

CHAPTER 6 - THE CHALLENGE OF RESOURCE MANAGEMENT

Food, water and energy are fundamental to human development.

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Resources in the UK create opportunities and challenges – AN OVERVIEW

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6.01 The significance of food, water and energy to economic and social well-being.

There are natural resources that are essential to human survival, these being **food** and **water**, but if we add **energy** to that list we have the resources that are fundamental to **human development**.

Key word

Resource Management - The control and monitoring of resources so that they do not become depleted or exhausted.

Food, water and energy have a huge significance in determining people's economic and social well-being across the globe. This is recognised by both the World Bank and the United Nations. However, access to these resources is unequal across the globe. Without access to these fundamental items, countries and people get trapped in the mire of poverty. Reliable energy supplies are vital to allowing a countries industry and economy to function, whilst human survival and well-being require clean and reliable food and water supplies.

When food water and energy are **abundant relative to the number of people** living in a place, their **quality of life increases**. Where there are scarcities of these items there can be social and political unrest. As global population and rates of consumption increase there is a need to increase water, food and energy supplies, but to do so in a sustainable manner to meet the

needs of all people. The world population crossed 7 billion in 2011, this puts increasing pressure upon resources.

A graph of the world's changing population through time

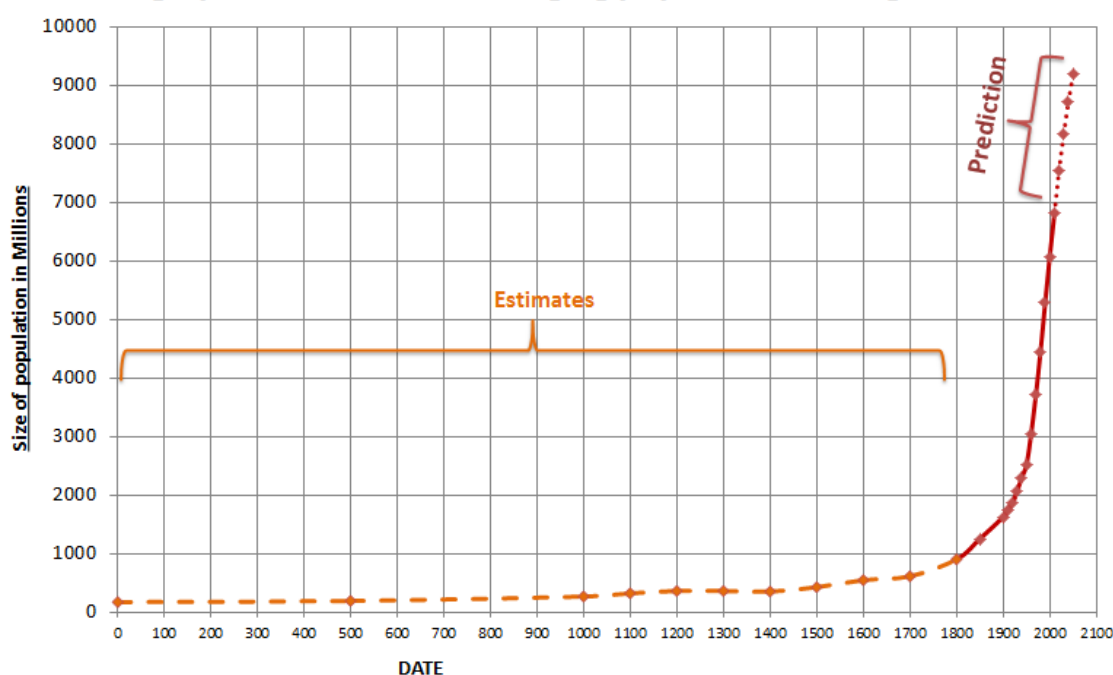


Figure 1 - Graph of world population

Food

People need enough food to survive and live a healthy life. According to the NHS the guideline figures per day are;

| | |
|---------------|-------------------|
| Women | 2000 Kcal |
| Men | 2500 Kcal |
| Teenage Boys | 2414 to 3150 Kcal |
| Teenage Girls | 2223 to 2462 Kcal |

Food production is governed by many factors including physical factors such as climate (temperature and rainfall), the gradient or slope of the land, and the quality of the soils. Human factors also play a role, with capital (money for investment, technology, land ownership and government policies all having an effect.

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Water

WATER SUPPLY and QUALITY vary around the world and not everyone has the luxury of safe, clean drinking water on tap. Water quality can have a massive impact on people; this is why India has attempted to clean up the River Ganges. Poor water quality has a direct impact on people's lives as it is an essential element for life. Poor water quality can lead to disease, which weakens people and therefore has a direct impact on their productivity and hence economic development. Diseases related to poor quality water include Bilharzia (snail fever, where snails transmit flatworms to people causing internal organ damage), Yellow fever and Malaria (both related to mosquitos which breed around water) and cholera (extreme diarrhoea). Water supply is another major issue because in many parts of the world unreliable water supplies limit agriculture and other development areas. If people are searching for and carrying water they cannot focus their energies on other areas of the economy, limiting development further.

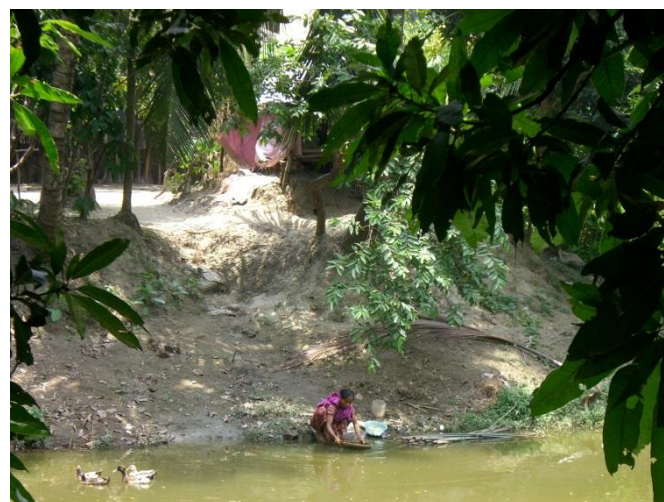


Figure 2 – Poor quality drinking water in Bangladesh - By Thyme28 (Own work) [CC BY-SA 3.0 (<http://creativecommons.org/licenses/by-sa/3.0>)], via Wikimedia Commons

According to Water Aid:

- Around 700,000 children die every year from diarrhoea caused by unsafe water and poor sanitation. That's almost 2,000 children a day
- 768 million people in the world don't have access to safe water. This is roughly one in ten of the world's population
- 2.5 billion people don't have access to adequate sanitation, almost two-fifths of the world's population.
- More than one fifth of the world's population live in areas of water scarcity, where there isn't enough water to meet everybody's needs.

Water supplies are also under pressure from uses in food production, energy production, industry and urbanisation.

Energy

We use energy in a huge variety of ways including powering our homes, for transport, in our industries and to help produce and process our food. There are big gaps in who uses energy around the world and how much. More traditional forms of energy involve burning wood and coal for heat, but we can also use fossil fuels to produce electricity and many countries are increasingly turning to renewable energy sources such as solar, wind and hydroelectric power to meet their energy needs.

There are other issues in energy, relating to the pollution of our atmosphere which can cause health issues and global changes in our climate, and issues related to the extraction of the resource and the damage that does to the environment. Another issue to consider is that of biofuels, where we use farmland to produce oils to be used as fuel. Is this a good way to get a fuel when some people around the world do not have enough food to eat?

6.02 An overview of global inequalities in the supply and consumption of resources.

The access to food, water and energy resources is not shared equally amongst the people of the world. There are massive **inequalities** (where people have **different** access to resources) in people's access to clean water, reliable energy supplies and adequate food supplies. The general pattern is for HICs to consume a far higher amount of resources than LICs. We have enough food, fresh water and energy resources to provide for everyone on our planet, but these resources are not evenly distributed or shared.

Global inequalities in the supply and consumption of food

There are still people in the world who do not have enough food to eat. The map below shows the daily kilocalorie intake for the countries of the world. Throughout sub-Saharan Africa there are countries where the number of calories is too low to sustain good human health. This is known as undernourishment. In some HICs like the UK the kilocalorie intake is actually too high and has led to an obesity "epidemic".

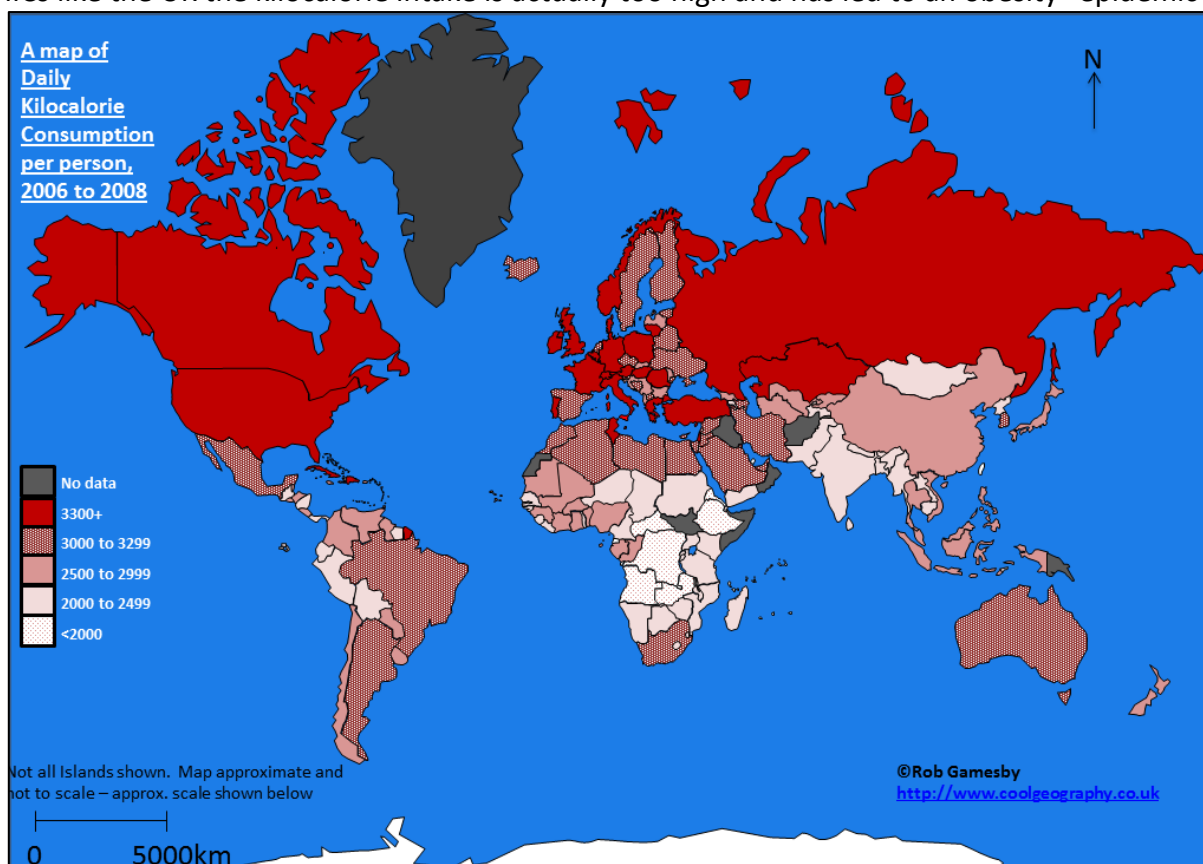


Figure 3 Calorie intake around the globe

Global inequalities in the supply and consumption of water

Water is essential to human life. Although our planet has abundant water over its surface (70%) only 2.5 percent of it is fresh. The rest is saline and ocean-based. Of that fresh water just 1 percent of is easily accessible, with much of it trapped in glaciers and snowfields.

A **water footprint** can be calculated to compare the consumption of water in different places. This includes visible water use such as water for drinking, cooking and washing but also less visible uses of water used for growing our food and for making our clothing, cars or computers. The less visible uses of water can often contribute the biggest portion of the water footprint.

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The UK's water footprint is 3400 litres per person per day, whilst in Bangladesh it is just 2,100 litres per person per day.

The map shows countries that are suffering from water scarcity. Physical water scarcity is when countries do not have enough water due to climatic reasons and other physical reasons, such as Northern Mali in the Sahara Desert. Economic water scarcity is where a country has water, but does not have the economic means to access it, as is the case in parts of Afghanistan.

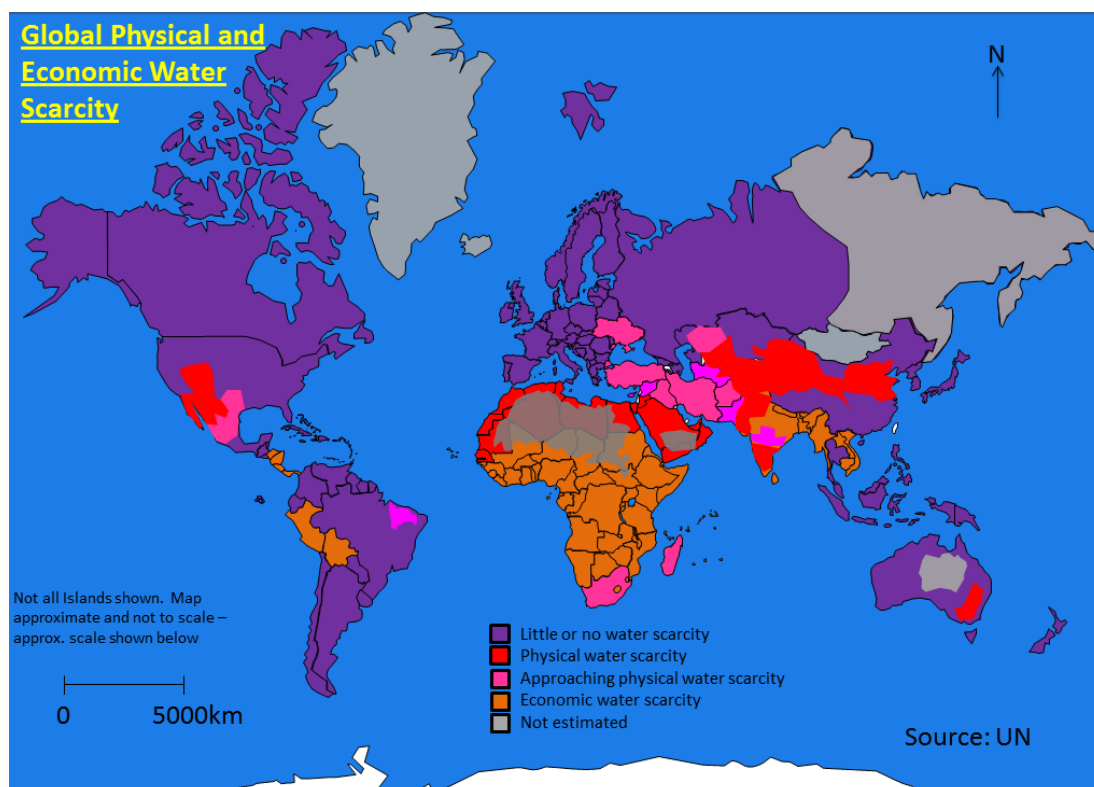


Figure 4 - Global water scarcity map

Energy resources are also unequal, and the consumption of energy varies hugely across the globe. According to the International Energy Agency, the richest countries in the world of around 1 billion people consume 50% of the world's energy, while the poorest 20% consume only 4%. These patterns are clear on the energy consumption map.

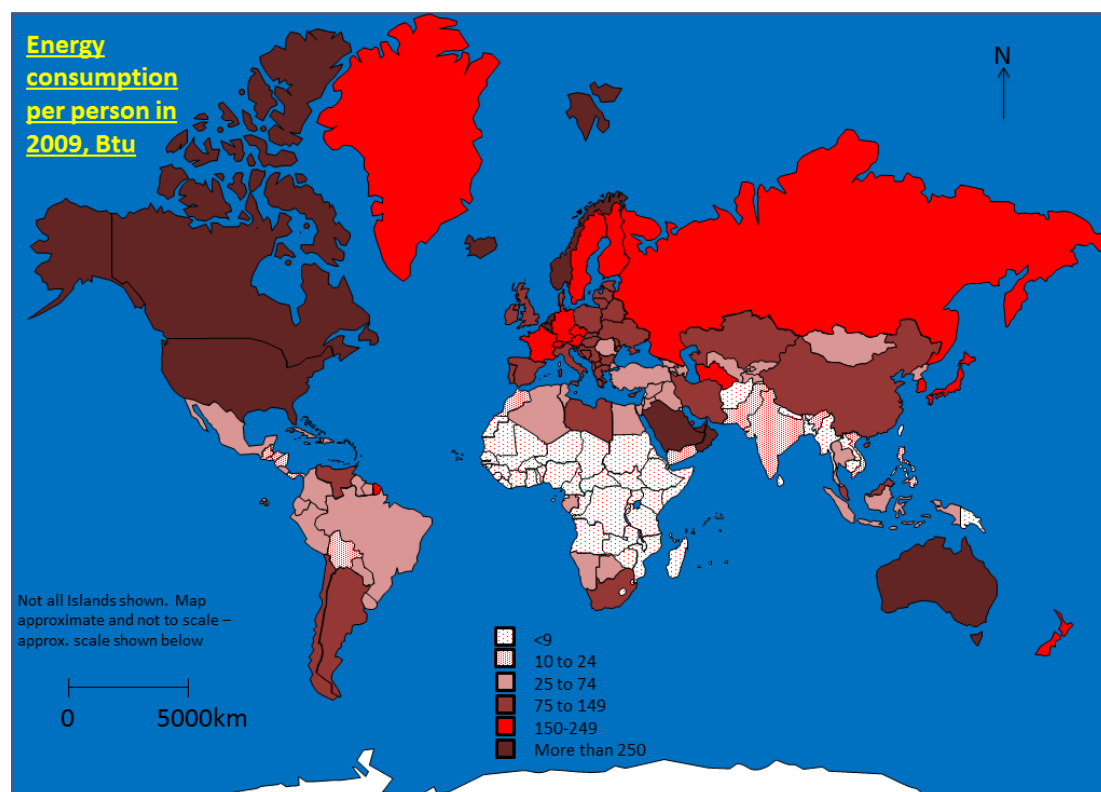


Figure 5 - Energy consumption map

OVERVIEW 1 - Food:

6.03 - The growing demand for high-value food exports from low income countries and all-year demand for seasonal food.

Food supply and consumption in the UK has changed incredibly since World War 2. The UK's population has risen, the large supermarkets have grown and diets have changed. Prior to WW2, much of the food consumed in the UK would have been home grown and seasonal with some exotic exceptions. Fruit and vegetables would have been grown and sold according to the seasons, with products like strawberries only available in summer and winter vegetables like Brussels Sprouts later in the year. People used preservation methods such as canning, bottling, making jams etc. to preserve food for use out of season.

Non-seasonal produce

Today this has changed. The UK population is used to having non seasonal produce all year round and we consume far more exotic produce which cannot be produced in the UK due to our climate. There are issues with this. This food has to be transported by ship or plane many thousands of miles, creating problems with food miles. Even food that can be grown in the UK, such as onions or apples, are now grown in other countries where the cost of production is cheaper. Often this production is in countries such as Kenya, LICs or NEEs where labour costs and environmental legislation is weaker so farmers can produce more cheaply.

Kenya – an example of a producer of no seasonal produce

The demand for non-seasonal and high value products in the UK has had an impact on poorer countries such as Kenya. Do they use productive farmland to feed their own people or to boost their economies by growing commercial crops for trade with richer, Western nations.

In 2009, at the same time as the Kenyan government was reporting food shortages in some areas, large quantities of food were being loaded on to planes and sent by air from Kenya to fill the supermarket shelves in the UK. More than 75% of the population work in agriculture, which contribute almost 25% to the national production. Horticultural produce and tea are the major items of export for Kenya.



Figure 6 - Greenhouses around Lake Naivasha In Kenya - By NASA [Public domain], via Wikimedia Commons

According to the Royal Geographical Society – *“Many of the farms based in Kenya that have contracts with UK companies are high-tech, commercial businesses that have to produce food to very high standards. They employ large numbers of labourers. However, they sometimes pay relatively low wages and they have been accused of environmental damage through water pollution and overuse of irrigation. Those farmers producing for the*

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local Kenyan market, rather than for overseas, struggle to produce sufficient food as a result of their small farms, a lack of technology and unreliable rainfall."

Kenya food facts;

1. Kenya prepares 350 tonnes of vegetables and cut flowers each night ready to be sold next day in UK supermarkets.
2. Leguminous vegetables (peas, beans, mange tout) constitute the largest proportion of Kenyan imports to the UK. Due to their high perishability and value, leguminous vegetables tend to be imported by air freight.
3. In 1988, the UK imported around 3,800 tonnes of legumes from Kenya. By 2005, this had increased to around 25,000 tonnes.
4. In 2005, the UK also imported 18,650 tonnes of cut flowers from Kenya with a value of around £52m. Due to the high unit value and highly perishable nature of the products, virtually all of the African trade in cut flowers are imported by air freight - they need to be in UK supermarkets within 24 to 48 hours of picking in Kenya.
5. Horticulture (growing fruit, flowers and vegetables) employs about 70,000 Kenyans directly, and another 20,000 in ancillary industries, for example transport. Add in their dependents and it may support as many as 500,000 people.
6. Horticulture is Kenya's second biggest earner of foreign exchange after tea, having leapt up from fourth place since 2001.

6.04 Carbon footprints, 'food miles' travelled, local sourcing of food and the trend towards agribusiness.

Organic produce

There has been an increasing demand for Organic produce in the UK too. Organic farming does not include the use of chemical fertilisers and pesticides and involves the production of animals, fruit and vegetables.

The Soil Association certifies 70% of the UK's £1.95bn (2016) organic food sector and sales grew by 4.9%. Organic farming is a much more sustainable method, in that it reduces the

intensification of food production and encourages a more local approach. Artificial fertilisers are banned and farmers develop fertile soil by rotating crops and using compost, manure and clover. Strict regulations, known as 'standards', define what organic farmers can and cannot do –

and place a strong emphasis on the protection of wildlife and the environment;

- Pests are controlled using natural predators
- Crops are rotated so that farmers can maintain the fertility of their fields
- Animals are farmed in lower numbers and without the use of growth hormones and antibiotics
- Weeds are controlled either by hand or machines rather than by spraying chemicals on them.

Carbon footprints, 'food miles' and local sourcing of food.

Food miles are a basic way of showing how far our food travels to get to us. The amount of food miles is increasing for each family in the UK. The increase in food miles poses significant problems to the environment because of the energy required to transport the food. This is becoming increasingly

Key words

Agribusiness - Application of business skills to agriculture.

Carbon footprint - A measurement of all the greenhouse gases we individually produce, through burning fossil fuels for electricity, transport etc. expressed as tonnes (or kg) of carbon-dioxide equivalent.

Food miles - The distance covered supplying food to consumers.

Sales of Organic Produce in the UK (Millions of £)

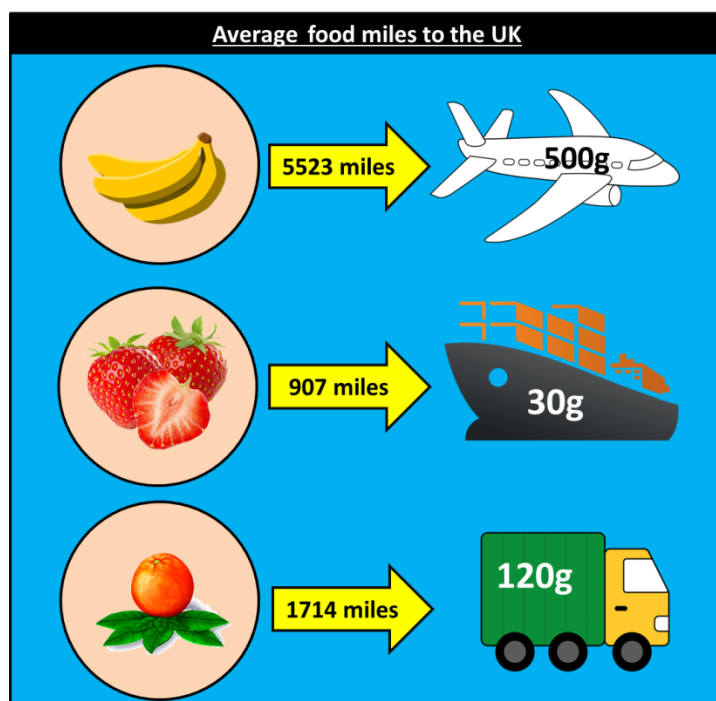
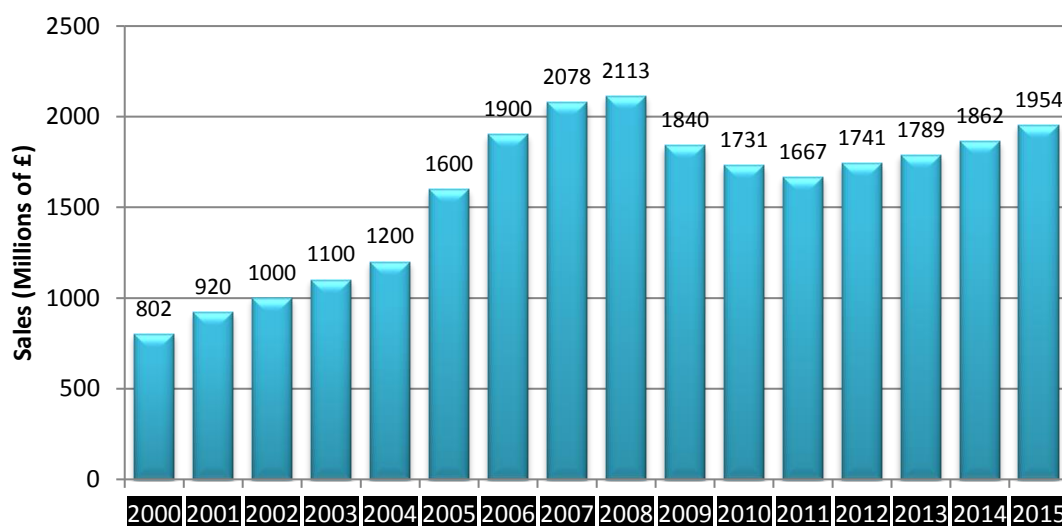


Figure 7 - food miles

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important as increasing quantities of our food are now being air-freighted, the worst type of transport for air pollution. The number of food miles also varies per food type, and we import 89% of our fruit. We also transport food stuffs that can be grown here in the UK, including potatoes. This is surprising, and according to the British Potato Council, the UK imports 350,000 tonnes of potatoes a year, and that includes during potato season. Kenya benefits massively (24% of GDP and 50% of export earnings come from agriculture) from its export of chillies, sugar snaps, green beans, flowers and baby corn, but is it environmentally ethical and socially ethical (in a food shortage country) to do so?

Food miles therefore contribute to the carbon footprint of our food. The transport types used output huge quantities of greenhouse gasses such as Carbon Dioxide and Nitrous Oxides. However, transport is only part of the carbon footprint of our food and this has a direct impact on our environment. Other items produce carbon dioxide, including packaging, especially plastic packaging, the retail spaces that sell our food (in the form of their electricity use, heating, refrigeration etc.), agricultural production of carbon, food use etc.

There are alternatives to eating imported food;

1. Try growing some of your own on an allotment
2. Eat only seasonal produce, grown in the UK
3. Look for the Red Tractor food standards label which assures that your food is British
4. Use local farmer's markets and try to eat locally grown food, this will support your local famers and the local economy

The trend towards agribusiness.

In the UK we used to have a lot of small farms run by families. This has changed. Most of our farms are now agribusinesses. **Agribusiness** involves the application of business skills to agriculture or food production. This means that farms are run as big businesses which attempts to increase food production by using lots of inputs such as fertilisers or labour saving machines. These farms have increased food production by;

- Increasing in size by buying up smaller farms
- Increasing in size by removing hedgerows and draining wetlands
- Producing one crop or animal in monocultures in big quantities
- Applying huge amounts of chemicals in the form of fertilisers and pesticides
- Applying the best technology such as a combined harvester or using better seeds
- Using modern production methods

These big businesses have come to dominate the food markets in the UK. This is because they have **vertical integration** allowing them to produce the food and get it to markets easily – “**from farm to fork**”. The big food processing companies will often buy food before it is planted and can put huge pressure on farmers over the appearance, quality and quantity of food produced. The positives of agribusiness include more **food security** and cheaper prices for consumers. However, many farmers have been forced out of business and the big companies can be seen to have too much power over the market price of goods. There are also negative consequences for the environment from this type of farming. In east Anglia, farm sizes have increased considerably over the past 40 years because of this type of farming.

OVERVIEW 2: Water resources in the UK:

6.05 The changing demand for water in the UK

The UK is highly variable in terms of water supply and demand. A lot of the rainfall received by the UK falls in the North and West, whereas most people live in the South East. This means that the North and West of the British Isles are **WATER SURPLUS** (areas that have more water than is needed by the population) areas, whilst the south east is a **water shortage area** (where demand can exceed supply).

The North and the West receive more rainfall because the bulk of our weather comes from the South West with our prevailing wind. This brings moist air because the air is warm and has travelled a long way over the Atlantic Ocean. The wet areas also coincide with our highland areas, as the wet incoming air is forced to rise over these hills, and as it does so it cools, condenses and forms clouds and then rain. These patterns are clearly visible on the maps opposite:

Water use

People in the UK use a lot of water, they use on average of **175 litres of water per day**. This contrasts to just **83 litres in Bangladesh**. Only 4 percent of the drinkable water in the UK is actually drunk. The rest is used for other uses such as toilet flushing, washing clothes, or cleansing. The demands on our water in the UK have also gone up by 70% since 1985, this is because;

1. The UK population has increased a lot over that time period.
2. Personal habits have changed, people shower more regularly whereas people in the past would have had less frequent baths, often sharing the water with family members.
3. People are wealthier so have more water intensive machines such as dishwashers, washing machines and even power washers.
4. Farm uses have gone up as irrigation systems improve and consumers demand out of season food which needs watering in greenhouses.
5. Industrial uses of water have increased, as has our use of water in producing electricity.

Areas of the UK that suffer from severe water shortages are said to be under water stress. The UK can have unreliable rainfall and during these water stress periods it has been known for hosepipe bans to be put in place and even for standpipes to be put into streets to limit water use.

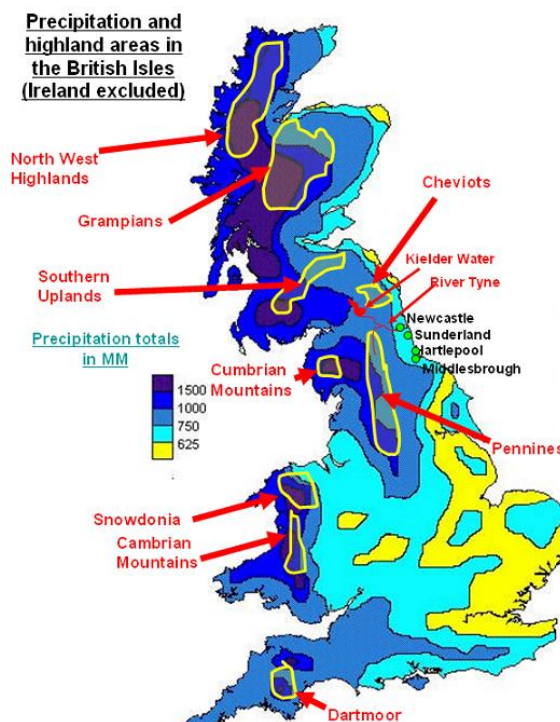


Figure 8 - UK precipitation

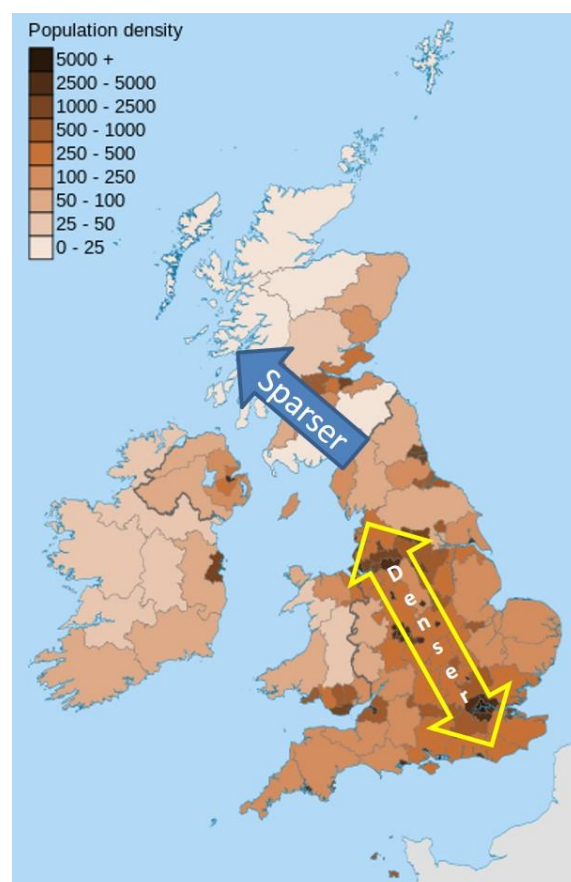


Figure 9 - population density of British Isles - Contains Ordnance Survey data © Crown copyright and database right [CC BY-SA 3.0 (<http://creativecommons.org/licenses/by-sa/3.0/>)], via Wikimedia Commons

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Water transfer schemes.

To combat these issues, we have several water transfer schemes to move water from areas of surplus to areas of demand. Water transfer schemes attempt to make up for water shortages by constructing elaborate systems of canals, pipes, and dredging over long distances to transport water from one river basin to another. More large-scale transfers have been planned to meet future demands but are controversial. The schemes would cost a lot and cause large scale environmental disruption. The schemes can be seen on the map and one suggested scheme would move water from Kielder Water in Northumberland to the reservoirs around London, over 350 miles away.

Kielder water is a good example of a current LOCAL water transfer scheme. Water is trapped behind a dam in North West Northumberland then moved by pipe and rivers into the Derwent, River Wear and River Tees to supply the major settlements along the north east coast such as Newcastle and Middlesbrough.

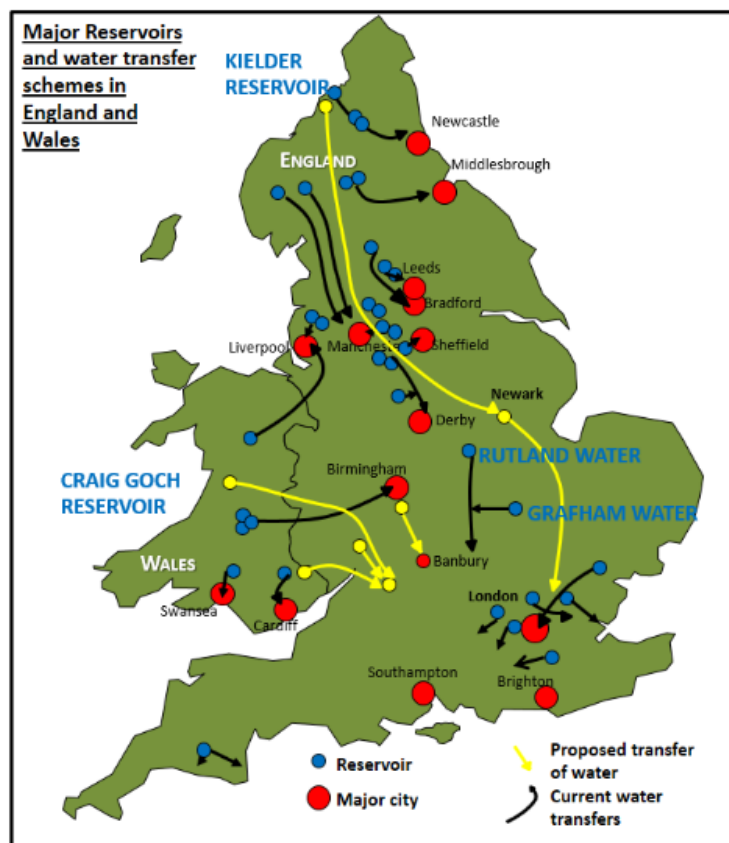


Figure 10 - England and Wales water transfer schemes

6.06 Water quality and pollution management

Whilst it is very important to transfer water to combat water shortages it is equally important to consider the **QUALITY** of the water that is being moved. Water quality can be measured in terms of the **chemical, physical, and biological content** of water. The most common standards used to assess water quality relate to health of ecosystems, safety of human contact and drinking water.

Water in the UK has generally improved in quality over time since the cleaning up of our industrial past. According to the EU, only 27% of our water meets its stringent water quality standards. This means that we have some work to do in ensuring that our open water areas are clean. However, many attempts have been made to keep improving our water.

There are many **sources of pollution** in the UK that threaten the quality of our water including;

1. Agricultural runoff water, this picks up chemical pesticides and insecticides, nitrates and phosphates (found in fertilisers) and run into our lakes and rivers
2. Historical wastes, water running through old mine workings and old industrial sites can pick up hazardous heavy metals
3. Runoff from roads and motorways including salt used for gritting, oil and heavy metals from car engines and exhausts
4. Sewage waste can end up in our water courses, despite our attempts to clean it



Figure 11 - A stream in the town of Amlwch, Anglesey which is contaminated by acid mine drainage from the former copper mine at nearby Parys Mountain. By Cls14 (Own work) [CC BY-SA 3.0 (<http://creativecommons.org/licenses/by-sa/3.0>)], via Wikimedia Commons

Poor water quality affects the UK because;

- It can potentially poison our water supply, essential for human life
- Eutrophication can occur – this is where fertilisers washed into our rivers and lakes encourage plants and algae to grow, starving other life of oxygen
- Sewage contains bacteria which can spread disease
- Heavy metals and toxins can poison wildlife. These toxins can then end up in people as they work their way up through the food chain in a process of bioaccumulation
- Insect and animal life can be killed unintentionally by pesticides and insecticides, affecting food chains

To combat water pollution, the UK government attempts to do lots of things.

- **Educate people** – the government having run campaigns for the public to show them the need to use as little water as possible and to not dispose of inappropriate items in our waste water. Not leaving the tap running when brushing your teeth is one way to save water, whilst not disposing of oils or baby wipes is a way to protect our disposal network.
- **Laws and legislation** – The EU and the UK have very strict laws for our water, which make sure that industries and farms do not pollute it. For example, phosphates contribute to eutrophication. The amount of phosphates allowed in laundry detergent was reduced in 2013 and will be reduced for dishwasher products in 2017.

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- **Treat our water** – we have invested huge amounts of money in new treatment plants to clean our water. This is shown on the flow chart below. This can cost a lot of money which creates bigger bills for consumers, but ensures our clean water supply. We have also invested in our pipe and sewer network, to reduce losses of treated water from pipes and to prevent spills of sewage which lead to pollution.

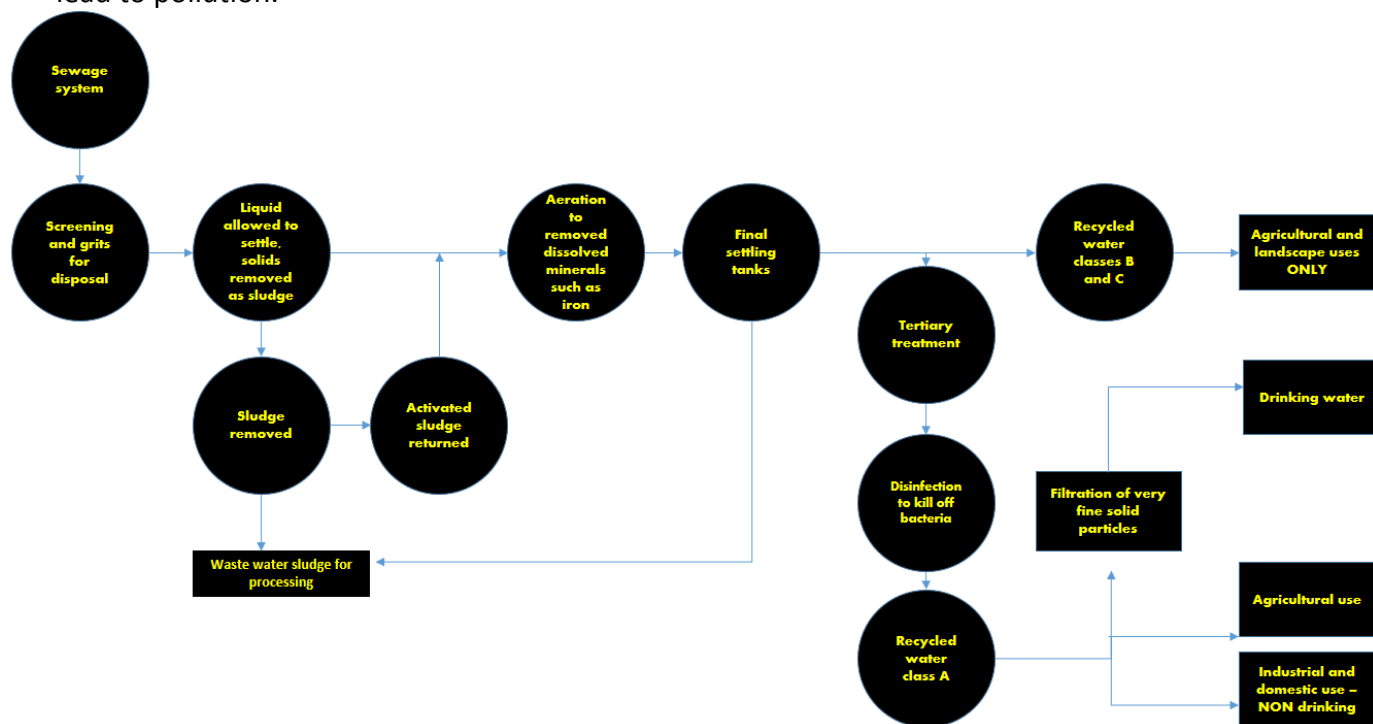


Figure 12 - How water treatment works

- **Improving our water courses** – the government have invested in pollution traps downstream of old sources of pollution such as old mine workings, or by using innovative schemes such as the Tees Barrier.

OVERVIEW 3 - Energy in the UK:

6.07 - The changing energy mix – reliance on fossil fuels, growing significance of renewables

Modern life is heavily reliant upon our use of energy, to heat our houses, power our forms of transport, help our industries work and produce our food and clothes.

The “energy mix” relates to the **different energy sources** we use as a country and in what **proportions**. This is often spilt into renewable and non-renewable forms of energy. **Fossil fuels** such as **coal, oil and gas** are used to provide heat or to produce electricity. These are non-renewable so will run out and also pollute the atmosphere with greenhouse gases such as Carbon Dioxide (CO₂). **Renewable sources** of energy include sun, wind, waves, the tides, running water and geothermal heat. They are renewable because they **will not run out** and they are **non-polluting**. However, they return smaller amounts of energy and take up lots of land, and they require regular maintenance. The last energy type is

nuclear, which is non-renewable as Uranium is a fuel that will run out. Many of the UK’s nuclear reactors are due to be replaced and there is a massive scheme planned with the French company EDF and the Chinese government to build a reactor at **Hinkley Point that will provide 7% of the UK’s energy needs**.

The way that we source our energy has changed over time and will change again in the future. Up until the mid-20th Century we were heavily reliant on coal, until oil drilling in the 1950’s changed this. The government would like this to change again by 2020 as shown on the graph. We are heading towards a more renewable energy future if the UK government can maintain investment in this area. At present, many of the grants for this are being reduced or withdrawn. It is also clear that the total amount of energy we produce is expected to fall as a result of falling use. This is an ongoing pattern; we use less energy today than we did in 1970 despite our population having risen! Households are using less energy due to improvements in heating and heat conservation technologies such as insulation and triple glazing. Industry is using less because many of our heavy industries have shut down, gone abroad or become more energy efficient. In contrast, we are using more energy for transport as the number of cars on our roads has gone up significantly.

Key words

Energy mix - The range of energy sources of a region or country, both renewable and non-renewable.

Fossil fuel - A natural fuel such as coal or gas, formed in the geological past from the remains of living organisms.

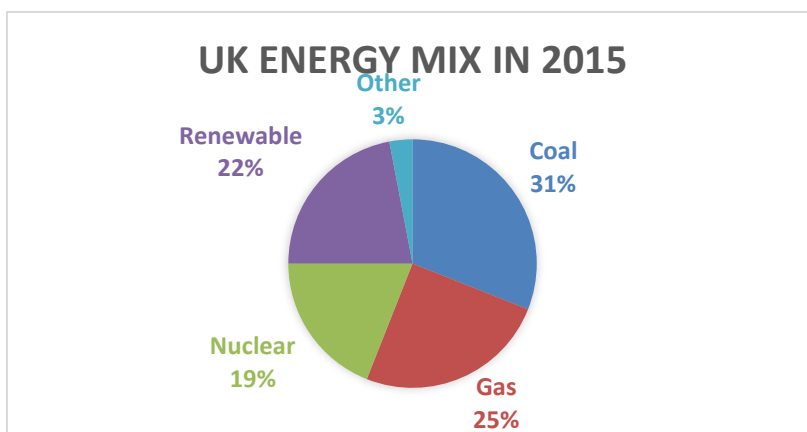


Figure 13 - UK energy mix

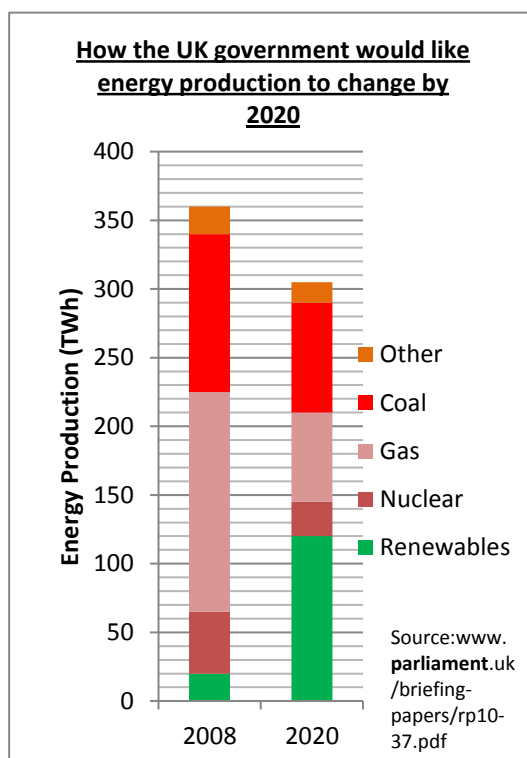


Figure 14 - UK Government's desire for changing energy mix by 2020

6.08 - Reduced domestic supplies of coal, gas and oil

The UK has been blessed with large reserves of coal, oil and gas and has exploited these over time. The coal industry including the NE coal fields such as the Durham coal field the industrial revolution in the UK and led to our rapid economic development. Some of our coal mines simply ran out or become exhausted, but we still have reserves of coal in the UK. However, our coal became gradually less economic to mine because much of it is deep underground and therefore difficult and expensive to get at. The UK therefore turned to cheaper imports of Polish and Australian coal, which were open cast. There are still coal mines in the UK;

- 10 deep mines
- 22 open cast surface mines
- New proposed areas such as Druridge Bay in Northumberland which has just been given permission to start mining again.

Oil and gas –

The UK has reserves of oil and gas in the North Sea, and exploitation of this resource began in 1975. Oil and gas are vitally important to the UK and most of our reserves fall in Scottish territorial waters. Getting at these resources is difficult, as it involves drilling under the sea from large offshore oil and gas rigs. This is dangerous, and there have been accidents such as the Piper Alpha disaster where an oil rig set on fire and various helicopter disasters where workers have been killed just trying to get the rigs to work. However, these 2 resources bring lot of wealth to the UK and provide people with jobs. They also

boost the local economies of towns such as Aberdeen.

The UK's reserves are in decline and we are producing less and less oil and gas. This leaves the UK reliant on overseas imports of oil and gas which makes our energy supply vulnerable. For example, some of our gas imports come from Russia, who have used gas supply as a political tool in the past against the Ukraine for example.

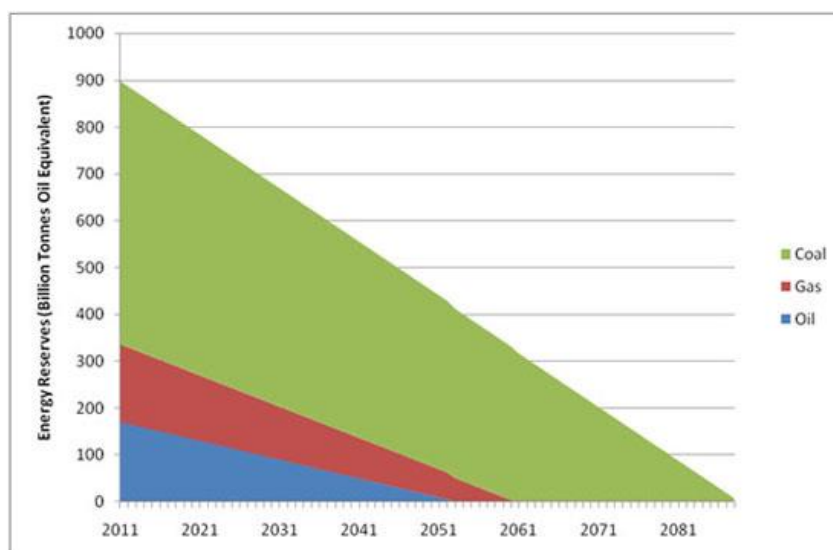


Figure 15 - Remaining reserves of Fossil Fuels in the UK. Source: <https://www.ecotricity.co.uk/our-green-energy/energy-independence/the-end-of-fossil-fuels>

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6.09 - Economic and environmental issues associated with exploitation of energy sources.

There are many issues attached to exploiting our remaining reserves of fossil fuels. Some of these affect our natural and built environment, whilst others issues involve the economic impacts of using these resources. Some of the main issues with fossil fuel use is the damage to the natural environment during extraction and the production of pollutants during burning such as CO₂ which lead to global warming, dust which is hazardous to human health and Sulphur Dioxide which contributes to acid rain.

Coal is a reasonably cheap source of energy for example compared to other fossil fuels and we still have reserves left in the UK, in areas such as the Northumberland coalfield for example. However, is it correct and morally right to continue to use non-renewable and unsustainable fossil fuel reserves when we have viable renewable alternatives such as wind or solar power? We also have nuclear power stations across the UK, but many of these need renewing or completely rebuilding. Many of the current nuclear power plants will need decommissioning, a very costly and long process. In addition, nuclear power plants produce nuclear waste, which needs disposing of in a safe manner (currently it is stored underground). Many people around the country worry about the safety aspects of nuclear power and nuclear waste disposal and don't want it in their local area. This is known as **NIMBYism, Not In My Back Yard**. However, Nuclear energy can produce lots of power and has a low carbon footprint except for in the initial construction of the plants. A huge new plant is planned for Hinkley Point to start generating electricity in 2025 in a joint project between EDF (Électricité de France, a French energy company mainly owned by the French government) and financed in part by the Chinese government. Questions have been raised about the whether it is a good idea to allow foreign governments access to our energy infrastructure.



Figure 16 - Hinkley Point A nuclear power station which will be replaced by Hinkley Point C, by Mark Robinson (originally posted to Flickr as Colour Scheme) [CC BY 2.0 (<http://creativecommons.org/licenses/by/2.0>)], via Wikimedia Commons

Even renewable energy types, such as biofuel, wind, tidal and solar power have issues relating to them despite being broadly supported by environmental groups. Renewable energy takes up space that could be used for other uses, such as producing food, and the natural environment can suffer. Offshore wind farms damage the sea bed for example and are hazardous for birds, whilst on land local s can complain about wind turbines being an eyesore and producing too much noise. More information on the positives and negatives of these fuel types can be seen in section 1.17.

Fracking is a current and new technology that is being investigated in the UK. It is already used in the USA and the UK government seems keen on its use in the UK. The first Fracking site on the Fylde in Lancashire has been approved. The process generally involves pumping a mixture of sand and chemical laden water into Shale rocks at very high pressures. This shatters the rock and releases Shale Gas which is trapped within the rocks. This has drastically reduced energy costs in the USA and has reduced the USA reliance on imported gas and oil. However, the long term environmental impacts of this process are unknown and fears exist over water contamination, water use and even small earthquakes in fracking areas. Also, in a country such as the UK which has huge potential for using wind power, tidal power and solar power (in the south and east) do we need to exploit something as environmentally damaging?

**Approved
Fracking
sites in
the UK
October
2016**



Figure 17 - October 2016 approved Fracking sites

Demand for food resources is rising globally but supply can be insecure, which may lead to conflict.

6.10 - Global Patterns of food surplus and deficit.

Across the globe we now produce a huge amount of food in different regions and countries which is transported globally. Countries use their geographic advantages to specialise in different food stuffs which can be consumed locally and/or sold internationally. There is enough food for EVERYONE on the globe to have enough to eat, unfortunately this food is not **DISTRIBUTED EQUALLY**. This leaves countries and places in one of 2 states;

- **Areas of DEFICIT have Food insecurity** - Being without reliable access to a sufficient quantity of affordable, nutritious food. More than 800 million people live every day with hunger or food insecurity.
- **Areas of surplus have Food security** - When people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.

Key words

Famine - A widespread, serious, shortage of food. In the worst cases it can lead to starvation and even death.

Food insecurity - Being without reliable access to a sufficient quantity of affordable, nutritious food. More than 800 million people live every day with hunger or food insecurity.

Food security - When people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life.

Undernutrition - This occurs when people do not eat enough nutrients to cover their needs for energy and growth, or to maintain a healthy immune system.

Generally, there are clear patterns of food consumption. The richest nations consume the most Kilocalories per day (from 2,600 up to 3800), including North America, Europe, Australia, South Korea, Japan and parts of South America. All of these places are part of the G20 group of richest world nations. This can be seen on the map earlier in the chapter.

Large parts of central Africa, Asia and South America consume far fewer calories and can be said to be suffering from **UNDERNUTRITION** - where people consume less than the United Nations Department for Health's recommended daily MINIMUM totals at 1940Kcal for Women and 2550Kcal for men.

An added problem to deal with for those countries where people suffer under nutrition is the concept of **MALNUTRITION**. This is where people may get sufficient calories a day but not have a balanced diet - all of their calories might come just from rice for example. This can also have grave health consequences. The double "whammy" is where a country or person suffers from both conditions at the same time. The undernourishment issue is shown clearly on the map opposite.

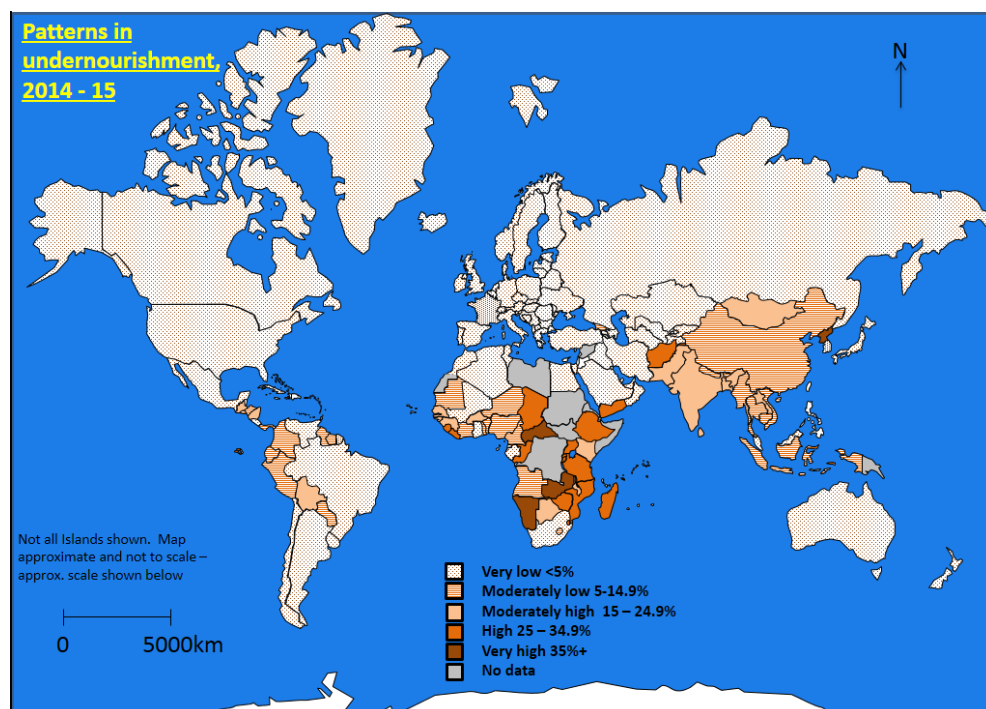
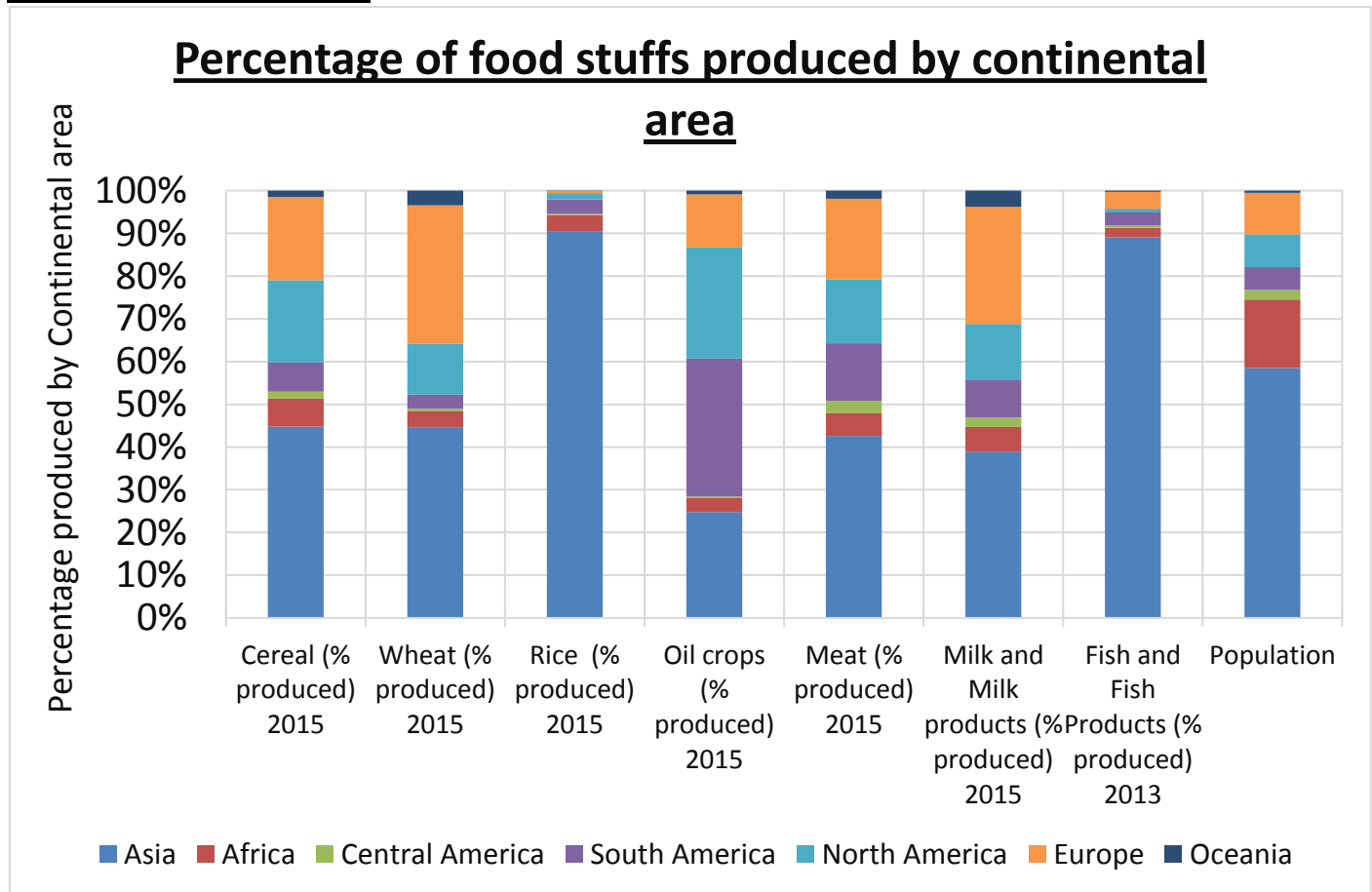


Figure 18 - World Undernourishment map

Food Production and supply



The graph shows that different parts of the world have different advantages or preferences in producing certain foods. Rice is a great example, with the production being dominated by Asia where the climate is ideal for rice growth and the population consumes a lot of it. What is clear is that HICs like Europe and North America have smaller percentages of the World's population but can produce more food than that percentage. LICs like the majority of the continent of Africa, on the other hand, have larger percentages of the world population and produce less food. There are also clear patterns of global food supply and consumption, and these patterns are linked together by the trade in foodstuffs. Agricultural goods are continually produced in some regions and sold in others. Indeed, food and other agricultural products are GLOBALISED commodities that are traded the world over, and this has some startling consequences for our planet and the people that live upon it.

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6.11 - Reasons for increasing food consumption: economic development, rising population

The amount of calories consumed by people around the world has gone up, but as you have seen this is not the case in all parts of the world. However, the average calorie intake even for the poorest countries, the LICs, has gone above UN safe values. Values in HICs are well above what is required for human well-being.

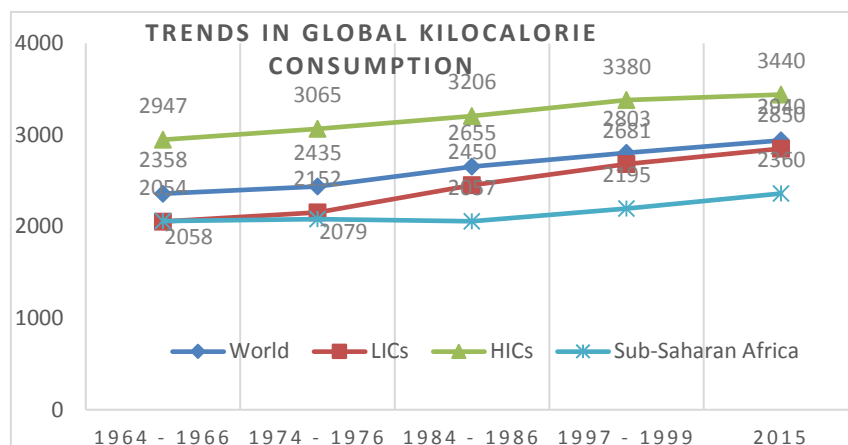


Figure 19 - trends in Kilocalorie consumption

Population Increase

One of the main reasons for the increase in the amount of food we consume is the rise in global population. As global population and rates of consumption increase there is a need to increase water, food and energy supplies, but to do so in a sustainable manner to meet the needs of all people. The world population crossed 7 billion in 2011, this puts increasing pressure upon resources. In addition, the rates of population growth are not the same around the world. In Africa for instance, population is growing at 2.6% a year, this makes it very difficult to provide a secure food supply for everyone.

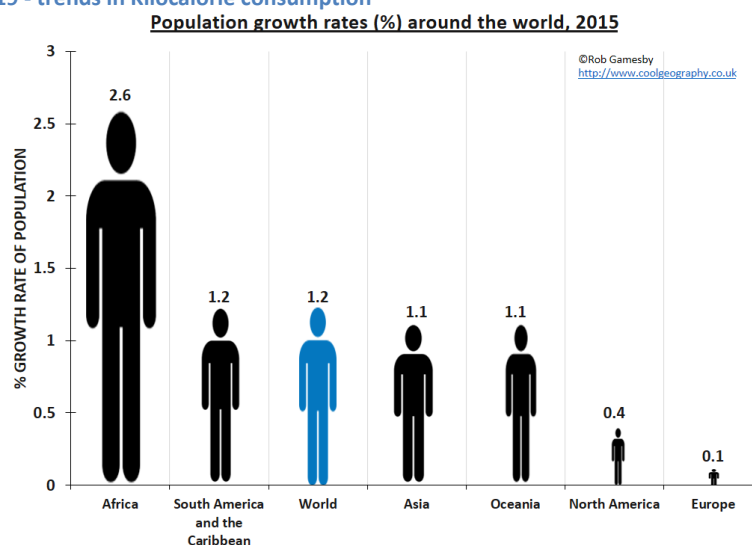


Figure 20 - World Population growth rates

Economic Development

Many countries across the world are developing rapidly. In the Newly Emerging Economies (NEEs) such as China or India are becoming wealthier and so are the people that live there. This is allowing a change in the diet of people who live in those countries. It has been observed that the amount of meat consumed in those countries has gone up as development improves. In 1980 people in China consumed just 12kg of meat per person per year, by 2015 this had risen to almost 60kg. This is problematic as approximately 7kg of grain are needed to produce just 1kg of beef, and a typical meat eater needs 2.5 times the amount of land than a vegetarian. This means that people in NEEs need more land and more food produced to meet the needs of their new lifestyles.

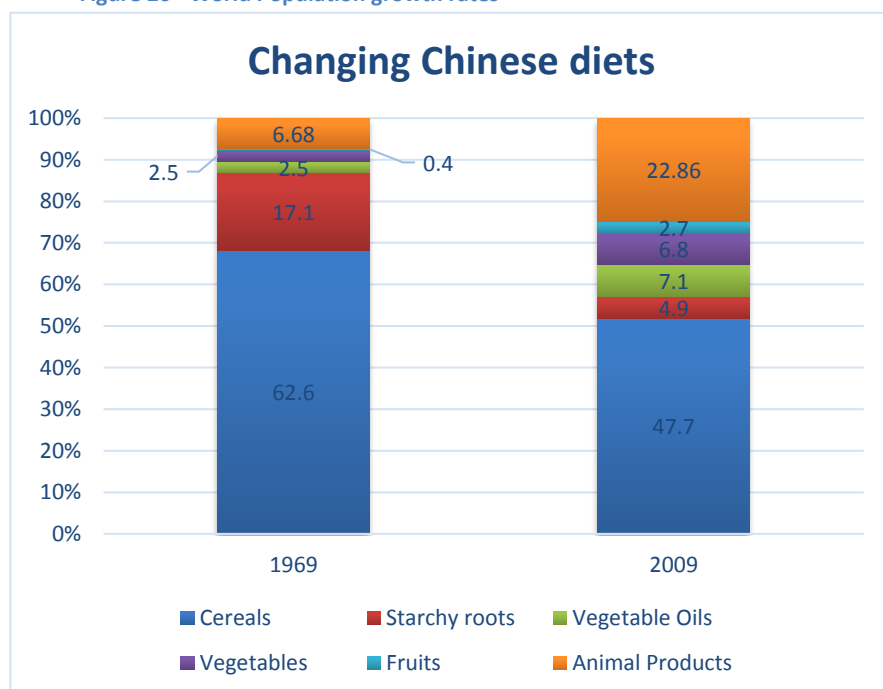


Figure 21 - Changing Chinese diets

6.12 - Factors affecting food supply:

There are many factors which can affect whether a country has a food surplus or a food deficit. In many LICs there is a large portion of the population who live in rural areas and who suffer from undernourishment. In most HICs undernourishment is much lower and in many cases limited to few people in society. According to the United Nations Food and Agriculture Organization (FAO);

- About 795 million people of the 7.3 billion people in the world, or one in nine, were suffering from chronic undernourishment in 2014-2016.
- Almost all the hungry people, 780 million, live in developing countries, representing 12.9 percent, or one in eight, of the population of LICs.

What affects the amount of food available?

Climate

Having the right climate is essential for crop growth and having good conditions for rearing animals.

Temperature is critical for plant growth as all crops have a minimum temperature in which they will grow and a minimum growing season. In Britain, wheat and Barley will only grow when the average temperature is above 6°C. You also need a decent amount of rainfall - few crops can grow where there is less than 250mm of rainfall a year (the



Figure 22 Wheat crops

classification of a desert) and grasses will predominate above these figure. Trees and fruits require greater amounts. In many LICs droughts are suffered which can result in food shortages. In the Horn of Africa in countries such as Ethiopia and Somalia there have been many droughts that can last for years (such as between 2011 and 2012). Drought can also result in desertification. Other climate factors include our changing and warming climate and natural hazards, such as floods and tropical storms which can damage crops (you can find more on these in other sections of this book).

Technology

Technology has been used for centuries to make farming easier and more productive. HICs can afford to invest in combined harvesters, irrigations systems for watering and road networks to improve communications. investment in technology can also make different forms of crop or pastoral farming possible in areas where they previously were not. The Green Revolution has transformed agriculture in certain parts of the world and is tied in with technological innovation. In many LICs they cannot afford these things and this limits the



Figure 23 Crop spraying, an example of the use of technology

productivity of their agriculture. Richer nations also have access to improvements in transport and storage of food, and Transnational corporations process food making it more freely available.

Pests and disease

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There are many pests that can affect a crop and reduce the amount a farmer gets to eat or sell at the end of the harvest. Mice and rats can eat crops, as can locusts and slugs. Animals can be affected by diseases such as foot and mouth and cattle can have their lungs affected by bovine pleuropneumonia. Many HICs can combat these problems using medicines via vets for their animals or using pesticides and insecticides on their crops. These interventions are expensive and often out of the reach of LICs. HICs are even using natural pest remedies to stop insects devouring crops.

Water stress

Water stress has a huge impact on food production. Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. Without water people do not have a way of watering their crops and, therefore, to provide food for the fast growing population. Some countries have sufficient rainfall year round for their crops. Irrigation systems can be used in drier areas or during drier periods to allow for the watering of crops. These can lead to a doubling of crop yields. Many LICs struggle to afford these systems. Other issues include floods which contaminate water supplies and (ironically) put agriculture under water stress, and climate change which is changing the amount of rainfall and when it falls.

Conflict

Conflict and wars affect food supply in many ways and can often lead to hunger. For example;

- Many of the farm workers leave their land to join the fighting, this leaves the land untended.
- Many farmers and their families are forced to flee the areas and become refugees
- Food can become a weapon, as armed forces are taken by soldiers and destroyed or stolen
- Soldiers can deliberately pollute water supplies to affect the local population
- Crops can also be burnt and destroyed in battle.

This has been the case in many places over the past decades including in parts of Syria and Sudan.

Poverty.

People who have little money or possessions are said to be living in poverty. They often do not have enough money to buy food and this makes them physically weaker and less productive in their work. It also makes them more susceptible to suffering from disease and ill health. They also cannot afford many of the things that improve food supply such as seeds, tools and fertilisers.

Many of these factors can interlink and act together to severely limit food supply for people.

TASK – produce a poverty cycle on how being poor can affect food supply



Figure 24 - UN poster on the risks of water stress



Figure 25 People wait in line to check in to a food distribution in UN House, a UN base on the outskirts of Juba, 2014. Photo taken by Crystal Wells/Concern Worldwide.

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6.13 - The Impacts of food insecurity

Food insecurity is a major concern for many countries, and as we have seen in particular countries with lower incomes such as those found in Asia and parts of sub-Saharan Africa. Food insecurity has major impacts on people personally and on the ability of a country to lift itself out of poverty. Some of the impacts of food insecurity include famine, undernutrition, soil erosion, rising prices, and social unrest.

Famine and undernutrition –

Undernutrition occurs when people do not eat enough calories or get enough nutrients to cover their needs for energy and growth, or to maintain a healthy immune system. This is a direct result of food insecurity in many countries and regions. Hunger is **chronic** or severe undernourishment. The hungry of the world have enough food to survive, but not enough food for good health, on a continuing basis. The FAO describes hunger in this way:

“People who are chronically hungry are undernourished. They don’t eat enough to get the energy they need to lead active lives. Their undernourishment makes it hard to study, work or otherwise perform physical activities. Undernourishment is particularly harmful for women and children. Undernourished children do not grow as quickly as healthy children. Mentally, they may develop more slowly. Constant hunger weakens the immune system and makes them more vulnerable to diseases and infections. Mothers living with constant hunger often give birth to underweight and weak babies, and are themselves facing increased risk of death. Every day, millions of people around the world eat only the bare minimum of food to keep themselves alive.”

Famine is a different problem. People affected by famine do not have enough food to survive. Famine is a widespread, serious, shortage of food. In the worst cases it can lead to starvation and even death.

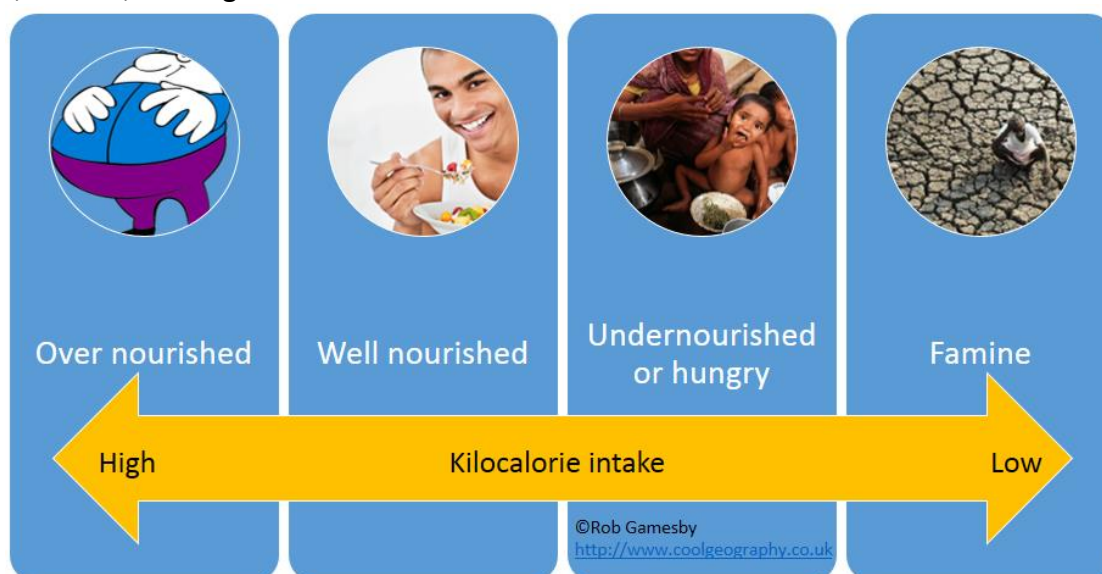


Figure 26 The difference between over nourishment and famine

Soil erosion

Soil erosion is the removal of topsoil faster than the soil forming processes can replace it, due to natural, animal, and human activity. Often it is a complex mix of all 3 activities. During times of food insecurity farmers can cause soil erosion by breeding and rearing too many cattle or by trying to grow too many crops.

There are 3 common human causes of soil erosion;

1. **Overgrazing** – keeping animal stocks at numbers higher than the environment can support can cause soil erosion. The animals not only eat the vegetation which allows more soil to be washed away by rain or



Figure 27 Soil erosion in Germany

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blown away by the wind, but they also compact the soil limiting new plant growth.

2. Deforestation or removal of natural vegetation – trees and shrubs act as a protective layer against falling rain or the wind. Taking this protective layer away allows the soil to get washed away.
3. Over cultivation – Try to go too many plants, and never letting the soil rest removes vital nutrients from the soil. This means less plants grow, so more soil is exposed and is more likely to get eroded away.

Rising Food Prices

The price of food like many commodities is controlled by the laws of supply and demand. If there is a lot of demand for a product that is in short supply the cost goes up. If there is more than enough supply of the food item compared to the demand the price goes down. The chart below shows that food prices have gone up globally. This has major consequences for poorer countries that may already be food insecure as they cannot afford these higher prices.

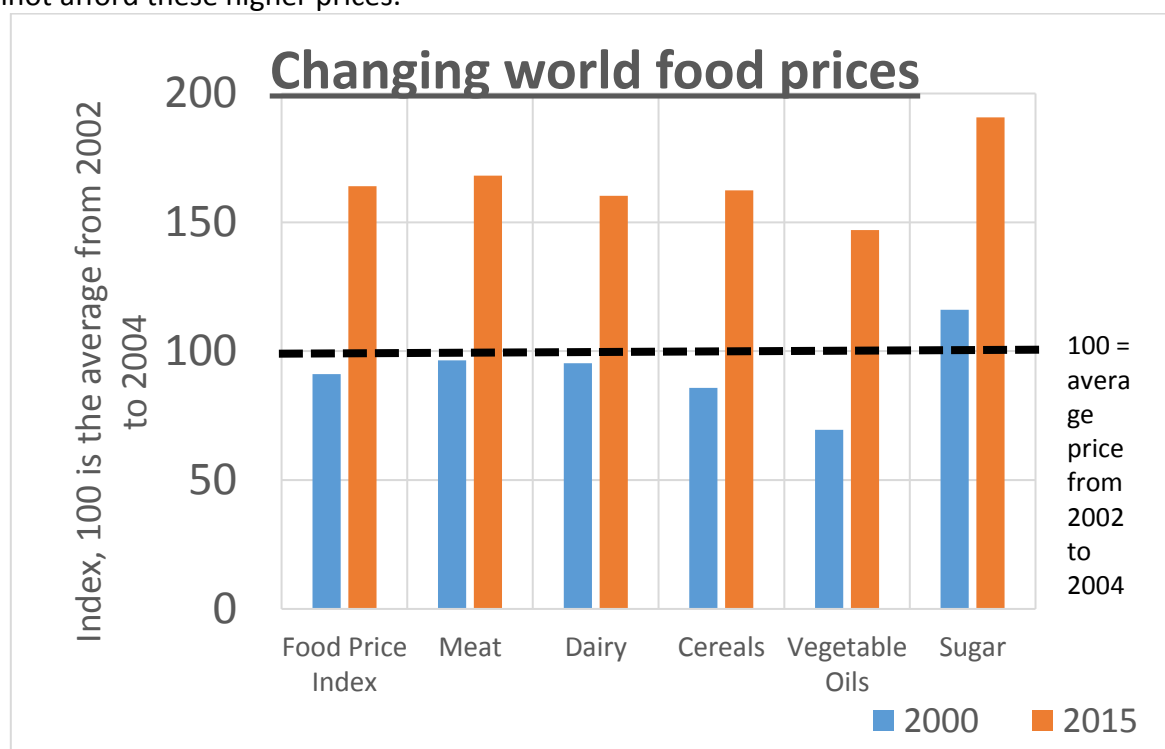


Figure 28 - Graph about food prices

In 2012 food prices went up because of a number of reasons such as rising demand from developing China and India, poor harvests of vegetables in Russia, Australia and South America and even the impact of the Japanese tsunami of that year on fish stocks!

Social unrest

When food is in short supply it can result in social unrest both regionally and internationally. During 2007-2008, a rise in global food prices led to riots in various countries. Prices of food went up because of the use of farmland for biofuel, increased petrol/fuel prices, unfair global competition, increasing population and failed harvests of some food stuffs. In Burkina Faso on 22 February rioting broke out in the country's second and third largest cities over soaring food prices (up to a 65 percent increase). Over 100 people were arrested in one of the towns. The capital, Ouagadougou, was saved because of a high number of soldiers on the streets. The government promised to lower taxes on food and to release food stocks but food riots returned in 2014. Social unrest could continue into the future because of food security as climate change, increased population and more competition for food supplies put pressure on resources and increase prices.

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6.14 - Different strategies can be used to increase food supply.

We have seen that there are many problems that face the human race in terms of providing enough food for everyone to avoid undernutrition, malnourishment and famine. However, we can feed everyone across the planet and many scientists think we are capable of producing enough food using modern methods of agriculture and science. The main issues are in LICs, but there are simple and low cost technologies that can be used to increase food supply there. There are also more high technology approaches, and both could help us to increase global food supply and reduce food insecurity.

Overview of strategies to increase food supply:

Irrigation

Irrigation is the application of water to land in order to supply crops and other plants with necessary water. This is used to maintain plant productivity when water supply is low. This can be seasonal as in the UK, when many plants need irrigation in summer months, or it could be applied to a dry region to allow food production to take place there. Irrigation is crucial to the world's food supplies. Irrigated land made up about one-fifth of the total arable area in developing countries but produced two-fifths of all crops

and close to three-fifths of cereal production. These

systems increase food supply but can cause a lot of damage. They reduce water tables in the ground and affect downstream river flow. They also increase evaporation losses of water and increase the salinity of soils.

Aeroponics and hydroponics,

Aeroponics involves growing plants in an air or mist environment without the use of soil. This involves growing plants suspended in greenhouses (which reduces and controls the amounts of pests) with their root systems exposed. The roots are then sprayed with a mist that contains nutrients every few minutes to provide the plant with what it needs, in the absence of soil. As the roots are exposed to more oxygen the plants tend to grow faster.

This system is good as the farmer needs to use less nutrients and water as they go directly onto the roots of the plant and are not lost into the soil. Also, the plants can be easily moved around and it takes less space as plants can be stacked on shelves, one on top of another. The quicker growth increases the number of yields and it is easy to maintain the plants as they are in a controlled environment (so less pests) and can be elevated to a good height for farm workers to access. However, it is very expensive so is less of an option for LICs, and the nutrient mixing and spraying system is essential so if this breaks down the

Key words

Aeroponics - Growing plants in an air or mist environment without the use of soil

Biotechnology - The manipulation (through genetic engineering) of living organisms to produce useful commercial products (such as pest resistant crops and new bacterial strains).

Hydroponics - A method of growing plants using mineral nutrient solutions, in water, without soil.

Irrigation - Applying water to land in order to supply crops and other plants with necessary water.

The new green revolution - A combination of modern technology, traditional knowledge and an emphasis on farming, social and agro-ecological systems as well as yields, especially in poorer countries.



Figure 29 - irrigated Blueberries - Image taken by Pollinator, released under GFDL



Figure 30 - Figure 11 - Irrigation in Bangladesh, By Mohammed Tawsif Salam (Own work) [CC BY-SA 3.0 (<http://creativecommons.org/licenses/by-sa/3.0/>)], via Wikimedia Commons

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whole crop is lost. Also it requires specialist knowledge especially for the nutrient mix of the plants and it requires a lot of maintenance of the plants and equipment.

Hydroponics is a method of growing plants using mineral nutrient solutions, in water, without soil. The plants have their roots dangling into a nutrient solution which provides for their needs, many of the advantages are the same as for Aeroponics as well as the additional advantage that the plants can even be transported in a nutrient base, allowing for extra freshness in the shops.

The new green revolution and use of biotechnology.

The original green revolution involved changing farm practices in many parts of LICs between 1940 and the 1960s. This revolution sought to get rid of famine in many nations and massively increase food production, by effectively ending subsistence agriculture and replacing it with commercial agriculture. The idea was to take many of the systems, ideas and technology of European and USA farming into (mainly) Asian agriculture, whilst researching and utilising the resources Asian countries had. New High Yielding Varieties (HYVs) were introduced yields of wheat, rice and maize rose by as much as 40%. This worked well in many areas, but also led to an increase in debt for farmers in poorer countries and damaged the natural environment because of the increasing use of chemical fertilisers and pesticides. Groundwater became polluted and over use of water led to water shortages and increasing salinity of the soil.

The new green revolution is more focussed in Africa rather than Asia, and mainly involves the use of biotechnology to overcome the environmental issues faced there. It involves a combination of modern technology, traditional knowledge and an emphasis on farming especially in poorer countries. At the same time, it emphasizes alternative approaches and improved farm management and information systems in order to minimise environmental damage from external inputs and benefit poor farmers and marginal areas bypassed by the original green revolution.

Some examples include;

- breeding of crop varieties that can withstand adverse conditions, such as salt-tolerant rice or more drought-resistant sorghums and millets;
- soil nutrient cycling, through crop rotation and biomass recycling;
- reliance on genetic pest and disease resistance to replace or reduce chemical and mechanical pest control;
- integrated crop management strategies to control pests and diseases and maintain soil fertility.

Biotechnology

Biotechnology is the application of science towards food supply. It involves the manipulation (through genetic engineering) of living organisms to produce useful commercial products (such as pest resistant crops and new bacterial strains). This is useful as it produces plants and animals that have certain characteristics to help them cope and thrive in different environments. This is nothing new, and we have selected the best grains to plant the next year or mated the best animal species to produce better crops and animals for many millennia. However, it is now a very scientific process. For example, a species of

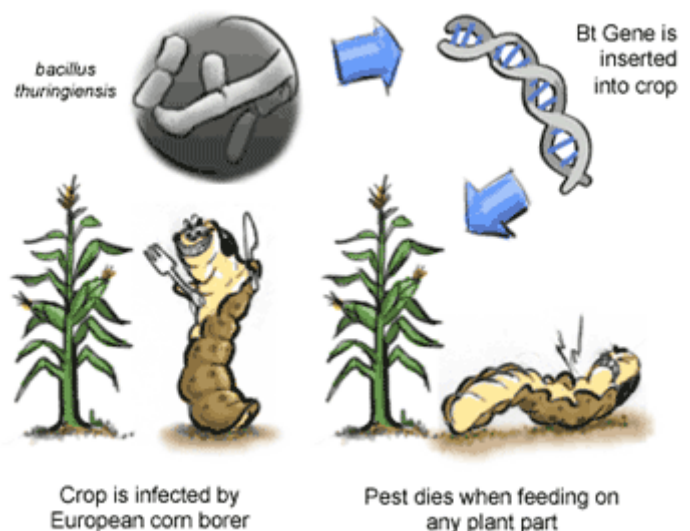


Figure 31 - Bt corn -
Source: <http://www.scq.ubc.ca/quarterly023/0203hall.html>

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corn has been developed with the bacterium *Bacillus thuringiensis* added to it as a genetic modification. This has dropped pesticide use on corn crops by 90 percent as the bacterium in its genes helps it ward off corn borers and other pests. Other useful modifications include;

1. producing insect repellent crops which reduces pesticide use
2. Producing crops which resist disease
3. Producing foods which take longer to "go off" or perish
4. Crops that increase the number of vitamins or proteins in them, such as rice or potatoes. It is even thought that crops could be produce to carry certain medicines.
5. Drought resistant crops that can grow in poor conditions
6. Meat has even been "grown" in a laboratory, this would reduce the need for large stocks of animals.

Appropriate technology

Appropriate technology is a method used to improve farming methods in LICs that is lower tech. It was founded by Dr E.F. Schumacher as an alternative path for development for poorer people. He founded his Intermediate Technology Development Group (ITDG) in 1966 and published his ideas in a book "small is beautiful" in 1973. His argument centred around the old proverb

"Give a man a fish and you feed him for a day, teach him how to fish and you feed him for life"

Appropriate/intermediate technology is usually;

- A) **Labour intensive** - utilising and creating employment for local labour.
- B) **Using sustainable technology and tools**/knowledge of local people.
- C) Uses **newly developed technology** that are low cost and local which local people can manage and control rather than IMPORTED techniques and technologies.
- D) In **harmony with the local environment**.

For example, Appropriate Technology Asia have invented a greenhouse that can cheaply installed in mountainous areas of Asia to prolong the growing season. They call this solar agriculture and it allows them to provide a source of fresh vegetables that are currently unavailable in many remote areas during the winter months. They can even be used above 2,700m!



Figure 32 A solar greenhouse, source - <http://www.ataasia.org.uk/>

6.15 Almeria Spain: an example of a large scale agricultural development

When we first started growing food what we could grow was controlled by natural factors. However, as technology advances we are capable of growing food in ways and places that we couldn't before.

One place where this happens is on the Costa Del Sol on the South Coast of Spain. In Almeria, the landscape is dramatic and unforgiving. It has desert scrub plants, and very dry soils. It is one of the driest parts of Europe (the total annual rainfall is only 228mm) but has become the site of an agricultural revolution. Millions of tons of vegetables are exported to

other European countries and other parts of the world each year.

A huge number of greenhouses, made mainly of polythene and plastic, are found 30 km southwest of the city of Almeria in southern Spain.

It is estimated that there are 40,000 hectares of greenhouses producing over 2.7 million tonnes of produce each year. This creates over €1.2 billion in economic activity.

In the 1950s any plants the farmers planted were simply blown down by the wind. However, they put up plastic sheeting on poles to stop the wind damaging their plants. They then realised that this had a secondary benefit, it helped their plants ripen earlier. Protecting crops meant that farmers could make the barren landscape fertile with the added bonus of a long extended growing season. This was the start of an amazing transformation. The farmers saw the chance to turn the area into a massive market garden using enormous greenhouses. There are greenhouses with over a ¼ million kilos of tomatoes (including the Angel tomato), and nature is taking a back seat. The plants are grown under cover, but also not in soil but using a system of hydroponics. Here, the plants are grown without soil! They grow in grow bags with what is effectively loft insulation with a mix of water and nutrients to avoid contamination from the ground. The water/nutrient solution is fed into the base of the plants via water pipes with small holes in called irrigation tubes.

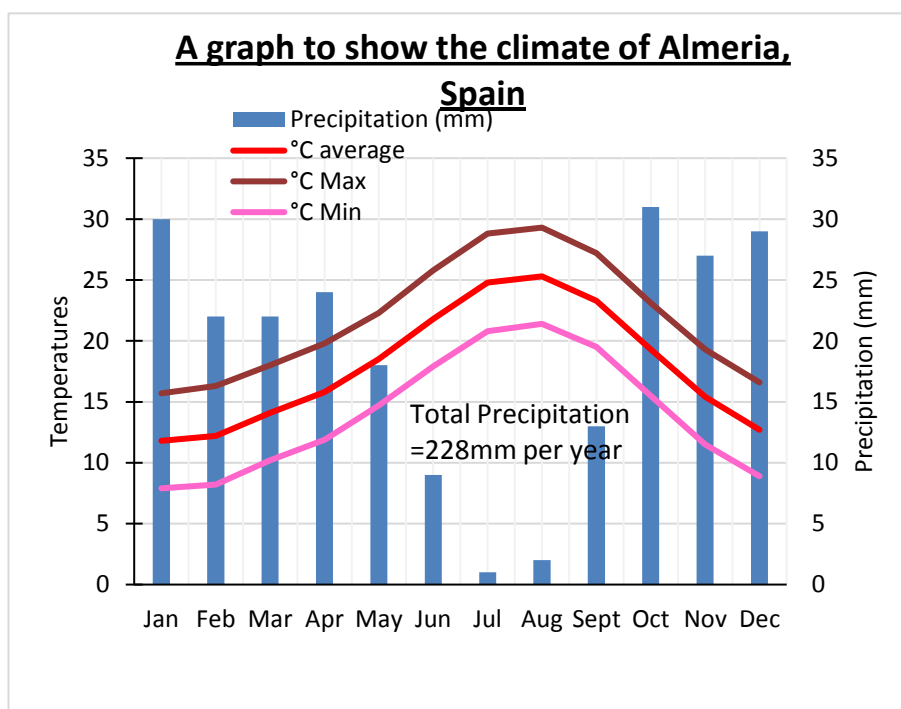


Figure 33 - Almeria Climate Graph



Figure 34 - The location of Almeria

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This is an industrial way of growing crops and can grow 2 entire crops a year. The whole area contains the largest concentration of greenhouses in the world. A $\frac{1}{4}$ of all of those tomatoes come to the UK. Londoners eat over $\frac{1}{2}$ a million tonnes of fruit and veg a year, enough to fill Trafalgar Square half way to the top of Nelson's column!

Advantages and disadvantages.

There are many advantages to this style of farming. The area produces relatively cheap fresh fruit and vegetables for people all year round. Indeed, plants can be grown outside of their normal growing season, increasing the variety of diet for people throughout the year.

The Spanish Government and EU offered support through infrastructure, technical advice and sources of funding. There are also large amounts of cheap temporary labour available to help in the farming. Many migrants come from Eastern Europe and North Africa. The fruit and vegetables also need packing, and this creates extra jobs. There are factories that produce the necessary plastic and also recycle it. This has created a secondary industry and extra jobs. Many agribusinesses have located in the area providing high quality R&D jobs. Especially in the Almeria Agribusiness cluster.

In addition to this, hydroponic growing techniques have helped to save on soil and resources and boost harvests. Hydroponics also mean that the plants only get the nutrients they need via the drip hoses, so there is less waste. Less water is used due to the use of drip hose irrigation, and greenhouses limit evaporation losses. The area also has the Bajo Almanzora desalinisation plant, which is helping to provide freshwater to the region. The year round warm temperatures help to cut energy costs. Finally, strict EU rules on quality have helped cut chemical use and raise the standards of production

However, this large scale agriculture is controversial and has lots of critics. This is because there are negatives to this type of farming. The immigrant labour force is paid very low wages and they live in poor conditions for example. Some of the immigrants are from North Africa and work illegally in Spain, this raises tensions in the region. There are many environmental impacts, the plastic used has badly damaged local ecosystems and the environment. Waste plastic is often burnt and this is toxic and hazardous to human health. The greenhouses often use pesticides to protect the crops from pests, these increase health risks for people working there and have been proven to cause some cancers. Large amounts of litter have been left in the area including containers used for chemicals and plastic sheeting. Local riverbeds have been blocked up, there are fears that these could break and cause catastrophic flooding during intense rainstorms in this part of Spain. Despite efforts to limit water use the farming has put a strain on local water sources despite the use of desalinated sea water. Natural underground aquifers are drying up. The greenhouses even cool the local area by reflecting sunlight back

out into the atmosphere!

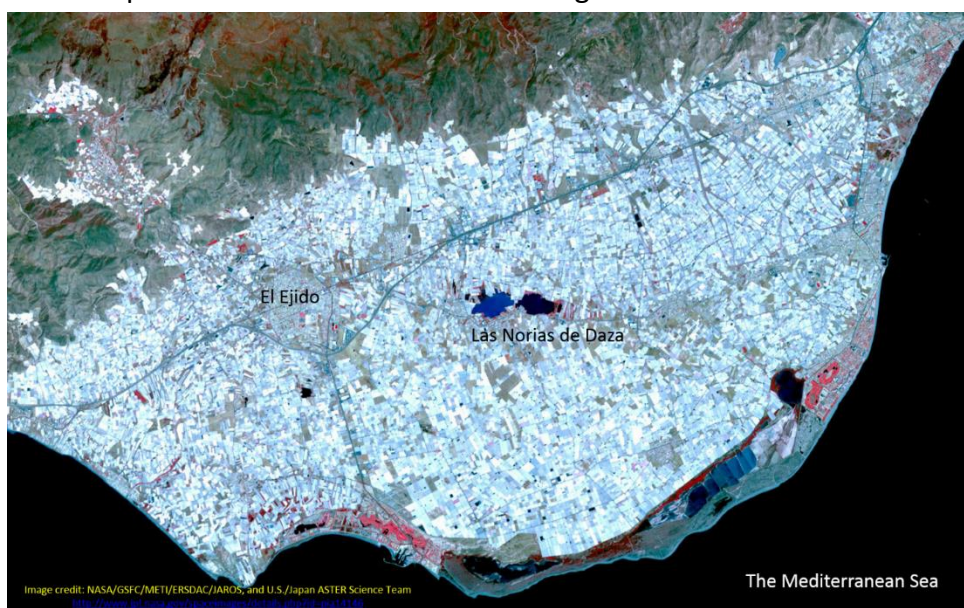


Figure 35- Satellite image of the greenhouses in Almeria

6.16 The potential for Sustainable Food Production

The case of Almeria and many other modern farming methods show that although we can produce enough food for places to be food secure and keep people fed, many of our methods are **unsustainable** and have a negative impact on the environment.

Many people are now concerned about having sustainable food supplies and limiting their impact on the environment. This links to the idea of **sustainable development** - development that meets the needs of the present without limiting the ability of future generations to meet their own needs. This means that **sustainable food supplies** are those that are produced in ways that **avoid damaging natural resources**, provide social benefits such as **good quality food** and safe and healthy products, and contribute to **local economies**. Some of the ways we can do this are discussed below.

Permaculture

These ideas tie in with the idea of developing a permaculture. The word permaculture refers to **permanent agriculture**, or agriculture that we can use for ever. Permaculture involves developing agricultural systems that co-operate with nature rather than working against it. An agriculture that respects the plants and animals that are produced. Examples of permaculture include using organic farming, farming in the urban environment, making fish and meat supplies sustainable, eating seasonally and reducing food wastes.

1. Organic farming

The UK's organic farming sector is worth £1.95 billion (Soil Association, 2016). Perhaps organic agriculture is the way forward to reducing chemical and crude oil use and making our farming more sustainable. Organic farming is a much more sustainable method of producing food because;

- It reduces the intensification of food production allowing the land to "rest"
- It encourages a more local approach
- Artificial fertilisers are largely banned
- Farmers develop fertile soil by rotating crops and using compost, manure and clover.
- Strict regulations, known as 'standards', define what organic farmers can and cannot do – and place a strong emphasis on the protection of wildlife and the environment.
- It uses biological pest control rather than pesticides. This is where natural predators are used to kill insects that damage crops, a ladybird can eat more than 5000 aphids in its lifetime for example.

Key words

Local food sourcing - A method of food production and distribution that is local, rather than national and/or international. Food is grown (or raised) and harvested close to consumers' homes, then distributed over much shorter distances.

Organic produce - Food which is produced using environmentally and animal friendly farming methods on organic farms. Artificial fertilisers are banned and farmers develop fertile soil by rotating crops and using compost, manure and clover. It must be free of synthetic additives like pesticides and dyes.

Permaculture - A system of agricultural and social design principles based upon or directly using patterns and features observed in natural ecosystems.

Sustainable food supply - Food that is produced in ways that avoid damaging natural resources, provide social benefits such as good quality food and safe and healthy products, and contribute to local economies.

Urban farming - The growing of fruits, herbs, and vegetables and raising animals in towns and cities, a process that is accompanied by many other activities such as processing and distributing food, collecting and reusing food waste.



Figure 36 - Ladybug feeding on an insect by Chetankjain (Own work) [CC BY-SA 4.0 (<http://creativecommons.org/licenses/by-sa/4.0>)], via Wikimedia Commons

2. Urban farming initiatives

Growing food in the UK is nothing new. People have been farming in UK cities for hundreds of years and were encouraged to do so in WW2 when food was short. Urban farming can be very productive, with some estimates saying it can be 15 times more effective than large scale farming. Urban farming is **small scale** in its nature, with people being allocated small plots of land on which to produce food. Food can also be produced on rooftops (known as **green roofs**, this can include bee keeping, on trees in parks, in people's back gardens and allotments of land. This type of farming is healthier for people, is local so cuts food miles, saves people money and encourages people to think about where their food comes from.

The northern UK town of Middlesbrough launched an urban farming scheme which encouraged many sectors of the community including school children to grow their own food. All of this in one of the UK's most industrial cities. The US city of Seattle is establishing the Beacon Hill Food Forest which will be full of edible plants and fruit trees.

The photograph shows a 1.5-acre urban farm in Chicago. It is provided rent-free, to this non-profit initiative. It shows how it is possible to grow lots of food even in a small space.



Figure 37 - An urban Farm in Chicago, By Linda from Chicago, USA (New crops) [CC BY 2.0 (<http://creativecommons.org/licenses/by/2.0>)], via Wikimedia Commons

3. Fish and meat from sustainable sources

Producing both fish and meat for human consumption can have big impacts on the environment and is viewed by many as unsustainable. The meat industry is



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unsustainable in many ways. Feeding animals grain consumes a lot of resources, animals can be kept in very poor conditions in enclosed spaces, and keeping animals at such high numbers produces a lot of methane and CO₂. Grazing livestock outside in the UK can be a good way of keeping this sustainable as the land can only support so many animals and it also maintains things like moorland landscapes. The more sustainable way forward is to use free range methods where the animals are more free to roam around fields within the farm. We have developed labelling systems too where people know how their food has been produced.

Fishing can have a really big impact on our marine environment. The fish themselves, sensitive habitats, endangered species and the marine food chain need to be maintained to keep the oceans healthy and productive. To have sustainable fisheries means that fish populations should be able to recover their numbers in the long term allowing fishing activity to be at a level which ensures it can continue indefinitely. This can be done by;

- Ensuring sustainable fish stocks** by using data in the form of catch records and stock surveys. This data collection and research must be ongoing to ensure that the fishery can respond to declines in fish populations by reducing the level of fishing.
- Minimising environmental impacts of fishing** – for example, drag net fishing or trawling for shell fish destroys the entire sea bed ecosystem, encouraging diving is much more sustainable. Dolphin friendly nets have been encouraged in tuna fishing too.
- Stopping Illegal fishing** – This is where people fish in areas they are not supposed to and ignore limits or quotas put on fish catches. The illegal fishing industry is estimated to be worth US\$10-23.5 billion annually, this illegal fishing threatens the sustainability of fish stocks, the health of marine ecosystems and the livelihoods of those who fish legitimately.
- Managing fishing practices** – here local authorities can work with the fishing industry to encourage ways of fishing that ensure long term stocks.



4. Seasonal food consumption

There is a growing movement in the UK for people to eat seasonal vegetables and fruit wherever possible, in order to reduce the food miles. Seasonal food involves producing food locally without the need for expensive heated greenhouses or imports of food from thousands of miles away. This would mean not eating strawberries at Christmas time that have been produced in Morocco for example. Local food sourcing is also becoming more and more popular. The red tractor logo appears on lots of food stuffs now to show that the food is produced in the United Kingdom. Red Tractor Assurance exists to maintain, develop and promote standards throughout the whole food industry.

5. Reduced waste and losses

In many HICs a huge amount of food is wasted. If you look at the

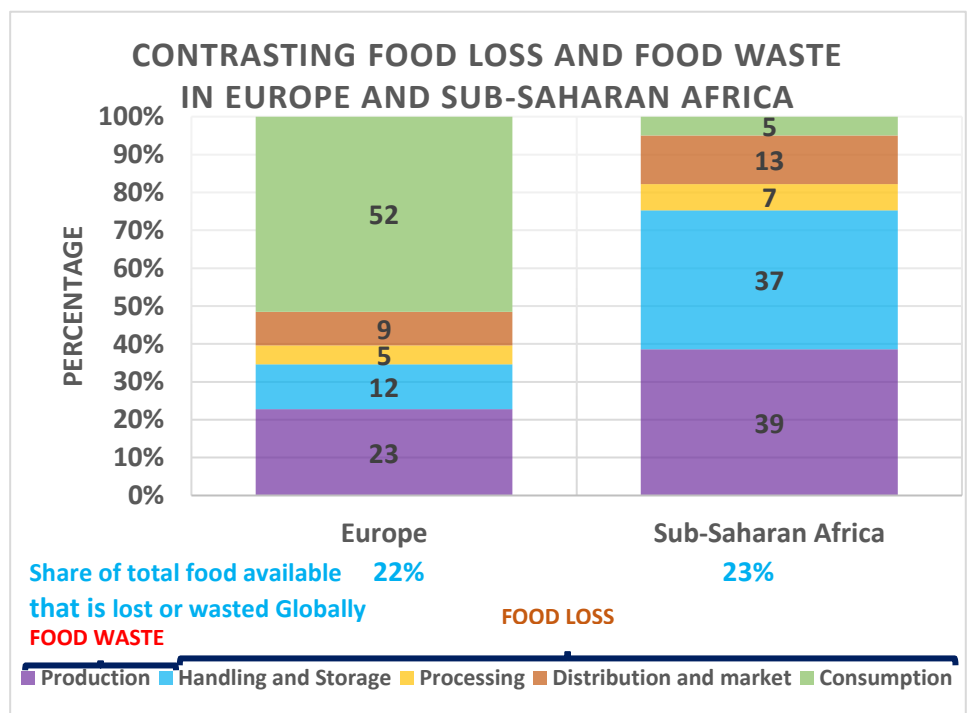


Figure 38 - Contrasting food waste

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graph opposite the food waste part of the graph relating to consumption shows a huge contrast between Europe and Sub-Saharan Africa. In Europe most of waste is related to consumption, where people have bought their food and either allow it to go to waste in storage or throw out food. This is an issue with education and management of food by consumers. This section is larger than production, handling and storage, processing and distribution and market combined! In the LICs as found in Sub-Saharan Africa, most of the food loss is through production and handling/storage, representing an issue for the way food is grown and then handled.

According to lovefoodhatewaste.com in the UK;

- We throw away 7 million tonnes of food and drink from our homes every year in the UK, and more than half of this is food and drink we could have eaten.
- Wasting this food costs the average household £470 a year, rising to £700 for a family with children, the equivalent of around £60 a month.
- If we all stop wasting food that could have been eaten, the benefit to the planet would be the equivalent of taking 1 in 4 cars off the road.

This food waste is also a problem because it contributes to the filling up of our landfill sites where we store our waste.

We can reduce the amount of food waste and loss in many ways;

1. Plan your weekly shop – by planning what you will cook throughout the week before you go shopping reduces impulse buys and unnecessary purchases which leads to less waste
2. Reduce portion sizes – this means that people don't overeat and also that there is no waste left on the plate that will go directly into the bin. Taking smaller portions several times can also reduce this waste.
3. Buy "ugly" fruit and vegetables – these are fruit and vegetables that do not pass supermarket "norms" for appearance, a knobbly carrot for example, but are perfectly edible. This stops this food getting landfilled
4. Store food correctly – using your fridge and cupboard space correctly to prevent food going off. For example, most fruit and vegetables are actually preserved better outside of the fridge
5. Keep the fridge clutter free - use the "first in, first out" principle: After you buy new food, move the older products to the front so you consume them first.
6. Treat expiration and sell-by dates as guidelines - many foods are perfectly edible after the sell by date, use your senses of sight and smell to judge if a food can be eaten or not.
7. Use leftovers the next meal or day rather than throwing them away
8. Compost waste so you can reuse the compost in your garden – this reduces waste going to landfill.

Food loss can also be reduced. In my LICs issues relating to the farming are largely technical and can be resolved. Many problems arise after the food has been harvested, including loss of food due to poor pest control, lack of adequate storage facilities, poor access to refrigeration and "cold chain" storage and poor marketing. These all result in food loss in areas that are often food insecure. If we invested in these areas more food would reach consumers and GDP for these countries would rise.



Figure 39 - 42.4 kg of avoidable food waste found in New Zealand household rubbish bins in 2014 By Love Food Hate Waste NZ (Own work) [CC BY-SA 4.0 (<http://creativecommons.org/licenses/by-sa/4.0/>)], via Wikimedia Commons

6.17- An example of a local scheme in an LIC or NEE to increase sustainable supplies of food – Rice and fish farming in Bangladesh

Much of the world's hunger and poverty exists in either Low Income Countries or Newly Emerging Economies. There are many things that can be done to reduce hunger and poverty, in a sustainable and appropriate manner.

Practical Action are a charity that works to try and improve the lives of people across the globe through direct, people led, practical projects. One such project is the use of a rice-fish agriculture project designed to help farmers in the Bangladeshi district of Jamalpur. This is a very poor part of Bangladesh north of the capital city Dhaka, and is a very agricultural area. You can see how Bangladesh compares to the UK in the table, and that Jamalpur has a massive 65.5% of its population in agriculture.

Rice fish farming

In this project farmers are introducing another 'crop' into their rice fields - small, indigenous fish that can live in flooded paddy fields whilst the rice is growing. This technique is good for both the fish and the rice. Safely hidden from birds, the fish thrive in the dense rice plants, while they in turn provide a source of fertilizer with their droppings, eat insect pests and help to circulate oxygen around the rice field. Keeping fish in rice fields can increase rice yields by up to 10% – plus they have the additional supplies of fish.

A diet of fish is an excellent source of protein and so improves people's health. Extra rice yields, meanwhile, not only put meals on tables but enable families to sell surplus food at market.

Construction

First, Practical Action works with a farmer to identify a suitable site: one that is less likely to be washed away should a flood occur. Together we then build a dyke or bund approximately 60cm high around the outskirts of the field. This has a dual purpose – to keep the fish in the rice fields and enable vegetable cultivation around the field. The next step is digging a ditch for the fish to live in during the dry season – this is something the whole family can get involved in.

Planting and stocking

The farmer plants the rice in rows that are roughly 35cm apart, then fills 50% of the ditch with water.



Figure 40 Map of Jamalpur in Bangladesh

| Indicator | Bangladesh | Jamalpur | UK |
|--|--|--------------|------------------------------------|
| Population | 156 million | 2.29 million | 64 million |
| GDP per capita PPP | \$3600 (a lower middle income country by World Bank) | | \$37,700 (A HIC by the World Bank) |
| % working in agriculture | 47% | 65.5% | <1% |
| People Living in Poverty (less than \$2 per day) | 31.5% of the population | | 16.2% |
| Access to Clean Water | 86.9% of the population | | 100% |
| Life Expectancy | 73.2 years | | 80.4years |
| Literacy Rate | 61.5% | 38.4% | 99 |
| People Per Doctor | 3,255 people per doctor | | 355 people per doctor |

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The water is purified with a small quantity of lime, and a little organic fertiliser is added. Then, when the rice starts to shoot, the water level across the field is increased to 12–15cm, and small fish or ‘fingerlings’ are released into the ditch. As soon as they have acclimatised to the rice field water, the farmer releases them into the field and raises the water level as both the fish and rice grow.

Harvesting

Come the first harvest, approximately 4–5 months later, the

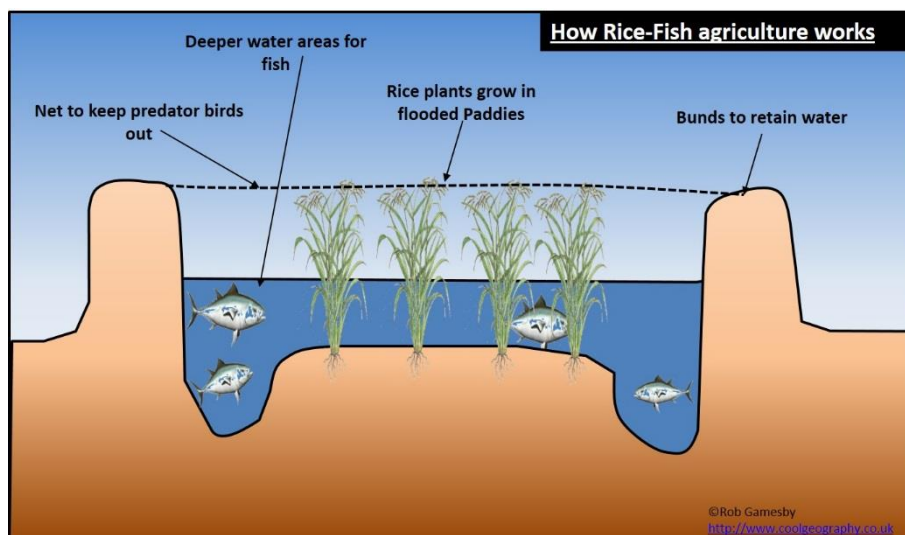


Figure 41 - how rice-fish farming works

farmer will harvest the rice first, and then drain the rice field to collect the fish into the ditch where they can easily be caught. In areas where Practical Action has helped people to develop rice-fish culture, farmers have reported a 10% increase in rice yields, plus enough fish to provide regular, high-protein meals for their families.

Every year, Kamrul Barik’s family was faced with starvation, but thanks to rice-fish culture he has been able to turn their lives around. Once he could only produce enough food to last two thirds of the year, now he’s able to grow more food for his family to eat and some to sell at the local market. His story can be seen opposite



This scheme is good because it is sustainable, involves using local people and expertise, improves the diet of these people and is relatively easy to establish. This is a good example of appropriate technology. Other schemes include the use of floating rafts where vegetables can be grown, the use of livestock and even how to keep bees.

“My name is Kamrul Barik and I live in a village in the Jamalpur Sadar district of Bangladesh. It’s a small village and I have very little land to live on or to farm – my home is just 15 square metres with 48 square metres of rice fields. I have two sons and one daughter, and my parents are old so they live with us too. In the past it was very hard to grow enough food to feed us all. I could grow enough rice for perhaps 8 months, but the other months I struggled to find food. I had to scrape together money by borrowing from money lenders at a very high interest. I could not afford to send my children to school and we often went hungry for days. Things were very bad.

“Then in 2006 Practical Action taught me all about rice-fish culture. I learnt how to choose rice that was more resistant to floods. I also learnt how to protect the fish in my fields. Soon I was able to grow more rice and fish and earn money from selling them – 26,200 tk (£195) from my fish and 18,000 tk (£135) from my rice. Practical Action also showed me how I could farm bananas and vegetables on the dykes, which meant I was able to earn another 10,200 tk (£75).

“The extra money has made a very big difference. We can now buy fruit and vegetables at the market so my family can eat better – and of course the fish also give us important nutrients and vitamins. My children are now going to school and I hope they will now be able to find good jobs. I have been able to install a new latrine in our home and I hope to lease another piece of land to start rice-fish culture in another plot. Now the future looks much brighter.”

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