3 GLOBAL RESOURCE CONSUMPTION AND SECURITY

This unit examines how population growth and the expansion of the world's middle class have affected consumption of resources (for example, water, energy and food) to the point where there are issues of water, food and energy security in some regions. Nevertheless, there are possibilities to manage the world's resources sustainably, such as resource stewardship and the circular economy.

You should be able to show:

- ✔ how global development **processes** affect resource availability and consumption;
- ✔ how pressure on resources affects the future security of **places**;
- ✔ that there are **possibilities** for managing resources sustainably and **power** over the decision-making process.

3.1 GLOBAL TRENDS IN CONSUMPTION

- **Biocapacity** – the land and water to provide resources for humanity.
- **Ecological footprint** – the hypothetical area of land required by a society, a group or an individual to fulfill all of their resource needs and assimilate all of their waste. It is measured in global hectares (gha).
- **Embedded (virtual) water** – the amount of water used in the production and transport to market of goods.
- **Hydrocarbons** – chemical compounds consisting of carbon and hydrogen, such as oil and natural gas.
- **Green water** – the rainfall that is stored in the soil and evaporates from it; the main source of water for natural ecosystems, and for rainfed agriculture, which produces 60% of the world's food.

You should be able to show how global development processes affect resource availability and consumption:

- ✔ Global and regional/continental progress towards poverty reduction, including the growth of the "new global middle class";
- ✔ Measuring trends in resource consumption, including individual, national and global ecological footprints;
- ✔ An overview of global patterns and trends in the availability and consumption of:
  - ✔ Water, including embedded water in food and manufactured goods;
  - ✔ Land/food, including changing diets in middle-income countries;
  - ✔ Energy, including the relative and changing importance of hydrocarbons, nuclear power, renewables and new sources of modern energy.

Global and regional/continental progress towards poverty reduction, including the growth of the "new global middle class"

One of the main successes of the millennium development goals (MDGs) was the global reduction in extreme poverty between 2000 and 2015. In 1990 around 50% of people in LICs lived on less than US$1.25 a day; by 2015 it was around 14%. In contrast, the number of people classified as middle class—that is, living on at least US$4 a day—almost tripled between 1900 and 2015. This population accounted for 18% of people in LICs in 1900 and nearly 50% in 2015.

The growth of the "new global middle class"

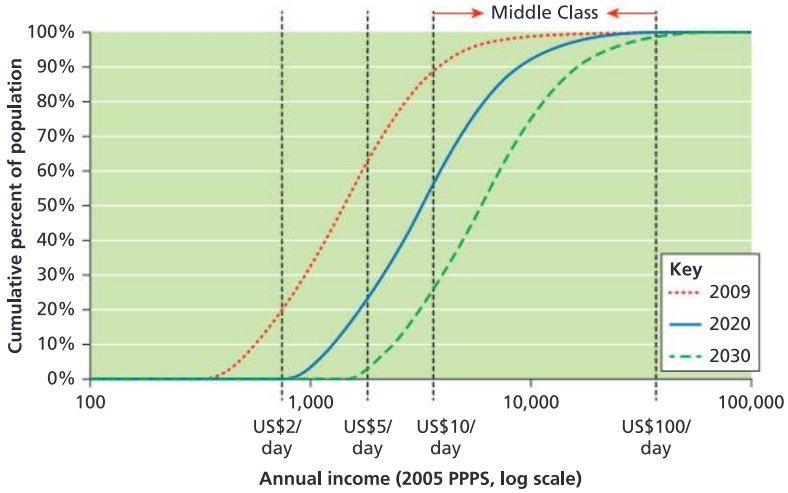
According to the World Bank (2016):

- Low-income economies are defined as those with a GNI per capita of US$1,045 or less in 2014.
- Middle-income economies are those with a GNI per capita of US$1,046–US$12,735.
- Lower-middle-income economies have an income of US$1,046–US$4,124.
- Upper middle-income countries have income of US$4,125–US$12,735.
- High-income economies are those with a GNI per capita of US$12,736 or more.
- Lower-middle-income and upper-middle-income economies are separated at a GNI per capita of US$4,125.

▼ **Table 3.1.1.** Size of the middle class, 2009–2030 (millions of people and global share)

	2009 (Millions)	(%)	2020 (Millions)	(%)	2030 (Millions)	(%)
North America	338	18	333	10	322	7
Europe	664	36	703	22	680	14
Central and South America	181	10	251	8	313	6
Asia-Pacific	525	28	1740	54	3228	66
Sub-Saharan Africa	32	2	57	2	107	2
Middle East and North Africa	105	6	165	5	234	5
World	1845	100	3249	100	4884	100

Source of data: Kharas, H., *The emerging middle class in developing countries*, World Bank (2011)



▲ **Figure 3.1.1.** Changes in annual income in China, 2009–2030

Measuring trends in resource consumption

As individuals and countries become wealthier, their consumption of resources increases. This includes food, water, energy and consumer goods, for example. Changes in diet, with increasing consumption of meat and dairy products, have an impact on the amount of water and energy used in agriculture. One way of examining resource consumption is to look at ecological footprints.

- **Blue water** – renewable surface water runoff and groundwater recharge; the main source for human withdrawals and the traditional focus of water resource management.
- **Grey water** – waste water that has been produced in homes and offices. It may come from sinks, showers, baths, dishwashers, washing machines, etc., but it does not contain fecal material.

Test yourself

3.1 Compare the relative distribution of middle-class population between 2009 and 2030. [3+3]

Test yourself

3.2 Identify the type of scale used in figure 3.1.1, and state why it has been used. [1+2]

3.3 Outline the changes in projected annual income in China, as indicated in figure 3.1.1. [2+2+2]

Concept link

PROCESSES: The rise of the new global middle class can be attributed to a number of geographical processes that have enabled people to escape from poverty and to join a segment of the global demographic. This is increasing the ecological footprint due to rising consumption.

Ecological footprints

The ecological footprint is the theoretical measurement of the amount of land and water that a population requires to produce the resources it consumes and to absorb its waste under prevailing technology. The ecological footprint tracks the use of six things: cropland, grazing land, fishing grounds, built-up land, forest area and carbon.

On the supply side, a city, state or nation's biocapacity represents the productivity of its ecological assets (including cropland, grazing land, forest land, fishing grounds and built-up land). These areas, especially if left unharvested, can also absorb much of the waste we generate, especially our carbon emissions.

Both the ecological footprint and biocapacity are expressed in global hectares—globally comparable, standardized hectares with world average productivity.

Test yourself

3.4 Describe the main characteristics of the countries with the highest ecological footprints. [2]

3.5 Outline the main characteristics of the countries with the lowest ecological footprints. [2]

Rank	Country	EFP
1	United Arab Emirates	10.68
2	Qatar	10.51

▲ **Table 3.1.2.** Countries with the highest ecological footprint (EFP)

Rank	Country	EFP
187	Timor-Leste	0.49
188	Eritrea	0.48

▲ **Table 3.1.3.** Countries with the lowest ecological footprints

Test yourself

3.6 Study table 3.1.4. Using an appropriate data presentation technique, plot the urban ecological footprints for Barcelona and Cairo. **Compare** the main differences between the two footprints. [2+3]

3.7 Suggest why Barcelona has a higher biocapacity than Cairo. [2]

3.8 Briefly **explain** two reasons why the overall ecological footprints in urban areas are higher than in rural areas. [2+2]

3.9 Identify, and **justify**, one component of the ecological footprint that may be smaller in urban areas compared to rural areas. [1+2]

	Barcelona (4.52 gha)	Cairo (2.85 gha)
Food	33.3%	35.0%
Housing	4.7%	13.9%
Personal transportation	20.6%	12.2%
Goods	13.3%	9.4%
Services	3.9%	8.9%
Government	6.1%	7.2%
Infrastructure investment (houses, bridges, roads, factories)	18.1%	13.3%

▲ **Table 3.1.4.** Composition (%) of ecological footprints for Barcelona and Cairo

An overview of global patterns and trends in the availability and consumption of water, land/food and energy

Patterns and trends in the availability and consumption of water

Annual water availability is highest in Asia. Asia also has the highest annual consumption, at around 1,350 km^3 per year. North America has the next highest water availability and consumption, followed by Europe. Both Africa and South America have much smaller consumption rates, while Oceania has the lowest availability and consumption rates.

Content link
Factors affecting water availability are explored further in option A.3.

Patterns and trends in the availability and consumption of food

Economic development is normally accompanied by improvements in a country's food supply. Increasing urbanization will also have consequences for the dietary patterns and lifestyles of individuals, not all of which will be positive. Changes in diets are referred to

as the "nutrition transition". The pace of these changes seems to be accelerating, especially in the low-income and middle-income countries.

The dietary changes that characterize the "nutrition transition" include both quantitative and qualitative changes. The adverse dietary changes include shifts in the structure of the diet towards a higher energy-density diet with a greater role for fat and added sugars in foods, greater saturated-fat intake, reduced intakes of complex carbohydrates and dietary fibre, and reduced fruit and vegetable intakes.

Diets evolve over time, being influenced by many factors and complex interactions. Income, prices, individual preferences and beliefs, cultural traditions, as well as geographical, environmental, social and economic factors all interact in a complex manner to shape dietary consumption patterns.

The world has made significant progress in increasing food consumption per person. The growth in food consumption has been accompanied by significant structural changes and a shift in diet away from staples, such as roots and tubers, towards more livestock products and vegetable oils. However, this comes at a price—it requires far more water to produce meat and dairy products than it does to produce grain and vegetables. So water shortages are likely to become more frequent and intense as the demand for meat and dairy products increases.

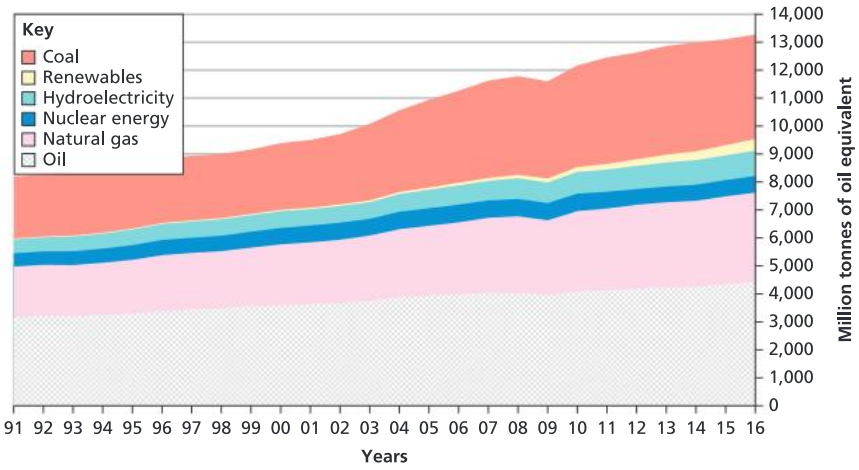
▼ **Table 3.1.5.** Global and regional per capita food consumption (kcal per capita per day)

Region	Year 2015	Year 2030
World	2,940	3,050
Developing countries	2,850	2,980
Near East and North Africa	3,090	3,170
Sub-Saharan Africa[a]	2,360	2,540
Latin America and the Caribbean	2,980	3,140
East Asia	3,060	3,190
South Asia	2,700	2,900
Industrialized countries	3,440	3,500
Transition countries	3,060	3,180

[a]Excludes South Africa

Source of data: Food and Agricultural Organization of the United Nations (2002)

Patterns and trends in the availability and consumption of energy



▲ **Figure 3.1.2.** World consumption of energy resources, 1991–2016

Source of data: BP Statistical Review of World Energy, June 2017

Assessment tip

Remember that in IB Geography, the term "region" refers to a group of countries, such as the Middle East, rather than part of a country.

Test yourself

Study table 3.1.5.

3.10 Determine the region with (i) the greatest calorie intake and (ii) the lowest calorie intake in 2015. [1+1]

3.11 Identify the regions predicted to experience the highest (i) absolute and (ii) relative increase in calorie intake between 2015 and 2030. [1+1]

Assessment tip

When asked to describe a graph or identify changes, data should be quantified rather than just copied, otherwise full marks will not be awarded.

Test yourself

Look at figure 3.1.2.

3.12 Explain the scale "million tonnes of oil equivalent" (mtoe). [2]

3.13 Identify the type of graph that is being used, and **explain** briefly why it is appropriate for this data. [1+2]

3.14 Describe the main changes in the consumption of energy resources between 1991 and 2016. [3]

Overall global oil production increased from around 65 million barrels per day in 1991 to over 90 million barrels per day by 2016. The largest relative increase was in the Middle East and South and Central America, but there were relative falls in Europe/Eurasia and North America, despite an absolute increase in the amount of oil produced.

Nuclear energy provides a relatively small amount of the world's energy. In 1991, it accounted for less than 500 mtoe out of a global total of approximately 8,000 mtoe (which is around 6%). By 2016, less than 5% of world energy consumption came from nuclear.

Nuclear energy peaked in 2006 but then fell around 2011 (possibly reflecting reaction to the Fukushima-Daichii nuclear disaster in Japan).

New sources of modern energy

Biofuels are a type of modern energy source. They are made from plants grown today, whereas fossil fuels are made from plants and animals that died millions of years ago. For decades, Brazil has turned sugarcane into ethanol, and some cars there can run on pure ethanol or as an additive to fossil fuels. In 2016, United Airlines announced a new initiative to integrate biofuel into its energy supply in the hope of reducing greenhouse gas emissions by 60%.

3.2 IMPACTS OF CHANGING TRENDS IN RESOURCE CONSUMPTION

- **Recover** – capture some value (for example in an energy-from-waste plant or as a nutrient, such as compost).
- **Recycle** – use in a different way (may involve "downcycling").
- **Reduce** – use less resource to meet the need (also called "minimization").
- **Remove** – eliminate demand altogether (also called "prevention" or "conservation").
- **Re-source** – change materials or sources (for example, using low-carbon electricity to meet demand).
- **Resource stewardship** – a concept that humans can use resources in a way that is sustainable.
- **Return** – put back in an environmentally benign way. This may require treatment or containment.

You should be able to show how pressure on resources affects the future security of places:

- ✔ The water–food–energy "nexus" and how its complex interactions affect:
  - ✔ National water security, including access to safe water;
  - ✔ National food security, including food availability;
  - ✔ National energy security, including energy pathways and geopolitical issues;
- ✔ The implications of global climate change for the water–food–energy nexus;
- ✔ The disposal and recycling of consumer items, including international flows of waste.

The water–food–energy "nexus"

The water–food–energy nexus refers to the interrelationships between these three economic sectors. For example, the water sector influences the food sector and vice versa. Water infrastructure and use impact land use (such as irrigation), food production and fish stocks. Food production may impact on water quality (such as eutrophication, salinization). Water influences energy, for example, hydroelectric power (HEP), water for cooling/cleaning. In turn, energy developments may influence water by altering water temperature, quality and availability for other purposes. Food production requires energy for machinery, lighting, transport, processing, etc. In return, food production may produce energy sources, such as biofuels, and help to reduce the

negative impacts of burning fossil fuels, for example, by acting as carbon sinks. By promoting one type of development over another, the water available for food developments is reduced. Similarly, if water is used for food (irrigation), the potential for energy developments is reduced. The nexus shows that developments in one sector may have unintentional impacts on the other sectors. The water–food–energy nexus is central to sustainable development. Demand for all three is increasing due to rising population, increasing wealth, rapid urbanization, changes in diet and economic growth.

- **Reuse** – reintroduce into the same method as before.
- **Energy security** – having access to sufficient, clean, reliable and affordable energy sources for cooking, heating, lighting, communications and productive uses.
- **Food security** – having a sufficient amount of good-quality food.
- **Nexus** – the interrelationship, interdependence and interactions between water, food and energy.
- **Water security** – continuing access to safe drinking water and sanitation.

National water security

Despite the recognition of water–food–energy nexus linkages, current approaches to water management in many areas treat the three sectors independently. That is the case in the Southern African Development Community (SADC), where a lack of cooperation and coordination has hampered developments in the water sector. Moreover, many of the river basins are transboundary (have parts of their river system in different countries) which makes coordination more difficult. Most of the dams in the region were built for a single purpose although some, such as the Kariba Dam in Zambia, are now being adapted for multiple purposes.

There is an uneven distribution of water in the SADC. Up to 75% of the region receives less than 650 mm of rain per year. Although there are plentiful supplies in DR Congo, the infrastructure to redistribute it around the region does not exist. A large proportion of SADC's population lives in rural areas (for example, 67% in Zimbabwe and 59% in Zambia), and access to safe water is limited. In Zimbabwe, around 25% of households have to pay for their water. Even in South Africa, the richest country in the region, around 5 million people lack access to clean water. In addition, climate models forecast a decrease of about 20% in annual rainfall by 2080 in southern Africa. With increasing demand for water from agriculture and energy, the availability of water for domestic consumption will be squeezed.

▲ **Figure 3.2.1.** Human pressure on water resources in the Eastern Cape, Republic of South Africa

National food security

Within the SADC region, only around 6% of the land is cultivated, but this sustains the livelihood of 60% of the population. Only 3.5% of the region's arable land is irrigated, and this increases the vulnerability of the region to food insecurity. During the drought of 2015–16, over 40 million people became food insecure. Nevertheless, agriculture contributes some 17% of the regional GDP. Despite the importance of agriculture in the region and its consumption of 76% of the region's water resources, the current agricultural performance is insufficient to ensure regional food security and economic growth. Reasons for the low growth include low investment, regular droughts, lack of credit and poor farming practices. In addition, climate change is causing increased rainfall variability and reductions in crop yields. As more water is needed for energy developments or domestic/industrial uses, there may be increased pressure on the agricultural sector's supply of water. The area is likely to experience more food shortages, and reductions in food availability despite its growing population.

Concept link

PLACES: Some places are more secure than others in terms of their access to food, energy and water. The resources could be sourced within the country's borders, or alternatively they can be secured from other places. The spatial interaction between countries and their ability to trade enables the latter.

National energy security

The SADC faces energy insecurities. Some dams, such as Kariba, which were originally constructed for the purpose of hydroelectric

production, how been diversified to provide for aquaculture, urban water supply, ecotourism, transport and mining activities. SADC has large energy resources that are relatively unexploited. There are 15 transboundary river basins which could be developed for HEP, although cooperation between countries is not guaranteed. Angola, DR Congo, Mozambique and Zambia have the capacity to supply the whole region with electricity, if not the funds. However, biomass remains the main source of energy, as only 24% of the total population and 5% of the rural population have access to electricity. Over-dependence on biomass has led to large-scale deforestation and desertification in the region.

Demand for energy is increasing due to urbanization, industrialization and economic growth, and that has led to frequent power blackouts in the region.

The pressure to produce more food and energy under increasing water scarcity requires careful management, coordination and cooperation among the three sectors. However, the predicted decline in rainfall totals will impact on energy production, food production and access to safe water.

Content link
Oil policies of Middle Eastern countries are discussed further in unit 4.1.

Countries in the Middle East control about 50% of the world's remaining oil reserves. This gives the Middle East an economic and political advantage—countries that want oil may have to stay on friendly terms with those that supply it. Countries that depend on the region for their oil need to:

- help ensure political stability in the Middle East
- maintain good political links with the Middle East
- involve the Middle East in economic cooperation.

On the other hand, the situation is also an incentive for rich countries to increase energy conservation or develop alternative forms of energy.

The implications of global climate change for the water–food–energy nexus

Climate change could influence the water–food–energy nexus in many contrasting ways. In some areas it may reduce agricultural productivity, whereas in other areas it may increase it. Water supplies will diminish in some areas and increase in others. The demand for energy will also change. Climate change is expected to increase the frequency of climate-related shocks, and these will have an impact on food, water and energy supplies. Moreover, due to their interconnections and interdependence, an impact on one part will have an influence on the other two.

Attempts to limit climate change may also have an impact on the water–food–energy nexus. The production of biofuels and hydroelectric power may create new demands for water resources. Some methods of adaptation to climate change, such as the use of drip irrigation and desalination of seawater, are very energy intensive. Increased groundwater use would also require extra pumping and therefore energy resources.

Content link
The consequences of global climate change are discussed in unit 2.2.

Global climate change creates critical challenges for water, energy and food, with increasing temperature, reducing snowpack and changing precipitation, as well as ecosystem processes at regional scales. In the Sacramento–San Joaquin Delta and Central Valley

watersheds in California, USA, the ecosystem services are reduced due to the increased regional temperature, changes in snowpack and precipitation, and increased water stresses from drought. The reduced services affect the water and energy nexus and agricultural food production, as well as fish and wildlife habitats.

Likely impacts include:

- Projected temperature increase ranging from 2 to 5°C by 2100;
- Loss of snowpack, with 48–65% of snow water content loss by the end of this century;
- Droughts, with more dry years and less water, which will affect food and energy;
- More frequent flooding and fire, affecting water quality in the watershed;
- Rising sea levels;
- Increasing energy demand;
- Changes in species and habitats.

Countries with contrasting levels of resource security

Two countries with very different levels of resource security are Saudi Arabia and Yemen. Saudi Arabia is currently water-, food- and energy-secure. It relies on its oil-based economy to import food and to cover the costs of desalination of seawater. Its water consumption is very high per person, and it has depleted its groundwater reserves.

By 2050, Saudi Arabia's population is forecast to be 50 million, up from 29 million in 2015. This will place great pressure on food and water production. Rapid urban growth and improved living standards have influenced the demand for food and water, and the country has experienced a nutrition transition.

Around 97% of Saudis have access to safe water. Average water consumption is 100–350 litres per day in urban areas, and 15–20 litres per day in rural areas. Despite its limited resources, Saudi Arabia produces and exports dates, dairy products, eggs and some fruit and vegetables. Agriculture has been heavily subsidized by the government in the past, although the levels of subsidies have been reduced.

In contrast, Yemen is the most food-insecure country in the Middle East and has one of the world's highest rates of hunger. It imports about 60% of its food. Over 10 million Yemenis, over 40% of the population, are food-insecure. Its population, 26 million, is expected to double by 2040.

Yemen's food and water crisis is linked to its political and social instability. However, scarce natural resources, including water, have increased this instability. Conflict has exacerbated food insecurity. Population displacement means that some farmers cannot harvest the food they have grown, and have no income to buy food at a market. Water scarcity reduces crop yields. The production of qat, a narcotic drug, is widespread and accounts for about 40% of Yemen's agricultural water consumption.

Yemen is one of the five most water-stressed countries in the world, with around 86 cubic metres of water available per person per year. Yemen's current food and water demand already exceeds supply. Moreover, due to the conflict between Saudi Arabia and Yemen, oil imports have been badly affected.

Test yourself

3.15 Analyse how, and why, global climate change may affect the water–food–energy nexus in California. [2+2]

3.16 Outline two advantages and two disadvantages of global climate change for the water–food–energy nexus. [2+2]

The disposal and recycling of consumer items

There are many forms of disposal and recycling of consumer items.

- Remove—the elimination of demand altogether
- Reduce the amount of waste
- Reuse goods to extend their lifespan, for example reuse of milk bottles or reuse of old tyres to reduce soil erosion
- Recycle—create new forms of the same product (recycled paper), or put used goods to another use (for example plastic bags used as bin liners; old clothes used as cleaning cloths)
- Recover value—compost biodegradable waste for use as fertilizer and/or incinerate (burn) waste; collect electricity and heat from it
- Disposal—put waste in landfill sites (natural or the result of quarrying) or use to make artificial hills.

▲ **Figure 3.2.2.** Recycling is becoming more widespread in many HICs

Flows of waste

Increasing amounts of waste are being exported internationally. In general, the flow of waste (including electronic waste) is from HICs to LICs and MICs. The European Environment Agency estimates that between 250,000 tonnes and 1.3 million tonnes of used electrical products are shipped out of the EU every year, mostly to west Africa and Asia. Research by the Massachusetts Institute of Technology (MIT) suggests that, in 2010, the US discarded 258.2 million computers, monitors, TVs and mobile phones, of which only 66% were recycled.

Test yourself

3.17 Contrast two positive and **two** negative impacts of the disposal of e-waste. [2+2]

3.3 RESOURCE STEWARDSHIP

Concept link

POWER AND POSSIBILITIES: Resource stewardship is a pathway to achieving environmental sustainability and involves a range of stakeholders. This complex web of vested parties involves multi-governmental organisations such as the UN with their SDGs and national governments altering their mindsets and policies to engage with the circular economy. People also have everyday choices to make regarding resources. As environmental degradation, consumerism and population sizes all increase, the decisions made at a number of levels and scales will determine the future of the planet and its citizens.

You should be able to show examples of possibilities for managing resources sustainably and power over the decision-making process:

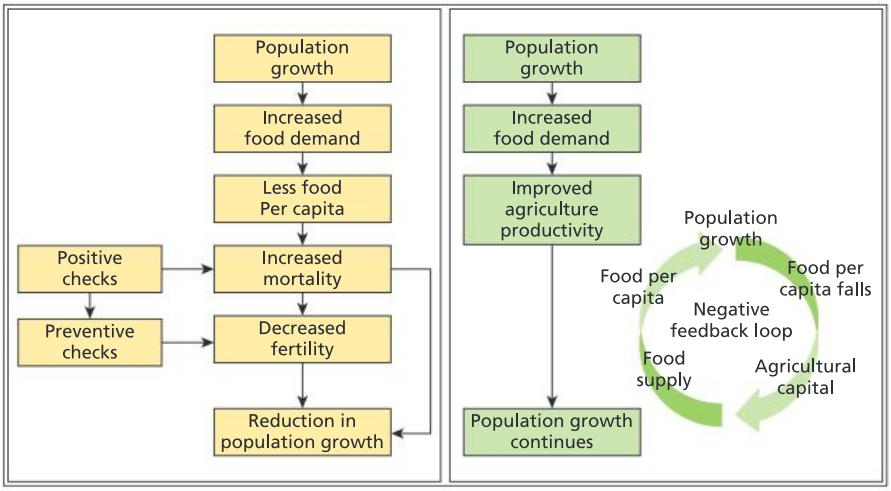
- ✔ Divergent thinking about population and resource consumption trends:
  - ✔ Pessimistic views, including neo-Malthusian views;
  - ✔ Optimistic views, including Boserup;
  - ✔ Balanced views, including resource stewardship;
- ✔ Resource stewardship strategies, including:
  - ✔ The value of the circular economy as a systems approach for effective cycling of materials and energy;
  - ✔ The role of the UN Sustainable Development Goals and progress made toward meeting them.

Divergent thinking about population and resource consumption trends

There are many views on the relationship between population and resources. Two of the most famous are the views of Thomas Malthus and Ester Boserup.

Malthus wrote in 1798 but his main idea—that population growth would outstrip the growth of resources—has been updated by neo-Malthusians, such as Paul Ehrlich and the Limits to Growth team. The neo-Malthusians have the same pessimistic message, but they encourage the use of contraception and family planning as a way of reducing population growth. Malthus himself was against the use of artificial contraception, as he considered it to be immoral (he was a vicar). Neo-Malthusians also suggest that there needs to be greater redistribution of wealth and fairer access to resources.

In contrast, Ester Boserup suggests that, as the need arises, people will find solutions to overcome shortages of resources. She suggested that new techniques/methods would increase productivity, for example, using the land more intensively, increasing the use of irrigation and fertilizers, and using high-yielding varieties of crops.



▲ **Figure 3.3.1.** Malthusian (left) and Boserup (right) views on population growth

The neo-Malthusians have been predicting global famine because of an overpopulated planet. In *The Population Bomb*, Ehrlich pronounced: "The battle to feed all humanity is over" (Paul Ehrlich, *The Population Bomb*, 1968, Buccaneer Books). Neo-Malthusians predicted a crisis of food, energy, water and land resources.

According to the economist Amaryta Sen, famine was not caused by declining availability of food, but a decline in food entitlement, as a result of unemployment, a lack of benefits, rising food prices, etc. For example, many landless labourers in Kalahandi, India, may help to produce rice but cannot afford to buy it. However, Stephen Devereux of the International Development Institute believes that it is more than an economic factor for example, political regime, natural disasters, civil war, local and global governance, climate change and environmental issues are all important in different places.

The term "stewardship" refers to the careful management of the environment and its resources, in a way that benefits humanity and is sustainable. "Stewardship" suggests that people are caretakers—looking after the environment and its resources for the benefit of

- **Divergent thinking** – finding new solutions to old problems; thinking "outside the box".
- **Circular economy** – an economy that preserves natural capacity, optimizes resource use and reduces loss through managing finite stocks and renewable flows.
- **Refurbish** – to restore and to make useful again.
- **Recycle** – refers to the manufacturing of a used good into another good that can be used again, such as bottles, paper, aluminium. However, not all products can be recycled. Coffee cups made from cardboard with plastic coating cannot be recycled.
- **Biochemical feedstock** – refers to the production of renewable energy from crops such as corn, sugarcane, soyabeans and palm oil.
- **Anaerobic digestion/ decomposition** – the production of biogas and/or fertilizer from crops.

Test yourself

3.18 Distinguish between the Malthusian and neo-Malthusian views of population growth and resources. [2+2]

Assessment tip

Make sure that you answer the question! If a question asks about neo-Malthusian solutions to the population–resources issue, make sure that you provide neo-Malthusian solutions rather than Malthusian ones.

Test yourself

3.19 Briefly **describe** how increased demand for food could lead to improvements in agricultural productivity. [3]

3.20 Outline the contribution of academics, such as Sen and Devereux, to the debate about population and resources. [2+2]

3.21 Explain the term "resource stewardship". [2]

3.22 Suggest how resource stewardship contributes to the management of population and resources. [2]

3.23 Define "circular economy". [1]

3.24 Suggest how materials from animals used for the production of meat and milk could be used for biochemical feedstock. [2]

humanity, rather than just preserving environments for their own benefit. It is a concept that operates on a global scale, and, as such, is very difficult to achieve. Examples of global resource stewardship include attempts in reaching agreements on things like climate change, marine fishing policies and reducing plastic pollution.

Resource stewardship strategies

The circular economy

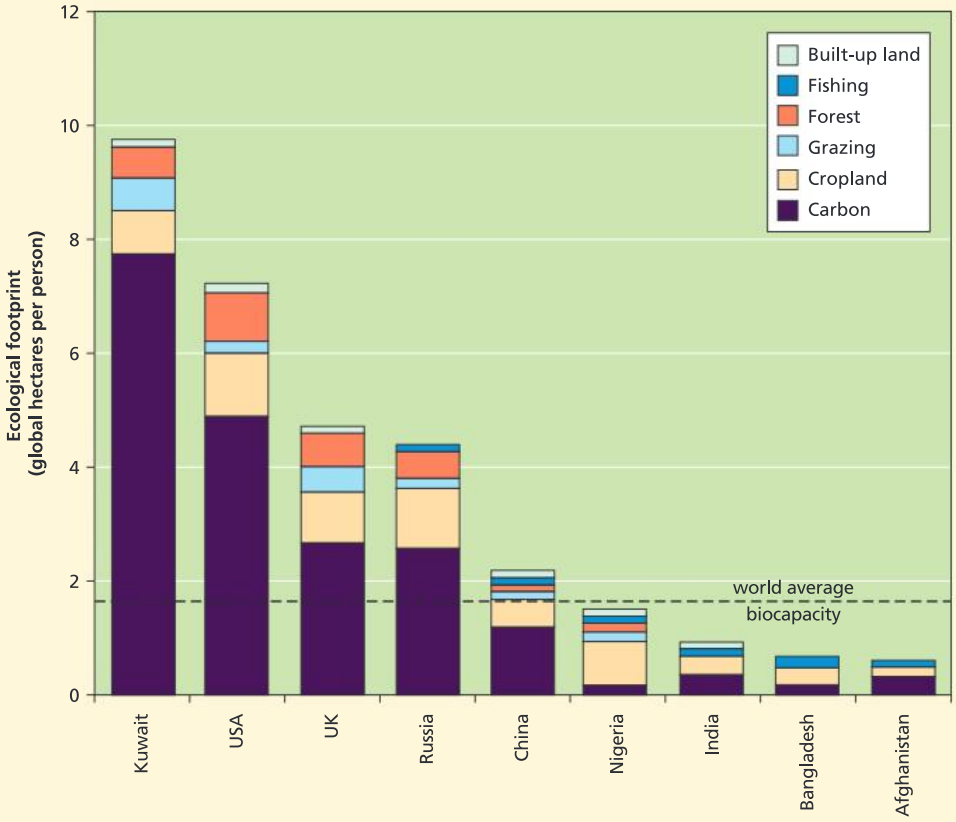
A circular economy is one that preserves natural capacity, optimizes resource use and reduces loss through managing finite stocks and renewable flows. It is an economy that restores and regenerates resources, and keeps products, materials and components at their highest utility and value.

The role of the UN Sustainable Development Goals (SDGs)

The SDGs were introduced in 2015 and will run until 2030. They follow on from, and extend the original, Millennium Development Goals that existed between 2000 and 2015. It is too early to assess how the SDGs are faring. There is still much poverty around the world, and problems related to gender equality, climate change, desertification, acidification of the oceans and many more. The SDGs are ambitious.

QUESTION PRACTICE

The following graph shows the size and composition of the ecological footprint for selected countries.



a) **Define** the term "ecological footprint". [2]

b) **Outline two** differences in the ecological footprint of the USA and Nigeria. [2 + 2]

c) Briefly **explain** two factors that lead to a decline in food availability. [2 + 2]

Essay

"By the end of the 21st century there will be too many people and not enough resources left."
To what extent do you agree with this statement? [10]

How do I approach these questions?

a) This asks for a definition. It is worth 2 marks, so you should have two specific points in your answer.

b) You are required to give two differences in the ecological footprint of the USA and Nigeria. One difference could be the size of the ecological footprint and another could be the composition. You will need to add details.

c) An explanation is required. You should identify two valid factors and then develop each one further and/or give some exemplification.

SAMPLE STUDENT ANSWER

a) The theoretical measurement of the amount of land and water that a population needs to produce the resources it consumes and to absorb its waste measured in global hectares.

▲ Good point

▲ Valid point

A good definition.

Marks 2/2

b) The USA produces much more carbon than Nigeria does, 5 ghas per annum in the USA compared with just above zero in Nigeria. This is because the USA uses more energy and therefore more fossil fuel as it is a more economically developed country and it has a higher population. The use of more fossil fuels emits more carbon, and uses more carbon. The USA also has a higher proportion of forest use of about 1 gha. This is because forest products are used for fuel, infrastructure and furniture. The USA needs more of this due to its high population and standard of living. Overall, the USA's ecological footprint is bigger than Nigeria's at 7 gha for the USA and just over 1 gha/person in Nigeria, which is below the world average biocapacity.

▼ Inaccurate use of data

▼ Not valid as the EFP is given as gha per person

▲ Valid point

▲ Valid point

▲ 1 mark

Somewhat contradictory in places. Could have developed the composition of Nigeria's EFP. Some valid points are made.

Marks 3/4

c) Physical factors and human factors cause food shortages. One of the physical factors that cause food shortages is the climate. If there is a drought, that is 29 consecutive days without rainfall, then the crops do not get enough water to grow. This is a very common problem in Sub-Saharan Africa.

▲ Definition of drought

▲ Development

Physical factor correctly explained, and some development, e.g. location, and definition of drought.

▲ Correct identification of human factor

▲ Located example

A human factor that can cause food shortages is civil war. For example, in Yemen they import 90% of their food. But because of the civil war, there was a blockade which prevented weapons being sent over but also food. This caused famine throughout their country as there was hardly any food available.

Human factor correctly identified/explained and located example – very contemporary

Marks 4/4

Essay

"By the end of the 21st century there will be too many people and not enough resources left." **To what extent** do you agree with this statement?

▲ Starts with a statistic

▲ Links to relative growth

▲ Increase in quality of life as well as quantity of people

▲ Suggests a population 'dilemma'

▲ Identifies the main problem

▲ Clear range of issues regarding resource use

▲ Very clear introduction

▲ Good to cover the nexus

▲ Exemplification of concepts

By the end of the 21st century, the world's population is projected to be around 11 billion, up from 7 billion at present. This is an increase of over 50%. More importantly, the world's population will have more middle income countries (MICs) than at present and fewer low income countries (LICs). If the Sustainable Development Goals (SDGs) are to be achieved, poverty will be eradicated by 2030 and everyone will be living in MICs or HICs. This may be good news for the world's population but it may be bad news for resource depletion. As people become richer they consume more resources. Richer people eat more meat and dairy products than poorer people; they use more water (showers, baths, water the garden, wash the car) and consume more energy (more electrical goods, private vehicles). More land, water and energy resources will be needed to fuel the increased demand for consumer and non-consumer goods. The water-food-energy nexus is the concept that explains how increased demand and use of one component of these three resources has an impact on the other two. For example, if more energy is needed to produce food, there is less energy available for water production (e.g. desalination, pumping of groundwater, HEP). This shows that there could be a problem with resource security in the future.

The neo-Malthusians, such as Paul Ehrlich and the Club of Rome, suggest that population growth has the potential to outstrip the growth of resources, and that ultimately there will be a population crash. However, with population control, an increase in food supply, and redistribution of wealth, this could be avoided. However, reduced population growth is usually associated with higher resource consumption, due to greater wealth.

▲ Considers neo-Malthusian view

▲ Solutions offered

In contrast, Ester Boserup believed that people have the resources (knowledge and technology) to find a solution to the problems. She believed that increasing population size stimulated changes in agricultural techniques. At present, this could be GMOs, in-vitro meat production (stem cells) and greater use of hydroponics.

▲ Counter-view

▲ Range of new technologies

Other theories include Hardin's 'Tragedy of the Commons' i.e. common resources such as the oceans will be over-fished through greed and a lack of proper management. Resource stewardship suggests that resources can be used in a way that can be made available to future generations. It suggests environmental sustainability and social equity. The idea of a circular economy maximises resource use, preserves natural capital and reduces loss. It is possible that with more re-use and recycling of goods, waste disposal can be reduced and the life of natural resources extended.

▲ Goes beyond normal Malthusian vs Boserup argument

▲ Introduces sustainability and equity

▲ Good range of concepts and exemplification

Thus it is not inevitable that there will be too many people or not enough resources. However, it will take a major shift in the way we use resources – and waste them – if the world is to reach 2100 and have a high standard of living for all.

Conclusion brings it all together—touches on 'inevitability' but shows that the population-resource balance could go either way. Perhaps a more in-depth account of one or more resources and their use, decline and/or alternatives could allow for greater evaluative comments.

Marks 9/10