OXFORD IB DIPLOMA PROGRAMME

2ND EDITION

GEOGRAPHY

COURSE COMPANION

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UNIT 3
GLOBAL RESOURCE CONSUMPTION AND SECURITY

Key term

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 fulfil all their resource needs and assimilate all their wastes. It is measured in global hectares (gha).
Energy security	Access to clean, reliable and affordable energy sources for cooking, heating, lighting, communications and productive uses.
Food security	The "availability and access to sufficient, safe and nutritious food to meet the dietary needs and food preferences for an active and healthy life" (FAO).
Nexus	The interrelationship, interdependence and interactions between water, food and energy.
Virtual (or embedded) water	The way in which water is transferred from one country to another through its exports.
Water security	Continuing access to safe drinking water and sanitation.

Key questions

1. How do global development **processes** affect resource availability and consumption?
2. How does pressure on resources affect the future security of **places**?
3. What are the **possibilities** for managing resources sustainably and **power** over the decision-making process?

As countries increase their standard of living, the global demand for resources – including water, food and energy – is increasing. New sources of modern energy include hydropower, wind, solar and electric. The use of any one of these resources has an impact on other resources. For example, the export of food has implications for water and for energy. In addition, countries that trade are essentially trading water and energy resources "virtually". Resource use can be measured by using the ecological footprint concept, which varies between countries and changes over time.

As demand for resources increases, issues related to national resource security are also likely to increase. Some countries are using resources from other countries to reduce pressure on their own resources but at the expense of those other countries. Moreover, some countries export their waste, which has important health implications for receiving countries. Methods of waste management are tending to encourage more recycling, reuse and reduction of waste.

There is an ongoing debate between the neo-Malthusians and the anti-Malthusians over the relationship between population and resources. The circular economy attempts to re-use and recover the resources that are used, and the UN Sustainable Development Goals include "Affordable and clean energy" as well as "Responsible consumption and production".

1 Global trends in consumption

Poverty reduction and the 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 per cent of people in LICs lived on less than $1.25 a day; by 2015 it was around 14 per cent. In absolute terms, the number of people living in extreme poverty fell from 1.9 billion in 1990 to 836 million in 2015. In contrast, the number of people classified as middle class – that is, living on at least $4/day – almost tripled between 1900 and 2015. This population accounted for 18 per cent of people in LICs in 1900 and nearly 50 per cent in 2015.

These increasing numbers of middle-class people are the result of the increase in average incomes and the fall in the number of people living in absolute poverty (Figure 3.1). In 2009, there were around 1.8 billion middle-class people, mainly in Europe (664 million), Asia (525 million) and North America (338 million). However, there was a small but increasing proportion of middle class in all other regions, too.

The increasing middle-class sector is an important economic feature, since it helps to increase sales of goods such as electrical goods, mobile phones and cars. For example, sales of cars and motorbikes have increased by over 800 per cent since 2009. However, continued growth is not always guaranteed. For example, during the 1960s Brazil and South Korea had similar incomes and economic growth rates. By the 1980s, Brazil's middle class accounted for less than 30 per cent of the population, whereas Korea's was over 50 per cent.

Conceptual understanding

Key question

How do global development **processes** affect resource availability and consumption?

Key content

- 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
- 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, new sources of modern energy

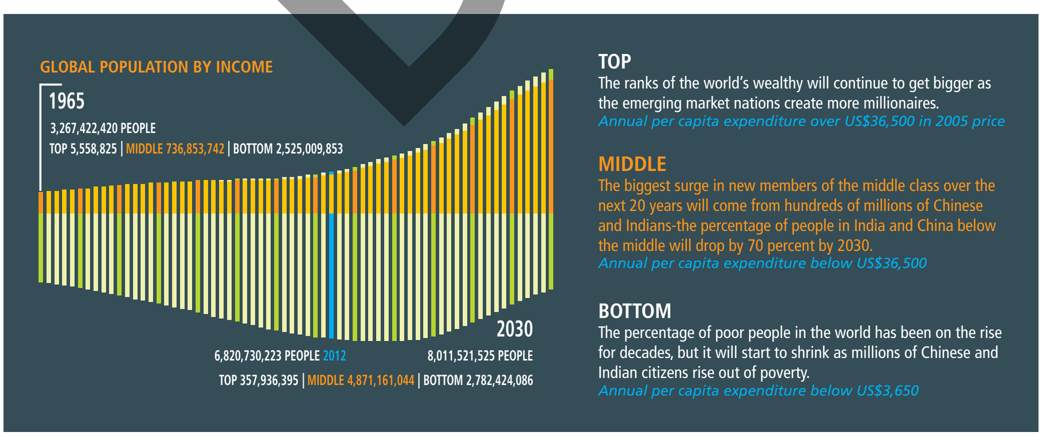
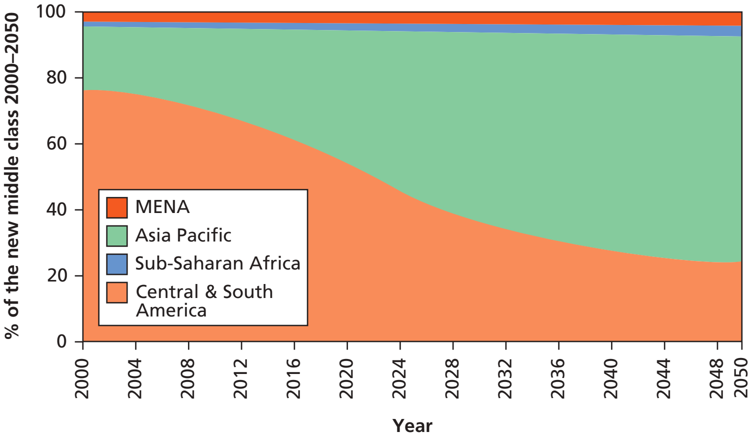


Figure 3.1: The rising numbers of the middle class

ATL Research skills

Visit http://www.reuters.com/middle-class-infographic

and see how the distribution of the world's middle class changed since 1965 and is predicted to change by 2030.



▲ **Figure 3.2:** The growth of the middle class by world region

Korea's middle class allowed Korea to diversify its economy away from export-orientation to domestic consumption.

Not all the middle class has economic security, however. Many people on incomes of over $4/day remain vulnerable to unemployment and underemployment. For many working in informal activities (see pages 000-00), there is little or no economic or social security.

There has also been uneven progress in reducing poverty. Some 800 million people still live in extreme poverty and approximately half of all global workers work in unsafe conditions. People are disadvantaged on account of their gender, ethnicity, disability and geographic location.

Case study

Economic growth in Vietnam

Since 1990, economic growth in Vietnam has averaged 6 per cent per year. As a result, it has developed from one of the world's poorest countries into a middle-income country (MIC). One of the main reasons for its success has been its proximity to China, which gives it a competitive advantage. As wages in China have risen, firms have relocated to low-cost Vietnam. In addition, Vietnam has a young population (see pages 000-00 for a discussion of the demographic dividend); whereas China's median age is 36, Vietnam's is only 30.

The Vietnamese government has also used a series of five-year plans to guide its development. It has invested in education, spending some 6.3 per cent of its GDP on education, around 2 per cent more than most LICs and MICs. In addition, Vietnam is a member of the Trans-Pacific Partnerships (TPP), a 12-country trade bloc that includes the USA and Japan. It also has a free trade agreement with Korea and is negotiating one with the EU.

There is no single reason for Vietnam's emergence as a middle-income country, but it has created a number of features that make it a good country to invest in.

Vietnam

Population 92.5 million
Average annual growth rate 2009–2014: 5.9%

Structure of employment:

Agriculture 46.8%
Industry 21.2%
Services 32.0%

Trade

Principal exports ($bn):

Telephones and mobile phones 23.6
Textiles and garments 20.9
Computers and electronic products 11.4
Footwear 10.3
Total 150.1

Principal imports ($bn):

Machinery and equipment 22.4
Electronics, computers and parts 18.7
Telephones and mobile phones 9.4
Textiles 8.5
Total (incl. other) 149.3

Main export destinations (% of total)
USA 20.0
China 10.4
Japan 10.3
South Korea 5.0

Main origin of imports (% of total)
China 30.3
South Korea 15.0
Japan 8.9
Thailand 4.9

In Latin America, for example, women are more likely to live in poverty than men: the proportion of poor women to poor men increased from 108 women to 100 men in 1997 to 117 women to 100 men in 2012. Globally, about 75 per cent per cent of men are part of the global labour force, but only around 50 per cent of women are, and women earn, on average, 25 per cent less than men.

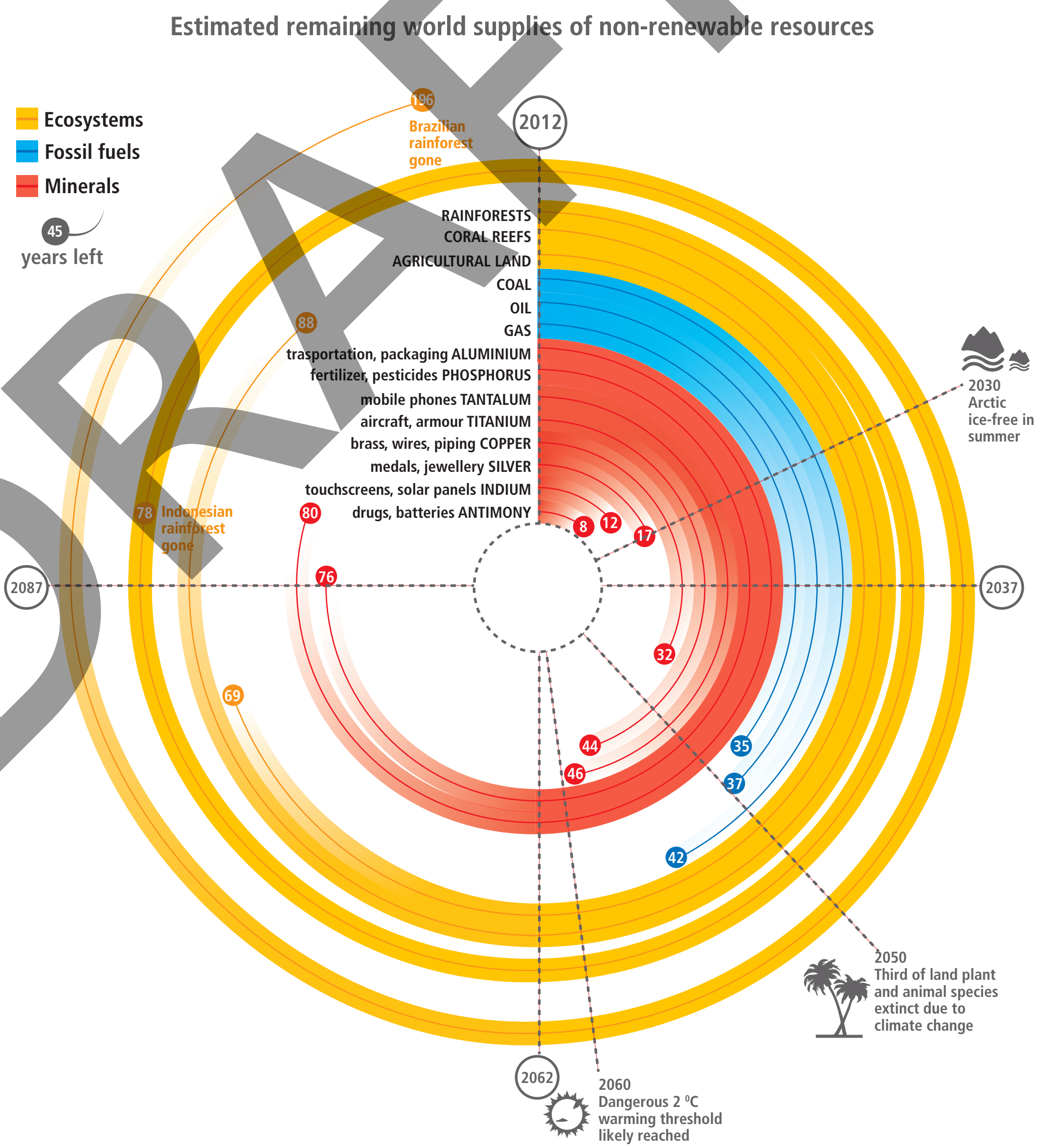
Global consumption of resources

As the world's population increases, and particularly as the number of wealthy people grows, consumption of resources increases. Many of the world's resources are in danger of being used up, as shown in Figure 3.3.

Ecological footprints

An ecological footprint is the hypothetical area of land required by a society, a group or an individual to fulfil all their resource needs and assimilate all their wastes. It is measured in global hectares (gha). The term was initially coined by William Rees in 1992, and further developed with Mathis Wackernagel in his book *Our Ecological Footprint: Reducing Human Impact on the Earth* (1998). A country described as having an ecological footprint of 3.2 times its own geographical area is consuming resources and assimilating its wastes on a scale that would require a land area 3.2 times larger than the actual size of the country.

Ecological footprints can act as a model for monitoring environmental impact. They can also allow for direct comparisons between groups and individuals, such as comparing LICs and HICs. They can highlight sustainable and unsustainable lifestyles: for example, populations with a larger footprint than their land area are living beyond sustainable limits.



▲ **Figure 3.3:** The human consumption of major global resources

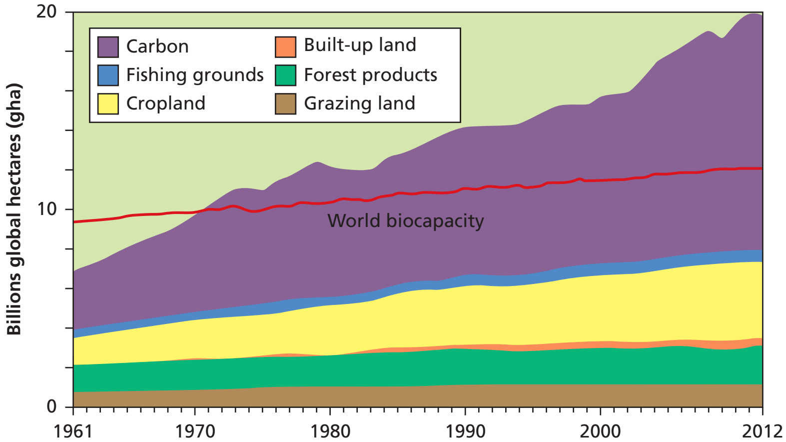


Figure 3.4: Changes in the components of the ecological footprints, 1961 to 2012

Wackernagel and Rees originally estimated that the available biological capacity for the population of the Earth (around 6 billion people at that time but more than 7 billion now) was about 1.3 hectares of land per person (or 1.8 global hectares if marine areas are included as a source of productivity).

The United Nations estimate that by 2030 we will need the equivalent of two Earths to supply the world's population with all the resources it wants. The Global Footprint Network uses the concept of Earth Overshoot Day – the day in the year when humanity has used up all the resources that it takes the planet to regenerate. In 2000, Earth Overshoot Day was in October, by 2015 it was 13 August and by 2016 it was 8 August.

A country increases its ecological footprint by:

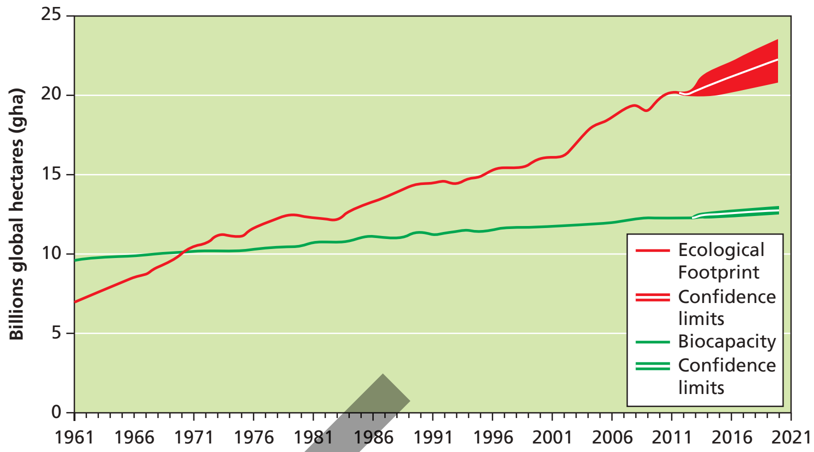
- relying heavily on fossil fuels
- increasing its use of technology and, therefore, energy (but technology can also reduce the footprint)
- high levels of imported resources (which have high transport costs)
- large per capita production of carbon waste (that is, high energy use, high fossil fuel use)
- large per capita consumption of food
- having a meat-rich diet.

A country can reduce its ecological footprint by:

- reducing the amounts of resources it uses
- recycling resources
- reusing resources
- improving the efficiency of resource use
- reducing the amount of pollution it produces
- transporting waste to other countries to deal with
- improving technology to increase carrying capacity
- importing more resources from other countries
- reducing its population to reduce resource use
- using technology to increase carrying capacity (for example using GM crops to increase yield on the same amount of land)
- using technology to intensify land use.

However, humanity is increasing the amounts of resources that it uses, and the capacity of the Earth to sustain this use of resources is diminishing (Figure 3.5).

Many innovations for reducing ecological footprints are still in the early stages (for example renewable technologies) but these could have a huge impact in the future. The funding to support technological change exists in HICs, which currently face the biggest problem with their ecological footprints (Figure 3.6).



▲ **Figure 3.5:** Changes in ecological footprint and the world's biocapacity

Calculating ecological footprints

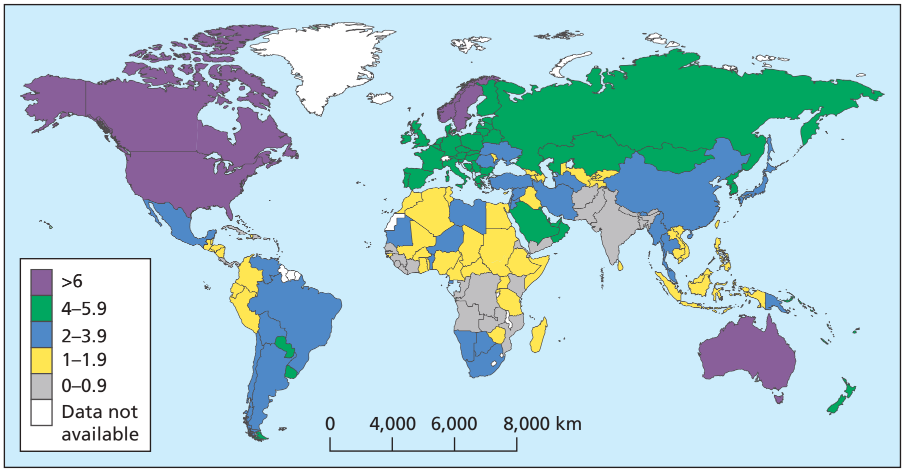
Ideally, all resource consumption and land uses are included in an ecological footprint calculation. However, this would make the calculation very complex. Ecological footprints are usually simplified, and an approximation achieved, by using only net carbon dioxide emissions.

Factors used in a full ecological footprint calculation include the following:

- bioproductive (currently used) land – land used for food and materials such as farmland, gardens, pasture and managed forest
- bioproductive sea – the sea area used for human consumption (often limited to coastal areas)
- energy land – an equivalent amount of land that would be required to support renewable energy instead of non-renewable energy. The amount of energy land depends on the method of energy generation (large in the case of fossil fuel use) and is difficult to estimate for the planet
- built (consumed) land – land used for development, such as roads and buildings
- biodiversity land – land required to support all non-human species
- non-productive land – land such as deserts, subtracted from the total land available.

Thus the simplified calculation of ecological footprint clearly ignores the following factors that influence the amount of land a population needs to support itself:

- land or water required to provide aquatic and atmospheric resources
- land or water needed to assimilate wastes other than carbon dioxide
- land used to produce materials imported into the country to subsidize arable land and increase yields
- replacement of productive land lost through urbanization.



▲ **Figure 3.6:** The ecological footprints (in global hectares) of countries around the world, 2014

Table 3.1: The world's largest and some of the smallest ecological footprints, 2014

Rank	Country	Ecological footprint (gha/person)
1	United Arab Emirates	15.99
2	USA	12.22
3	Kuwait	10.31
4	Denmark	9.88
5	New Zealand	9.54
109	India	1.06
114	Nepal	1.01
128	Ethiopia	0.85
135	Haiti	0.78
141	Bangladesh	0.60

Ecological footprints in HICs and LICs

Given their different standards of living and levels of resource consumption, energy usage and waste production, disparities are to be expected between the ecological footprints of LICs and HICs. LICs tend to have smaller ecological footprints than HICs (Table 3.1) because of their much smaller rates of resource consumption. In HICs, people have more disposable income, which means that consumption and demand for energy resources are high. HICs' resource use is often wasteful and HICs produce far more waste and pollution as by-products of production. People in LICs, by contrast, have less to spend on consumption and the informal economy in LICs is responsible for recycling many resources. However, as LICs develop, their ecological footprint size increases.

A meat-eating diet, prevalent in HICs where 30 per cent of the diet may be based on animal protein, requires the use of much more land than a vegetarian diet. This is because animals use up about 90 per cent of the food they eat for things like respiration, mobility and feeding; only a small percentage is converted into new biomass. More of the energy from the crop goes to humans if the crop is eaten directly (as in LICs, where less meat features in the diet – about 12 per cent). Data for food consumption are often given in grain equivalents; so a population with a meat-rich diet consumes a higher grain equivalent than a population feeding directly on grain. Since people in HICs obtain more than twice as much energy from animal products as people in LICs, grain production is higher, using high-yield farming strategies.

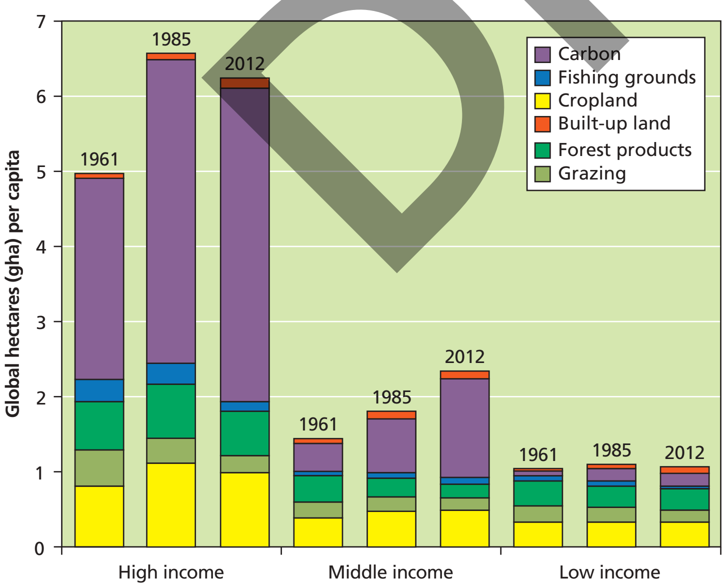


Figure 3.7: Changes in ecological footprints for HICs, MICs and LICs over time

Greenhouse gas emissions from agriculture also affect footprint totals. According to the International Panel on Climate Change (IPCC), the agricultural sector emits between 5.1 and 6.1 billion tonnes of greenhouse gases annually, about 10–12 per cent of total greenhouse gas emissions. The main sources of these gases are nitrous oxides from fertilizer, methane emissions from cows, and biomass burning.

Populations more dependent on fossil fuels have higher carbon dioxide emissions. Fixation of carbon dioxide is clearly dependent on climatic region and vegetation type, with countries nearer the equator containing vegetation with higher rates of net primary production. Lower rates of carbon dioxide uptake in HICs compared to LICs, and higher rates of emissions, contribute to the higher ecological footprints in HICs.

Ecological footprints are useful for describing the impact of humans on resources. However,

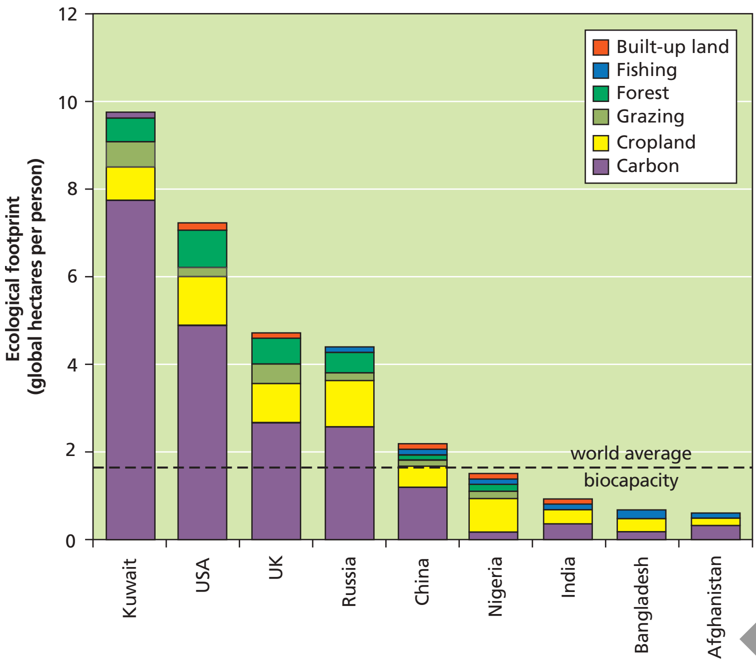


Figure 3.8: Selected ecological footprints for 2014

they are only a tool and much of the data is generalized. The 2014 data show a large difference between the ecological footprints of rich countries (HICs), with oil-rich countries at one end of the scale and poor countries (LICs) at the other.

Patterns and trends in water availability and consumption

Water is unevenly distributed over the world, and over 780 million people do not have access to clean water. The global population is likely to increase to 9 billion by 2050, which, combined with changes in diet, will increase demand for water. Moreover, the increased demand for water for hydroelectric power will further strain the earth's water resources.

Water availability is likely to decrease in many regions. For example, 300 million people in sub-Saharan Africa live in a water-scarce environment and climate change increases water stress in many areas. Central and Southern Europe are predicted to get drier as a result of climate change.

HICs are tending to maintain or increase their consumption of resources such as water, although an increasing proportion of this water is embedded in agricultural and manufactured products. The average North American and Western European adult consumes $3m^3$/day, compared with around $1.4m^3$/day in Asia and $1.1m^3$/day in Africa. In some cases, it is not just the transfer of water through products that reduces availability but also the loss of land through land grabs. Saudi Arabia cut production of cereals at home by 12 per cent but, through a series of land grabs, produced the cereals it needed in parts of Africa.

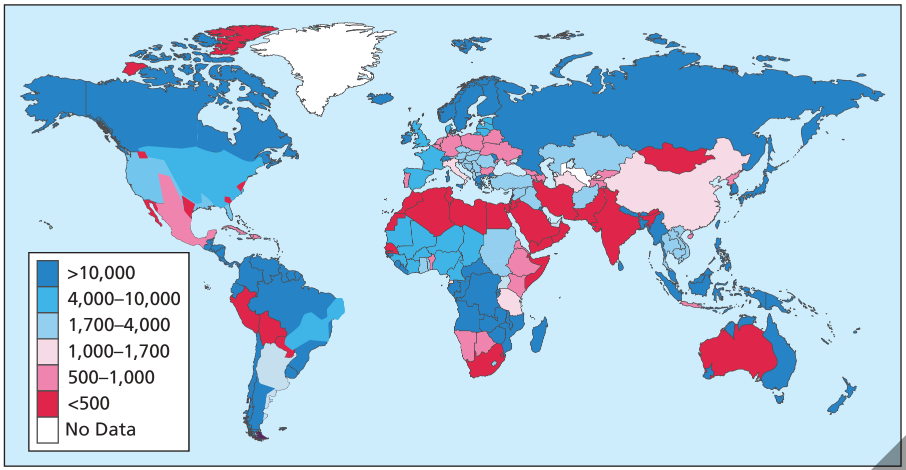
Activity 1

1. Describe the changes to the world ecological footprint, as shown in Figure 3.4.
2. Compare and contrast changes in the size and composition of ecological footprints for high-, middle- and low-income countries between 1961 and 2012 (Figure 3.7).
3. a. Compare and contrast the ecological footprints for the countries shown in Figure 3.8.
   b. Suggest reasons for the differences you have described.
4. Visit http://footprint.wwf.org.uk/ and calculate your ecological footprint. Which country has the nearest ecological footprint to yours?

Common mistake

✗ Some students think that the only impact people have is ecological, as measured by ecological footprints.

✓ There are social and economic impacts as well. People may exploit workers, and have an impact on sustainable development for others.



▲ **Figure 3.9:** Annual renewable water (m^3/person/year)

There are major differences in how water is used by HICs, NICs and LICs. Industrial use of water increases with GNI, rising from around 10 per cent for LICs to about 60 per cent for HICs (Figure 3.10).

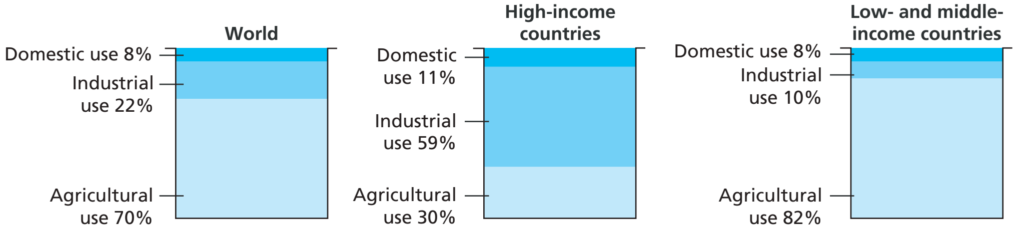
More water will be required to produce food for the world's growing population, partly because of changes in diet. Many industries, in particular the food, drinks, textiles and pharmaceuticals industries, need large quantities of water for their products, which will increase demand for water over the coming decades. Much of the growth will be in LICs, many of which are already experiencing water stress.

A number of trends are increasing the pressure to manage water more efficiently. These include:

- population growth – set to reach 9 billion by 2050; some estimates say it may eventually peak at 11 billion
- the growing middle class – increasing affluence leads to greater water consumption, for example showers, baths, gardening
- the growth of tourism and recreation, for example golf courses, water parks, swimming pools
- urbanization – urban areas require significant investment in water and sanitation facilities to get water to people and to remove waste products hygienically
- climate change – no one is precisely sure how this will influence the water supply but there will be winners and losers in the supply of fresh water.

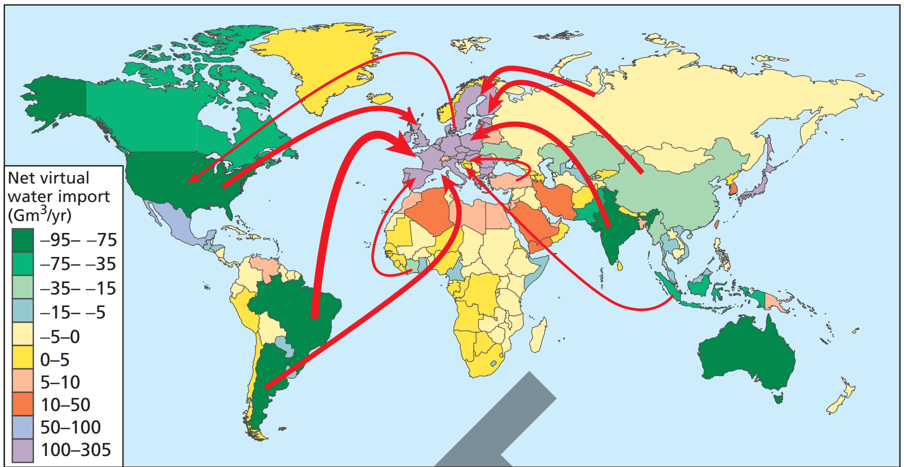
See also Option A, Freshwater.

The concept of virtual (or embedded) water refers to the way in which water is transferred from one country to another through its exports



▶ **Figure 3.10:** Water use in the two main income groups of countries and the world

(Figures 3.11 and 3.12). These exports may be foods, flowers or manufactured goods, for example. It allows countries with limited water resources to "outsource" their water from countries that have more water resources. It also allows a country to reduce the use of its own water resources by importing goods. For example, Mexico imports maize, and thereby saves 12 billion cubic metres of water each year.

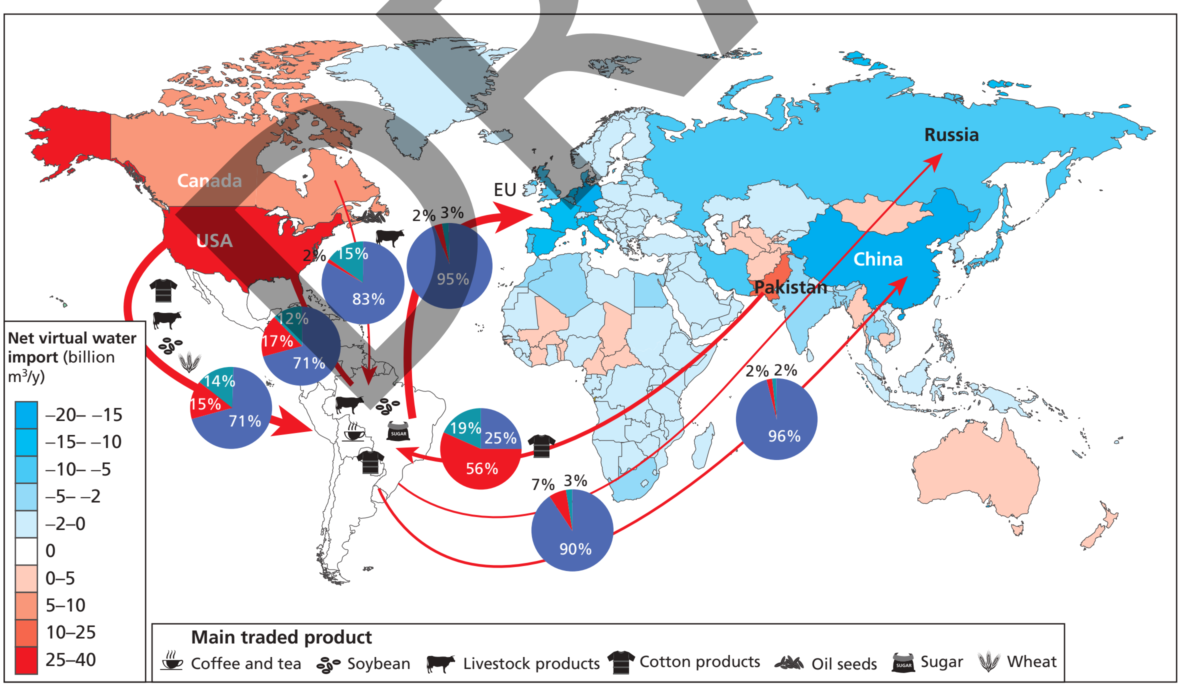


▲ **Figure 3.11:** Virtual water imports into Europe, 2011

Figure 3.12 shows countries with net virtual water imports related to the import of agricultural and industrial products from Latin American countries and countries with net virtual water exports from agricultural and industrial products to Latin American countries, 1996–2005. Only the biggest gross virtual water flows (over 10 billion cubic metres per year) are shown.

Activity 2

1. Describe the global variations in renewable water supplies.
2. Compare the uses of water between HICs and LICs, as shown in Figure 3.10.
3. Compare and contrast the imports and exports of virtual water from Latin America, as shown in Figure 3.12.



▲ **Figure 3.12:** Virtual water imports from Latin American countries (green) and virtual water exports to Latin American countries (red), 1996–2005