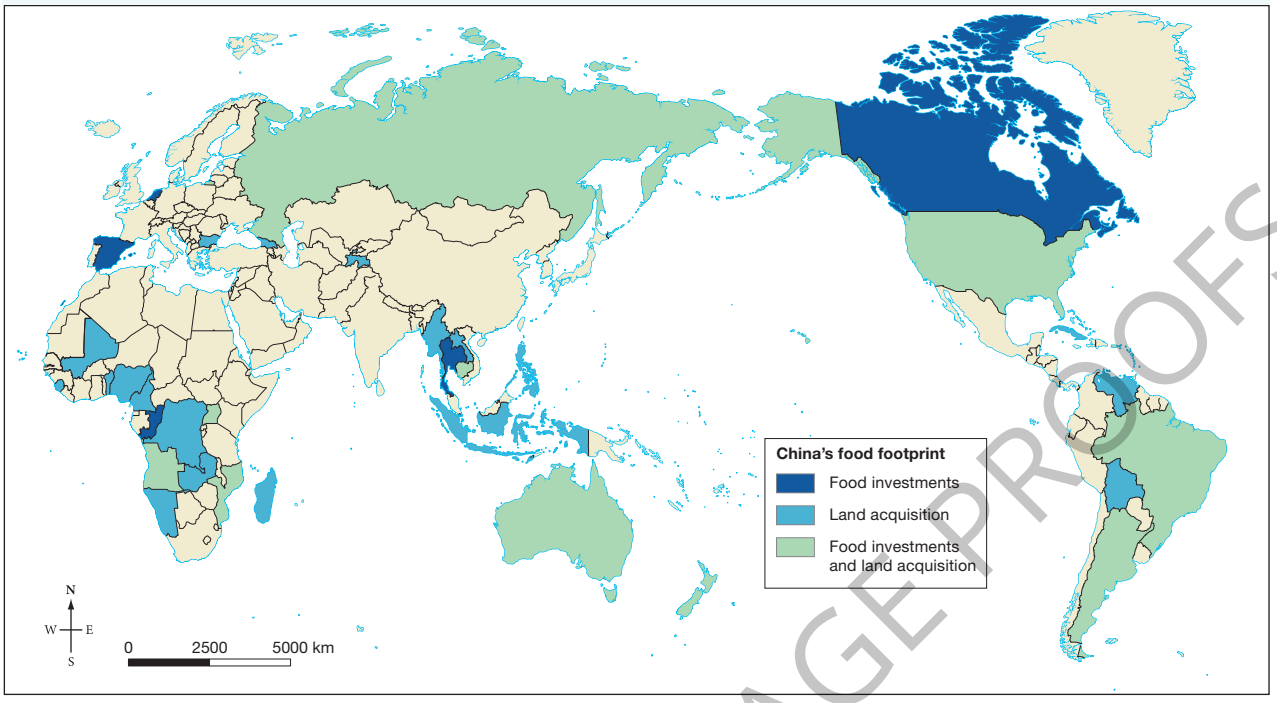
A growing challenge to world food security is the purchase or lease of land, largely in developing nations, by resource-poor but wealthier nations. Large-scale 'land grabs', as they are known, have the potential to improve production and yields but at the same time there is growing concern over the loss of land rights and food security for local populations.

Since 2000, foreign investors have acquired over 26 million hectares around the world to produce food crops and biofuels. **FIGURE 4** shows the extent of China's expansion into other countries with investments in land and agricultural businesses.

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

marginal land describes agricultural land that is on the margin of cultivated zones and is at the lower limits of being arable

FIGURE 4 Global map of China's land and food footprint



Source: The Heritage Foundation, GRAIN.org, Bloomberg. Map drawn by Spatial Vision.

FIGURE 5 Examples of land grabs in Africa

CHINA
Mozambique — $800 million invested to improve rice production
Democratic Republic of Congo — 2.8 million ha for biofuel production
Tanzania — 300 ha for rice farming
Zambia — 1.2 million ha for biofuel production

EGYPT
Sudan — Land acquired to grow 2 million tons of wheat annually

GERMANY
Ethiopia — 13 000 ha for biofuel production

INDIA
Ethiopia — $4 billion invested to produce flowers and foodstuffs

JORDAN
Sudan — 24 000 ha for crops and livestock

LIBYA
Mali — 101 000 ha for rice farming

QATAR
Kenya — 40 000 ha farmland
Sudan — Investment in agriculture

SAUDI ARABIA
Sudan — 918 million ha for foodstuffs
Tanzania — 506 000 ha for food production

SOUTH AFRICA
Republic of Congo — 10 million ha acquired

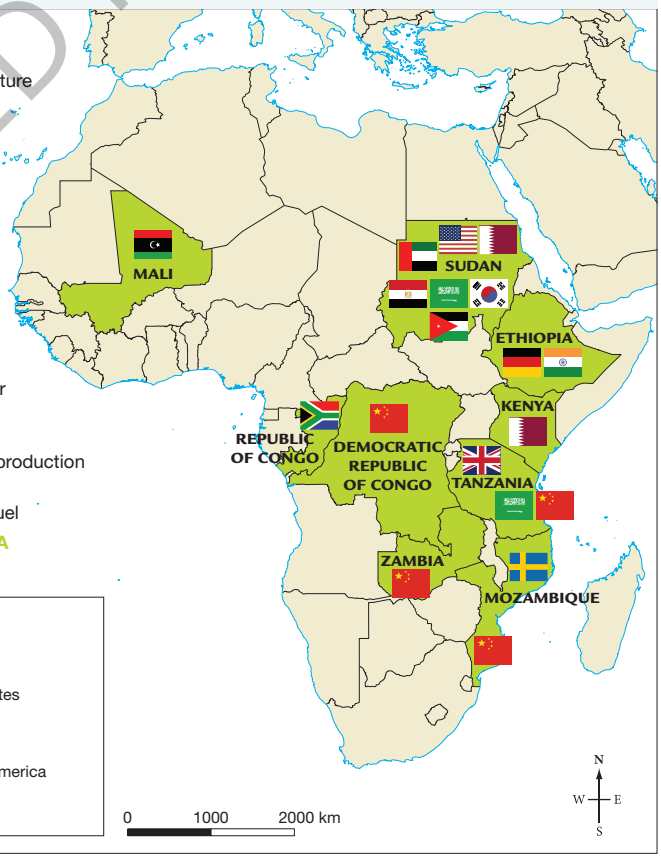
SOUTH KOREA
Sudan — 688 000 ha of wheat fields

SWEDEN
Mozambique — 101 000 ha for biofuel production

UNITED ARAB EMIRATES
Sudan — 376 000 ha for food production

UNITED KINGDOM
Tanzania — 45 000 ha for biofuel

UNITED STATES OF AMERICA
Sudan — 405 000 ha acquired



Overseas country leasing or owning land

China	Libya	Sweden
Egypt	Qatar	United Arab Emirates
Germany	Saudi Arabia	United Kingdom
India	South Africa	United States of America
Jordan	South Korea	

Source: Food and Agriculture Organization, International Food Policy Research Institute

Forty-two per cent of global acquisitions have occurred in Africa, examples of which can be seen in **FIGURE 5**. Africa's appeal is based on the fact that the continent accounts for 60 per cent of the world's arable land and yet most countries within it currently achieve less than 25 per cent of their potential yield.

The rise of land grabs came about as a result of the 'triple-F' crisis — food, fuel and finance.

- *Food crisis:* massive increases in world food prices in 2007–08 emphasised the need for those countries heavily reliant on importing food, such as Saudi Arabia and China, to improve their food security by obtaining land in other countries to produce food to meet their own needs.
- *Fuel crisis:* rising and fluctuating oil prices in 2007–09 created an incentive for countries to acquire land to produce their own biofuels (see **FIGURE 5**).
- *Financial crisis:* the global financial crisis in 2008 saw organisations switch from investing in stocks and shares to land in overseas countries, especially land that could be used to generate food and fuel crops.

14.3.2 The risk to food security

Investors in farmland are, understandably, seeking large expanses of land that has fertile soils and good rainfall or access to irrigation water. In many instances, land that is purchased is already occupied and used by small-scale farmers, often women who rarely benefit from any compensation. Prices for land can be much lower and there is frequently corruption, with much money going to local and government officials. People can also be forced off their land by governments keen to make deals with wealthy governments and corporations. Many land grabs have neglected the social, economic and environmental impacts of the deals.

With the purchase of land can come the right to withdraw the water linked to it and this can deny local people access to water for fishing, farming and watering animals. Withdrawal of water can reduce flow downstream. The Niger River, West Africa's largest river, flows through three countries and sustains over 100 million people, so any large-scale water reductions create significant impact to downstream environments and people.

Not all farmland grab projects have been successful. At least 17.5 million hectares of foreign-controlled land have failed. There are a number of interconnected reasons, including a lack of understanding of local conditions, natural disasters, failed accounting, and, increasingly, challenges from local communities that have been displaced. When projects collapse, communities rarely get their lands back or are compensated for their loss. Promises of new schools, health clinics, infrastructure and jobs simply disappear.

It has been estimated that the land taken up by foreign investors for biofuel projects could feed as many as 190 to 370 million people, or even more, if yields were raised to the level of industrialised western farming. In addition to these human costs, there are important concerns about environmental risks that are associated with monoculture farming and the loss of biodiversity in the region.

DISCUSS

'Land grabs are the solution to establishing a country's food security.' Provide an argument for this viewpoint and an argument against this viewpoint. Ensure that your arguments are logical and supported with evidence.

General capability: Critical and creative thinking

on Resources

Google Earth New Delhi

14.3 EXERCISE

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
Questions 3, 6, 7	Questions 1, 2, 8, 9	Questions 4, 5, 10

Check your understanding

1. What are the two main ways that productive farmland can be lost?
2. Why is the use of corn as a biofuel a threat to food security?
   - **A.** The use of corn as a biofuel is not a threat to food security.
   - **B.** Corn is a staple food item and could be used to feed humans.
   - **C.** The use of corn as a biofuel is too expensive.
   - **D.** The use of corn as a biofuel forces disadvantaged groups, such as women and the landless poor, to compete against the might of the biofuel industry.
3. Complete the following paragraph defining the term 'land grab'.
   'Land grab' refers to the _____ practice of countries purchasing or leasing land in other countries, in order to produce food to _____ back home. Countries usually do this to _____ their own food security, especially when their own environment may be _____ to types of farming (for example, _____), the population is large and growing (for example, _____) or where there is insufficient land to cultivate (for example, _____).
4. Refer to **FIGURE 1**.
   - **a.** Describe the changes in population growth and the arable land per person between 1960 and 2030, making use of figures.
   - **b.** What do the graphs in **FIGURE 1** suggest about food security?
5. Identify the advantages and disadvantages in developing and developed nations of using traditional biofuels, such as wood and charcoal, instead of oil and gas.

Apply your understanding

6. What is *jatropha*? What are the benefits of growing this rather than corn and other biofuels?
7. Do you think Australia will need to purchase farmland overseas? Give reasons for your answer.
8. Are land grabs the most effective solution for establishing a country's food security? Outline your view.
9. Refer to **FIGURE 4**.
   - **a.** Describe the distribution of countries in which China has acquired land.
   - **b.** Suggest reasons why China might invest in food production and land in Australia.
10. Refer to **FIGURE 5**. What patterns or connections do you notice about the use of land in Africa that is being acquired by foreign countries? Write two detailed paragraphs explaining your observations and suggesting reasons why these patterns or connections have come about.

For sample responses to every question, go to www.jacplus.com.au.

14.4 Access to water supplies

LEARNING INTENTION

By the end of this subtopic, you will be able to describe and explain the pressures placed on surface water and groundwater, and the relevance of this in maintaining food security.

14.4.1 Causes of water insecurity

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.

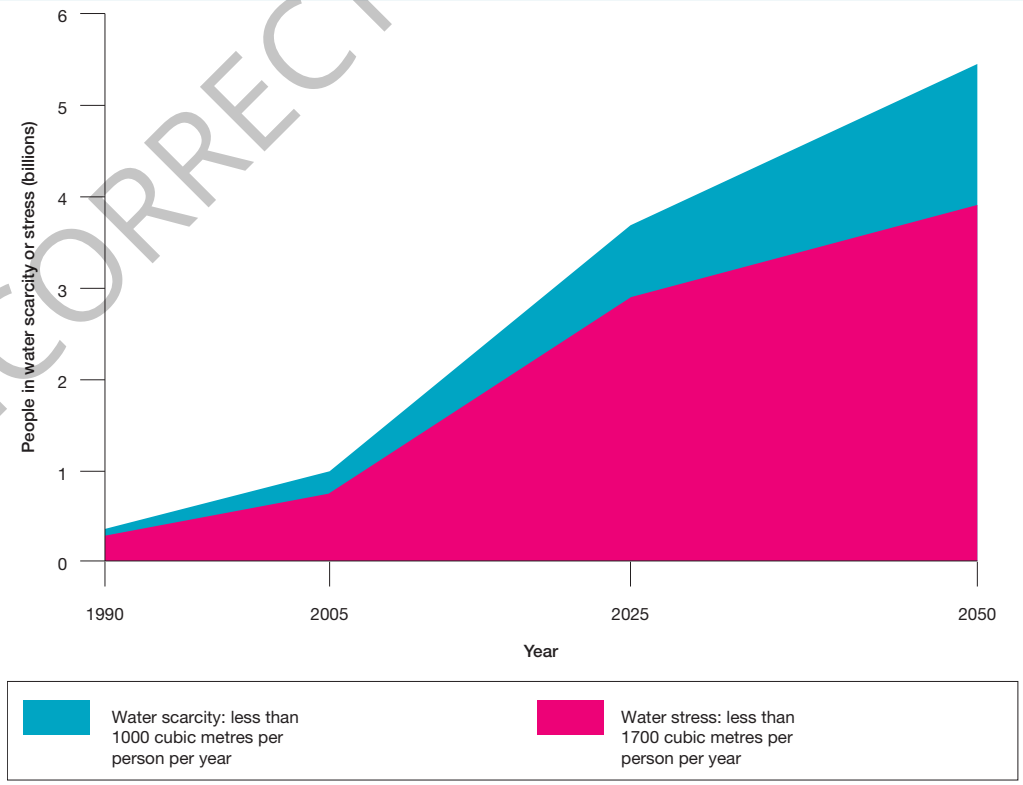
In theory, the world has enough water; it is just not available where we want it or when we want it, and it is not easy to move from place to place. We already use the most accessible surface water, and now we are looking for it beneath our feet. Underground **aquifers** hold 100 times more water than 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. **FIGURE 1** shows the predicted number of people who will face **water stress** and water scarcity in the future. A more complex view is seen in **FIGURE 2**, which shows an interconnection between increased demand for water and predicted climate change, population increase and greater industrialisation in the 2050s.

aquifer a body of permeable rock below the Earth's surface, which contains water, known as groundwater

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

FIGURE 1 People facing water stress and water scarcity

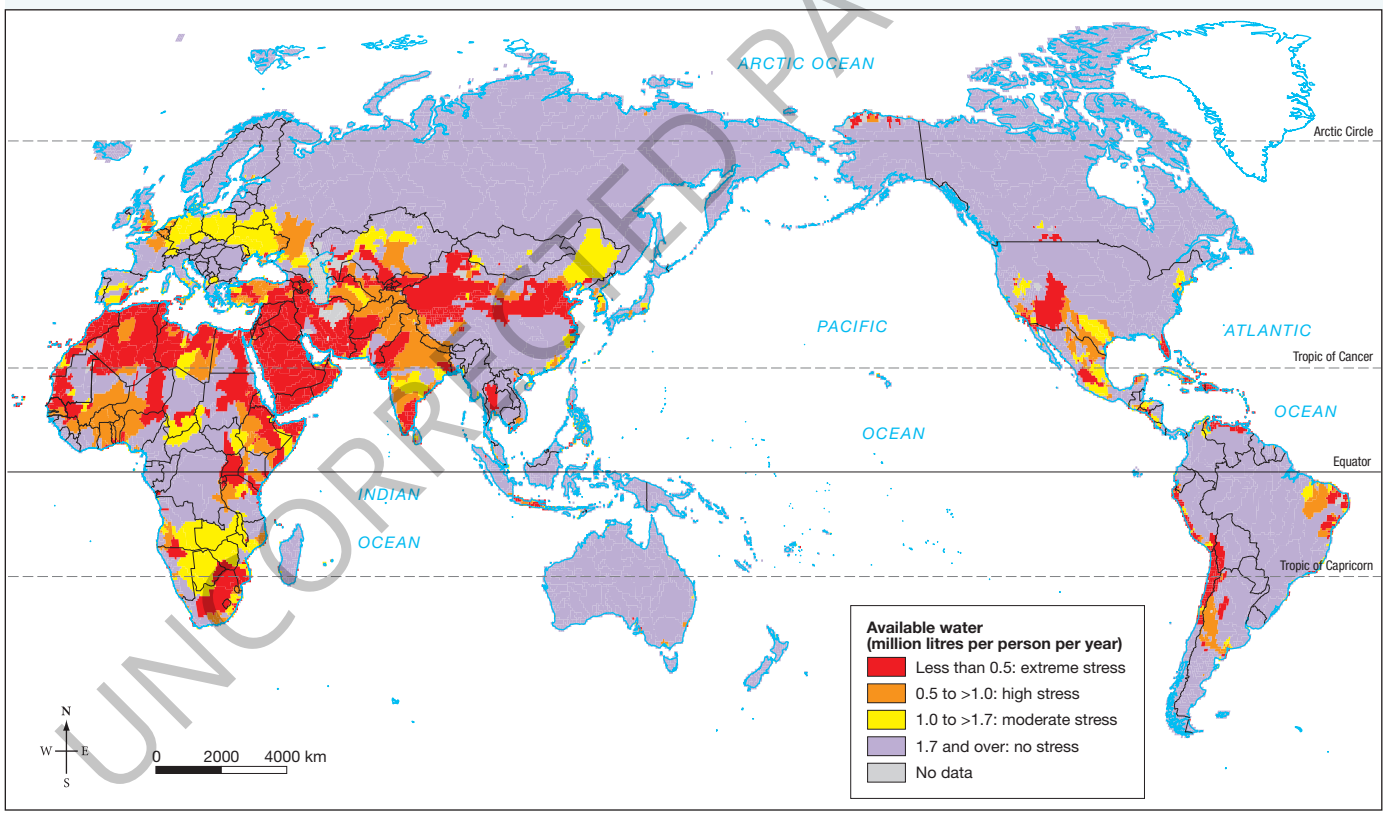


When water availability drops below 1.5 million litres per person per year, a country needs to start importing food; this makes the country vulnerable to changes in global prices. Developing countries that experience water stress cannot afford to import food. They are also more vulnerable to environmental disasters. In developing countries 70 per cent of food emergencies are brought on by drought.

The main causes of the growing water shortage are outlined below.

- *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.
- *Growth of urban and industrial demand*. Water for farming is diverted to urban populations, and productive land is converted to urban use.
- *Poor farming practices*. Water is wasted through inefficient irrigation methods and cultivating water-hungry crops such as rice. Poorly maintained irrigation infrastructure, such as pipes, canals and pumps, creates leakage.
- *Over-extraction*. Improved technology and cheaper, more available energy have enabled us to pump more groundwater from deeper aquifers. This is not always done at a sustainable rate, so as water is removed, less is available to refill lakes, rivers and wetlands.
- *Poor management*. Governments often price water cheaply, so irrigation schemes use water unsustainably. Some countries may have available water but lack the money to develop irrigation schemes.

FIGURE 2 Projected changes in water availability due to temperature, population and industrialisation increase, 2050s



Source: Spatial Vision

14.4.2 Deteriorating water quality

Agriculture is a major contributor to water pollution. Excess nutrients, pesticides, sediment and other pollutants can run off farmland or leach into soils, groundwater, streams and lakes. 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 and other medical problems, such as heavy-metal poisoning, to people. Pollution is an important contributor to the scarcity of clean, **potable** water.

potable drinkable; safe to drink

on Resources

Interactivity The last drop (int-3328)

Weblinks Water use
Water availability

14.4 EXERCISE

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Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
Questions	Questions	Questions
1, 2, 10	3, 4, 6, 7	5, 8, 9

Check your understanding

1. Examine **FIGURE 1**.
   a. Which sentence best describes the projected changes in the number of people affected by water stress between 1990 and 2050?
      A. The number of affected people will decrease dramatically.
      B. The number of affected people will decrease slightly.
      C. The number of affected people will remain fairly constant.
      D. The number of affected people will rise dramatically.
   b. Comment on how these changes compare with figures for water scarcity.
2. If a country has an average of 0.5 to <1.0 million litres of water per person per year, is it considered to be water stressed? Complete the following paragraph to explain why.
   Countries with an average of 0.5 to <1.0 million litres of water per person per year are experiencing high water stress. When water availability drops below _____ million litres per person per _____, a country needs to start importing food; this makes the country vulnerable to changes in global prices. _____ countries that experience water stress cannot afford to import food. They are also more vulnerable to environmental disasters. In developing countries _____ per cent of food emergencies are brought on by drought.
3. Is agriculture a contributor to, or a victim of water pollution?
4. Refer to **FIGURE 2**.
   a. Identify five places in the world that are predicted to be in high to extreme water stress in the 2050s.
   b. How could you explain why places like Eastern Europe could face water scarcity?
5. Why would underground aquifers be able to hold more water than surface rivers and lakes?

Apply your understanding

6. Suggest three strategies that water managers could employ to help prevent water scarcity affecting future food security.
7. Suggest one natural and two human activities/events that could cause a decline in the quality or potability of a water resource.
8. Suggest reasons why groundwater is often used for food production at an unsustainable rate.
9. Suggest an argument that would help convince people to reduce their meat consumption as a means of reducing our water needs.
10. Governments are often accused of pricing water too cheaply. What changes might your family need to implement if the cost of household water was to more than double?

For sample responses to every question, go to www.jacplus.com.au.

14.5 The challenges of climate change for food security

LEARNING INTENTION

By the end of this subtopic, you will be able to describe and explain the possible impacts of climate change on food production.

14.5.1 Impacts of climate change on food production

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 26 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 an average of 54 per cent in sub-Saharan Africa.

It is difficult to predict the likely impacts of climate change, because there are many environmental and human factors involved (see **FIGURE 1**), as well as different predictions from scientists (see **FIGURE 2**).

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 3** demonstrates the effects of climate change on cereal crops, while **FIGURE 4** shows the range of potential impacts across Europe.

FIGURE 1 Possible impacts of climate change on food production

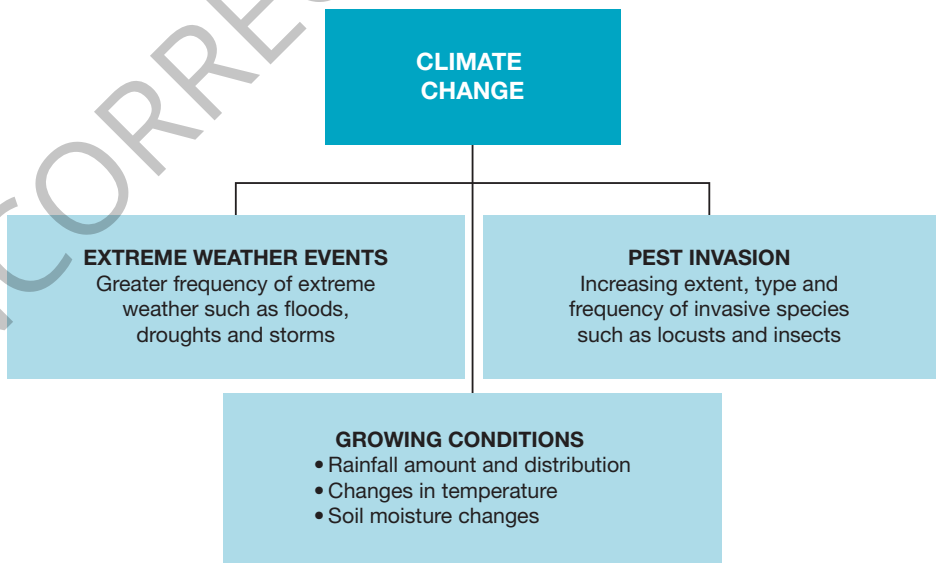
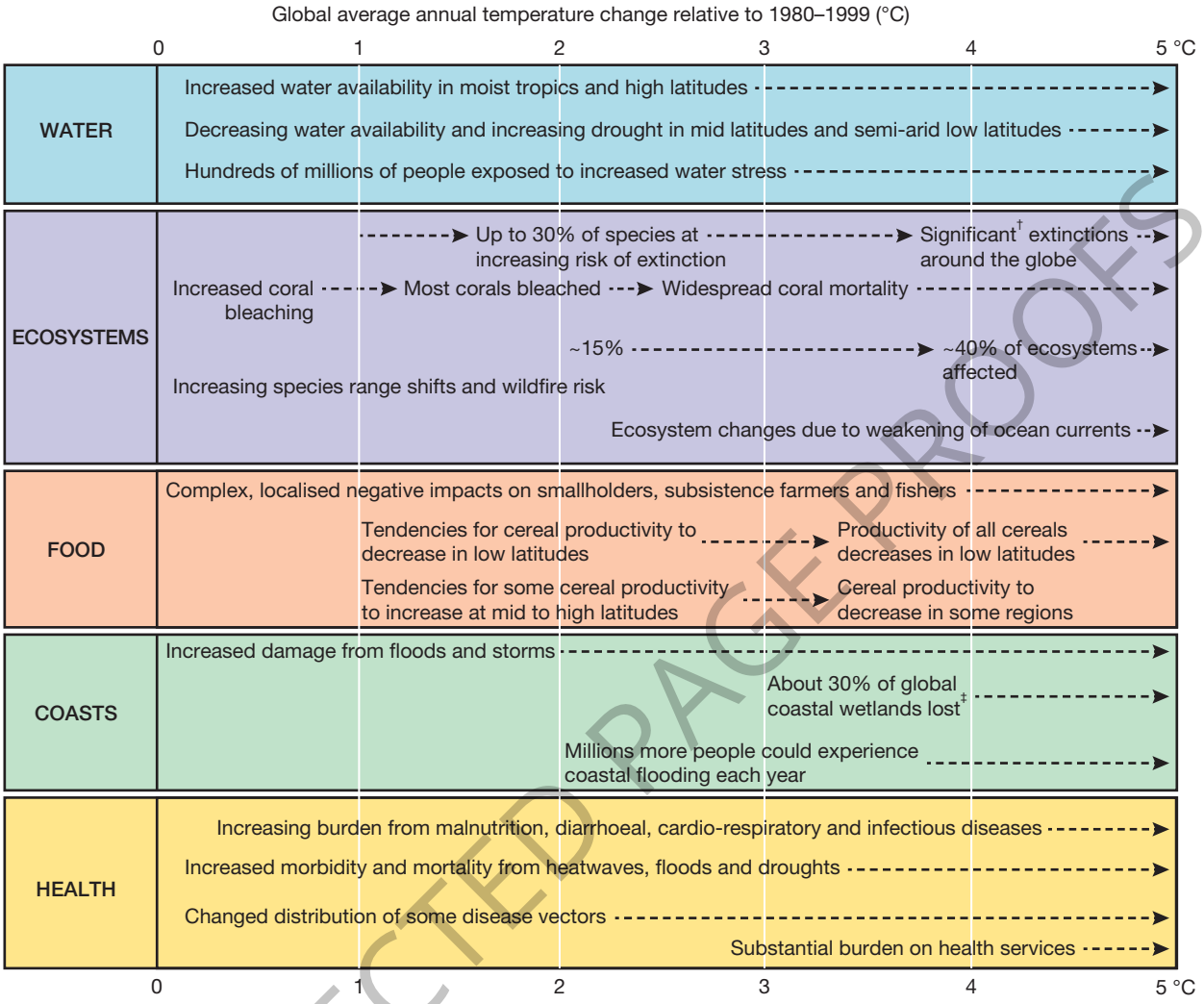


FIGURE 2 Projected consequences of climate change



† Significant is defined here as more than 40%. ‡ Based on average rate of sea level rise of 4.2 mm/year from 2000 to 2080.

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 the economy. There is also a risk of greater numbers of **environmental refugees** or people fleeing places of food insecurity.

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

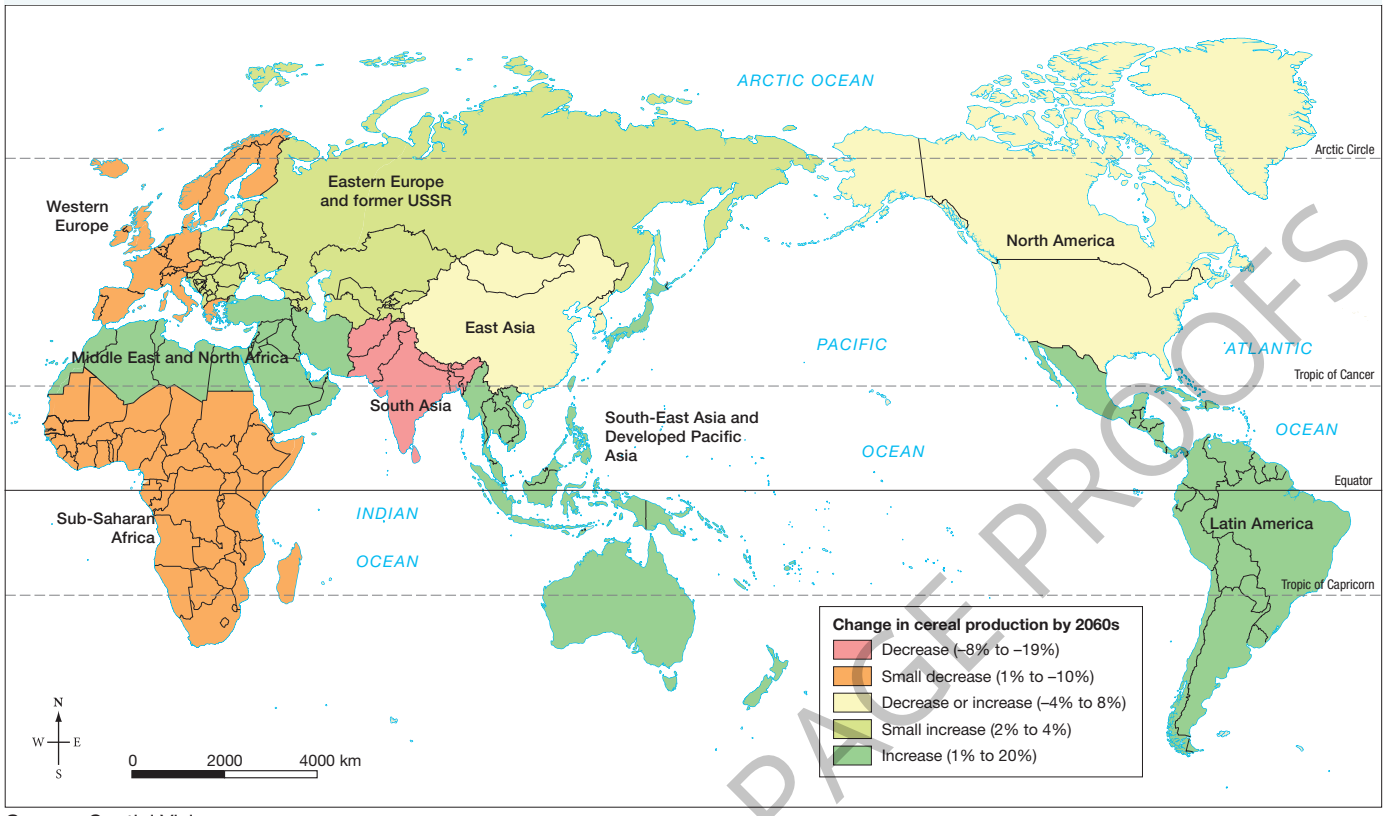
DISCUSS

Should food be shared more equitably around the world? How might this be achieved? **HASS skills: Evaluating**
General capability: Ethical understanding

on Resources

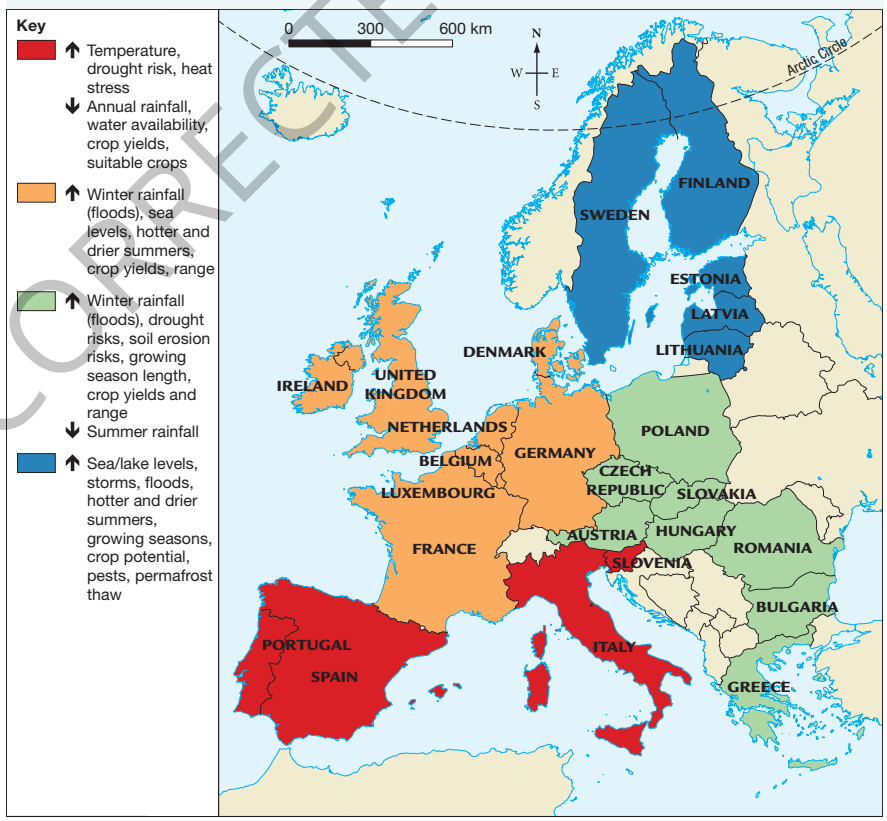
Weblink How to feed the world in 2050

FIGURE 3 Predictions of the effects of climate change on cereal crops



Source: Spatial Vision

FIGURE 4 Examples of potential consequences of climate change in selected European countries



Source: Spatial Vision

14.5 ACTIVITIES

1. Research potential impacts of climate change on Australia. Create an annotated map to illustrate your findings. **HASS skills: Questioning and researching**
2. Use the **How to feed the world in 2050** weblink in the Resources tab to find out more about the impact of climate change on food security. Suggest a series of strategies that global bodies should implement to protect global food security into the future. **HASS skills: Evaluating**
Geography concept: Sustainability
General capability: Critical and creative thinking

14.5 EXERCISE

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
Questions	Questions	Questions
2, 3, 6, 7	1, 4, 8, 9	5, 10

Check your understanding

1. Describe the interconnection between environmental refugees and climate change.
2. Explain how the impacts of climate change may be a benefit to food production in a particular place.
3. How would an increase in extreme weather events impact on food production?
   - **A.** Reduced yields, loss of livestock due to drought
   - **B.** Loss of crops from storm or flood damage
   - **C.** Damage to crops due to increased frost
   - **D.** None of the above would be possible
4. How might technologies such as glasshouses and irrigation help reduce the impacts of global warming?
5. Why are the impacts of climate change likely to be felt more in those countries with a high percentage of their population in the agricultural workforce?

Apply your understanding

6. Identify and explain one way that a country such as Australia might best prepare its food production systems to cope with potential changes in climate.
7. Refer to **FIGURE 2**.
   - **a.** If temperatures increase by 3 °C, how will this affect crop yields?
   - **b.** Changes in extreme weather events are unlikely unless temperatures increase by approximately how much?
   - **c.** Food insecurity will be felt greatly in developing regions if temperatures rise more than how many degrees?
   - **d.** Places that are likely to experience decreasing crop yields will be found where?
8. Refer to **FIGURE 3**.
   - **a.** 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?
9. Refer to **FIGURE 2, 3** and **4**.
   - **a.** Which countries of Europe will benefit from climate change in terms of food production and which countries are likely to suffer negative outcomes? Specify what types of food production will suffer.
   - **b.** Would increased irrigation be a sustainable solution to growing food in Spain? Explain your answer.
10. Refer to **FIGURE 3**. Create a table classifying each of the following countries according to their predicted change to cereal production: Bangladesh, Brazil, England, Germany, Indonesia, Mexico, South Africa, South Korea.

For sample responses to every question, go to www.jacplus.com.au.

14.6 Thinking Big research project: Famine crisis report

Scenario

The United Nations (UN) has asked you, a world-leading specialist in food security, to write a report that will assist them in organising a response to a famine. You will need to present your report to a famine taskforce panel at the UN headquarters in New York.

Background brief

While many countries across the globe face food insecurity, it is rare for a country or region to be officially declared in famine, the worst form of food insecurity. By definition, a famine is an extreme crisis of access to adequate food, resulting in widespread malnutrition and loss of life due to starvation and infectious disease. While the number of famines is on the decline, the twentieth century saw more than 70 million people die from famine across the globe.

There are three key indicators that the United Nations uses to identify and declare a famine:

1. Twenty per cent of the population experiences an acute shortage of food, eating only small amounts of one or two of the twelve food groups (usually grains) and cannot access four litres of safe water per person per day.
2. More than 30 per cent of children are acutely malnourished.
3. Within the community, two adults or four children out of every 10 000 are dying of malnutrition and disease each day.

People who are experiencing famine have lost the means of earning an income and have few, if any, resources to sustain themselves. In general, there is no one cause of famine; rather, it is a series of overlapping factors including climate extremes, crop failures, poor governance and, most importantly, conflict. Conflicts, such as civil wars, can prevent people from producing food, create large-scale movement of people fleeing the fighting, and prevent aid from reaching people. Often governments do not have the resources, planning or will to deal with the issue and international assistance is needed.

Task

Following the guidelines provided in the **Process** section, conduct research into and prepare a report explaining the situation in relation to a famine crisis. This could be a current famine, or one that has occurred in recent years. Your research report should allow you to fully explain the famine situation to the UN, and help them to formulate a response. Your report and presentation to the UN should include:

- a brief snapshot of the country, including details on population, life expectancy, GDP and one or two other relevant features
- a location map that shows the region/country suffering from the famine
- data on the number of people affected, death rates and other relevant statistics
- details of short-term and long-term impacts of the famine

- a table that describes three different types of responses to famine in general, and that suggests possible advantages and disadvantages of each response
- a recommendation as to the ways in which the UN can assist the people and the country experiencing the famine, and how the country can improve its food security in the future
- a reference list detailing your information sources
- You may wish to prepare a PowerPoint presentation to present key aspects of your research and your recommendations.

Process

- Open the ProjectsPLUS application in the Resources for this topic. Click on the Start new project button to enter the project due date and set up members in your project group to allow you to work collaboratively. Save your settings and the project will be launched.
- Navigate to the **Research forum**, where you will find topics loaded under the headings below to guide your research. You can add further topics to the research forum if you wish.
- Use the weblinks in the **Media centre**, along with your own research, to find information and make notes of relevant details under each of the research topic headings.
- Complete the tasks under each of the following subheadings (these are the topics in the Research forum) to develop your report.

Background information

- Use the internet and a reliable website such as the World Health Organization or Oxfam to identify a current famine or one that has occurred in the past few years.
- Provide a brief snapshot of the country affected, including details on population, life expectancy, GDP and one or two other relevant features. Websites of organisations such as the CIA or World Bank provide data. (You might like to use similar data from Australia as a comparison.)
- Create a location map to show the region/country suffering from the famine. Ensure you apply BOLTSS to your map. Additional maps can be included to show greater detail.

What are the factors contributing to the famine?

- Describe the factors that have caused the famine and, if possible, which factors were particularly important.
- Refer to a minimum of three references (include these in a bibliography at the end of your report) to identify the range of factors that have contributed to the famine. You may like to classify these as political, economic, social or environmental.

What are the impacts of this famine?

- Describe the impacts of the famine. Try to identify what might be short-term and long-term impacts of the famine.
- Newspaper articles and magazines such as *National Geographic* should provide you with data on the number of people affected, regions affected, death rates and other relevant material. Are there refugee camps involved? What about the spread of infectious diseases?

- Images can be included and should be referred to in your text (for example, 'refer to **FIGURE 1**'). You should also include captions that explain the images.
- What is likely to happen over the next few years as the country recovers from the famine? You might be able to predict different scenarios.

What are the responses to the famine?

- In your research try to find out what is being done about the famine. You can look at this at the national scale (government of the country affected) and the international scale (organisations such as WHO, UNICEF, UN World Food Programme, World Vision, CARE, Red Cross and other countries that might be donating money, food or expertise).
- Create a table that describes three different types of response to famine in general. This might need you to look at other recent famines and how they were dealt with, or investigate what steps organisations such as World Vision take in assisting people experiencing famine. For each response suggest possible advantages and disadvantages.

Recommendations

- From your study of this disaster, suggest ways that the UN can assist the people and country experiencing the famine. For ideas, you may wish to research how the UN has responded to other famines. As you are the expert, recommend how you think the country could improve its food security in the future.
- Prioritise the top 2 or 3 actions and justify their importance.
- Write up your report using the task subheadings as a guideline. Include specific data, where possible.
- Review your finished report, checking for spelling, grammar, completed map(s), tables and bibliography.
- If you are preparing a PowerPoint presentation, select key information, maps, images etc. to create your slides.
- If you wish to keep a copy of your project research, print out the **Research report** in the Research forum.
- Ensure you have completed all elements of the task and, when you are satisfied, submit or present your assignment to your teacher for assessment.

on Resources

ProjectsPLUS Thinking Big research project: Famine crisis report (pro-0191)

14.7 Feeding the future world population

LEARNING INTENTION

By the end of this subtopic, you will be able to explain the prevalence and impacts of hunger, the challenges to food production and the factors affecting food production.

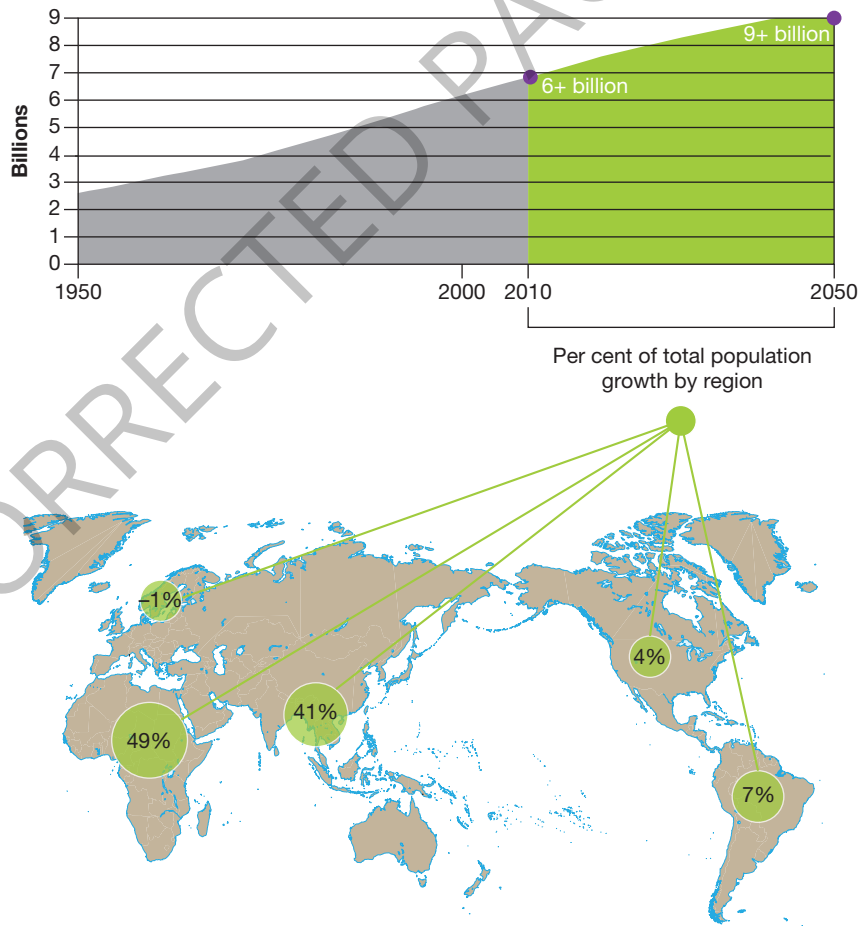
14.7.1 The prevalence and impacts of hunger

According to the World Health Organization, over 1.9 billion adults in the world are overweight, while 821 million go hungry each day. What can we do to change this imbalance and ensure equal, sustainable access to food for people across the globe?

14.7.2 Challenges to food production

The distribution of the world's population and the availability of arable land per person is uneven. Regions with the fastest-growing future populations (see **FIGURE 1**) are also those where there is limited arable land per person.

FIGURE 1 Global population growth and percentage of total population growth by region, 2010–50



Source: Redrawn from an image by Global Harvest Initiative (*2011 GAP Report®: Measuring Global Agricultural Productivity*), data from the United Nations

One solution to feeding people who live in crowded spaces, such as Asia, or in environmentally challenging spaces, such as sub-Saharan Africa, is to increase the amount of trade in food products. This will involve moving food from places with crop surpluses (North America, Australia and Europe) to regions that are crowded or less productive. This means there will be an increase in the interconnection between some countries.

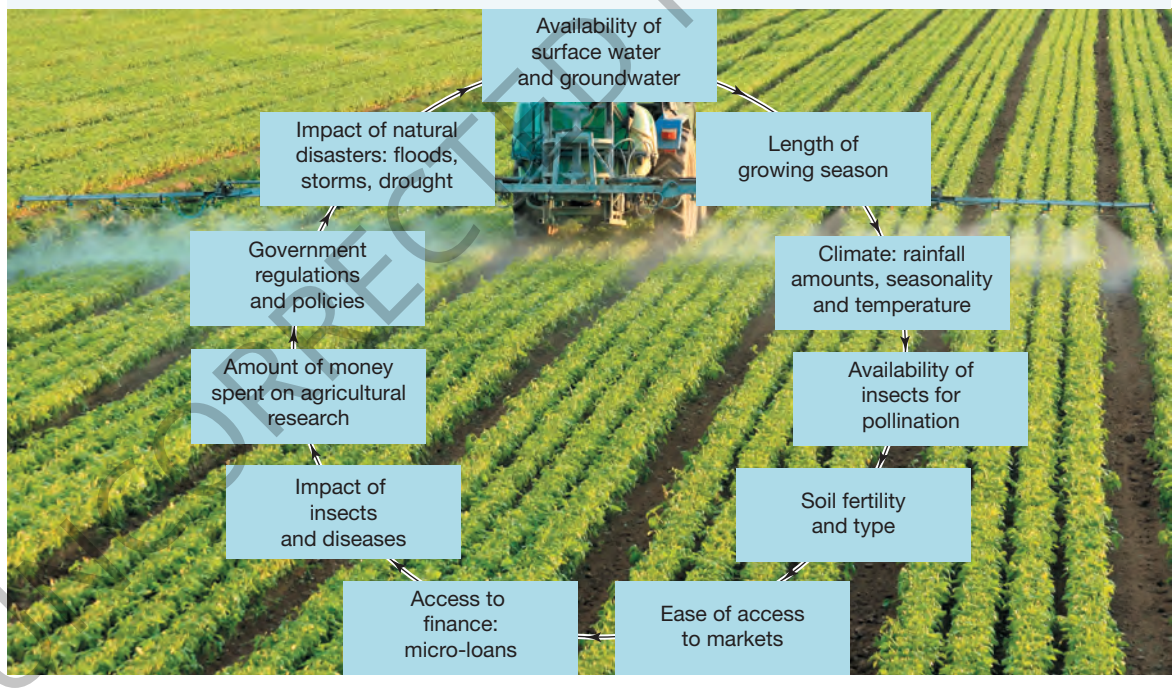
The impact of hunger on people cannot be overstated. Hunger kills more people each year than malaria, AIDS and tuberculosis combined. It is estimated that we will need to produce between 70 and 100 per cent more food in order to feed future populations. New ideas, knowledge and techniques will be needed if we do not want millions more people to suffer malnourishment, starvation and vulnerability to disease. The challenge, though, is to do this in a way that is also sustainable. Population growth and limited supplies of arable land will affect how much food can be produced.

Preventing hunger on a global scale is important, but action also needs to be taken on a local scale. Over 70 per cent of the world's poor live in rural areas; improving their lives would create greater food security. If poor farmers can produce more food, they can feed themselves and provide for local markets. Improved infrastructure, such as roads in rural regions, would enable them to transport their produce to market and increase their incomes.

Factors affecting food production

Farming is a complex activity, and farmers around the world face many challenges in producing enough food to feed themselves and to create surpluses they can sell to increase their incomes. Some of these are outlined in **FIGURE 2**.

FIGURE 2 Factors affecting farming yields



As urban areas grow, the amount of available arable land decreases. According to the United Nations Food and Agriculture Organization (FAO), the world has an extra 2.8 billion hectares of unused potential farmland. This is almost twice what is currently farmed. However, only a fraction of this extra land is realistically available for agricultural expansion, owing to inaccessibility and the need to preserve forests and land for infrastructure.

As mentioned, the growing populations of the future will be found in places where expansion of land for agriculture is already limited. Consequently, increased food production will need to come from better use of current agricultural areas, better use of technology, and new ways of thinking about food production and approaches to farming. One such example is the Ord River irrigation scheme in the East Kimberley region of Western Australia, which is transforming this semi-arid region and providing food in huge quantities for our Asian neighbours.

FIGURE 3 The Ord River Irrigation Scheme has alllowed great expansion of the available farming area in the region.

on Resources

Video eLesson Future food (eles-1721)

14.7 ACTIVITY

As well as affecting people's health, a shortage of food can have social and political effects. Undertake research into the series of food riots that occurred in a number of countries around the world in 2015.

a. Where did these riots occur?
b. What were the causes of these riots?
c. Why might governments need to prevent this situation from occurring again?

HASS skills: Questioning and researching, Analysing
General capability: Critical and creative thinking

14.7 EXERCISE

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
Questions 1, 2, 6	Questions 3, 4, 7, 8	Questions 5, 9, 10

Check your understanding

1. How much more food is it estimated that we will need to produce in order to feed future populations?
   - **A.** 0–30%
   - **B.** 30–60%
   - **C.** 60–80%
   - **D.** 70–100%
2. Explain why hunger is such a serious issue.
3. What is the relationship between areas with fast-growing populations and the amount of arable land per person?
4. What proportion of the world's poor live in rural areas?
5. **a.** Which of the following strategies might help to ensure there is enough food in the future for people who live in places with growing populations and limited arable land?
   - **A.** Increasing food production through better use of technology
   - **B.** Improving infrastructure, such as roads in rural regions
   - **C.** Increasing the amount of trade in food products from places with crop surpluses to regions that are crowded or less productive
   - **D.** All of the above

   b. Explain the reasons for your answer in part a.

Apply your understanding

6. Examine **FIGURE 1**.
   - **a.** Which region is predicted to decrease in population by 2050?
   - **b.** Which two continents are expected to have the greatest increase in population?
   - **c.** What is the predicted world population in 2050?
7. Classify the following factors affecting farming yields as either environmental, economic, or social/political. Factors: access to finance, money spent on agricultural research, access to markets, government regulations, availability of surface water and groundwater, length of growing season, rainfall amounts, seasonality and temperature, availability of insects for pollination, soil fertility and type, impact of insects and diseases, impact of natural disasters

Environmental	Economic	Social/political

8. How does a growing world population put pressure on food supplies?
9. Lack of food has caused people to leave their homes and move to cities in search of employment and food. Predict the places of the world where this is most likely to happen.
10. Identify three factors affecting farming yields: one environmental, one economic and one social/political. Explain how these factors impact production levels, and ways they can be either harnessed or mitigated to help ensure food security.

For sample responses to every question, go to www.jacplus.com.au.

14.8 Improving food production and distribution

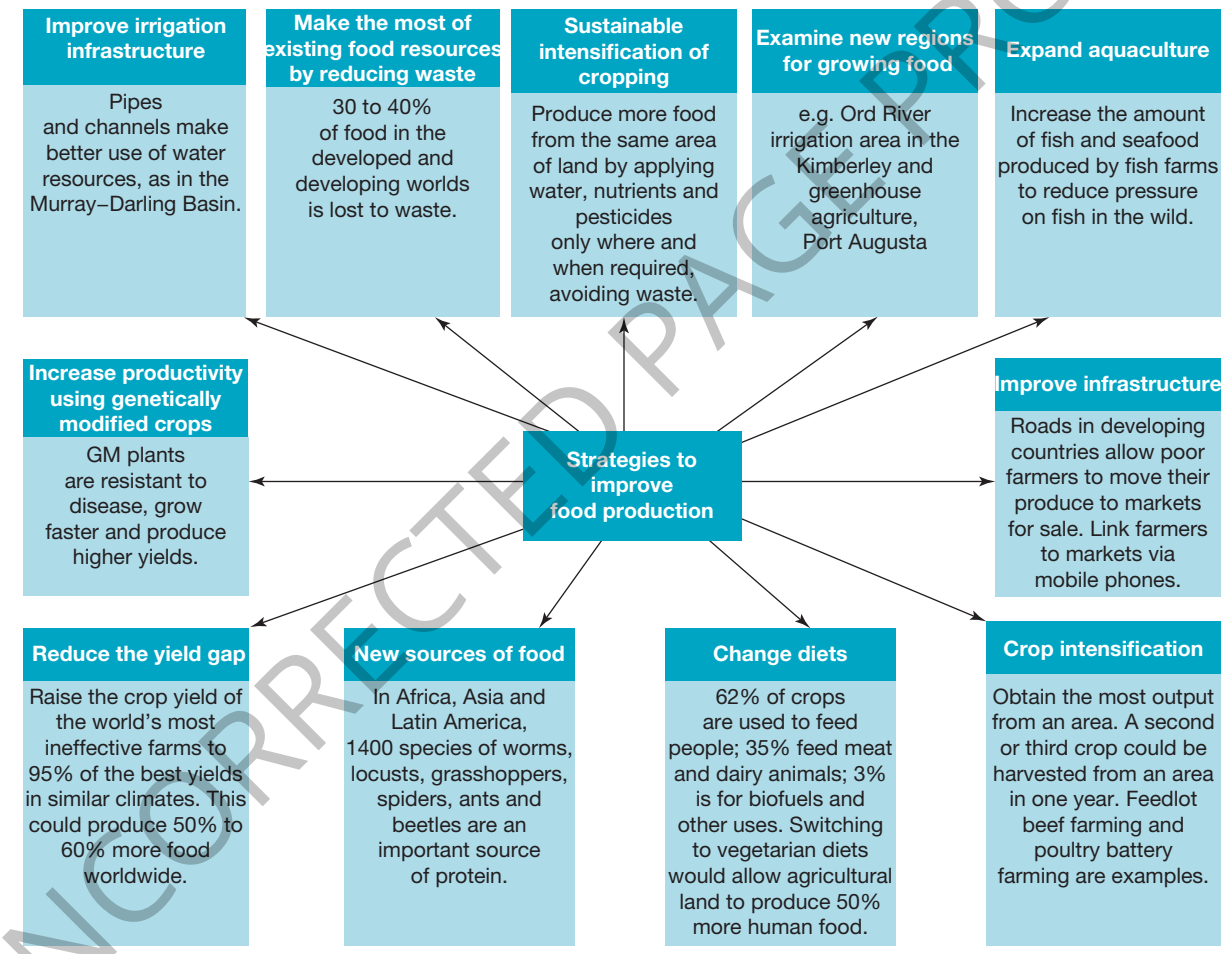
LEARNING INTENTION

By the end of this subtopic, you will be able to compare and evaluate various strategies for improving food production and reducing food waste.

14.8.1 Improving food yield

There are many strategies that can be used to create greater efficiencies and increased food production. **FIGURE 1** summarises some of these.

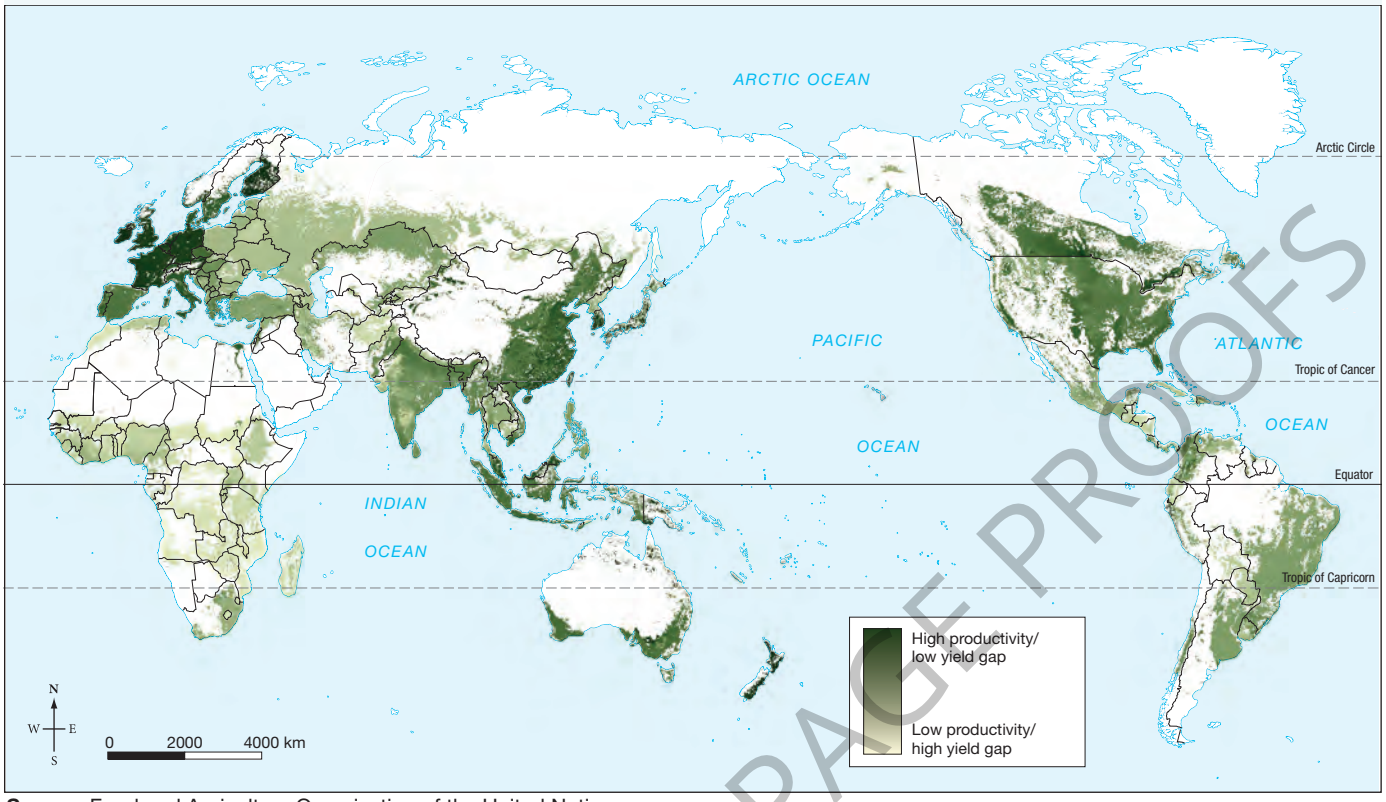
FIGURE 1 Strategies for improving food production



The strategy that is likely to be the most important in increasing future crop production is the reduction of the **yield gap**. This means that farmers who are currently less productive will need to implement farming methods that will lead to increased yields so that their outputs are closer to those of more productive farmers. There is a serious yield gap in more than 157 countries (see **FIGURE 2**). If this gap could be closed, larger amounts of food would be available without the need for more land. There are wide geographic variations in crop and livestock productivity. Brazil, Indonesia, China and India have all made great progress in increasing their agricultural output. Much of the increase has been achieved through more efficient use of water and fertilisers.

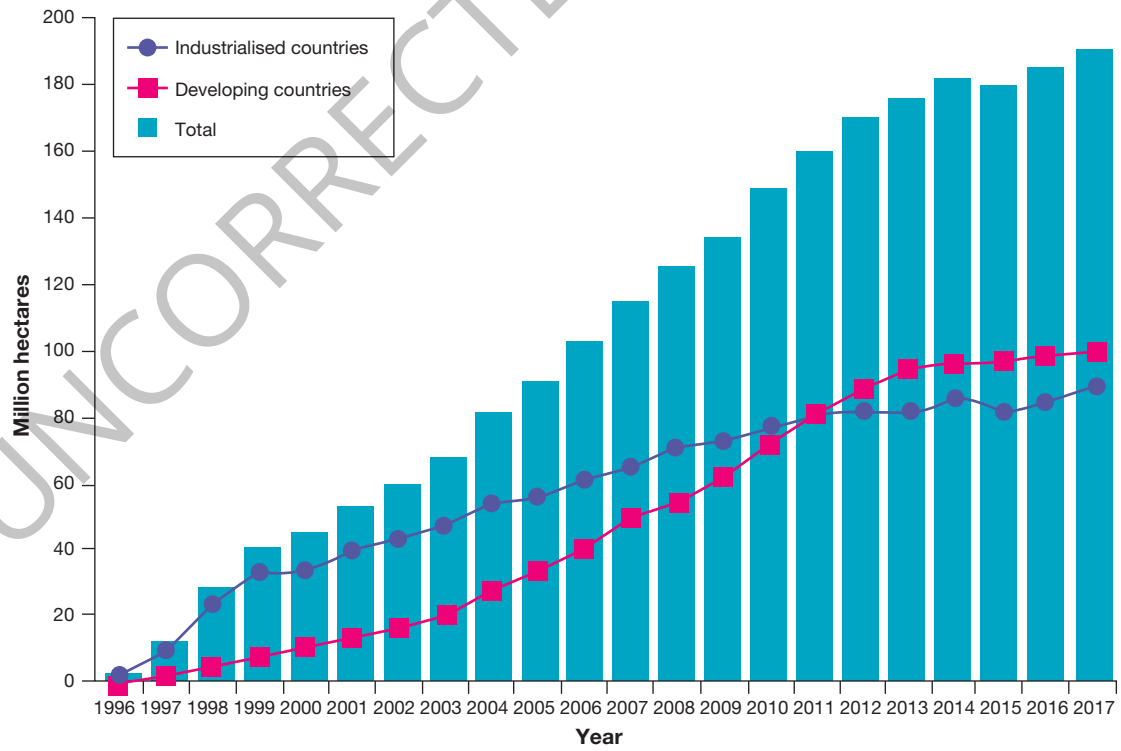
yield gap the gap between a certain crop's average yield and its maximum potential yield

FIGURE 2 Yield gap for a combination of major crops, 2015



Source: Food and Agriculture Organization of the United Nations

FIGURE 3 Global area of genetically modified crops in industrialised and developing countries 1996–2017



Source: c ISAAA 2017. ISAAA. 2017. Global Status of Commercialized Biotech/GM Crops in 2017: Biotech Crop Adoption Surges as Economic Benefits Accumulate in 22 Years. ISAAA Brief No. 53. ISAAA: Ithaca, NY. pp.3 & 4

The use of **genetically modified** (GM) foods has increased, and this has also increased crop yields. However, there is some opposition to GM crops because of concerns about:

- loss of seed varieties
- potential risks to the environment and people's health
- the fact that large companies hold the copyright to the seeds of GM plants that are food sources.

14.8.2 Innovative production solutions

Because agriculture uses around 70 per cent of the planet's increasingly scarce freshwater resources, any method that can produce food without needing fresh water at all is a great advance.

Port Augusta is located in a hot, arid region of South Australia, and is not normally associated with agriculture. However, one company, Sundrop Farms, is using this region's abundant renewable resources of sunlight and sea water to produce high-quality, pesticide-free vegetables, including tomatoes, capsicums and cucumbers, and it does so all year round.

In 2016, a 20-hectare greenhouse was opened, powered by a 115 m solar tower with 23 000 mirrors. The mirrors concentrate the sun's energy and the collected heat creates steam to drive electricity production, heat the greenhouse, and desalinate sea water from the Spencer Gulf, producing up to one million litres of fresh water a day for crop irrigation. The greenhouse aims to satisfy approximately 10 per cent of Australia's truss tomato demand and its sustainably farmed produce is already being sold at Coles supermarkets.

It is hoped that this type of technology can be used in more places in Australia and around the world that have hot, arid climates previously considered unsuitable for horticulture. The technology has the potential to supply millions of people with healthy food in a sustainable manner.

FIGURE 4 The world's first Sundrop Farm is situated in Port Augusta, South Australia.

Australian farmers see technology as a means of decreasing production costs and increasing crop production. Additional technologies in Australian agriculture include the following.

- Robots are being tested to determine whether they can be used in complex jobs such as watering or harvesting. This would be of advantage in the horticultural sector, which is the third largest sector in agriculture, with an export trade worth $2.2 billion in 2017–18.
- Technology such as satellite positioning is being used to determine the optimal amounts of fertiliser to use on crop farms, which could increase profitability by as much as 14 per cent.
- Robots and an unmanned air vehicle have passed field tests at an almond farm in Mildura, Victoria. They are fitted with vision, laser, radar and conductivity sensors — including GPS and thermal sensors.

genetically modified describes seeds, crops or foods whose DNA has been altered by genetic engineering techniques

14.8.3 Quantifying food wastage

What food have you thrown out today? Across the world, one-third of all food produced is wasted. Each year, around 1.6 million tonnes of food, worth up to $1.2 trillion, is dumped while more than 850 million people remain undernourished. According to the United Nations' Food and Agriculture Organization, one-quarter of the food wasted each year could feed all of the world's hungry people.

FIGURE 5 Surplus tomatoes dumped in Tenerife, Canary Islands

To meet the growing demand for food by the middle of this century, it has been calculated that the world will need to produce as much food as has been produced over the past 8000 years. Although the world does produce sufficient food for everyone, distribution and affordability prevent it from getting to everyone who needs it. However, dealing with food wastage could certainly help to reduce food vulnerability.

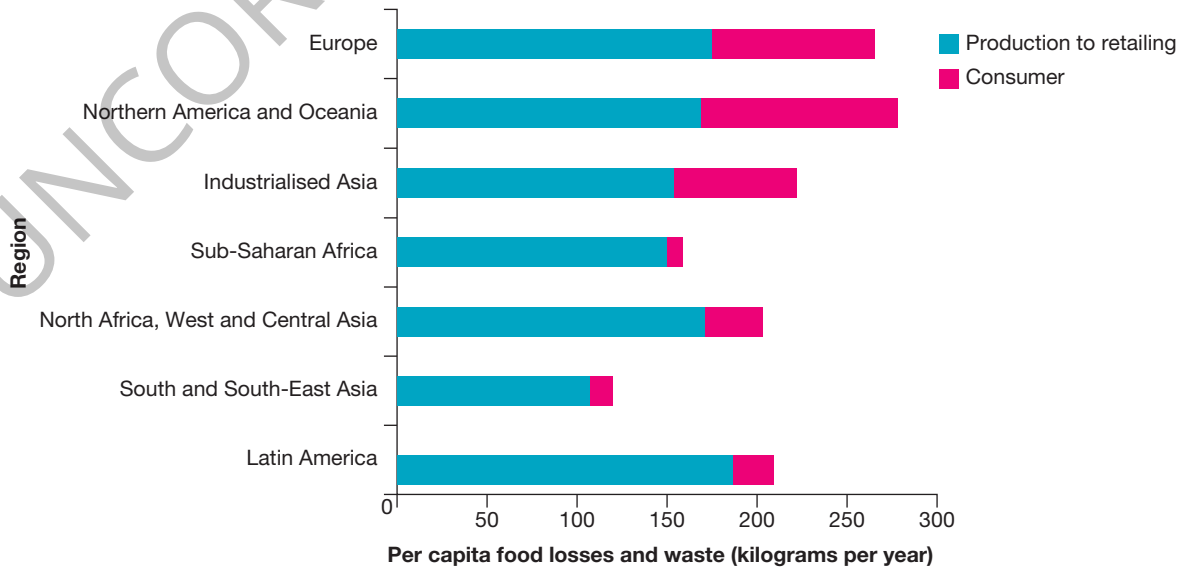
Food wastage also represents a waste of the resources used in production, such as land, fertiliser and energy. Waste can increase prices, making food less affordable. The World Bank has calculated that in sub-Saharan Africa, a region prone to food insecurity, a reduction of only one per cent wastage could save $40 million per year, with most of this saving going to the farmers.

A consequence of food wastage is the need to dispose of the waste, usually by dumping or burning. Food waste now contributes 8 per cent of global greenhouse gas emissions.

Food waste exists in all countries, regardless of their levels of development, although the causes of wastage vary. **FIGURE 6** shows the breakdown of food wastage on a regional basis.

In developing nations, food losses are mostly related to a lack of food-chain infrastructure and a poor knowledge of, or investment in, storage technologies on farms. Other causes of waste are: lack of refrigeration; limited or non-existent road and rail networks to deliver food to markets; and a shortage of processing and packaging facilities. In India, up to 40 per cent of fresh food is lost due to a lack of cold storage in wholesale and retail outlets. Over one-third of the rice harvest in South-East Asia can be destroyed by pests or spoilage.

FIGURE 6 World food losses per region



In contrast, in the developed world, food waste is more evident at the retail and home stages of the food chain. In this case, food is relatively cheap so there is little incentive to avoid waste. Consumers are used to purchasing food that is visually appealing and unblemished, so retailers end up throwing out perfectly edible, if slightly damaged, food. More and more people rely on 'use by' dates, so despite the food still being suitable to eat, it is discarded. Waste is also a part of the growing culture of 'supersize' or 'buy one get one free' advertising. Further waste can occur if the discarded food is sent to landfill when it could be used for animal feed or even compost.

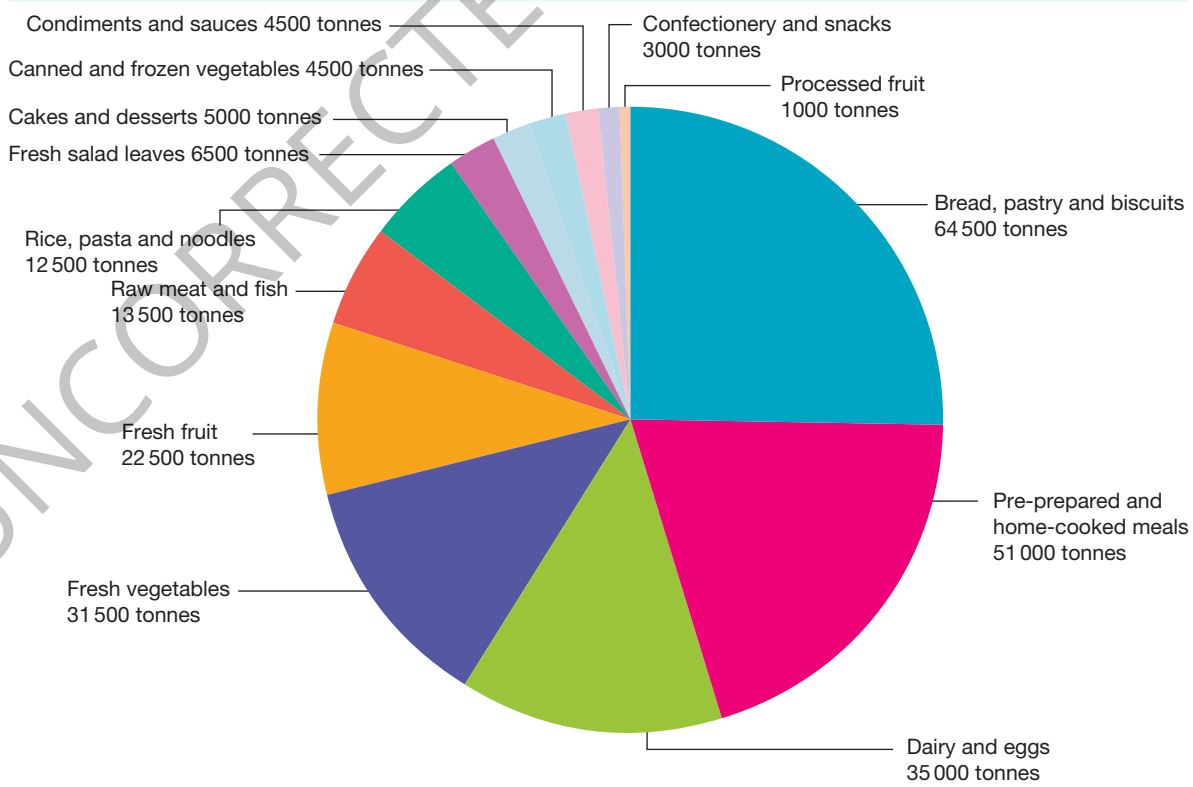
What is wasted in Australia?

Australia produces enough food for 60 million people, and this enables us to trade the surplus. Yet each person wastes an average of 361 kg of food each year. This costs the economy $20 billion annually. At the same time, four million Australians have experienced some form of food insecurity in the past year. This means that around 18 per cent of the population have not had enough food for themselves and their family, or could not afford to purchase food at some stage over the twelve-month period.

As an example of the extent of the waste in Australia, consider the example of Victoria, where food wastage costs $5.4 billion annually. The average household throws away $42 worth of food per week. **FIGURE** 7 shows the composition of the 255 000 tonnes of food thrown into rubbish bins in Victoria each year.

In 2007, the Western Australian government passed the *Waste Avoidance and Resource Recovery Act 2007* (WARR Act) with the hope of reducing overall waste generation in the state. In 2017–18, the waste generated in the states was 911 kilograms per person per year. While this average also took into account commercial and construction waste, 17 per cent of the total waste generated in the state (or 407 400 tonnes) was organic waste such as food and gardening waste. If each Western Australian produces 911 kg of waste per year, and 17 per cent of that is food and other organic material, that's around 155 kg of organic waste generated by each Western Australian every year.

FIGURE 7 Household food waste in Victoria, per year



14.8.4 Reducing food waste

Reducing global food waste is a part of the new Sustainable Development Goals, a set of targets designed to develop a more sustainable future for the world. The specific target is to cut per capita food waste by 50 per cent by 2030. If this can be achieved, food security will be improved, greenhouse gases can be reduced, and valuable land and water resources will not be wasted.

Here is a snapshot of what is happening around the world:

- Farmers in Ghana are trialling a new phone app that shows farmers, food transporters and traders the fastest route to market, which reduces food spoilage. In addition, the app can identify illegal roadblocks set up to take bribes from drivers.
- In France, an estimated 10 million tonnes of food is wasted each year. A new law now compels restaurants to provide containers in which customers can take home uneaten food. Shops are also banned from destroying food products, and supermarkets must give away unsold food that has reached its use-by date, for distribution to charities. By 2020, all Parisian households should have a biowaste recycling bin for food scraps. Waste will be collected and converted into fertiliser or biofuels.
- Seoul in South Korea has taken a different approach in an effort to reduce its food waste by 20 per cent. It is trialling a program whereby people are charged according to the weight of the garbage they produce. The more kilograms generated, the higher the bill. In South Korea 95 per cent of food waste is recycled into compost, animal feed or fuel. Landfilling of food waste is banned.
- Australia has now set a target to reduce the amount of food waste by 50 per cent by 2030. Much of this will come from supporting food rescue operations such as Second Bite and Foodbank Australia. These organisations collect and redistribute surplus food. Foodbank provides relief to 710 000 Australians every month, 26 per cent of whom are under 19 years old.

on Resources

Interactivity More, or less, food (int-3329)

Weblinks Vertical farming
WA Waste Authority

14.8 ACTIVITIES

1. In groups, and wearing disposable gloves, conduct a survey of the school rubbish bins after lunch. You may need to lay out newspaper onto which you can tip the contents of the bins. Some groups could also deal with food litter around the grounds.
   a. Construct a table so that you can record the different food types, such as fruit, cakes, biscuits and so on.
   b. Collate your results with the other groups in your class, and then graph your data.
   c. Write a summary of your findings. What food types were most and least represented and why?
   d. If your school has a canteen, ask the manager to address the class and talk about issues such as wastage, use-by dates and health department regulations.
   e. You could also do a home bin audit and follow the same procedure.

   HASS skills: Questioning and researching
   Geography concept: Sustainability
2. Visit a local food store, such as a supermarket, fresh food market, greengrocer or butcher. Interview a staff member and find out what happens to their food waste. Report back to the class.

   HASS skills: Questioning and researching
   Geography concept: Sustainability
3. Design a poster or short animation to inform other school members about the issue of food waste.

   HASS skills: Communicating and reflecting
   Geography concept: Sustainability

4. Use the **Vertical farming** weblink in the Resources tab to watch a video clip on this topic.
   a. What is being suggested about environmentally sustainable farming in the future?
   b. Draw a diagram to show what a future vertical farm might look like.
   c. How might vertical farms help to feed future populations?

HASS skills: Questioning and researching
Geography concept: Sustainability

5. Use the **Waste Authority** weblink in the Resources tab to research Western Australia's Waste Avoidance and Resource Recovery Strategy 2030. Create an infographic that outlines ways that Western Australians can reduce their food waste, and manage their organic waste responsibly.

HASS skills: Questioning and researching
General capability: Critical and creative thinking

14.8 EXERCISE

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
Questions	Questions	Questions
1, 2, 6	3, 7, 8	4, 5, 9, 10

Check your understanding

1. What is meant by the term *yield gap*?
   A. The difference between a particular crop's average yield and its maximum potential yield
   B. The sum of a particular crop's average yield and its maximum potential yield
   C. A particular crop's average yield
   D. A particular crop's maximum potential yield
2. Identify three different strategies, other than closing the yield gap, for improving food production from the list below.
   A. Reducing food wastage
   B. Planting fewer crops
   C. Improving irrigation infrastructure
   D. Increasing aquaculture catch
   E. Reducing the world's population
3. What is meant by the term *genetically modified* (*GM*)?
4. Explain the interconnection between food waste and global warming.
5. Why is there more food wasted by retailers and in homes in developed countries than in developing countries?

Apply your understanding

6. Explain why food waste is a global problem.
7. Refer to **FIGURE 6**. Which regions of the world are shown to waste the greatest amount of food in the production-to-retailing and consumer sectors? Use data in your answer.
8. Consider South Korea's and Australia's plans to reduce food waste.
   a. In table form, use a dot point summary to compare the strengths and weaknesses of the plans.
   b. Which of the two plans do you think will be most effective, and why?
9. Goal 12 of the United Nations Sustainable Development Goals aims to 'by 2030, halve per capita global food waste at the retail and consumer levels and reduce food losses along production and supply chains ...'. Do you think this is possible? Why or why not?
10. Many Australian cities have large housing estates on their outskirts. This land was often used for market gardens or farmland. Explain what impact the loss of this productive land might have on the price of food.

For sample responses to every question, go to www.jacplus.com.au.

14.9 Food aid

LEARNING INTENTION

By the end of this subtopic, you will be able to identify different types of food aid, describe how it is delivered and explain who contributes to global food aid.

14.9.1 Understanding food aid

Food aid is food, money, goods and services given by wealthier, more developed nations to less developed nations for the specific purpose of helping those in need.

People who need food aid include:

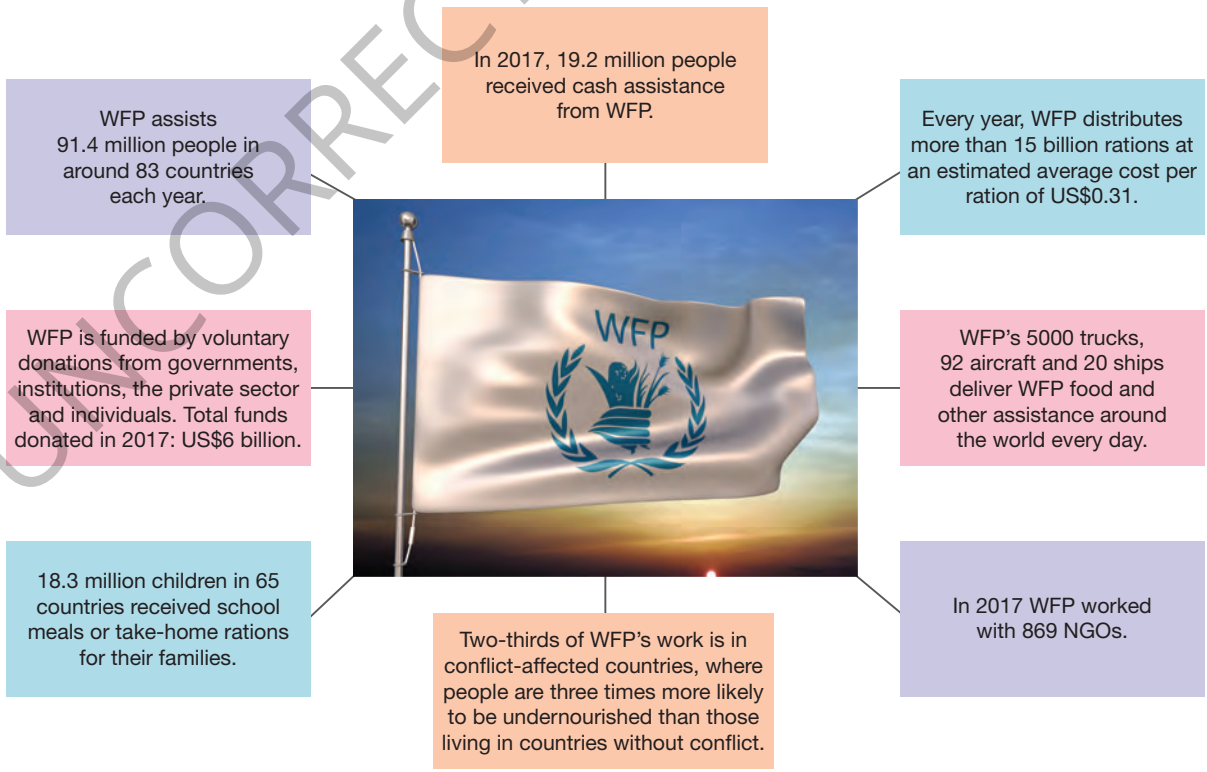
- poor people who cannot buy food even if it is available, as they are often trapped in a cycle of hunger and poverty
- people who have fled violence or civil conflict
- people devastated by natural disasters.

There are three general categories of food aid:

1. Program food aid, which is organised between national governments and provides resources that offer budgetary support to countries in need
2. Project food aid, which is targeted at specific areas or groups and provides support for disaster prevention activities and poverty alleviation measures
3. Relief (crisis or emergency) food aid, which assists victims of man-made and natural disasters

The United Nations World Food Programme (WFP) is a voluntary arm of the United Nations. It reaches more than 80 million people, in more than 92 countries, with food assistance after disasters and conflicts. The WFP provides different types of food aid to people after natural disasters such as cyclones, floods and earthquakes.

FIGURE 1 How the WFP works



Some relief aid is provided in the short term as emergency food. Project food relief is often required over lengthy periods, typically after civil war or prolonged drought.

Natural and **anthropogenic** disasters are the drivers of hunger and malnutrition. The WFP works to prevent, mitigate and prepare for such disasters. In 2018, the WFP worked on five major humanitarian disasters. In the Kasai region of the Democratic Republic of the Congo, over 7.7 million people are at risk of not having access to enough nutritious food. In Borne, Yobe and Adamawa in north-east Nigeria almost 3 million people are facing hunger. Since South Sudan gained independence in 2011, approximately 60 per cent of the population has suffered from the effects of famine. The WFP is assisting with these crises and also providing support for people affected by hunger caused by civil war in Syria and Yemen. Overall, the WFP's disaster response has helped more than 80 million people worldwide.

anthropogenic resulting from human activity (man-made)

14.9.2 Sources of food aid

The major donor countries to the WFP in 2018 are shown in **TABLE 1**.

TABLE 1 Major funding contributors to the WFP in 2018 (US$)

All donors and funding sources		
1	USA	2 541 479 166
2	European Commission	1 113 106 906
3	Germany	849 141 329
4	United Kingdom	617 188 873
5	Saudi Arabia	247 907 959
6	United Arab Emirates	226 215 581
7	Canada	222 172 109
8	UN Other Funds and Agencies (excl. CERF)	151 703 536
9	Sweden	148 185 097
10	UN CERF	138 632 047

Figures current as at 28 April 2019

FIGURE 2 US service members unload rice from a World Food Programme truck in Port-Au-Prince, Haiti, Hurricane Matthew, 2016.

FIGURE 3 Children wait for food aid after Cyclone Idai in Mozambique, 2019.

14.9.3 CASE STUDY: Plumpy'Nut — a short-term solution to malnutrition

In 2005 a revolutionary approach to treating malnutrition was released. This is a ready-to-use therapeutic food (RUTF) called Plumpy'Nut. It is a sweet, edible paste made of peanut butter, vegetable oils, powdered milk, sugar, vitamins and minerals.

FIGURE 4 Plumpy'Nut benefits children.

Its advantages are that it:

- is easy to prepare
- is cheap (a sachet costs about $2.50, including shipping costs)
- needs no cooking, refrigeration or added water
- has a shelf life of two years.

Children suffering from malnutrition can be fed at home without having to go to hospital. It is specially formulated to help malnourished children regain body weight quickly, because malnutrition leads to stunting of growth, brain impairment, frailty and attention deficit disorder in children under two years of age.

Plumpy'Nut is not a miracle cure for hunger or malnutrition; it only treats extreme food deprivation, mainly associated with famines and conflicts. It is not designed to reduce chronic hunger resulting from long-term poor diets or malnutrition. Since its introduction, Plumpy'Nut has lowered mortality rates during famines in Malawi, Niger and Somalia.

Most of the world's peanuts are grown in developing countries, where allergies to them are relatively uncommon. Manufacturing plants have been established in a dozen developing countries, including Mali, Niger and Ethiopia. These factories provide employment and ensure ease of access when needed. The patent for Plumpy'Nut is owned by the French company Nutriset. Nutriset has worked with UNICEF to save the lives of millions of children with this simple solution to childhood hunger.

14.9.4 CASE STUDY: Cash vouchers and school feeding programs

Where food is available but people simply cannot afford to buy it, aid is given by the WFP in the form of cash vouchers, which can be exchanged for food and other essential commodities. They allow recipients greater choice in the types of food and other commodities they can obtain. Cash has benefits for local economies because the money is spent within the community. Recently, cash voucher programs have been enhanced through the use of mobile phones, which have been used to provide instant payments to both beneficiaries and the shopkeepers who honour vouchers.

Another program provides schoolchildren with either full meals (breakfast and/or lunch) or nutritional snacks, such as high-energy biscuits. In some cases, school meals are provided alongside take-home rations that benefit the whole family and provide an added incentive for sending children to school. In 2017, the WFP provided meals to 18.3 million school students.

Australia has funded school feeding programs in Bangladesh, Myanmar, Laos and Cambodia, which have had strong positive impacts on both the children and the wider community. School rates of enrolment have increased and regular attendance has improved. Households have also benefited through a reduced need to purchase food. In 2017–18, Australia provided over $108 million to the WFP. This included $38 million in core funding, $2 million to provide school meals and $68 million towards disaster relief.

DISCUSS

Discuss the issues that may arise as a consequence of a country deciding to slash its overseas food aid program by half.

General capability: Ethical understanding

on Resources

Weblink World Food Programme

14.9 ACTIVITIES

1. Select a major donor of food aid from **TABLE 1**. Research the main population characteristics of this country, such as life expectancy, literacy levels and death rates. Discuss your findings in class.
   HASS skills: Questioning and researching
2. Use the **World Food Programme** weblink in the Resources tab to learn about the WFP's involvement in Syria and surrounding ***places*** since 2012. What action is the WFP taking there and why?
   HASS skills: Questioning and researching
3. Draw a poster or advertisement to inform Australians about Plumpy'Nut and its uses and impacts.
   HASS skills: Communicating and reflecting

14.9 EXERCISES

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
Questions	Questions	Questions
1, 3, 6	2, 4, 7, 8	5, 9, 10

Check your understanding

1. Refer to **FIGURE 1**. How many countries receive WFP assistance each year?
   A. 15 million
   B. 18.3 million
   C. 19.2 million
   D. 91.4 million
2. Refer to **FIGURE 1**. Where does the majority of the WFP's work take place? Explain why this is so.
3. Complete the following to outline how much Australia contributed to the WFP in 2017–18, and how this sum was distributed.
   In 2017–18, Australia provided over $..... million to the WFP. This was distributed to fund core programs ($..... million), school meals programs ($..... million) and disaster relief ($..... million).
4. Identify four reasons why the WFP is so active in school feeding and emergency aid programs.
5. Refer to the case study 'Cash vouchers and school feeding programs'. List the advantages and disadvantages of cash vouchers.

Apply your understanding

6. How might food aid change when a donor country experiences a major economic downturn?
7. Predict the likely consequences for children who suffer from malnutrition. Present your information in an appropriate diagram.
8. Should Australia's food aid commitment be increased? Write a letter to your federal member of parliament, outlining your views on increasing Australia's food aid contribution.
9. Suggest two advantages and disadvantages of using Plumpy'Nut or other RUTFs to treat childhood malnutrition in developing countries.
10. In 2018, how much more did the USA contribute to the WFP than the next highest single country donor? Suggest reasons as to why this might be so.

For sample responses to every question, go to www.jacplus.com.au.

14.10 Food aid in Australia

'Aboriginal and Torres Strait Islander readers are advised that this topic may contain photos of or references to people who have died.'

LEARNING INTENTION

By the end of this subtopic, you will be able to explain reasons why food security is an issue in Australia, and identify groups who are more likely to experience food insecurity in Australia.

14.10.1 Food insecurity in Australia

In 2018, over 3 million people, or 13.2 per cent of Australians, were living below the internationally accepted poverty line. This included almost 739 000 children, or 17.3 per cent of the total Australian child population. The prices of essentials — food, health, education, housing, utilities and transport — have climbed so much in recent years that people who were already struggling are now unable to cope. They may need food aid. The economic climate has seen people turning to charity who in the past would never have dreamed of seeking such support. It is not just traditionally vulnerable groups, such as the homeless, who are seeking food relief; it is also the aged, single parents and the 'working poor'.

In 2018 it was reported that:

- one in eight Australian adults were living in poverty
- one in six Australian children were living in poverty
- many people were living up to $135 per week below the poverty line
- most people (53 per cent) facing poverty were receiving Newstart, Youth Allowance or other government allowance payments
- the biggest threat to household finances were housing costs, including rent
- women made up 52 per cent of adults living under the poverty line.

For many people, charity food agencies are a vital source for their daily food needs. Programs around the country such as school breakfasts provide free, nutritious meals to children who might otherwise spend their day without food. Other charities such as OzHarvest, The Big Umbrella, Fareshare and SecondBite work to redistribute food that would otherwise go to waste, providing millions of meals for the many thousands of people who through economic disadvantage may be unable to regularly provide for their own needs. The demands for these services increased significantly with the impact of job-losses due to the COVID-19 pandemic in 2020, as many people found themselves out of work and with no income to buy even the most basic items for their families.

14.10.2 CASE STUDY: SecondBite

SecondBite rescues and redistributes food to agencies that service people in need. Food is donated directly from farms, as well as from wholesalers, markets, supermarkets and caterers.

SecondBite was founded in Victoria in 2005. Run by just three volunteers, in that year they redistributed 600 kg of food. Since these humble beginnings, SecondBite has grown dramatically. It is now a national organisation, operating with over 85 staff and partnering with more than 1300 community food programs to deliver food and meals to people in need. In the 2015–16 financial year alone, SecondBite rescued and redistributed, free of charge, enough food to provide 20 million meals.

FIGURE 1 SecondBite redistributes food to agencies that assist people in need.

14.10.3 CASE STUDY: APY lands food security plan

In September 2011, Indigenous Australian peoples in South Australia's far north faced food insecurity. Shops in the Anangu Pitjantjatjara Yankunytjatjara (APY) lands were reasonably well stocked, but people were undernourished because of the high cost of freighted fresh food. Essential foods in remote community stores were more than double the price of those in Adelaide. To alleviate the situation, the Red Cross and the South Australian government sent pallets of food to aid impoverished people living in the APY lands.

A government-developed food security plan for the area was established in 2011, with a focus on implementing improvements to food supply (through measures such as improved freight efficiency, stores management, cold storage upgrades and provision of generators for more reliable power supply), community education in choosing and preparing nutritious foods, and an arid lands horticulture project to develop capacity to produce fresh food within the region.

FIGURE 2 Indigenous communities living in remote areas face challenges to food security due to the cost of transporting and storing fresh food.

Since 2014, food security measures within the region have largely been driven by non-governmental organisations (NGOs) and the Mai Wiru Regional Stores Council Aboriginal Corporation, which coordinates and manages a number of the community stores within the region and uses store profits to fund various community projects. While improvements have been made, the challenges of providing affordable, healthy fresh food to remote areas such as the APY lands are ongoing, but preliminary reports completed in early 2019 suggest that healthy food choices, such as fruit and vegetables, are more widely available. Even though the average cost of a healthy diet in remote Australia is still high in comparison to major cities and regional centres, in comparison to unhealthy foods, healthy foods are now comparatively cheaper in the APY stores supported by the program. As of January 2019, feeding an average family on the healthy store-bought foods is just under $200 a fortnight cheaper than unhealthy store-bought choices.

14.10.4 CASE STUDY: Meals on Wheels

As Australia's population ages (see **FIGURES 4** and **5**), the services of groups such as Meals on Wheels may also be in greater demand. In 1997, the median age (the age that is the middle of a population's age range, dividing a population into two numerically equal groups) was 34 years, but this is projected to be 44–46 years in 2050. In 1997, people aged 65 years and over comprised 12 per cent of the population, and this is projected to rise to 24–26 per cent in 2050.

Meals on Wheels began in the United Kingdom during World War II, and in Australia (Melbourne) in 1952. Through delivering nutritious, relatively inexpensive meals, (a three-course meal generally costs between $7 and $10), Meals on Wheels plays an important role in helping older people and those living with a disability to live independently. Around 15 million meals are served annually to more than 50 000 people across the nation. In addition to providing vital nourishment to those who may have difficulty in preparing their own meals at particular stages of life, the social interaction provided by these regular visits is another important aspect of this service.

FIGURE 3 Meals on Wheels helps older people and people with disabilities live independently for longer.

FIGURE 4 Australia's population pyramid, 2016

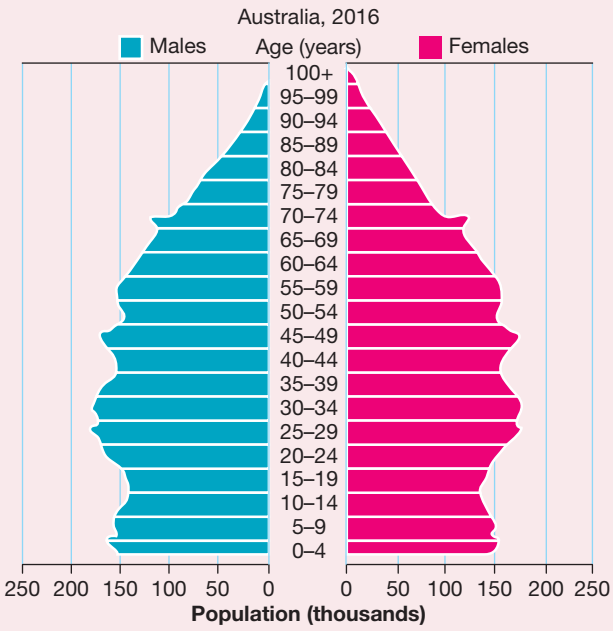
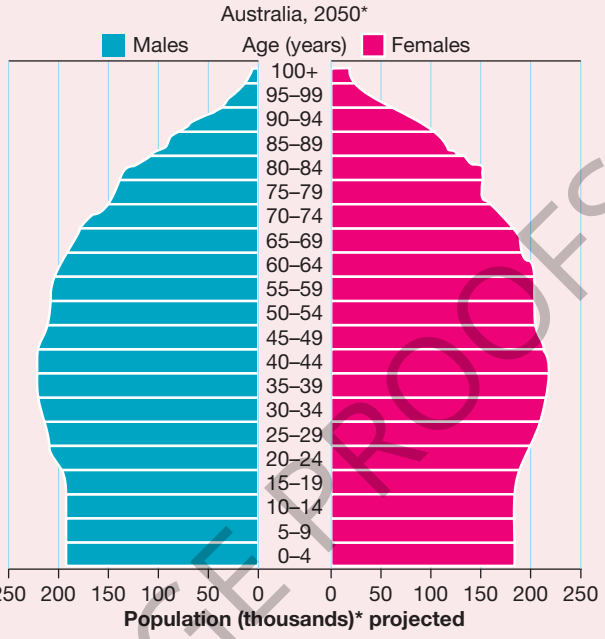


FIGURE 5 Australia's population pyramid, 2050*



on Resources

Weblinks Poverty in Australia
Improving Aboriginal food security and diet

14.10 ACTIVITIES

1. Conduct your own research into a local organisation that provides food aid. Create a digital presentation to detail your findings.
HASS skills: Questioning and researching
General capability: ICT
2. Use the **Australian poverty** weblink in the Resources tab to discover other aspects of poverty in Australia. Suggest how the data and trends you have discovered would affect the ability of a person to afford enough healthy food for themselves and their family.
HASS skills: Analysing
General capability: Personal and social capability

14.10 EXERCISE

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
Questions	Questions	Questions
1, 2, 6	3, 4, 7, 8	5, 9, 10

Check your understanding

1. Approximately what percentage of Australians are expected to be over 65 years of age in 2050?
   - **A.** 12.3 per cent
   - **B.** 14.7 per cent
   - **C.** 25 per cent
   - **D.** 30 per cent
2. Approximately how many people were living below the poverty line Australia in 2018?
3. SecondBite redistributes enough food to provide how many meals each year?
4. Explain the importance of volunteers in food redistribution.
5. Explain how Australia's size could lead to food shortage in some places.

Apply your understanding

6. Explain why there might be difficulties with access to food in 2050 if 25 per cent of the population is over 65.
7. Predict whether Meals on Wheels will experience an increase or decrease in its future clientele. Apart from the ageing population, what other factors might change the demand for services such as SecondBite or Meals on Wheels in future?
8. **a.** What would be your family's reaction if the cost of food doubled because of freight costs?
   b. Suggest two strategies or changes that could improve the affordability of healthy, fresh food in outback areas.
9. Discuss the need for changes to the way food is distributed in Australia.
10. 'When bills have to be paid, food becomes a discretionary item.' (an item that is bought out of choice, according to one's judgement) Food Bank Australia 2011. If household bills have to be paid before buying food, what are the likely consequences for families and organisations supplying food aid?

For sample responses to every question, go to www.jacplus.com.au.

14.11 The effects of dietary changes on food supply

LEARNING INTENTION

By the end of this subtopic, you will be able to outline the ways in which global diets are changing and predict what this may mean for global food production.

14.11.1 How have diets changed?

The human diet has changed throughout history, and continues to change today. Since the 1960s, the total calories per day consumed globally, together with the proportion of the diet comprised of animal products, oils and sweeteners have increased. These food types are typically found in higher amounts in the **Western-style diet** eaten by much of the population of developed countries. **FIGURE 1** shows the changing global diet, as recorded in a study of dietary trends from 1961 to 2009. **TABLE 1** presents the data for each food category.

Since 1960, diets around the world have become more similar and larger in terms of calories, protein, fat and food weight. While animal products, oils and sweeteners have long been a feature of the diet in developed countries, they are increasingly becoming part of the diet in developing countries also. These trends are predicted to continue along with these countries' economic development (see **FIGURE 2**). This is especially the case in countries such as India and China, where the standard of living is rising and people can increasingly afford access to a wider variety of foods.

Western-style diet eating pattern common in developed countries, with high amounts of red meat, sugar, high-fat foods, refined grains, dairy products, high-sugar drinks and processed foods

FIGURE 1 Changes to global diet 1961–2009

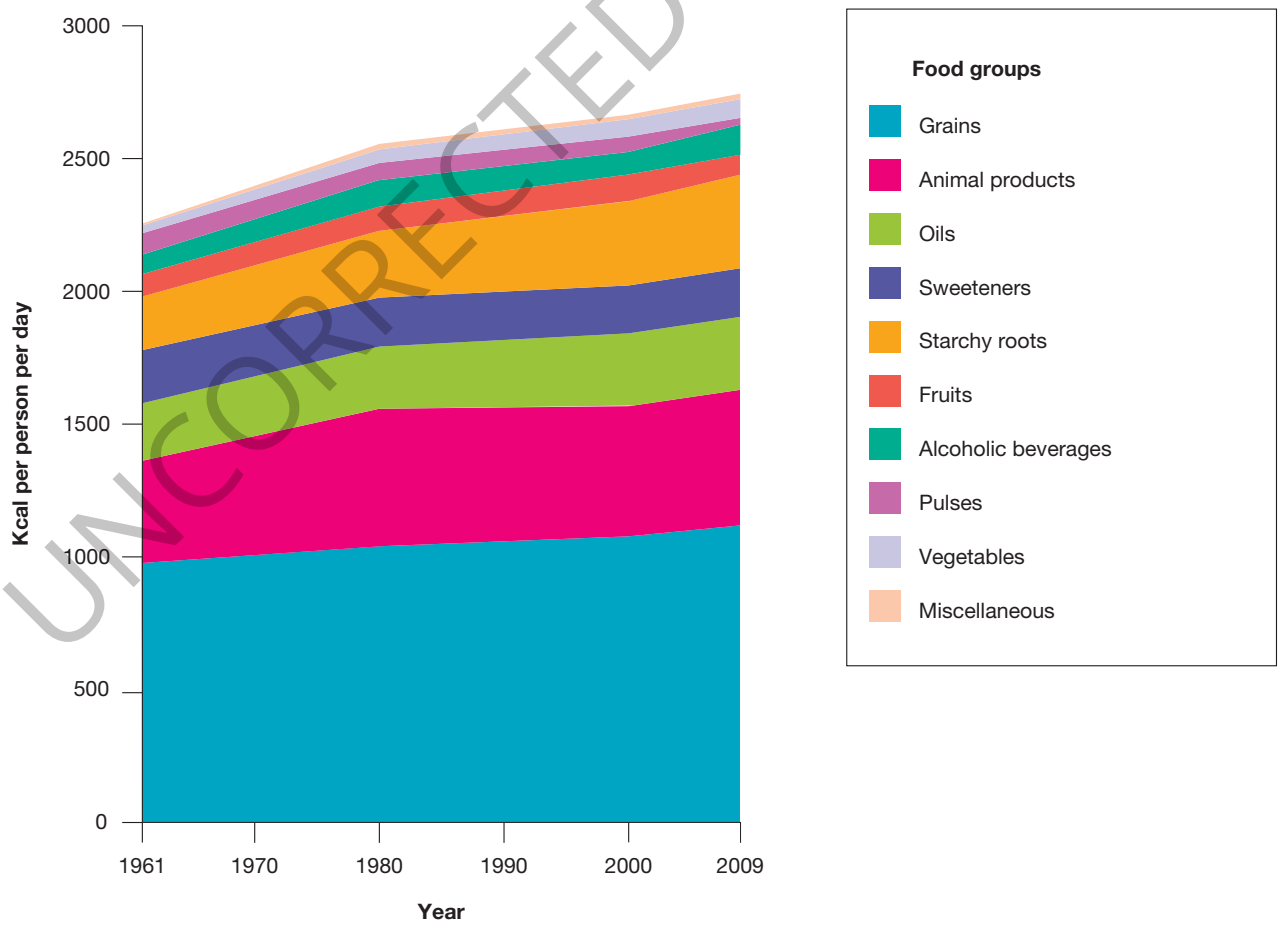


TABLE 1 Global diet calories per person per day, by food category, 1961–2009

Food category	1961	1980	2000	2009
Grains	976	1042	1077	1118
Animal products	383	473	488	508
Sweeteners	220	275	277	281
Starchy roots	214	184	180	178
Oils	186	255	316	349
Fruits	85.6	94.8	101	104
Alcoholic beverages	79.3	93.6	85	88.2
Pulses	63.4	61.3	58.9	64.9
Vegetables	31.8	40.7	53	55.4
Miscellaneous	0.8	3.4	5.8	9.1
Total calories per day	2239.9	2522.8	2641.7	2755.6

FIGURE 2 Changing diets in developing countries

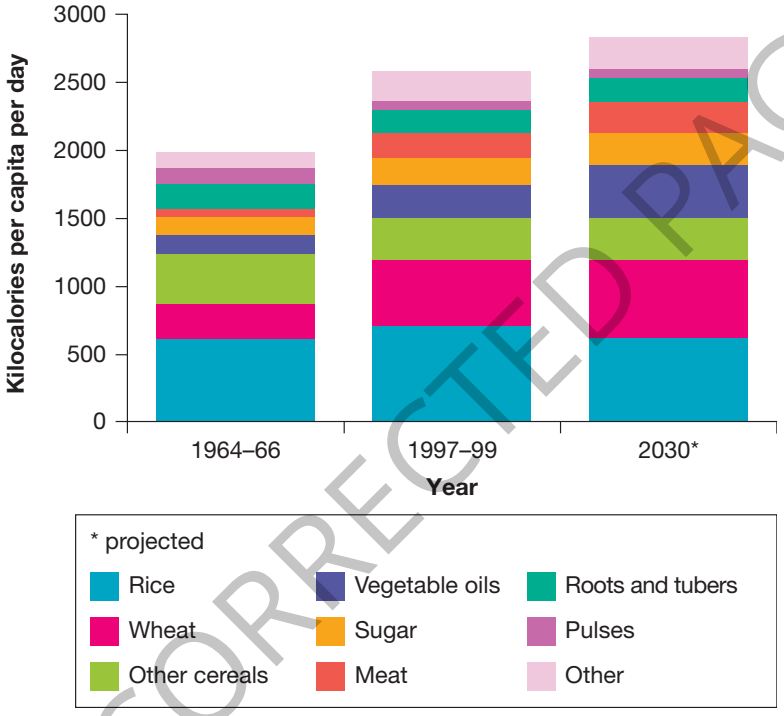
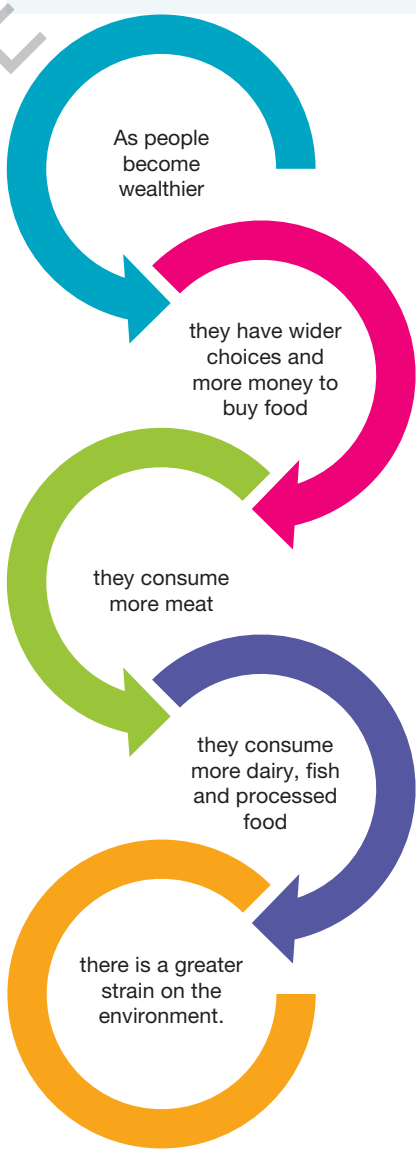


FIGURE 3 Impacts of economic growth and dietary change

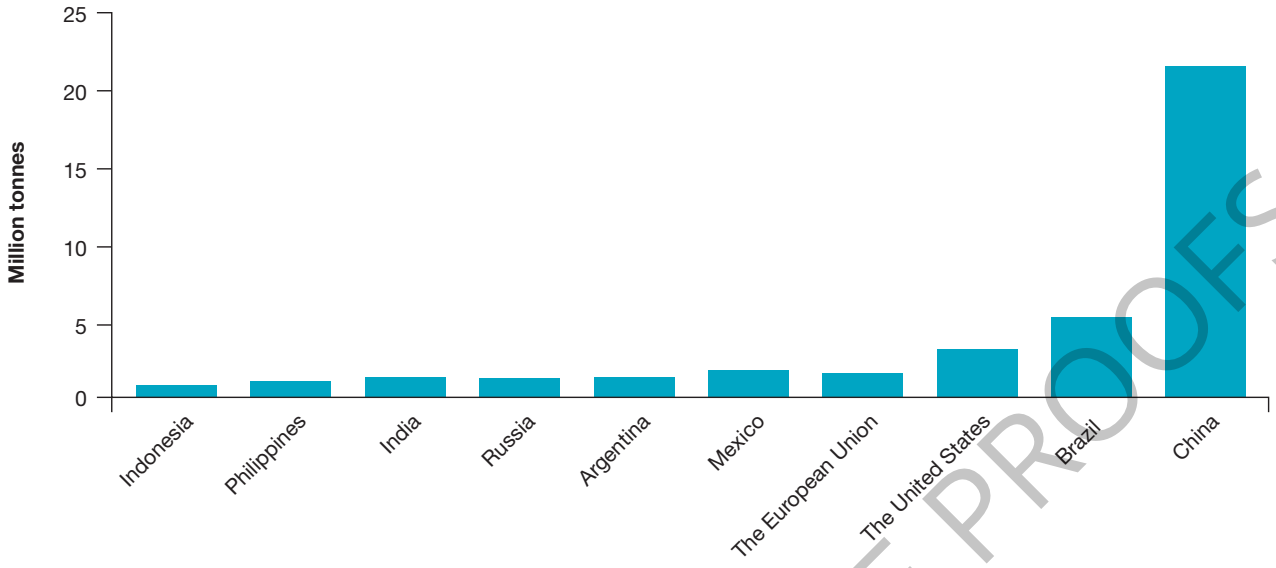


Changing diets in Asia

For centuries, the typical Chinese diet was rice and vegetables, supplemented by fish and small amounts of other meat. Rice is a valuable source of protein, but as people's incomes grow, per capita rice consumption is expected to decline and consumption of protein via meat sources is expected to increase accordingly.

Australians and Americans are the world's highest consumers of meat, eating an average of around 300 grams per person per day — significantly more than the global average of around 115 grams per person. In 1962, the average Chinese person ate just 4 kilograms of meat per year. By 2015, this figure was closer to 80 kilograms (around 220 grams per day) and rising (see **FIGURE 4**).

FIGURE 4 Expected growth in meat consumption, 2011–2021



14.11.2 Australian food exports to Asia

The countries of the Asian region are home to more than half the world's population. With significant economic growth occurring throughout much of the area, and over four billion people to be fed, Asia presents unparalleled opportunities for Australian farmers and the Australian economy. As Asian societies become more affluent, higher standards of living give rise to expectations of greater access to goods. Australia is well placed to provide many of these, including a wide variety of foods and quality fibres such as wool and cotton.

With a reputation for utilising 'clean and green' agricultural systems, coupled with our geographic proximity, Australian farmers are ideally placed to capitalise on the economic opportunities that the fast-developing Asian region presents.

'We have the potential for a new golden era of Australian agriculture, given the rise of Asia,' our prime minister said in 2012. The challenge for Australian farmers will be in meeting this booming global need for food and fibre by increasing production at a time when we have decreasing arable land, less water and fewer people working in agriculture.

14.11.3 The future of sustainable food production

One-third of the world's grain crop is fed to animals to produce meat. From a sustainability perspective, this can be considered wasteful, as the amount of grain used to feed a cow for the purposes of meat production is 11 times what would be needed to adequately feed a person with grain alone. Similarly, while 1500 litres of water are needed to produce 1 kilogram of cereal, 15 000 litres are needed to produce 1 kilogram of meat.

Meeting the needs of future populations is not just the responsibility of farmers and producers. We as consumers can also contribute. Attitudes may need to change towards how and what we eat.

- If we are to feed nine billion people sustainably in 2050, it is unlikely we'll be eating a meat-rich, Western-style diet.
- The world produces enough food to feed 10 billion people. However, a significant portion of our crops is used to feed animals or is used as biofuel to produce energy.
- A switch to a diet containing more plant material would allow land currently used to produce animal feed to instead grow crops to feed humans. Although such a huge change is unlikely, even a small shift can have an impact.

- The Meatless Monday campaign encourages people to go without meat for one day per week. This small change would benefit human health and the health of the planet. Meat production requires a large amount of land, water and energy. Cattle are also the largest source of methane gas, which is one of the main contributors to greenhouse gases.
- It is estimated that there are more than 20 000 edible plants that we do not currently eat. Exploring ways of developing and introducing these into our diets may provide additional, sustainable food sources for future generations. One example of an 'old food' that has become increasingly popular in the modern diet is quinoa (pronounced *keen-wah*). A crop from South America, quinoa was used over 4000 years ago by the Incas. It has high nutritional value and grows in a wide variety of climatic conditions. Another advantage of the crop is that all parts of it can be eaten. Peru and Bolivia supply 99 per cent of the world's quinoa demand, and many other countries are now investigating its suitability for their locations.

Increasing consumption of fruits and vegetables, whole grains, legumes and nuts, and limiting intake from animal sources, fats and sugars will not only have health benefits for individuals but will also benefit the planet, as more land and water resources can be directed to sustainable food crop development.

DISCUSS

'A Western-style diet is going to be unsustainable in the future.' Provide one argument for and one argument against this statement. **General capability: Critical and creative thinking**

on Resources

Interactivity What are we eating? (int-3331)

14.11 ACTIVITIES

1. How has our diet changed over time? Ask your parents, grandparents, and/or other adults you know to describe foods and cooking methods from when they were young. Summarise your findings and share with the class. **HASS skills: Questioning and researching**
   General capability: Personal and social capability
2. A United Nations report stated that 'As changing the eating habits of the world's population will be difficult and slow to achieve, a long campaign must be envisioned, along with incentives to meat producers and consumers to change their production and dietary patterns. Healthy eating is not just important for the individual but for the planet as a whole.' Design a television commercial to promote a Meatless Monday campaign. **HASS skills: Communicating and reflecting**
   Geography concept: Sustainability
3. Research the diets of First Nations peoples in your area before European colonisation. How was the diet different to the diet of most Australians now? Which diet is more sustainable for the Australian environment? Write a report explaining the key differences and impacts of each type of diet, and suggesting strategies for improving the sustainability of Australians' diets. **HASS skills: Questioning and researching**
   General capability: Intercultural understanding

14.11 EXERCISE

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
Questions 1, 2, 6	Questions 3, 4, 7, 8	Questions 5, 9, 10

Check your understanding

1. Refer to **FIGURE 1**.
   a. Which of the food categories makes up the greatest part of people's diets?
   b. Which category is the second-largest component?
2. Study **TABLE 1**. Between 1961 and 2009, how much has the total daily calorie consumption increased?
3. Refer to **FIGURE 2**. What crops are people in developing countries eating more of? Which crops are they eating less of?
4. Refer to **FIGURE 3**. What is the connection between diet and economic development?
5. Explain why people's diets have changed over time.

Apply your understanding

6. Predict what the consumption of meat in China and the United States might be in 2050. What did you base your prediction on?
7. Predict where your foods might come from in 2050.
8. Refer to **FIGURE 4**.
   a. By how much is meat consumption in the United States expected to increase in the ten-year period from 2011 to 2021?
   b. Compare the increase expected in meat consumption in the US with that expected in China. What might account for this difference?
9. What might be some of the issues confronting Australia as it attempts to become the 'food bowl of Asia'? What advantages does Australia have in this attempt? How might a farmer react to this suggestion?
10. Explain the interconnection between food and family traditions and celebrations.

For sample responses to every question, go to www.jacplus.com.au.

14.12 Urban farms

LEARNING INTENTION

By the end of this subtopic, you will be able to describe some urban farming techniques and explain how these may be used to help meet the food demands of urban populations.

14.12.1 Advantages of urban farming

Farming is usually associated with rural areas, but a growing trend in food production is urban farming. This involves the growing of plants and raising of animals within and around cities, often in unused spaces — even the rooftops of buildings.

In many industrialised countries, it takes over four times more energy to move food from the farm to the plate than is used in the farming practice itself. Properly managed, urban agriculture can turn urban waste (from humans and animals) and urban waste water into resources, rather than sources of serious pollution. In 2000, about 15 to 20 per cent of the world's food supply came from urban gardens; in 2018, more than 800 million people practised urban agriculture, contributing to over 20 per cent of all global agricultural production.

Benefits of urban farming include:

- increasing the amount, variety and freshness of vegetables and meat available to people in cities through sustainable production methods
- improving community spirit through community participation, often including disadvantaged people
- incorporating exercise and a better diet into people's lives, leading to improved physical and mental health
- using urban waste water as a resource for irrigation, rather than allowing it to become a source of serious pollution
- reducing the percentage of income people spend on food.

Urban farming could become more important with rapid urbanisation. With the developing countries in Africa, Asia and Latin America expected to be home to 75 per cent of all urban dwellers, they will face the problems of providing enough food and disposing of urban waste.

14.12.2 CASE STUDY: Kolkata sewage ponds

The East Kolkata wetlands in India (see **FIGURE 1**) cover 12 500 hectares and contain sewage farms, pig farms, vegetable fields, rice paddies and over 300 fishponds. With a population of more than 14 million, the urban agglomeration (the extended built-up area of a place, including suburbs and continuous urban area) of Kolkata produces huge volumes of sewage daily. The wetlands system treats this sewage, and the nutrients contained in the waste water then sustain the fishponds and agriculture. About one-third of the city's daily fish supplies come from the wetlands, which are the world's largest system for converting waste into consumable products. The wetlands are also a protected Ramsar site for migratory birds (a wetland of international importance, as defined by the Ramsar Convention — an intergovernmental treaty on the protection and sustainable use of wetlands). However, the area is now under pressure from urban growth and from the subsequent increase in waste that it needs to treat.

FIGURE 1 Catching fish in the Kolkata wetland system fishponds

14.12.3 CASE STUDY: Container fish farming

On a smaller scale, a German company has developed a sustainable form of aquaculture that can be used in small spaces in cities. It is called aquaponics (a sustainable food production system in which waste produced by fish or other aquatic animals supplies the nutrients for plants, which in turn purify the water). Fish swim in large tanks in a recycled shipping container (see **FIGURE 2**). Electric pumps move the fish-waste-filled, ammonia-rich water into a hydroponic vegetable garden in a greenhouse mounted above the tank (hydroponic describes a method of growing plants using mineral nutrients, in water, without soil). The fish waste fertilises tomatoes, salad leaves and herbs growing in the greenhouse, and the plants purify the water, which is returned to the tanks.

These structures can be set up almost anywhere, such as on rooftops and in car parks, and the sustainably produced fresh vegetables and fish can be delivered to nearby city markets and shops, reducing the distance that the products must travel. Farmers only need to feed the fish and keep the fish-tank water topped up to sustain the efficient aquaponic system.

FIGURE 2 Urban farming — fish and agriculture

on Resources

Weblinks Urban aquaponics
Vertical farming

Google Earth Kolkata

14.12 ACTIVITIES

1. Use the **Urban aquaponics** weblink in the Resources tab to outline the advantages of aquaponics.
HASS skills: Analysing
2. Use the **Vertical farming** weblink in the Resources tab to help you understand vertical farming.
   a. Draw an annotated diagram to illustrate vertical farming.
   b. Research an urban farming project in a city. Present your findings in a presentation.
HASS skills: Analysing, Evaluating

14.12 EXERCISE

To answer questions online and to receive **immediate feedback** and **sample responses** for every question, go to your learnON title at www.jacplus.com.au.

Learning pathways

LEVEL 1	LEVEL 2	LEVEL 3
Questions	Questions	Questions
1, 2, 6	3, 7, 8	4, 5, 9, 10

Check your understanding

1. What are the main features of urban farming?
   - **A.** Use of small spaces for farming in urban areas
   - **B.** Community produce gardens
   - **C.** Urban farms selling to urban communities
   - **D.** Urban dairy farms
   - **E.** Recycling of vegetable waste
2. What functions do the East Kolkata wetlands perform?
   - **A.** Growing vegetables
   - **B.** Production of rice paddies
   - **C.** Fishponds
   - **D.** Sewage treatment
   - **E.** Drinking water
   - **F.** International rowing course
3. Explain how communities benefit from urban farms.
4. Define hydroponic gardening.
5. Create a flow chart to show how an aquaponic gardening system works.

Apply your understanding

6. Consider the idea of vertical farming.
   - **a.** Predict the places in the world likely to have vertical farms.
   - **b.** Explain why you selected these places.
7. Think about urban farming. Could urban farms encourage agricultural tourism? Explain your view.
8. Write a letter to the minister for planning, suggesting that urban farming spaces should be included in every new urban development.
9. Suggest what the advantages and disadvantages might be of producing food on the rooftop spaces of city buildings, and explain the factors that might influence the types of food that could be produced on rooftops.
10. When investigating urban farms and people's gardening activities in Denver, United States, researchers found that:
    - people's community pride improved
    - graffiti and vandalism decreased
    - gardeners felt a greater connection with their local place.

    Are these worthwhile results from urban farming? Explain your view.

For sample responses to every question, go to www.jacplus.com.au.

14.13 Thinking Big research project: Community garden design

Scenario

Australia's largest urban areas are continuing to show signs of urban sprawl. Urban sprawl inevitably affects food production as areas that were once farmland are transformed into housing and commercial developments. One strategy that can reduce the impacts of urban sprawl is the creation of urban farms. Urban farms can range in size, from small community gardens in our inner-city suburbs to large warehouses dedicated to horticulture in our outer suburbs. The best community gardens are small and provide just a moderate amount of fresh produce to the people who live in that area.

Task

Your school may already have a small community farm or garden; your task is to research and design (and potentially build) a new, small community garden for your school or neighbourhood, to produce fresh vegetables and fruit to sell locally, or that might be used in your school canteen. Follow the steps outlined in the **Process** section to complete this task.

Process

- Open the ProjectsPLUS application in the Resources for this topic. Click on the **Start new project** button to enter the project due date and set up your project group. Working in groups of four or five will allow you to share ideas and responsibilities for various aspects of the project. Save your settings and the project will be launched.

- Conduct some preliminary research into community gardening. Navigate to the **Research forum**, where you will find starter topics loaded to guide your research. You can add further topics to the Research forum if you wish. In the **Media centre** you will find an assessment rubric and some weblinks that will provide a starting point for your research.
- Complete the following:
  1. Identify the social and economic benefits of a small community garden.
  2. Identify and describe the features of the closest community garden to your school or home.
  3. Brainstorm the features of your garden.
     a. Which foods do you wish to grow?
     b. How much space will your garden take up?
     c. What equipment will you need and how much will this cost to set up?
     d. How do you plan to recoup the costs of the set-up?

  4. After looking at information online (use the weblinks in the Media centre as a starting point) and gardens close to your home or school, create an annotated diagram of what your garden will look like and what will be planted.
  5. Create an inventory of the equipment you will need. You can add images to your inventory for clarity and interest, if you wish.
  6. Explain the potential social and economic benefits of your farm to your community. For example, you may be able to sell your produce to members of your community or provide fresh fruit or vegetables to your school restaurant or canteen.
  7. OPTIONAL — Build your urban farm! If you have space, your class could combine the ideas and plans of each project group to create a community farm, providing a beneficial service to your school and wider community.

- Submit your completed design, inventory and outline of benefits to your teacher for assessment.

on Resources

ProjectsPLUS Thinking Big research project: Community garden design (pro-0192)

14.14 Review

14.14.1 Key knowledge summary

14.2 Global food security

- *Food security* means having a sufficiently healthy and reliable daily diet.
- The proportion of people who have food security is not distributed evenly around the world.
- People who do not have food security suffer from illnesses and a shorter life expectancy.
- There are several interconnected reasons for global food insecurity.

14.3 Impacts of land loss on food security

- The global loss of productive land essentially comes from land degradation and/or competition from other land uses.
- The main types of land degradation are erosion, salinity, desertification, pest invasion and loss of biodiversity.
- Fertile farmland is often converted to urban land as cities expand.
- Many countries now aim to improve their food security by investing in land and agricultural businesses in other countries, but there can be social, economic and environmental impacts.

14.4 Access to water supplies

- To provide a growing world population with food security there needs to be water security as well; both quantity and quality are important.
- There is an interconnection between increasing demand for water, population growth and climate change predictions.
- A number of economic, political and social factors contribute to growing water shortages.

14.5 The challenges of climate change for food security

- Climate change will create both positive and negative impacts on the environment, societies, food production and food security.
- Farming in many places of the world will benefit from changes in climatic patterns while other places may suffer from changed climate conditions.
- People living in countries that are ill equipped to cope with changing climatic conditions run the risk of food insecurity and the possibility of becoming environmental refugees.

14.7 Feeding the future world population

- One in nine people on earth do not have enough to eat, while around a quarter of the population is overweight.
- Hunger kills more people each year than disease.
- The distribution of the world's arable land is uneven, and the fastest-growing parts of the world do not have enough land to grow sufficient food for this expanding population.
- Seventy per cent of the world's poorest people live in rural areas where trade is limited.
- Improving roads and other infrastructure would improve opportunities for trade.
- As urban areas grow, the amount of available arable land decreases.
- Farming yields are affected by a variety of factors, such as access to water, length of growing season, climate, soil types, access to finance and markets, impacts of insects and diseases, funds allocated to agricultural research, government regulations and policies, and the impact of weather events such as floods, storms and drought.
- Better use of current farming areas, better use of technology and more efficient methods of farming will improve food production.

14.8 Improving food production and distribution

- Strategies to improve food production include reducing the yield gap, developing genetically modified (GM) crops, expanding aquaculture, improving infrastructure and developing sustainable intensification of cropping.
- There are some concerns over the use of GM crops, including health risks and loss of seed variety.
- In Australia, there is an experimental greenhouse farming facility at Port Augusta, which produces fresh vegetables; other developing technologies are also being tested for their application in improving efficiency in agricultural production.
- There is sufficient food being produced to feed the world's population. However, it is unevenly distributed, unaffordable and wasted.
- Food wastage occurs everywhere, but more is wasted in developed countries, especially in the retail and home sectors.
- A number of different countries including Australia are trialling new methods to reduce people's food waste.

14.9 Food aid

- Food aid is food, money, goods and services given by wealthier, more developed nations to less developed nations for the specific purpose of helping those in need.
- The three broad types of food aid are program food aid, project food aid and relief food aid.
- The key organisation that provides food aid worldwide is the United Nations World Food Programme (WFP). The WFP reaches over 80 million people in more than 92 countries and supports those who are affected by natural disasters, conflict and the cycle of poverty.
- The largest donors to the WFP include the United States, Germany and the UK.
- In some cases, short-term methods of treating undernutrition need to be employed. One such method is the use of Plumpy'Nut, which has lowered mortality rates during famines in Malawi, Niger and Somalia.
- The WFP's school feeding program provides school breakfasts and lunches to children in schools; their cash vouchers allow recipients to obtain food and other essentials.

14.10 Food aid in Australia

- Over 3 million Australians live below the poverty line, including over 730 000 children.
- As the cost of living increases, food security is becoming a major issue in Australia.
- Housing costs including rent are the largest contributor to household poverty.
- For many people, programs provided by charity food agencies are a vital source of daily food needs.
- Indigenous communities in remote areas experience food security issues due to the cost of transporting and storing fresh food.

14.11 The effects of dietary changes on food supply

- The human diet has changed over time and continues to change; average calorie intake has increased significantly since the 1960s.
- Since 1960, diets around the world have become more similar and larger in terms of calories, protein, fat and food weight.
- Animal products, oils and sweeteners are increasingly becoming part of the diet in developing countries, just as they are in developed countries.
- As people's incomes grow in Asian nations such as China and India, per capita rice consumption is expected to decline and consumption of protein via meat sources is expected to increase accordingly.
- There is opportunity for Australia to become a significant food source for the growing nations of the Asian region.
- One-third of the world's grain crop is fed to animals to produce meat, and 15 000 litres of water are needed to produce 1 kilogram of meat. This is unsustainable. To help meet the future food needs of the world's population, changes to our diet will be necessary — away from animal sources and towards a plant-based diet.

14.12 Urban farms

- In many locations across the world, urban farms are becoming more common.
- Over 800 million people practise urban agriculture, contributing to more than 20 per cent of global agricultural production.
- Benefits of urban farming include increased food freshness, reduced transportation costs, reuse of urban waste water and increased community spirit.
- With rapid urbanisation, urban farming will become increasingly important as a sustainable food source for growing populations.

14.14.2 Key terms

anthropogenic resulting from human activity (man-made)

aquifer a body of permeable rock below the Earth's surface, which contains water, known as groundwater

arable describes land that can be used for growing crops

desertification the transformation of arable land into desert, which can result from climate change or from human practices such as deforestation and overgrazing

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

genetically modified describes seeds, crops or foods whose DNA has been altered by genetic engineering techniques

indicators things that provide a pointer, especially to a trend

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

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

marginal land describes agricultural land that is on the margin of cultivated zones and is at the lower limits of being arable

potable drinkable; safe to drink

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

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

Western-style diet eating pattern common in developed countries, with high amounts of red meat, sugar, high-fat foods, refined grains, dairy products, high-sugar drinks and processed foods

yield gap the gap between a certain crop's average yield and its maximum potential yield

14.14.3 Reflection

Complete the following to reflect on your learning.

Revisit the inquiry question posed in the Overview:

The world produces enough food to feed everyone. So why do hundreds of millions of people go hungry every day? Will there come a time when we don't have enough food to feed everyone?

1. Now that you have completed this topic, what is your view on the question? Discuss with a partner. Has your learning in this topic changed your view? If so, how?
2. Write a paragraph in response to the inquiry question outlining your views.

on Resources

eWorkbook Customisable worksheets for this topic (ewbk-5851)
Reflection (ewbk-5850)
Crossword (ewbk-5849)
Student Learning Matrix (ewbk-5839)

14.14 Review exercise

Multiple-choice

1. Which of the following statements are true about food security?
   - **A.** Food security means having a sufficiently healthy and reliable daily diet.
   - **B.** The proportion of people who have food security is not distributed evenly around the world.
   - **C.** People who do not have food security suffer from illnesses and a shorter life expectancy.
   - **D.** All of the above
2. Which of the following is one way that governments can attempt to prevent food shortages?
   - **A.** Stockpiling food when production is high
   - **B.** Charging people less for food
   - **C.** Preventing imports to their country
   - **D.** Refusing to accept food aid
3. What is the interconnection between urbanisation and food security?
   - **A.** As cities expand, more food is produced in their suburbs.
   - **B.** As cities expand, they tend to invade surrounding food-producing areas.
   - **C.** Smaller cities lead to a larger crop yield.
   - **D.** Big cities have wealthy populations who are food secure.
4. How might foreign owners benefit from owning farmland in Australia?
   - **A.** Financial gain
   - **B.** Food production
   - **C.** Improved food security
   - **D.** All of the above
5. **a.** Which type of cropland is predicted to be the most changed by a 1-metre rise in sea level in Asia?
   - **A.** Groundnut
   - **B.** Oilseed
   - **C.** Maize
   - **D.** Wheat
   - **E.** Rice

   b. From the options below, select the three countries that will be most at risk of losing cropland.
   - **A.** China
   - **B.** Bangladesh
   - **C.** Vietnam
   - **D.** India
   - **E.** Myanmar
   - **F.** Thailand
   - **G.** Indonesia
6. Which of the following would be a positive factor affecting the world's ability to produce enough food to feed everyone sustainably by 2050?
   - **A.** There will be a growing population at a world scale and increasing populations in some regions so food supply will not meet demand.
   - **B.** Transporting crops and food will become difficult and expensive as petrol and transport costs increase.
   - **C.** Changing climatic conditions will have altered growing regions for some crops.
   - **D.** Technology will allow previously unusable land to be used for agriculture.
   - **E.** There may be a shortage of water and the difficulty of irrigation in areas where climate conditions have changed
   - **F.** There may be a growing appetite for meat as economies become more developed.
7. Identify the reasons for supplying food aid for Cambodia.
   - **A.** Life expectancy is lower in Cambodia than in Australia.
   - **B.** It is much warmer in Cambodia and food perishes faster.
   - **C.** Literacy rates are lower in Cambodia than in Australia.
   - **D.** Under-5 mortality rates are higher in Cambodia than in Australia.

8. Which three water-stressed places of Australia might be able to sustainably use greenhouse food production?
   A. Places with irregular rainfall such as inland Australia
   B. Coastal regions not previously opened up to agriculture
   C. Coastal areas with low rainfall
   D. Inland areas with salty groundwater

9. a. Which of the following food categories provided the largest average calorie intake (per person per day) across the globe in 2009?
   A. Grains
   B. Meat
   C. Vegetables
   D. Fruits

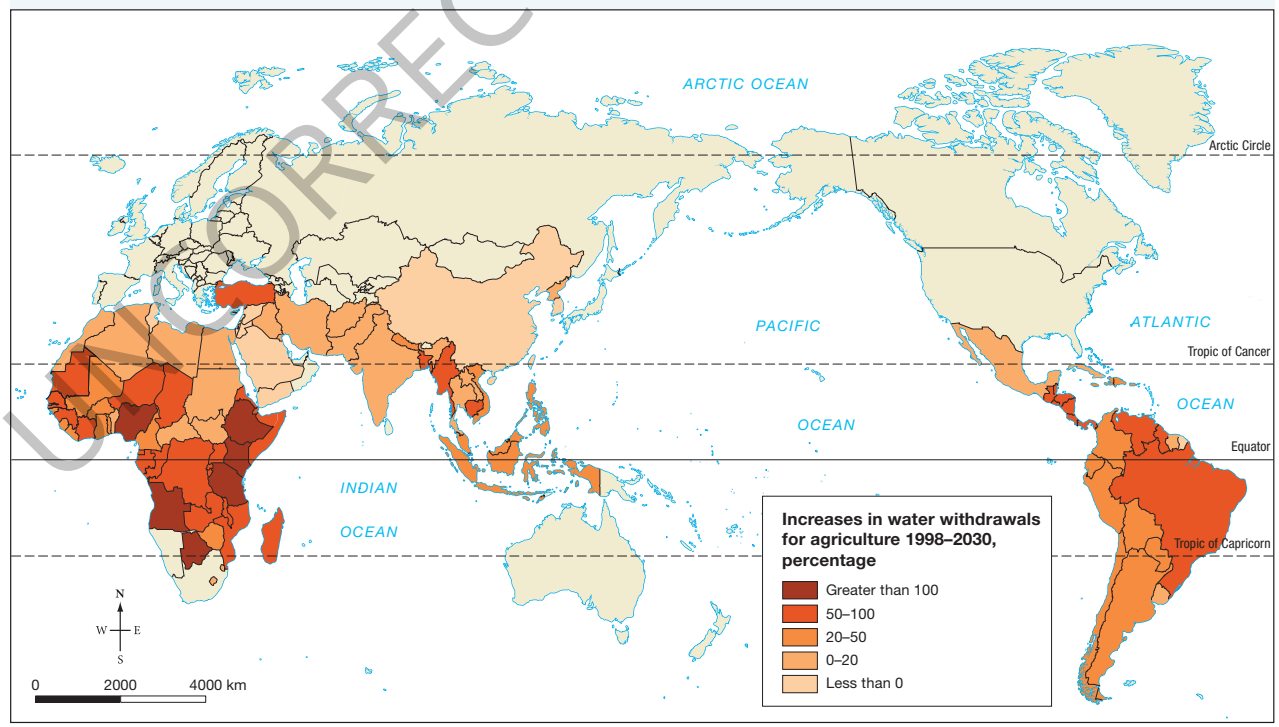
   b. Which of the following food types is expected to decrease in consumption in developing countries between 1999 and 2030?
   A. Wheat
   B. Rice
   C. Vegetable oils
   D. Sugar

10. Which of the following statements is true?
   A. The yield gap between developed and developing nations is small.
   B. Developed countries have the best chance of increasing gap yield as opposed to developing nations.
   C. China could increase the gap yield if they had access to disease-free strains of potatoes.
   D. None of the above

Short answer

11. Study the information in **FIGURE 1** shown below.
   Describe the distribution pattern of countries that are predicted to withdraw over 100 per cent more water in the years to 2030.
   Suggest a reason why Australia, the United States and countries in Europe are not in this category.

FIGURE 1 Predicted increases in water use for agriculture 1998–2030



Source: Spatial Vision

12. Refer to **FIGURE 2** in section 14.3.1. The original land use for this location was tropical rainforest.
    a. Why might this area have been cleared?
    b. Is this a suitable landscape for such extensive clearing? Explain your answer.
13. Predict what might happen to some of the 53 000 people living independently in Australia if Meals on Wheels could not deliver meals to them.
14. Predict what the impact might be on people and places if the greenhouse method of farming were to become more readily available.
15. Explain how an individual's choice of diet can influence their own health and the health of the planet.
16. Explain how urban gardens can be places of education.
17. Explain why more space in cities may need to be set aside — either vertically or horizontally — for urban farming in the future.
18. Urban farming is a sustainable option for overcoming some problems associated with feeding the world in 2050. Discuss.
19. Some countries, such as China, Saudi Arabia and South Korea, which cannot produce enough food for their needs, are buying agricultural land in other countries. Discuss the advantages and disadvantages of this scheme.
20. What is the cartoon below trying to tell us? Summarise the point of view about land grabs that is being expressed in this cartoon.

RESOURCE SUMMARY

on Resources

This is a summary of the digital resources you will find online for Topic 14 to help support your learning and deepen your understanding. When you see these icons next to an image or paragraph, go to learnON to access video eLessons, interactivities, weblinks and other support material for this topic.

14.1 Overview

Video eLesson
- Food for thought (eles-1720)

14.3 Impacts of land loss on food security

eWorkbook
- Land degradation (ewbk-5841)

Google Earth
- New Delhi

14.4 Access to water supplies

eWorkbook
- Impact of water security on food production (ewbk-5840)

Interactivity
- The last drop (int-3328)

Weblinks
- Water use
- Water availability

14.5 The challenges of climate change for food security

eWorkbook
- Impact of climate change on food production (ewbk-5842)

Weblink
- How to feed the world in 2050

14.6 Thinking Big research project: Famine crisis report

ProjectsPLUS
- Thinking Big research project: Famine crisis report (pro-0191)

14.7 Feeding the future world population

eWorkbook
- Feeding the future world population (ewbk-5843)

Video eLesson
- Future food (eles-1721)

14.8 Improving food production and distribution

eWorkbook
- Improving food production (ewbk-5844)

Interactivity
- More, or less, food (int-3329)

Weblinks
- Vertical farming
- WA Waste Authority

14.9 Food aid

eWorkbook
- Support for people facing hunger (ewbk-5845)

Weblink
- World Food Programme

14.10 Food aid in Australia

eWorkbook
- Local food aid (ewbk-5846)

Weblinks
- Poverty in Australia
- Improving Aboriginal food security and diet

14.11 The effects of dietary changes on food supply

eWorkbook
- The impact of dietary changes (ewbk-5847)

Interactivity
- What are we eating? (int-3331)

14.12 Urban farms

eWorkbook
- Urban farming (ewbk-5848)

Weblinks
- Urban aquaponics
- Vertical farming

Google Earth
- Kolkata

14.13. Thinking Big research project: Community garden design

ProjectsPLUS
- Thinking Big research project: Community garden design (pro-0192)

14.14. Review

eWorkbook
- Reflection (ewbk-5850)
- Crossword (ewbk-5849)
- Student Learning Matrix (ewbk-5839)

To access these online resources, log on to **www.jacplus.com.au**.