AQA Geography A-level

3.2.4: Population and the Environment

Detailed Notes

Understanding Population and the Environment

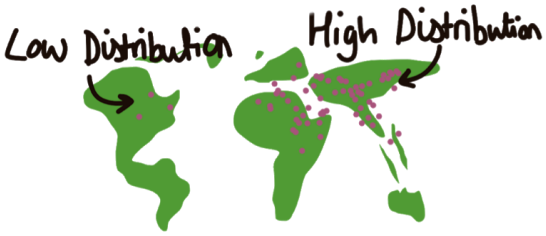
Population is the **amount of people** in a defined area, e.g. the **population of the world** is currently 7.6 billion (May 2018). Population can be **measured** in different ways:

Key Population Parameters

A parameter is a **measurable** factor. Population parameters are different ways in which the **population** is measured, and these are very useful to gain some insight into the **characteristics of a population.**

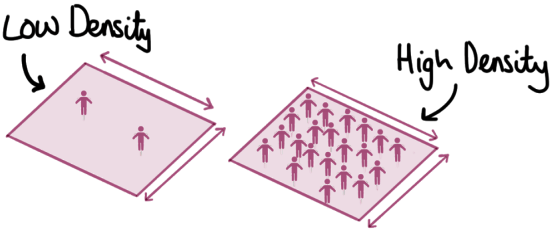
Distribution

How a population is **spread** globally or regionally.



Density

Measurement of population **per unit area**, e.g. population per km^2.



Numbers

The **amount of people** in a defined area (population) e.g. a town, a region, or a country.

Change

Increases and **decreases** in population over a **period of time**.

Factors Affecting Population

In general, population is mainly affected by physical **environmental factors** and **development processes**. These factors can influence a population in many ways; they may change birth/death rates, change the age composition of the population, quicken or slow population growth etc.

Physical Environment

The physical environment plays a **vital part** in the population as it holds **key resources** for human well-being. Different aspects of the physical environment affect how a population can be **supported** in an area.

- The **climate** affects the health and wellbeing of the population, ultimately dictating **how many people can be supported** in an area, if any. The climate affects **agriculture** as crops need certain conditions to grow, and **food** is needed to support a population. The climate also affects the incidence of **disease**, as some diseases thrive in certain climates, which affects the population.

- **Soil** is another aspect of the physical environment that the population relies on. The water content, nutritional content, and overall quality of the soil affects **agricultural productivity**, which is important in providing food to support populations.

- **Natural resources** are needed for a population to grow and be supported. A clean **water supply** is needed for hygiene, sanitation, agriculture, and drinking. Before there were means of transporting natural resources (and in some places this is still the case), materials for shelter, fuel etc. had to be sourced locally. Populations cannot be supported without access to these important resources.

Development Processes

A development process can refer to the process of **society advancing over time**, hence 'developing'. A development process will generally affect a **population**, whether it be providing **resources** to support a larger population, or **social developments** that create new opportunities for a population. Society has gone through multiple development processes, which have altered global populations.

Developments in Food Supply

There have been multiple processes throughout history that have revolutionised food supplies for populations, ultimately allowing for **a larger population to be supported**. Examples include:

- The **Neolithic Revolution**. 12,000 years ago, there was a shift from mobile **hunter-gatherer** populations to **agricultural communities**. **Birth rates and fertility rates rose** as women no longer had to wait to have more children; in hunter-gatherer communities it was difficult to have many **dependants** due to the mobile lifestyle. Agriculture could also feed **denser communities**, and although more intensive and nutritional standards were lower, these communities had a more **stable food supply**. Overall, there were baby booms and population growth rates quickened rapidly.

- The **Green Revolution**. The Green Revolution was the process of using **technology** and more **efficient farming supplies/practices** in agriculture to **maximise yields** in the 50s and 60s. The Green Revolution overall created more food, especially in developing countries, meaning a larger population could be sustained. An estimated **1 billion people** are able to be fed as a result of the Green Revolution, illustrating the effects on the population.

Other Societal Developments

Not only is food supply a main driver of population change, but several other processes have contributed to changes in population and its structure. Societal changes have had many effects on population growth, and not just because of changing food supplies.

The **Industrial Revolution**. Beginning in the mid-1700s, the Industrial Revolution was the transition from majorly labour-intensive industry to technology manufacturing processes, including the use of machinery, fossil fuels, and factories. The process revolutionised agriculture, the manufacture of goods, transportation. medicine and other aspects of society, overall making life less labour intensive for many people. Industrialisation caused world population growth rates to increase. At the start of the Industrial Revolution, the population grew by 57%, and 100 years on the population grew by 100%.

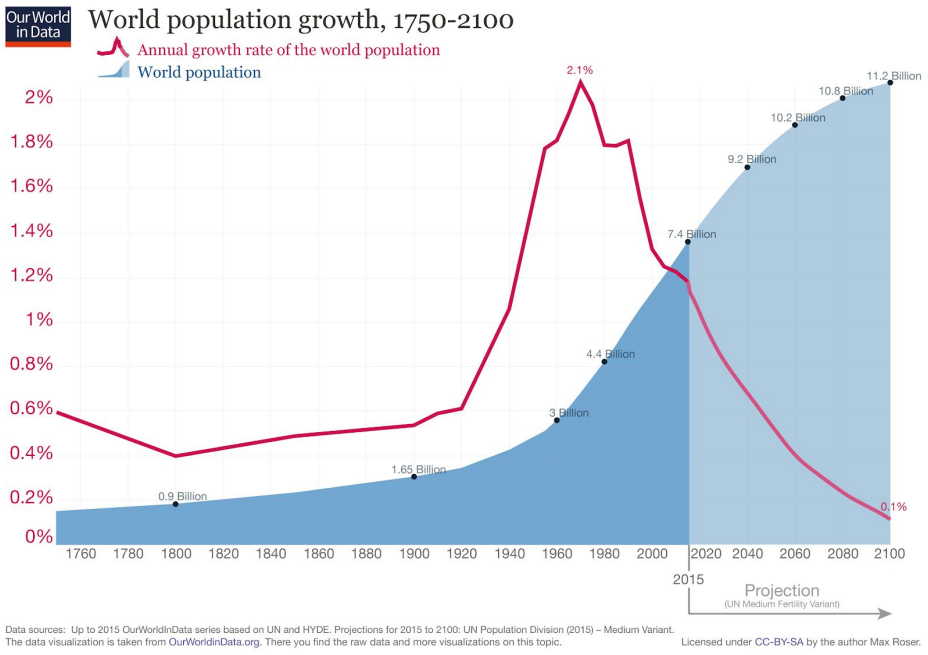
Development processes are also having **negative** effects on population growth, in the sense that some societal developments are causing population growth to slow, and in some cases causing populations to decrease.

Global Population Patterns

The global population follows distinct patterns in terms of the **numbers** of the population, the **distribution** of populations, and the rate at which population **changes** in different areas of the world.

Global Population Numbers

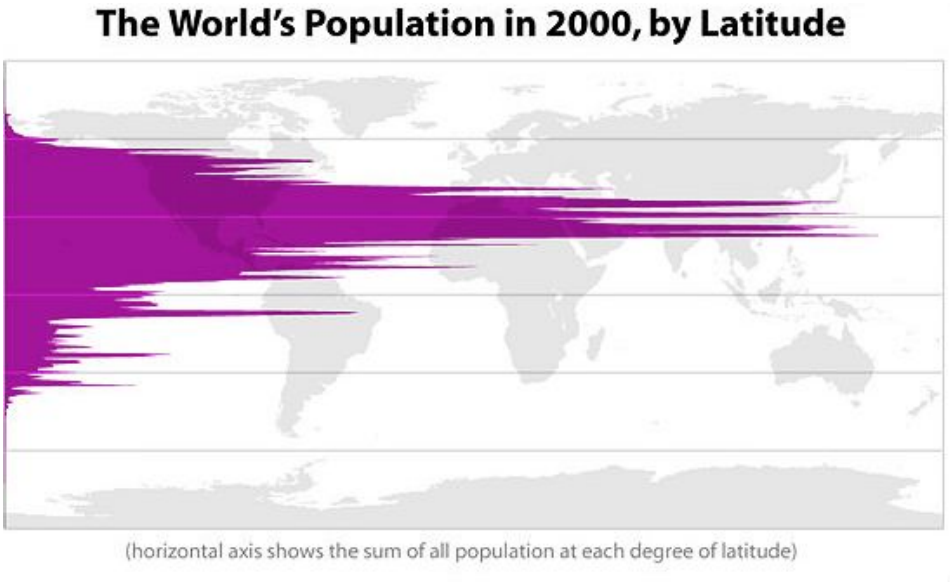
The world's population **stayed below 1 billion until 1804**, yet to reach 2 billion it only took just over **100 years**. Population growth rates are sometimes classed as **exponential**, which gives reason as to why global population numbers have risen so rapidly within 2 centuries. Global population growth has truly been rapidly increasing since the 1960s, where the population had **doubled from the start of the 20th century**. Population is estimated to reach 9 billion by 2050.



Global Population Density

Urbanised areas are the most **densely populated** areas, as many people move for job prospects and other opportunities. 55% of the population currently live in urban areas, and this is expected to rise to **two thirds of the population by 2050**. Areas of China (Macau and Hong Kong) and Bangladesh are known for being **densely populated**. The majority (an estimated 90%) of the

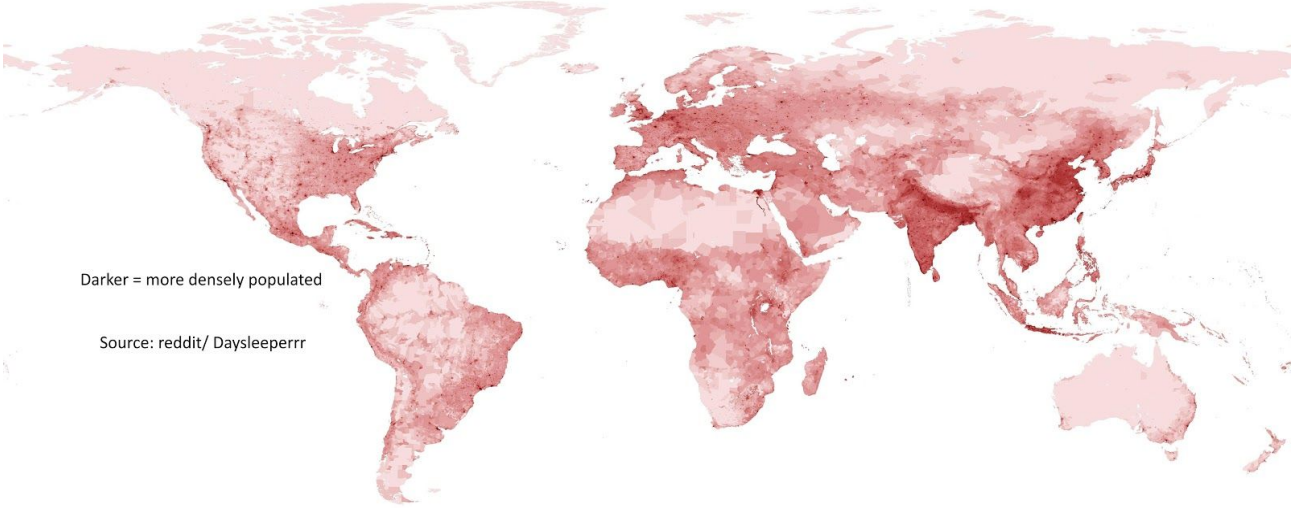
population live in the **Northern Hemisphere**, and the distribution of populations is shown on this graph:



(Source: https://www.flickr.com/photos/123522713@N06/14911155646)

Areas that are **sparsely** populated (e.g. Sahara, Central Australia, Canada) often have **uninhabitable conditions**, meaning the population cannot be supported, for example there is a lack of food to accommodate the population.

In contrast, areas that are densely populated can usually support a population, which is why areas that can produce a large amount of food are often densely populated. For example, some densely populated areas of **Bangladesh** have very fertile soil, and the floodplains are good for crops, meaning many people choose to live in these areas.



For an enlarged version, visit: http://i.imgur.com/gBYMfWO.jpg

Rate of Population Change

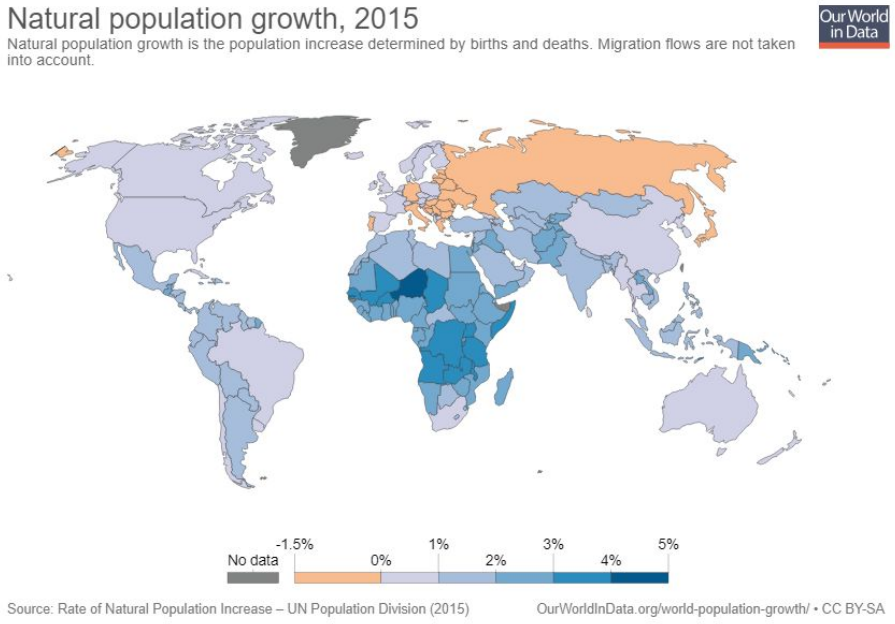
Population growth rates have changed globally; there has been a **shift** from rapid population growth in richer countries, to rapid population growth in poorer countries (and a slowing of population growth in the richer countries). Reasons for this change are outlined by the **Demographic Transition Model**, which will be discussed in further detail.

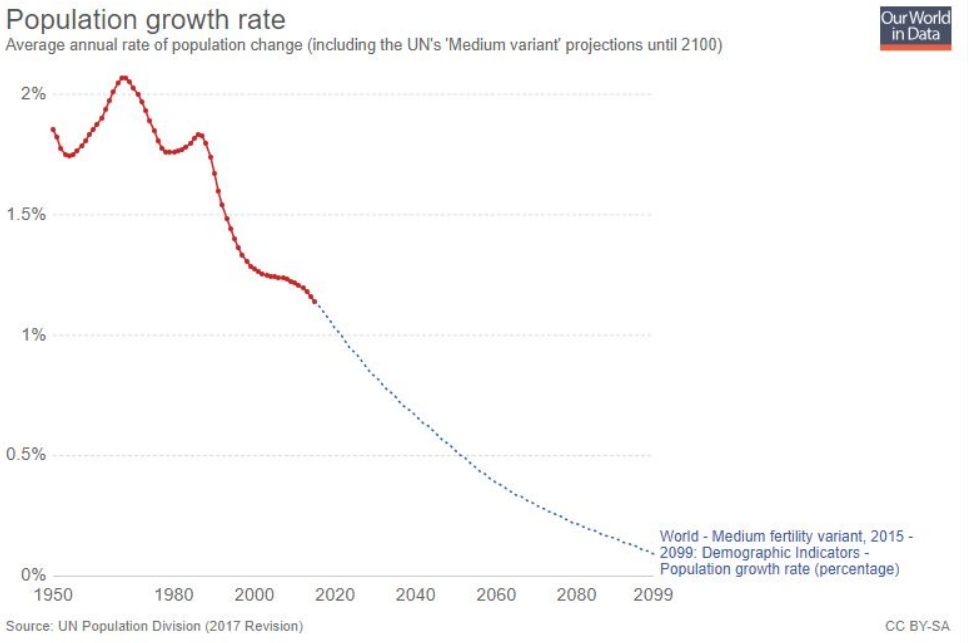
Until the mid-1900s, the majority of population growth was in **HICs**, as there was **more social and economic change concentrated in these areas**. Better healthcare, better job opportunities, and better living standards accelerated birth rates and lowered death rates, causing **rapid growth**.

In the present day, this trend has changed; **HICs have the lowest population growth rates**, and in some countries the population growth rate is decreasing. This is due to a range of reasons, such as more contraception available, the emancipation of women, urbanisation, changes in society etc.

In contrast, **developing countries/LICs have the highest growth rates,** mostly due to these countries 'catching up' and going through **similar trends** that high income countries went through in the 1900s. Overall though, global population growth rates are slowing.

Urban areas have higher population growth rates than rural areas in general, which is down to many reasons, especially due to the already high populations, and migration.





Food Production and Consumption

Production

Food production has **tripled** globally in the past 50 years, and global arable land has increased by **67 million hectares** (although it has decreased in developed countries). More crops are being grown on more land, and these crops are of better quality.

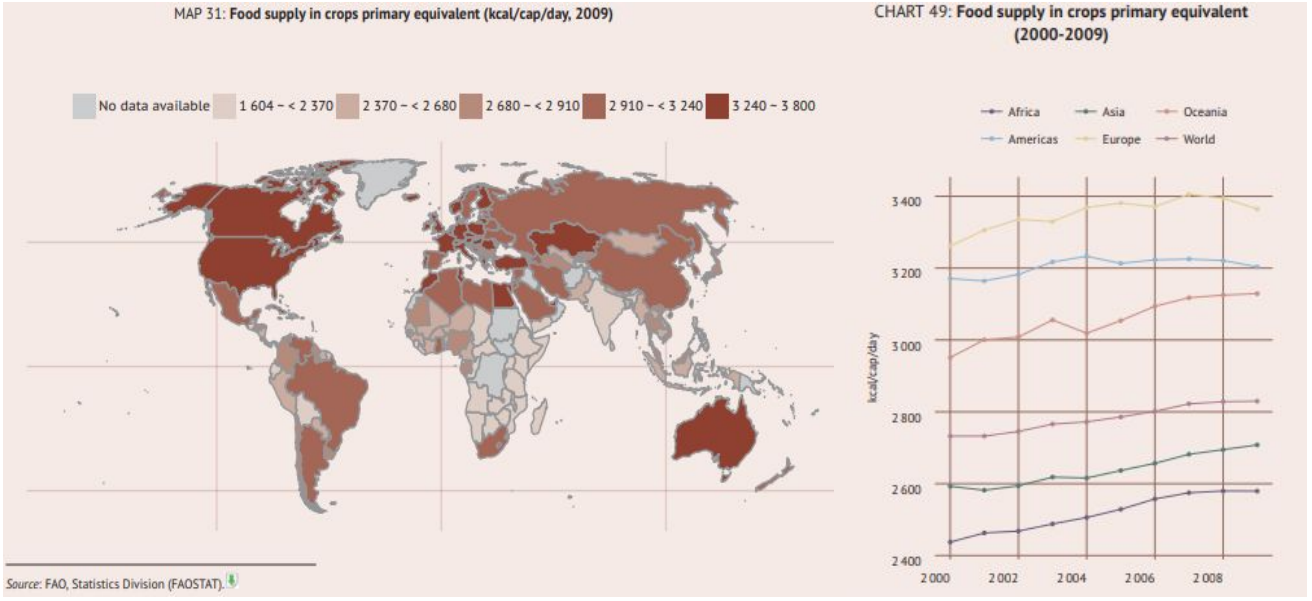
Food production has increased globally for many reasons:

- An increased use in **farming machinery** (e.g. combine harvesters) which allows for more crops to be collected in a quicker time frame.
- Increased use of other **farming resources**, such as herbicides and pesticides, to maximise yields.
- Better farming **management** to maximise yields and create more farmable land.

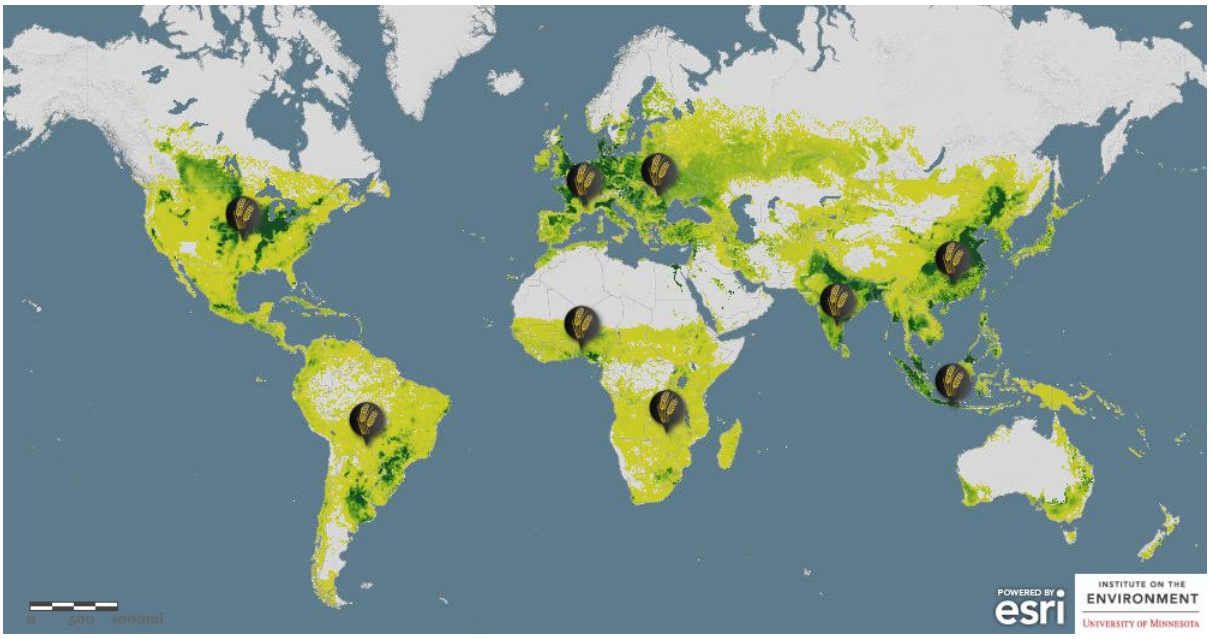
Food production has increased in **different regions** for **different reasons**. For example, wheat and rice production has increased in Asia and Northern Africa due to **higher yields**, whereas maize production in Latin America and the Caribbean has increased due to methods of **land expansion** (creating more arable land).

In general, **food production is unevenly distributed**, with lower income countries producing the least amount of crops. The richest countries have the largest food supplies, meaning they produce enough/more calories for their population. This production trend varies crop by crop, usually due to **environmental limitations** in other countries, meaning consequent lower crops.

Global Food Production per Region



Current Regional Crop Yields



(Source: http://storymaps.esri.com/stories/feedingtheworld/)

Examples of Regions with Differing Crop Yields

- **Eastern Asia**
- **North America**
- **Western Europe**

These areas have consistent **high yields**, due to the availability of resources, such as nutrients and water. Eastern Asia receives high amounts of rainfall, facilitating in **crop growth**. **The Great Plains** in Central North America also create high yields.

- **India**
- **South America**
- **Western Africa**

These areas have moderate yields, but can be at risk of **environmental limitations**, such as droughts and flooding, especially due to **climate change**.

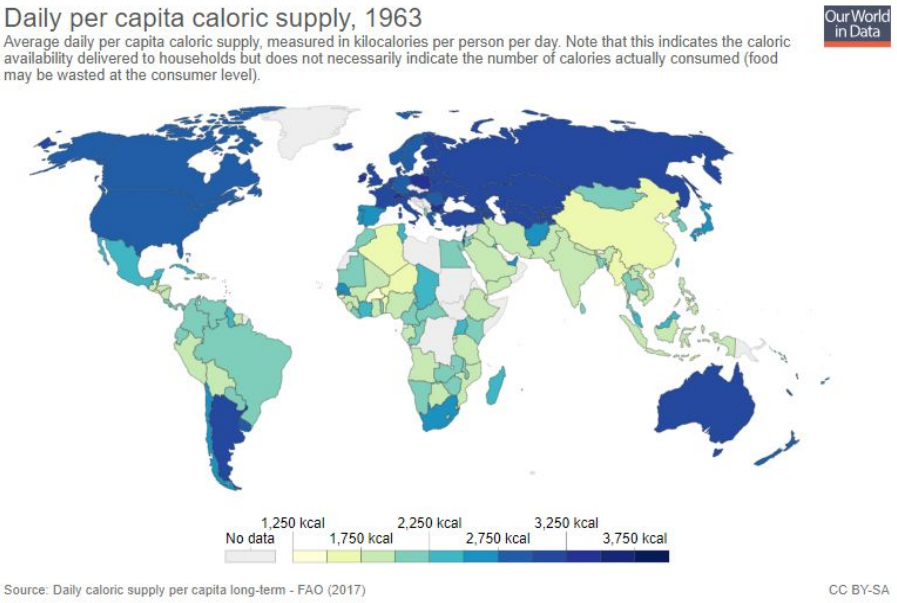
- **Central Australia**
- **Saharan Africa**
- **Eastern Russia**

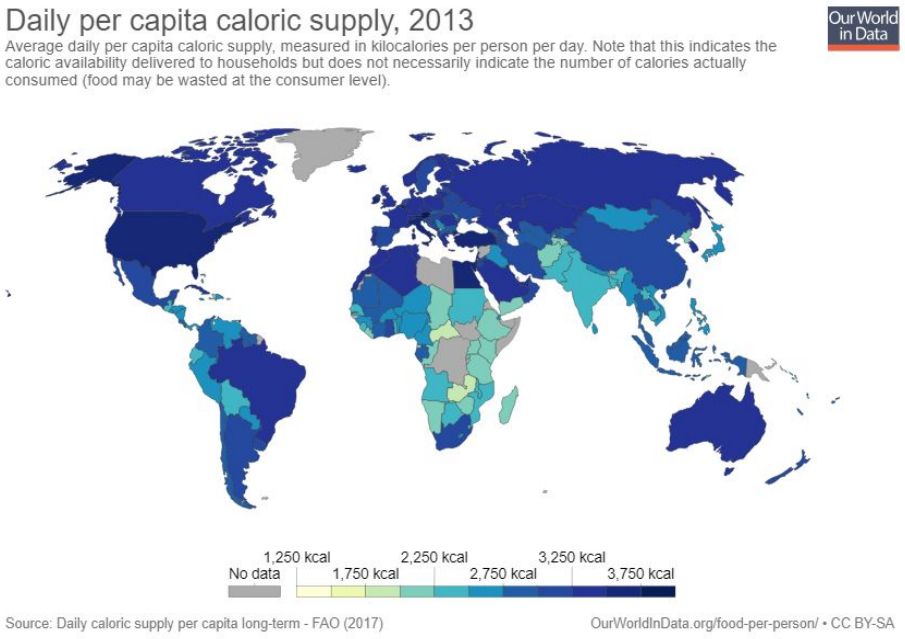
Due to **extreme environmental limitations**, such as droughts and temperatures unsuitable for crop growth, these regions of the world have little if no crop growth to feed the population.

For regional crop yields information, visit the FAO's factfile: (www.fao.org/docrep/018/i3107e/i3107e03.pdf)

Consumption

Globally, food consumption has **increased over time**; there are **more people** (higher populations) consuming food, and per person they are consuming **more food**. These maps show that globally food consumption has increased, and few countries now average under 1750 kcal a day.





In general, the **trend is very similar to food production**; lower income countries consume less food than high income countries. This trend is majorly due to HICs having more money to **import food and invest in agriculture**, as well as more money per person to buy food. Furthermore, developing countries consumption rates are growing the **quickest**. These trends can be seen in the following:

- Africa consumes the least calories out of every continent: over 27% of Africa's population are affected by severe **food insecurity**.
- North America has the highest consumption rate, followed by Europe.
- Asia's consumption rate has seen the **quickest growth**; China's consumption has increased by nearly **1000 calories in 50 years**.

Food consumption **varies regionally**, as different regions of the world consume different types of food due to **socio-economic reasons**:

Cereals

- **50% of calories** globally are from cereals, more so in developing countries (**54%**).
- In **Africa** and parts of **Asia**, cereals account for up to **70% of energy intake**, whereas in high income countries this number is around **30%**.
- **Rice** consumption is highest in **China** and **Eastern Asian countries**, although this is projected to **decline**.
- **Wheat** consumption is highest in **developing countries** and increasing.
- **Coarse grains** are a major contributor to **Sub-Saharan Africa**'s cereal intake.

Meats

- **Developed countries** eat the most meat, whereas **developing countries** tend to get protein from **non-animal based sources**
- **Pig, sheep, cattle, and poultry** are the main meats consumed in **HIC regions** like **North America** and **Europe**.
- In the **Middle-East**, **India**, and **Africa**, **camels and goats** are the dominant meat.
- **Meat consumption is increasing**, especially in **rapidly developing countries**. There's been a **threefold** increase in meat consumption in **Asia** since the **60s**, and **China** specifically consumes **nine times the amount of meat** they once did.

Livestock products (eggs and dairy)

- **Developed countries** dominate **consumption of animal products**, although egg consumption has increased in some developing countries.
- **Africa has the lowest consumptions of dairy**, and consumes little compared to the rest of the world.

Fats, oils and sugars

- Consumption of these products are **highest in HICs** due to the **consumerist culture**.
- Consumption is **rapidly increasing in developing countries**, but is still slower in the least developed countries.

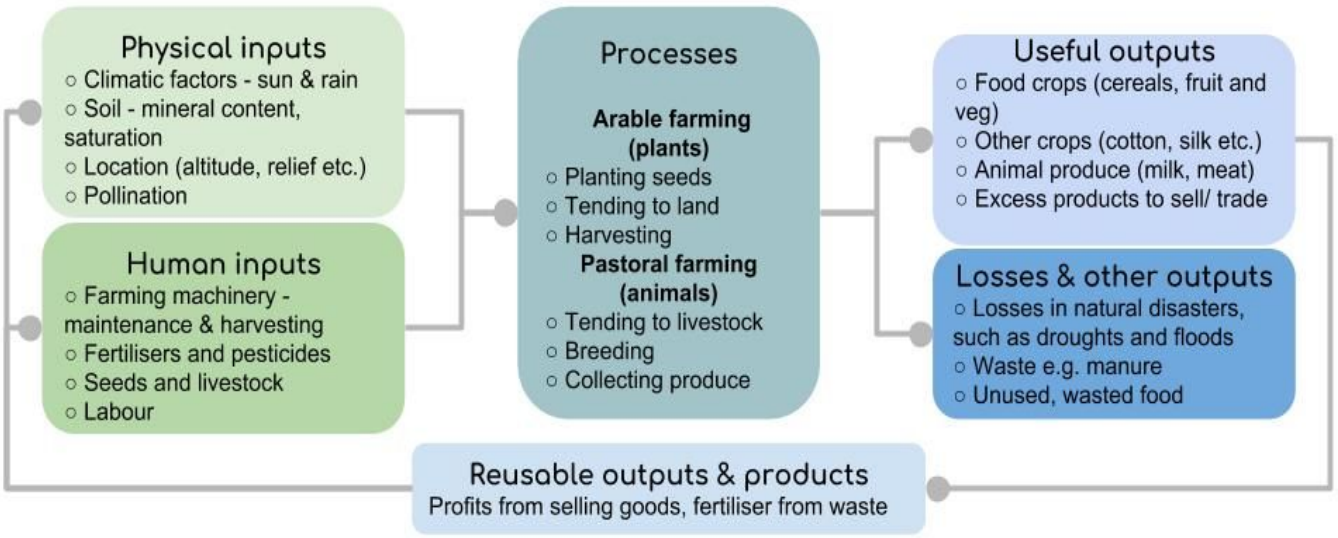
Agriculture

The global population **relies heavily** on the products of **agriculture** for food, as well as many other purposes. How **productive** agriculture is affects how a population can be **supported**.

Agricultural Systems

Agriculture produces **yields** (crops) through the **addition of resources**, as well as **processes** (such as planting the seeds, tending to crops, and harvesting). In this sense, agriculture can be classed as a **system**, as there are **inputs**, **processes**, and **outputs**. The diagram on the next page covers how the production of food is in a system.

The Agricultural System



Agricultural Productivity

Agricultural productivity is the amount of **useful outputs (yield)** in proportion to the amount of **inputs**, showing the **efficiency** of the farm. High productivity means **high yields** are being achieved through **low inputs**, saving time, labour, and money. High productivity farms also usually have little to no losses as they are **efficient**, e.g. they may reuse excess crops to feed livestock, saving money.

As an example, here are two theoretical farms with different productivities:

Farm 1:
- Spends **£3 million** on farming equipment, labour, and land
- Crops **fail** due to poor management, poor soil, and poor weather
- Sells crops for **£3 million profit**
- Overall, this is a **low productivity farm**

Farm 2:
- Spends **£3 million** on farming equipment, labour, and land
- Crops **thrive** due to good management, good soil, and good weather
- **Sells crops for £50 million profit**, as there are more crops and they are of better quality
- Overall, this is a **high productivity farm**

Factors Affecting Productivity

- **The type of agricultural system:** There are **different agricultural systems** in practice globally, which have varying inputs to yield varying outputs. The **management strategies** within an agricultural system control inputs and outputs, hence productivity. Examples include:
  - **Intensive farming:** **High inputs** in relation to agricultural land to produce the **highest possible output**. High inputs could include a **lot of labour**, or **high capital inputs** - such as machinery - to maximise yields.
  - **Extensive farming:** **Low** labour and capital **inputs** in relation to agricultural land, thus usually producing **lower outputs**.

  - **Commercial farming:** Agriculture with the intention of providing **yields** that can be **sold commercially**, making a **profit**. This type of farming is usually associated with **intensive farming**, as more profits can be made using this management strategy.
  - **Subsistence farming:** **Self-sufficient farming**, where crops are grown only to support those growing the crops family or community, with little or no profit.

- **Climate:** Crops and livestock are reliant on the climate, as the climate creates the nutrients and environment for them to thrive in. Climatic factors such as **precipitation, temperature, humidity, and winds** dictate what type of agriculture can occur and its productivity. For example:
  - Some crops and animals can only be farmed in certain climates, such as tropical fruits, meaning the **productivity** of farms is limited with climate. High productivity farms will be those that choose agriculture that **will thrive in the climate**.
  - Certain levels of water are needed to sustain plant and livestock growth, e.g. plants need watered and livestock needs to drink. Climates that provide **appropriate precipitation** will allow for high yields, whereas drier climates must source water from elsewhere, or risk obtaining lower yields.
  - Temperatures must be within a certain range, as too cold or too hot temperatures will cause productivity to decrease (e.g. livestock and plants dying).
  - Climatic conditions that are **unfavourable** for agriculture, such as **subzero temperatures** or **deserts** also reduce productivity massively, and little agriculture can be sustained within these climates
  - Climate change has also affected agricultural productivity, as specialised farming cannot produce high yields due to the changing climate, and the amount of arable land is **decreasing** (i.e. more floods, more droughts etc.)

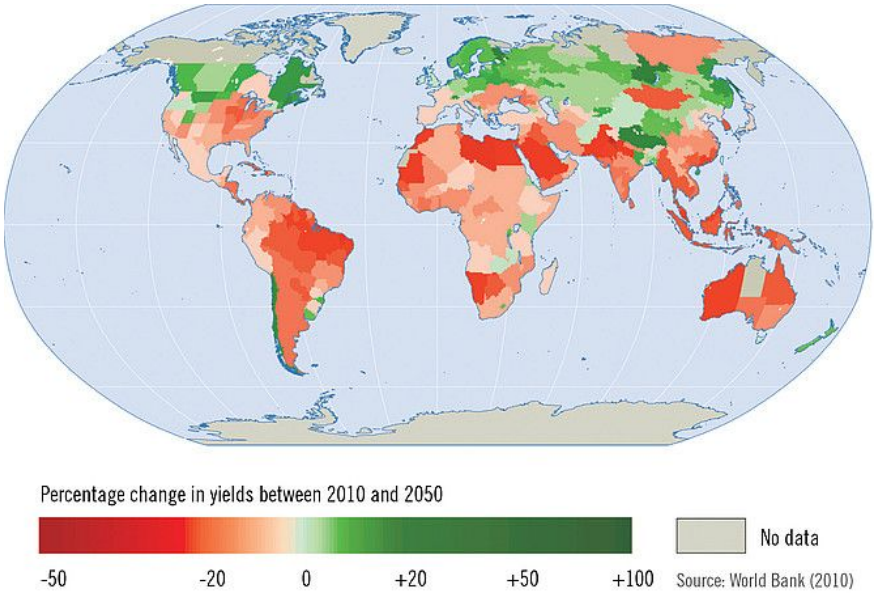
- **Soils:** Agricultural productivity is dependent on the **quality of soil**. Different soils are suited to different types of agriculture, meaning there is only productivity of certain types of crop in some soils. **Issues with soils** - such as erosion, flooding, or desertification - may also decrease productivity, as low **nutrients** in soil will affect plant growth and animal food supply. Soils effects on agriculture will be discussed in more detail.

How Climate Change Affects Agriculture

As previously mentioned, the climate provides **vital resources** for agriculture, and agriculture across the world is **specialised** to suit its climate. A **change in the climate** consequently has **varying effects** on different global agricultural systems, many of which are detrimental to agricultural productivity and food security. Some places will become **more productive,** others will become **less productive**.

The majority of the world will suffer from **yield declines**, with only areas like Canada, Europe, and some areas of Central Asia having noticeable increased yields.

Global Change in Agricultural Yields

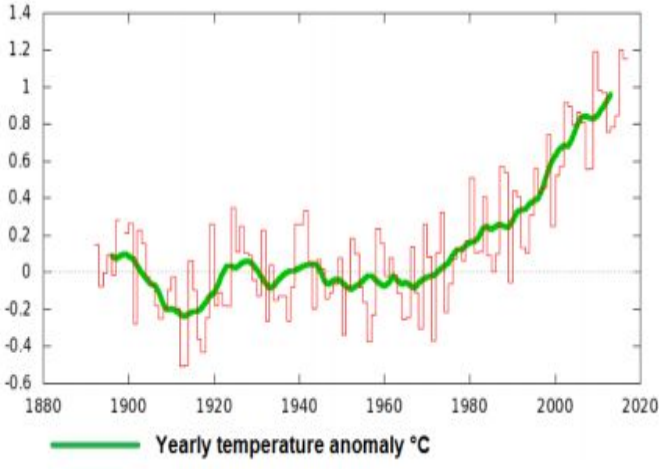


The increase in **extreme weather events** (floods, droughts, tropical storms, wildfires) is likely to **decrease productivity**, as these events can devastate large areas of arable and pastoral land.

Temperature rises and **precipitation changes** will also cause agricultural land to decrease in many areas. In Asia, it is predicted that per 1°C temperature rise, rice yields will decrease by **20%**.

Severe droughts in **East Africa** are thought to be worsening due to **global warming**, especially in Kenya and Somalia. Not only are **temperatures rising** abnormally in relation to historic records in these regions, but rainfall is becoming more **scarce and unpredictable**. In the past 10 years, 7 years have experienced severe droughts. With 70% of Africa's agriculture being rainfed, climate change has begun to - and will continue to - have disastrous effects in this region.

East Africa Temperatures



(Source: https://www.oxfam.org/sites/www.oxfam.org/files/mb-climate-crisis-east-africa-drought-270417-en.pdf)

Soil problems such as erosion, desertification, and salinisation are projected to **increase** in some areas due to higher temperatures. This will continue to make arable land unusable. (On the flip side, thawing permafrost will increase agricultural productivity in colder regions).

Rising sea levels due to melting sea ice is thought to cause **flooding** in low lying areas, such as Bangladesh, devastating crop yields.

Pests insects and plant diseases are projected to increase in some areas due to climate change, which will continue to **decrease agricultural productivity** in some areas. There is limited evidence that this is currently occurring, but it is a definite threat in the future.

Soil Problems

The **quality** and **structure** of soil can deteriorate for a number of reasons, including weathering and agriculture. Soils can **erode**, meaning the **topsoil** is worn away, or they may **degrade** due to other reasons.

SOIL EROSION

Soil erosion is a specific soil issue regarding the **wearing away** of soil, especially and most importantly the **topsoil**. Topsoil is the **upper layer of soil**, responsible for providing the majority of **nutrients** and **structure** for agricultural activities. If the top soil wears away, either through **water-related processes** or **wind**, soil erosion becomes an issue.

Water Erosion

Water erosion is the **degradation** and **wearing away** of soil due to water.

Water erosion can occur for a number of reasons, including **climatic factors** (flooding and heavy rainfall), lack of plants/trees for **interception**, and **topography** (e.g. on a slope, soil can wash away quickly due to rapid surface runoff). **Agricultural practices** can also contribute to water erosion; poor **irrigation** (**controlled** management of water for **agriculture**, rather than relying on **precipitation**), the removal of plants/ natural **interceptors** of precipitation, or poor **contouring** can cause water erosion, among other things.

Water erosion takes various forms, including:

Sheet erosion: Sheet erosion refers to the washing away of soil in a **uniform** manner, leading to the **widespread** removal of topsoil. **Heavy rainfall and flooding** can cause a **'sheet'** of water to wash over an area - especially when that area is on a slope - displacing the soil and its nutrients. Sheet erosion occurs providing that the water does not develop into faster flowing **streams**, known as **rills**.

Rills and gullies: Rills are small streams that develop by **erosional flowing water**. They often develop on **slopes**, as water flows naturally due to gravity. Over time, rills can develop into large ravines known as **gullies** (pictured). Huge amounts of **soil** and **nutrients** are washed away through this type of erosion, often leaving a permanently damaged landscape. This erosional process is exacerbated by agriculture, as **fields** empty of crops, plants, or trees allow for **streams** to develop.

(source: https://www.agric.wa.gov.au/water-erosion/water-erosion-agricultural-region-western-australia)

Riverbank erosion: Riverbank erosion is the **degradation** of riverbank sides, causing large sections of the bank to be **eroded away**. This can be devastating to agriculture, as it destroys **agricultural land**. Agricultural land surrounding the Brahmaputra river in Asia have been eroded away through this erosion.

(Source: https://www.prokerala.com/news/photos/brahmaputra-river-14261.html)

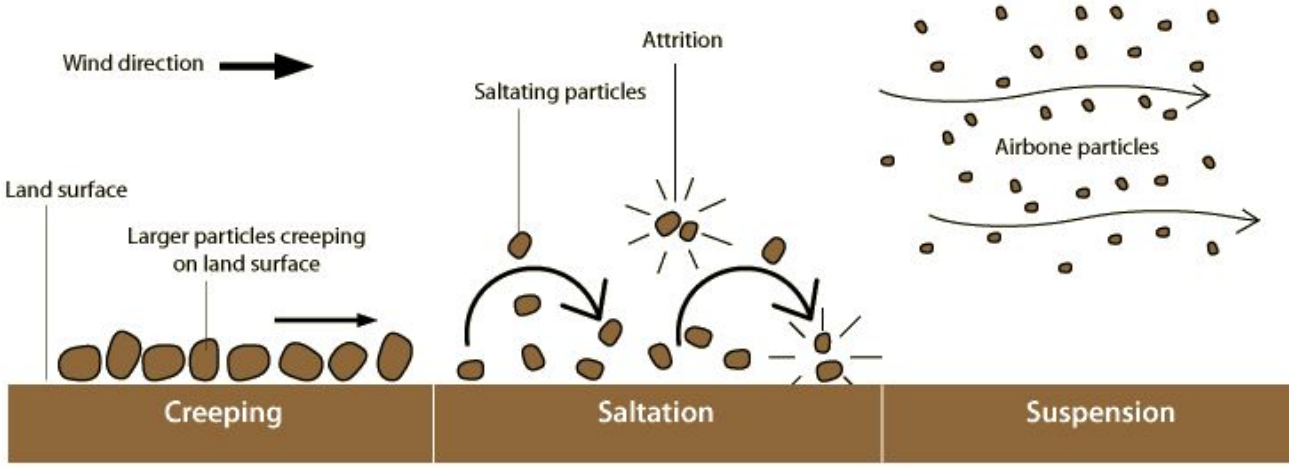
Water erosion creates several **issues for agriculture**:

- Soil is **washed away**, which causes **crops** to become unstable, and crops may also be **washed away**.
- Nutrients are **leached** away into lower parts of the soil, or entirely washed away, which can negatively affect plant growth
- **Weeds** can spread from other areas if carried in water, which can reduce the productivity of a farm
- **Rills and gullies** can obstruct farming equipment, reducing the amount of **agricultural land** and causing potential dangers. Undercut riverbanks are also dangerous, and can collapse.

Wind Erosion

Soil may also be eroded due to **high winds** blowing away the agriculturally valuable **topsoil**.
Wind erosion is prevalent in **dry climates**, as the soil particles are less **cohesive**, meaning the top soil becomes **unstable**. Areas of agricultural land are **more vulnerable** to wind erosion, as practices such as **ploughing and tilling** can loosen the soil particles. Furthermore, **overgrazing** or **clearing land** for crops causes the soil particles to become less bound together (as vegetation helps keep soil together and blocks wind).

Wind erosion differs by the **size of the soil particles** that are transported. Larger soil particles are usually heavier, meaning they cannot be transported as freely as smaller particles. Soil particles may slowly roll along the floor by **creep**, bounce by **saltation**, or be **suspended** in the air.



(Source: http://www.eschooltoday.com/landforms/the-process-of-wind-erosion.html)

Wind erosion causes several issues for agriculture:

- The most fertile **topsoil** is blown away, leaving crops with less **nutrients** for growth.
- Crops can become **buried** in thin layers of soil after high winds, which can damage crops and restrict sunlight.
- Wind erosion lowers a soil's **capacity to store water** as the depth of soil is reduced, which causes the soil to become drier. This, in turn, affects crops as there is less **water** available, and less space in the topsoil for **roots** (lowering productivity).

STRUCTURAL DETERIORATION

Structural deterioration is the **loss of the structure of the soil,** especially the **pores** (spaces) between soil particles that contain air.
Structural deterioration may **occur** for a number of reasons:

- **Livestock** can **trample** on the ground, which compacts soil and removes the natural spaces between the particles.
- **Crops** and plants' roots give **structure** to the soil, so removing these for clearing **agricultural land** or for **harvests** can disrupt the structure.
- Farming machinery can cause **soil compaction**, removing air spaces in the ground.

Structural deterioration can cause several **problems for agriculture**:

- Water cannot **infiltrate** due to the lack of space in the soil, meaning plants may become dehydrated.
- Root cells need **air** to survive, which they get from the soil environment. Structural deterioration can remove **air pockets** and essentially suffocate roots.
- Root growth may become **obstructed** as the roots cannot infiltrate compacted soil.
- Soil is harder to **work with** when the structure has deteriorated, e.g. it is harder to plough or till.

WATERLOGGING

Waterlogging refers to when the soil becomes **oversaturated** with water. A soil may be considered **waterlogged** when it is so **oversaturated** that there is no longer **oxygen present** in the soil, meaning plants cannot **respire aerobically** (with oxygen).
Although waterlogging may happen naturally due to **heavy rainfall** and flooding, it may also occur due to **structural deterioration** (as water cannot drain) or other farming practices, such as too much **irrigation**. The type of soil influences how easily it may become waterlogged.

(Source: https://www.agric.wa.gov.au/waterlogging/managing-waterlogging-crops-and-pastures)

Waterlogging has multiple **negative effects** on agricultural productivity:

- There is **limited oxygen supply** in the soil, restricting plant respiration and causing them to 'drown'.
- Roots may also **rot** in stagnant water, killing the plant or stunting growth.
- Waterlogged conditions can **leach away minerals for plant growth**, or bring **unwanted minerals** to the topsoil, such as salts.
- Water **lowers the temperature of soils**, which slows photosynthesis.

SALINISATION

Salinisation is the increase of **salt content** in soil, usually causing a **crust of salt** on the topsoil.

Salinisation can occur for a number of reasons, both environmental and human-caused:

In general, salinisation occurs when **saline water** (salt water) **rises** to the surface of the soil, and then water **evaporates**. This leaves salt concentrated in the topsoil.

(https://www.nrcs.usda.gov/wps/portal/nrcs/detailfull/national/water/quality/tr/?cid=nrcs143_010914)

High temperatures may draw **saline** soil water to upper parts of the soil. **Dry** climates may also heighten this process as the salts cannot be **leached away by precipitation.**

Irrigation water has a salt content (as does all water) and sometimes **saline water** may be used for irrigation when there are limited supplies. If there is no **proper drainage** or leaching in place, the salts will accumulate.

When **groundwater levels rise**, salts from lower levels of the soils are brought upwards. Groundwater levels can rise for a number of reasons, including increased precipitation in the area or human interference, such as dams. Fertilisers may also cause salinisation.

Salinisation negatively affects agriculture in multiple ways:

- Salts are **toxic** to plants, which can reduce the fertility of plants, reduce yields, or kill them.
- High salt contents in soils affect how plants can **absorb water**. Water usually moves from an **area of high concentration to an area of low concentration**, this process is known as **osmosis**. In normal soils, water will move **from the soil** (high concentration) **to the roots** (low concentration). However, when the salt content is high, this can hinder the process, or even **dehydrate the plants**. Even when there are **sufficient water supplies**, plants may still suffer from the effects of salinisation.
- Salinisation may also **break up natural soil structure**, affecting plant growth and productivity.

DESERTIFICATION

Desertification is where fertile land becomes dry, cracked and desert-like, leaving land unproductive.

Desertification is caused due to the **climate**; little precipitation and high temperatures dries out soils. However, **overgrazing** and **over cultivation deplete nutrients** in the soils and break down the structure. **Irrigation** may also drain **underground water stores** or cause **salinisation**, eventually causing desertification.

Desertification has detrimental effects on agriculture; plants cannot grow in the dry, compact, eroded, structurally degraded soils. As much as **a third of global land** is at risk of desertification.

Management of Soil Problems

Soil problems may be **managed and mitigated** through different **techniques**.

Overall, it is much more efficient to **prevent** these issues rather than **fix** them once they have already occured. Processes such as salinisation and desertification are very **difficult and expensive** to reverse, meaning strategies to manage soil problems are most effective when they are used to **prevent** soil degradation.

Efficient irrigation and drainage

Waterlogging, water erosion, and salinisation can all be caused by a **water surplus**, which can be managed by **controlling water levels**.

Drip irrigation can be used to avoid overwatering (using less water to efficiently water plants). Agricultural areas can also use methods of **drainage**, such as underground drainage systems.

Runoff can be redirected through several techniques:

- **Contour ploughing** (where lines are contoured across a downhill slope so that water does not flow downhill quickly in the contours, but is obstructed)
- **Terracing** (where steps are carved into a hillside to spread out water levels, rather than it flowing downhill)
- **Diversion channels** (where runoff can flow in channels that provide the quickest route, redirecting them away from crops

Moving livestock

Regularly moving livestock ensures the ground is not **trampled extensively**, which limits structural deterioration. This also avoids **overgrazing**, so that plants can keep the structure of the soil intact.

Cover crops

A **cover crop** is a crop that is planted primarily for **maintaining soil quality**. The crop is used to cover a **bare field**, so it is less vulnerable to soil issues such as erosion. It's main purpose is not necessarily to obtain a yield.

Cover crops maintain the **structure** of the soil, as plants hold soil together with roots, take up soil water, and protect soil particles from wind and rain. **Waterlogging, water erosion, wind erosion** and **structural deterioration** may all be prevented.

Multiple cropping

Multiple cropping is the process of planting **more than one crop** in an agricultural area during an agricultural season (i.e. at the same time).

Having **multiple crops** on agricultural land stops certain nutrients being overexploited as which maintains soil quality. **Monoculture** (one crop) depletes **certain nutrients** from the soil, leading to poor soil quality and structural deterioration. Multiple crops provide a more fertile and healthy soil.

Changing soil composition

Altering the **composition of soil** can limit **wind erosion** and **structural deterioration**, as adding certain materials can encourage a **well-binded soil** with natural **pores**.

Adding **mulch** to soils can protect small soil particles from wind erosion, as it binds the soil together. Adding **sand** to clay soils can stop soils **clumping** and **structurally deteriorating**.

Windbreaks

Bushes, trees, or man-made windbreaks such as **netting** can **obstruct winds**. This can limit wind erosion on arable land, yielding higher productivity.

Food Security

Food security is the concept of having **available**, **accessible**, and **affordable** food that is safe and **nutritious**, so that people may live a **healthy** lifestyle.

Strategies to Ensure Food Security

Not every population in the world has **food security**, in fact **1 in 10 people** globally experience **chronic hunger** as they do not have access to sufficient food. There are strategies to **overcome food insecurity**; not only can **more food be produced**, but the food that is available can be made more **accessible**, and waste can be reduced to **save food**.

Increasing access

Increasing a country's access to **foreign markets** means they can import food, increasing food security.

Trading agreements such as **trade blocs** can be very beneficial to a country that is struggling to **provide enough food** for its population.

In times where food security is dangerously limited, such as after a crisis or natural disaster, **aid** and **relief** can also increase food security.

Increasing amount

Strategies and **new technology** (e.g. GM crops) can increase the amount of food being produced, which therefore increases food security as there is more food **available**, and this food may also be **healthier**.

Managing farms more successfully through training, farming equipment, and **high yielding varieties** (HYVs) can increase food supplies. This means a country has more food **available** to distribute to its population.

Increasing efficiency

Similarly to increasing the amount of food, increasing the efficiency of a farm can save time and food, meaning overall there is more food **available** and it may be more **affordable** as there are **less expenditures**.

Equipment and **better management** can produce more crops in less time, helping affordability and availability of food.

Waste can be reduced by harvesting natural resources and having better storage.

Green Revolution

The Green Revolution (mid-20th century) is an example of how **technology** increased **food security** by increasing the **amount** of food and the **efficiency of a farm** - specifically in developing regions.
The increased use of **fertilisers/pesticides**, **mechanisation**, **irrigation**, and development of **high yielding varieties** (HYVs) increased yields in areas such as India.
The Green Revolution is thought to be responsible for increased calorie intake in low income countries, e.g. it is thought to have **raised grain yields by 160%**. However, there have been issues associated with the revolution, such as **salinisation** caused by irrigation, or farmers **unable to repay loans** on expensive equipment.

Practical Action

Practical Action work to show people **practical ways** to overcome issues such as **food insecurity**. By increasing efficiency of food practices, the **amount of food** and its **quality** is increased.
For example, Practical Action have worked to incorporate **rainwater harvesting** in disadvantaged communities to save water for drinking and agriculture. **Zeer pot fridges** are another example of Practical Action's work; these easily made pots are naturally cool, making them useful for preserving food in hot climates.

Global Agriculture & Food Security Programme (GAFSP)

GAFSP is a global partnership that supports sustainable agriculture in developing countries, with the intention of creating **food security**. It works to increase the **efficiency** of smallholder farmers.

For example, a GAFSP funded programme in **Rwanda** increased some yields by 30%. Training communities and farmers in efficient practices such as crop drying and compost making helped to increase yields and save money for more investments.

Global Patterns of Health, Mortality, and Morbidity

HEALTH Physical and mental well-being

MORTALITY Death

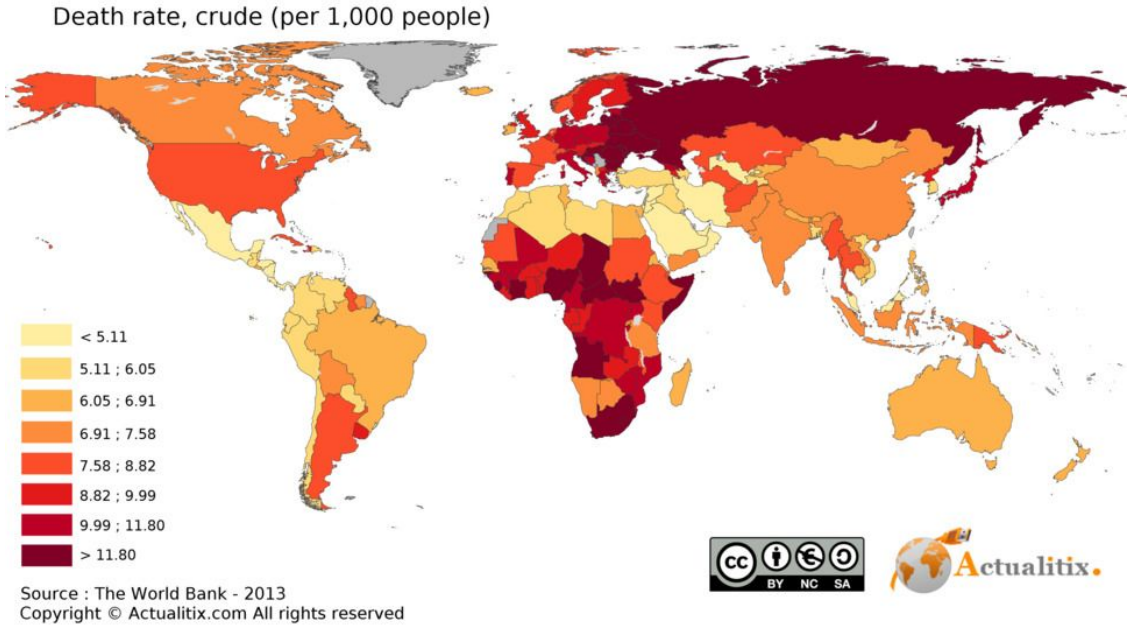
MORBIDITY Illness from disease

Health, mortality, and morbidity can be used as **indicators** of a population's development.

Mortality can be numerically measured by **mortality rate** (number of deaths over time, per unit of population - usually per 1000) and morbidity can be measured by **disease incidence** or **prevalence**. Health can be measured using a range of measures, including mortality and morbidity rates.

Patterns of Mortality

Mortality rates do vary throughout the world, and provide some indication of the **socioeconomic status** of a region/country. **Crude death rates** are highest in all but Northern **Africa** - a low income region - but are also high in **Russia** and **Eastern Europe**. Mortality is particularly low in **Central America** and the **Middle East.**

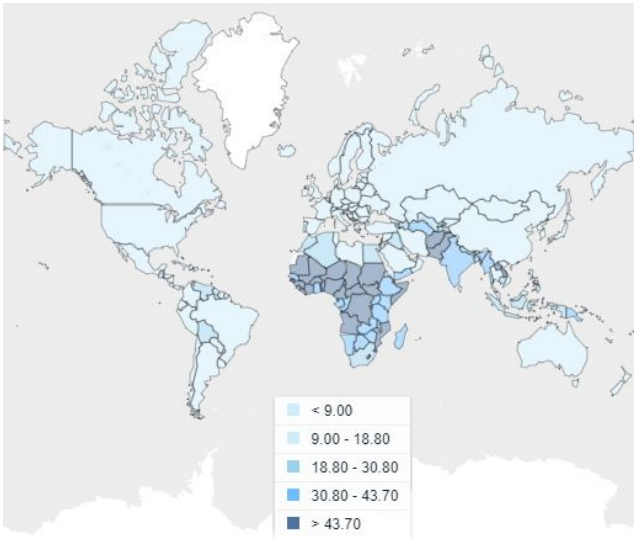


Infant mortality (the amount of infants that die per 1000 births) is another indicator of **mortality**, and perhaps a better indicator of the **socioeconomics** of a region. Infant mortality is highest in Africa, as well as Pakistan, Afghanistan, and Laos.

Infant mortality rates are usually lower in high income, developed countries, such as in the regions of Europe and North America.

The map to the right shows infant mortality rates per country, 2017.

Source:https://data.worldbank.org/indicator/SP.DYN.IMRT.IN?view=map)

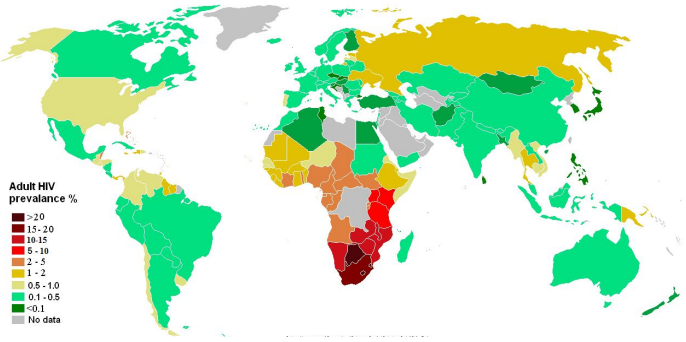


Patterns of Morbidity (and Health)

The incidence and prevalence of disease **varies regionally**, and to a certain extent these trends show **health** in these areas also.

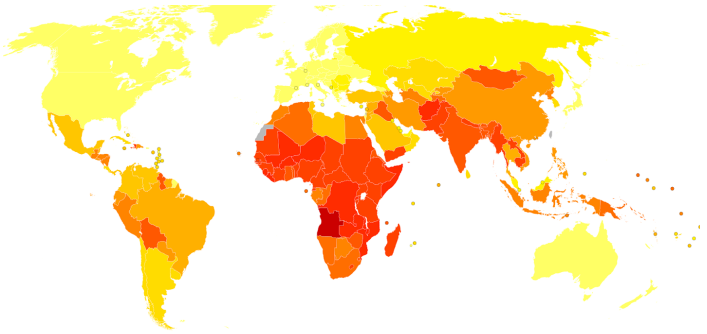
Morbidity rates are shown through **the incidence** of diseases. In general, **non-communicable diseases** are higher in HICs, whereas **infectious diseases** or **biologically transmitted diseases** are more prevalent in LICs. This trend can be seen in the maps below; note how infectious diseases are higher in poorer regions such as Africa.

HIV prevalence



(Source:https://upload.wikimedia.org/wikipedia/commons/d/d7/]HIV_Epidem.png)

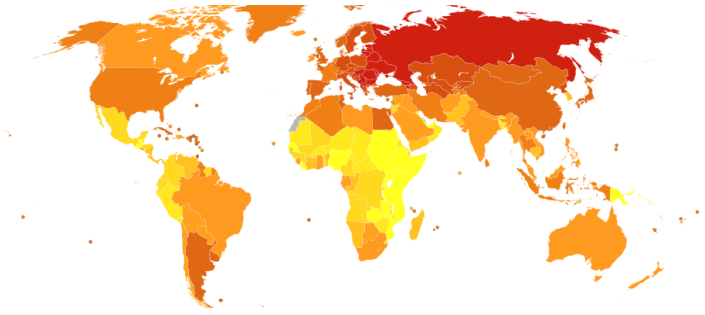
Diarrhoeal Diseases prevalence



(Source:http:/upload.wikimedia.org/wikipedia/commons/5/51/Diarrhoeal_diseases_world_map_-_DALY_-_WHO2002.svg)

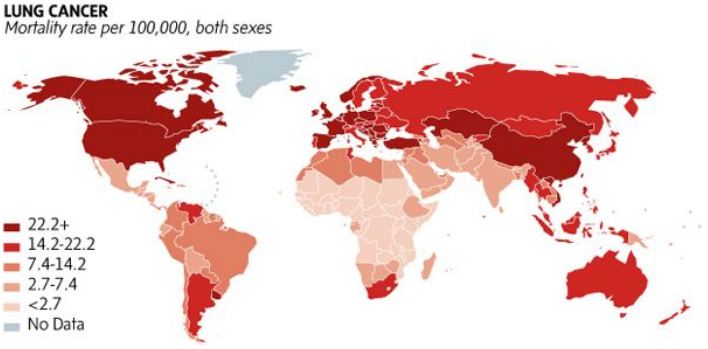
As previously mentioned, some diseases are more prevalent in **high income countries**. These diseases are usually influenced by lifestyle choices, e.g. lung cancer can be caused by smoking or poor air quality.

Cardiovascular Disease Prevalence



(Source:https://commons.wikimedia.org/w/index.php?curid=50287978)

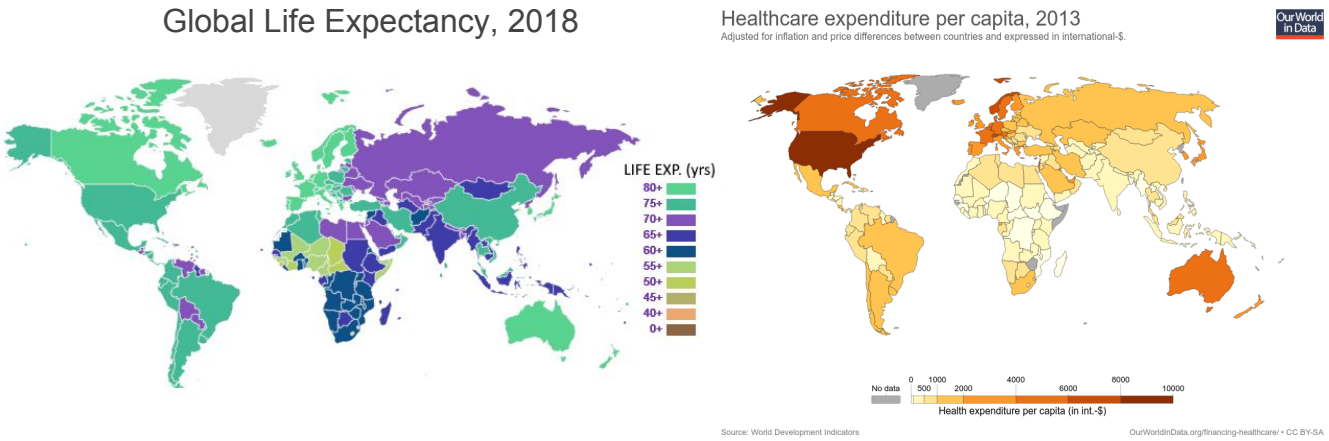
Lung Cancer Prevalence



(Source:https://www.theglobeandmail.com/life/health-and-fitness/health/five-maps-that-put-cancers-global-spread-into-focus/article16679285/)

A mortality rate of a disease is dependent on the ability to **treat morbidity**. Usually, mortality rates are lower than morbidity rates as people can usually be treated. However, the proportion of those who die from the disease they have contracted is higher in LICs than HICs.

Health is usually better in **high income countries** compared to low income countries, which is somewhat demonstrated by the **morbidity rates** of certain diseases in HICs compared to LICs. Another indicator of health is life expectancy, which is higher in HICs. HICs usually **spend more money on health**, which often correlates to the higher life expectancy.

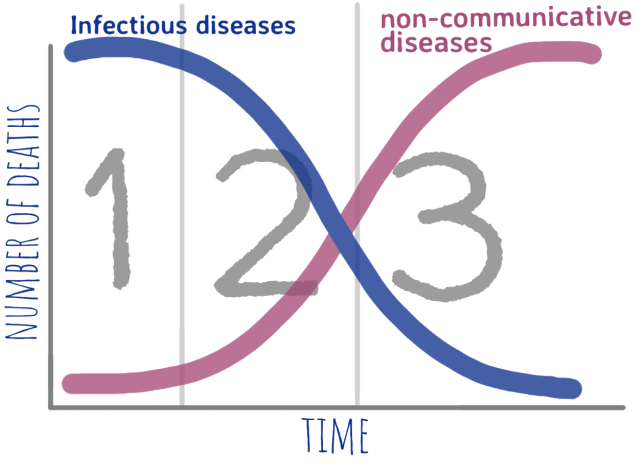


(Source:https://www.worldlifeexpectancy.com/world-life-expectancy-map)

The Epidemiological Transition

The epidemiological transition is a theory regarding **population change**, specifically how **morbidity** (and therefore **mortality**) **changes** as a society develops **over time**. Although the concept of the epidemiological transition will consequently have effects on **population** (as disease prevalence and type has effects on birth rates, death rates, and fertility rates), the **Demographic Transition Model (DTM)** shows these changes more clearly. The epidemiological transition is rather concerned exclusively with how **disease** and consequent **deaths** (hence '*epidemic*' meaning prevalence of disease) change as society develops socially and economically.

The concept of the epidemiological transition can be shown on the **Epidemiological Transition Model**. The model outlines how as time goes on and society develops, the **number of deaths from infectious diseases decrease** (due to societal advancements such as better healthcare, technology etc.), and consequently **the number of deaths from non-communicable diseases increases** (due to changed lifestyles, people living longer for diseases to develop etc.).



1. **Pestilence and famine:**
   - Infectious disease
   - Many pandemics
   - High mortality due to disease
2. **Receding pandemics:**
   - Advances in technology
   - Advances in medicine
   - Social change - hygiene etc.
   - Less infectious disease
3. **Degenerative & man-made diseases:**
   - Developments in society creating diseases, e.g. coronary heart disease from lack of exercise
   - Infectious diseases are low

The Environment and its Effects on Health

As well as social and economic factors, the environment has a **major** part to play in the **health** of a population. **Environmental factors** such as climate can impact the prevalence of **disease**, as well as general physical/mental **wellbeing**.

Environmental Variables and Incidence of Disease

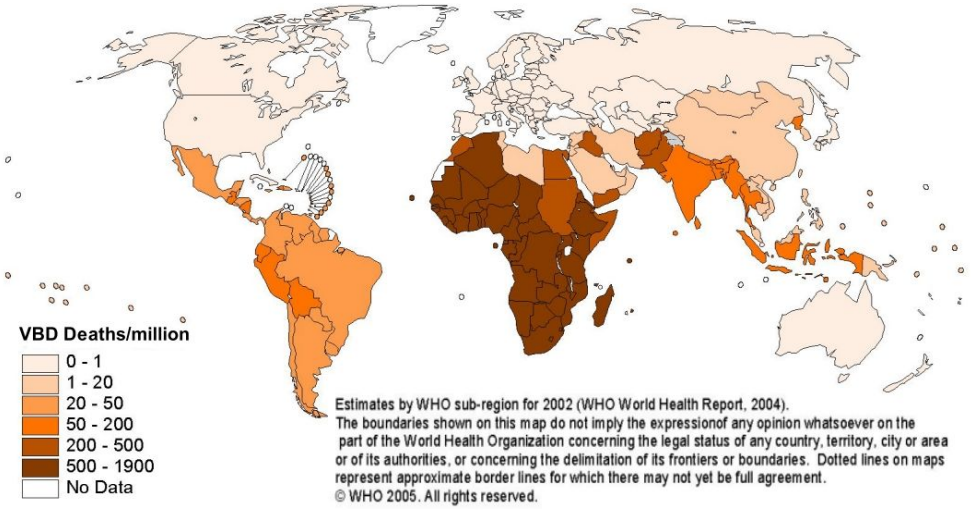
Climatic factors can **influence** the incidence of disease, as many diseases are **dependent** on the environment (e.g. temperature, precipitation, humidity etc.). Some examples of diseases that are influenced by climate are:

Vector-borne diseases (VBD)

These are diseases caused by a '**vector**' (a **carrier**) passing on a **pathogen** (**disease**) to a **human**. A prevalent example of a VBD is malaria; **mosquitoes** act as a **vector** to transmit the **pathogen**, which infects **humans** when a mosquito bites them.

Vector-borne diseases are usually reliant on **specific conditions** that allow for the vectors to **live** and **breed**. **High temperatures** and access to **water bodies** (i.e. places with high precipitation) are needed for mosquitos to thrive, which is why many mosquito-borne diseases are prevalent in the region of the tropics.

Deaths from vector-borne diseases



Extreme weather events

Some areas are more prone to **environmental hazards** than others; tropical storms, floods, tornadoes, wildfires etc. vary in prevalence globally. With these extreme climatic events brings **disease** after they strike, especially in the case of water-borne diseases. **Cholera, typhoid, dysentery, and diarrhoeal diseases** all spread in water, meaning there are commonly outbreaks after natural disasters such as floods and tropical storms. However, the spread of diseases after natural disasters is not **exclusively caused by environmental variables**, moreover the incidence of disease is exacerbated by socio-economic disadvantages in an area.

TOPOGRAPHY & GEOGRAPHICAL LOCATION

Disease is also influenced by **location** and **physical environment** of an area. The **topography** of an area (the way in which an area is **set out**) can influence how easy it is for disease to spread. Furthermore, the **latitude/longitude** of an area can influence the incidence of disease, especially those influenced by **sunlight**.

Topography

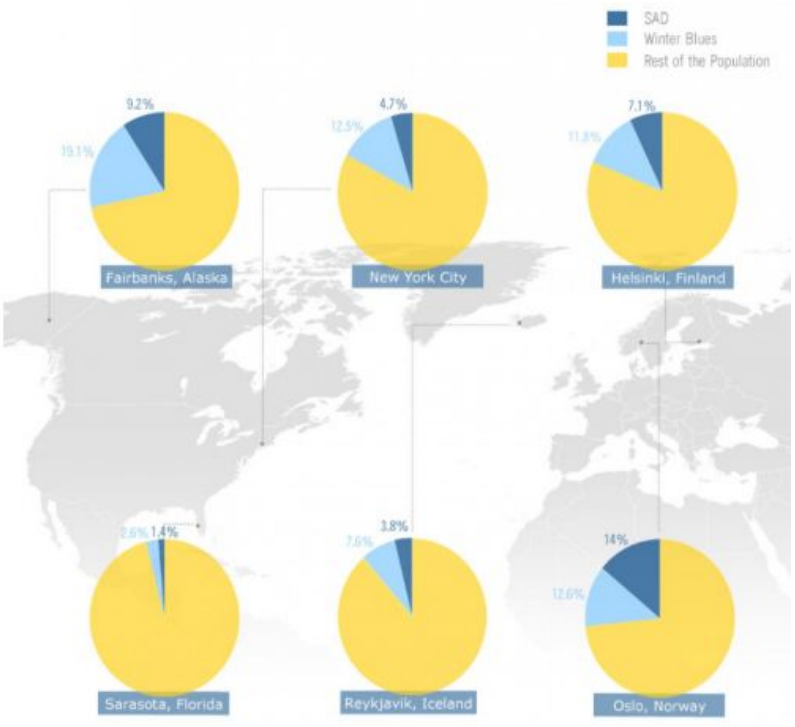
Low-lying areas, especially floodplains and valleys next to steep hills, are particularly prone to **water-borne disease**. Unlike steep areas where precipitation can leave an area through **runoff**, low-lying areas can have poor **drainage**, and can **stagnant water** can develop. Floodplains also host water-borne diseases, as they are consistently flooded and over saturated. Flooded areas and stagnant water also open up the risk of other diseases, such as disease associated with mould or contaminated water.

Sunlight and Exposure

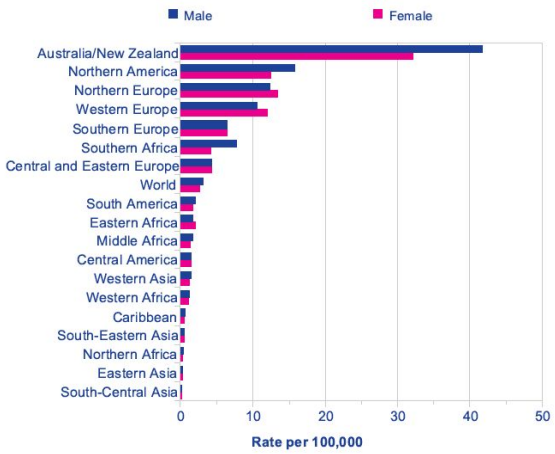
Too much or too little sunlight can cause **disease**, which is why places at varying latitudes have varying levels of disease.

The lack of sunlight can cause **deficiencies**, especially a vitamin D deficiency. This is known to lead to bone pain, muscle weakness, and the disease **rickets**, among other issues. Aboriginal Arctic populations are among the most severely affected by vitamin D deficiencies and related diseases.

Seasonal Affective Disorder (SAD) also correlates to geographical location. In general, areas that experience low daylight hours in winter months have higher rates of SAD.



(Source:https://visual.ly/community/Infographic/health/how-beat-seasonal-affective-disorder-and-winter-blues)



Overexposure to sunlight can also cause diseases, meaning areas that receive **more intense sunlight** (which is dependent on latitude/longitude/altitude) can heighten the risk. **Various types of skin cancer** can develop from overexposure to UV radiation, meaning areas that receive intense UV radiation have higher cancer cases.

Australia has the highest **skin cancer** rates in the world, which is partly due to the **high amounts of UV exposure it receives** (due to its latitude and its proximity to the hole in the ozone layer).

(Source:https://theworldofcancer.files.wordpress.com/2014/05/skin-cancer-worldwide.png)

Environmental Variables and Effects on Health

Water Quality

Good water quality is absolutely critical for the maintenance of **good health**. Not only do we need to drink water in order to stay **healthy** and **hydrated**, but water is also used to maintain **sanitation** and **hygiene** (which prevents the spread of disease).

Water-borne diseases and other pathogens (e.g. poliovirus) can contaminate water supplies. Diseases such as cholera, dysentery, and typhoid are carried in water, which - when ingested - cause **illness**, **complications** (such as infections), and sometimes **death**. Poor water quality leads to the prevalence of **diarrhoeal diseases**, which have multiple implications on health; diarrhoea is the **second leading cause of death in children under 5 globally**.

Limited access to clean water for bathing, washing, and general sanitation creates **poor water quality**. In low income countries especially, many people use the same water supply for **dumping** human waste, **cleaning** themselves, cleaning **livestock**, washing up, and **drinking**. **Faecal matter** in water supplies can cause illness and **spread disease**. Pathogens in water may also enter the body through open wounds or accidental ingestion when bathing/ eating from dirty washed items.

Toxicants (a toxic substance that enters an environment) may also enter water supplies and have the potential to poison or kill. Water can become contaminated and polluted by a number of harmful chemicals. Factories may **dump toxic waste** into water supplies, or **insecticides and pesticides** can enter water supplies after rainfall, to name a few examples.

Image: Isnapur Lake, which is located near several large drug factories in Hyderabad, India.
(Source:https://www.wsj.com/articles/big-pharma-investor-calls-for-supply-chain-transparency-1516815722)

Many people do not have **access** to clean drinking water, meaning they have to use dirty water, as there is no alternative.

Air Quality

91% of the population live in areas of unsatisfactory air quality. The air can be contaminated by a number of **pollutants** that can cause **illness** when **inhaled**. There are two main types of air pollution: **ambient** (outdoor) air pollution and **household** air pollution.

1 IN 9 DEATHS WORLDWIDE ARE CAUSED BY AIR POLLUTION

Ambient Air Pollution

Although there are natural causes to ambient air pollution, such as forest fires and dust storms, **anthropogenic** (human) activities contribute **much more severely** to ambient air pollution. Sources include:

- **Fossil fuel combustion** from motor vehicles, heat and power generation etc.
- **Industrial facilities** (e.g. manufacturing factories, mines, and oil refineries)
- Waste sites or waste **burning**
- Use of **polluting fuels in homes** for cooking/ heating

(Source: http://time.com/4259548/mexico-city-air-pollution-alert/)

Ambient air pollution cause illness and deaths all over the world, especially in urban areas where these pollutants are concentrated.

Household Air Pollution

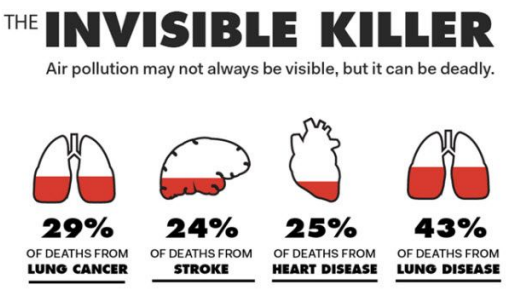
Household air pollution is caused by a variety of issues, mainly the **burning of polluting fuels inside households that are not properly ventilated** (which is why household air pollution is majorly concentrated within LICs, where housing standards are lower). **Smoke**, **carbon monoxide**, **sulfur dioxide** and other harmful pollutants can be emitted through burning fuels inside when cooking/ heating.

Non-combustion related pollutants include mold, and building materials such as asbestos.

(Source: https://thelogicalindian.com/awareness/air-pollution-deaths-india/)

All types of air pollution have severe effects on health. These effects include:

- ❏ Lung disease
- ❏ Strokes
- ❏ Heart attacks
- ❏ Cancer
- ❏ Respiratory problems - bronchitis, asthma etc



(Source: https://www.who.int/airpollution/en/)

Role of International Agencies and NGOs in Maintaining Global Health

Global organisations play a vital part in **promoting health** and **fighting against disease**.

International agencies **work with governments**, **conduct research**, **spread awareness**, and **provide resources** with the intention of achieving **good health globally**. **Non-governmental organisations** (NGOs) are non-profit organisations that work independently from governments. Many NGOs are charities that rely on donations, although international agencies can also be classed as charities. Many NGOs provide **healthcare** in areas where it is **essential**, especially in humanitarian crises or natural disasters.

International Agencies

Many established international agencies are branches of the **United Nations**, including:

World Health Organisation

The WHO aims to improve global health and fight disease. Their main responsibilities are outlined on their website:

- Providing leadership on matters critical to health and engaging in partnerships where joint action is needed
- Shaping the research agenda and stimulating the generation, translation and dissemination of valuable knowledge
- Setting norms and standards and promoting and monitoring their implementation
- Articulating ethical and evidence-based policy options
- Providing technical support, catalysing change, and building sustainable institutional capacity
- Monitoring the health situation and assessing health trends

(Source: www.who.int/about/what-we-do/en/)

Food and Agriculture Organisation

The FAO aims to overall **prevent hunger**, thus maintaining global health. A main aspect of the FAO is its research, allowing people to work with their information to come up with mitigation strategies to avoid disease and promote health.

World Food Programme

The World Food Programme aims to **eradicate hunger** globally, therefore promoting good health. The organisation delivers food assistance in emergencies, such as after natural disasters. They also work with communities to '**improve nutrition and build resilience**'.

NGOs

Médecins Sans Frontières (MSF)

Médecins Sans Frontières (Doctors without Borders) is a **charity** that provides **aid** globally, e.g. after a natural disaster or an epidemic. Their website states that ' at the core of MSF's identity is a commitment to **independence**, **neutrality** and **impartiality**.'

Oxfam

Oxfam is a charity that aims to **eradicate poverty** globally. They work with countries in need, providing clean water, sanitation, and other essentials both in **emergencies** and **over time** to promote long-term health.

The Bill & Melinda Gates Foundation

Commonly known as the Gates Foundation, this charity is the **richest** in the world. The charity has a broad range of focuses, from **eradicating disease to promoting health**. The Gates Foundation works with research and prevention of diseases such as HIV, malaria, tuberculosis and other diseases. The charity also works to promote **global development**, i.e. through providing vaccines and emergency response teams etc.

Natural Population Change

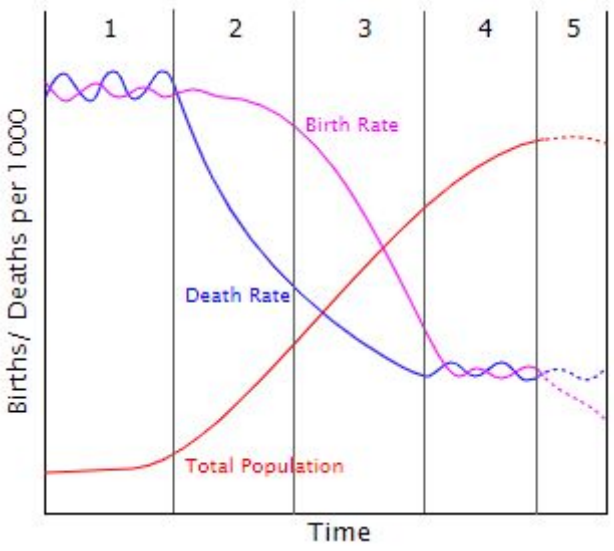
Natural population change is affected by multiple factors influencing the total population of an area.

Vital rates show how the most **important** (vital) aspects of the population **change**, and the **speed** at which they change (rate):

- **Birth rate**: Number of **live births** per 1000 of the population per year.
- **Death (mortality) rate**: Number of **deaths** per 1000 of the population per year.
- **Infant mortality rate:** Number of **deaths of infants** under the age of 1 per 1000 of the **live births** per year.
- **Total fertility rate:** The **average number of children** a mother will birth in her **reproductive** age.
- **Population growth rate**: **% change** (in a year). If birth rates exceed death rates, % change is positive, if death rates exceed birth rates, % change is negative.
- **Life expectancy**: Average number of years someone is **expected to live** for.

Demographic Transition Model

The trends of **natural population change** (from the start of a population to present day) is represented within the **Demographic Transition Model (DTM)**. This model shows how the birth rate and death rate change over time, and how this affects population numbers.



Stage 1

High, fluctuating birth and death rates due to high levels of **disease**, **pestilence**, **famine** etc. **Birth control** is virtually **non-existent**, giving reason as to why birth rates are **high**, although they **fluctuate in correspondence to pestilence/disease/famine** etc.

Population remains **constant and low**, as birth rates do not exceed the equally **high death rates**. Population is dependent on food, meaning any **limits to food supply** (e.g. from droughts or other disasters) would have significant effects on **population**. It is generally agreed that there are very few populations that are still in stage 1 of the model, aside from perhaps tribal communities.

Stage 2

This stage is characterised by a **fall in death rates**. The reason behind the fall in death rates is due to major **societal developments**, for example the Agricultural Revolution. Advancements in **healthcare**, **hygiene**, and general **living standards** lower the **incidence of disease**, causing **less deaths** in that respect. Furthermore, increased **food security** also leads to less famines etc. lowering the **death rate**. **Birth rates** are still **high** (although it is important to note they are not increasing generally, they just **remain** high) leading to a **rapid increase in population** as there are more people living. A notable example of a country in this stage would be **Angola**, although many Sub-Saharan African countries, as well as Yemen, Afghanistan, and Iraq fall into this category.

Stage 3

In stage 3, **birth rates start to fall** due to further **societal developments**. These changes in society are less concerned with **health and food** like in stage 2; they are instead **cultural and social changes**. For example:

- **The emancipation of women**: **Women's rights** become more **recognised societally** in this stage; it becomes **more socially acceptable** for women to choose whether they wish to have children, and how many they choose to have. Women are no longer seen as **child bearers**, but instead are **beginning to work** and earn their own livings, decreasing birth rates.
- **Contraception**: Developments in science **and** the right for women to choose both lead to the development of **contraceptive methods** for birth control. The availability of contraception allows birth rates to fall.
- **Reduced need for large families**: As society develops, the need for a **large family** is reduced. In the past, children were **assets** to a family for **labour**, e.g. providing work on farms. As **society develops**, there is a shift in **industry** causing there to be less need for large families, e.g. living in an **urbanised** area. Furthermore, as death rates have previously fallen, it is now recognised that there isn't a need for many children (i.e. there is less risk of them dying and the parents being left without carers).
- **Education and change in societal values**: Higher **literacy** rates (especially in women), education about **contraception**, and a more educated **workforce** all lower the need for many children. Furthermore, society's view of the **'ideal family'** changes, and it is no longer an expectation to have a large family, causing birth rates to fall.

Many Low-Middle income countries are in this stage, including Mexico and India (both rapidly developing economies).

Stage 4

Birth rates and death rates are both **low**, causing **population growth to slow**, but still grow overall. The majority of high income, developed countries are in this stage, including the UK.

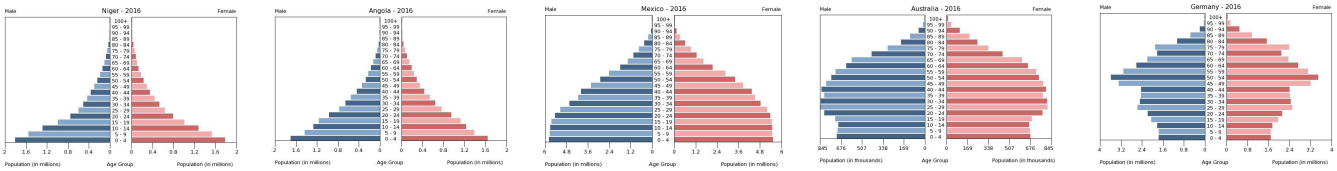
Stage 5

This stage is not officially in the model, but has been proposed. In this model, **birth rates fall below death rates**, causing a **decline** in population. Germany is usually named as an example of a stage 5 country, however unnatural population growth (migration) is changing the population structure.

Aspects of Demographics

Age-sex composition

Age and **sex** are the two major demographic variables in a population, and these variables can indicate a country's level of development. Age-sex composition can be shown on graphs known as **population pyramids**. These graphs can be related to different stages of the DTM.



(Source: CIA World Factbook. Left (blue) is male population and right is female population)

STAGE 1 **STAGE 2** **STAGE 3** **STAGE 4** **STAGE 5?**

Stage 3 and 4 - The Demographic Dividend: A **demographic dividend** is where **birth rates and death rates fall**, causing the **dependency ratio to decrease**, resulting in a large **work force** contributing to the economy.

Dependency ratio: The proportion of **dependants** to **economically active**. Dependants are typically under 18s and over 65s, but this definition varies.

Stage 5 - Ageing population and replacement levels: The more populous age group in stage 4 will eventually become **older and dependent**, creating an ageing population that needs to be cared for. The **'replacement level'** refers to the amount of population needed to **replace** the amount of people **getting older.** This population needs to sustain the economy as well as care for the large elderly population. When birth rates fall, birth rates do not meet the replacement level, causing '**sub-replacement fertility**'.

Controlling Natural Population Change

Population change has been affected by a number of **cultural controls**. The population may be **controlled** by the government, but it may also decrease naturally (like in stage 3 of the DTM).

- **Societal population control:** creating **policies** to artificially **alter** with populations. This may be through **encouragement** (e.g. incentives to have more children) or **laws** (e.g. China's one child policy beginning in 1980). As population growth decreases in countries, governments often encourage people to have more children to avoid the risk of **sub-replacement fertility.** In the 1930s/40s, France tried to avoid this by banning contraceptives, giving grants to families with three childrens, and extending maternity leave.

- Access to **contraception** and **education**: sex education and contraception can **lower birth rates** and fertility rates as people can control whether they want to have children.

- The **emancipation** of women: over time, **society's view of women has changed,** and women majorly have the **freedom** to choose whether they want children, and when they want children. Women's rights to work especially has lowered birth rates and fertility rates.

- **Societal norms** and the 'ideal family': Aspects of culture such as cultural norms and religious views can affect the number of children in families. Some cultures see large families as important and normal, whereas other cultures prefer a smaller family.

Unnatural Population Change: Migration

Population is affected by **migrants** moving in and out of countries. Types of migration differ:

Economic migrants - People who have moved **voluntarily** for reasons of work and improved quality of life.

Refugees - People who have been forced to leave their homes and travel to another country due to fleeing **conflict, political or religious persecution**. They have been granted permanent or temporary residency by the host country or the UN refugee agency (UNHCR).

Asylum seekers - People who have **left their country** and are seeking **asylum** in another. They are waiting to be granted residency and to become a refugee.

Causes of Migration

International migration is caused by **push and pull factors**.
Push factors: reasons migrants wish to **leave their current country** (pushing them away)
Pull factors: reasons migrants wish to **move to another country** (pulling them towards).

Push Factors	Pull Factors
High **unemployment**, low job opportunity and low wages causing **economic difficulty**. **Environmental quality** is low: lots of **pollution**, hazardous environment e.g. toxic waste, low access to clean drinking water and sanitation. **War** or **persecution** in home country. **Political unrest** in home country. Poor **public services** (education, healthcare emergency services etc.). Overall **low quality of life**.	More **job opportunities** with **higher wages** and safer working standards. **Environment** is better, including living environment (access to clean water, sanitation, central heating in homes etc.). No **wars**/ **persecution** for beliefs, meaning people can live **freely**. **Public services** are better (better education, better healthcare, emergency services) More **leisure activities** and ways to enjoy yourself, especially due to a higher disposable income.

For example, many Polish people move to the UK in search for better job opportunities due to high unemployment in Poland.

Processes of Migration

Migration is influenced by a number of processes and factors:

- **Governments control migration**, meaning the process of migration is greatly influenced by a country's **migration policies.** For example, in the EU there is **freedom of movement**, allowing EU citizens to move, live, and work within other EU countries. In other countries, there are stricter immigration rules. In Australia, for example, there is an immigration **points system**, only allowing skilled citizens that will contribute to the economy to live there.
- **Barriers**, both physical and socioeconomic, limit migration. Many migrants have limited **access to transport**, or little money to migrate. Many must resort to illegal migration,

where they face **a dangerous migration process**, such as the crossing of the Channel from Calais to South England (using small boats, hiding in lorries etc.).

Impacts of Migration

Migration has a range of impacts on both the country **receiving** migration and the country being **emigrated** from.

Impacts	Country that people are migrating **to**.	Country that people are emigrating **from**.
Social	o Societal **multiculturalism**. o Those fleeing from **conflicts** or **poor quality of life** may have a better life in countries they move to. o Migrants can contribute to society, e.g. **services** such as healthcare.	o **Relaxed pressure on services**, meaning people may have a better quality of life as there could be better access to healthcare, lower house prices etc.
	o **Overpopulation** can cause **pressure on services** such as healthcare o **Conflicts** between nationals and migrants due to **negative effects of migration**.	o **Underpopulation** could cause more pressure on services (less people **working** so many jobs are left unfilled). o As many migrants are more desperate for work than nationals, they may be vulnerable to **exploitation**, such as poor working conditions and low wages.
Environmental	o Larger **workforce** for **environmental protection**.	o Possibly reduces **waste**, fuel usage, emissions etc. as there are **less people.**
	o Higher demand for **environmentally unsustainable resources** (e.g. need for housing, waste, fuel) when population increases in an area.	o Smaller **workforce** for environmental protection and conservation, e.g. more derelict businesses and houses, less people employed for waste removal etc.
Economic	o Migrants become intertwined in **work forces** and do often unwanted jobs, as well as pay **taxes**.	o Workers send **remittances** back to their home country, helping their economy to grow.
	o May become **dependent** on the migrant workers, causing issues e.g. if migrants stop coming. o **Lack of jobs** for nationals o Remittances do not benefit host country's economy.	o **Skilled workers leave** to work in HICs, meaning unskilled people are left to keep the economy running. o Home country may be **dependent** on remittances, so a change in circumstance may be detrimental to the economy.

Political	o Countries that accept large quantities of migrants often have strong ties with the home country, decreasing **likelihood of conflict**.	o **Relaxed pressure on services** and resources can decrease political conflicts and tensions, e.g. less criticism of the government for doing a poor job.
	o Possible political disagreements due to **overpopulation**, causing international disputes. E.g. the UK leaving the EU partly because of free movement of EU migrants. o **Laws/policies** may be introduced to limit population.	o **Population policies**/ laws may be put to get the **workforce** to grow, e.g. encouraging more migration or more births. Population control may be seen as a restriction of freedom.

Overall impacts on the **demographic**:

- **Mass migration** can cause **overpopulation** and **underpopulation**.
- **Economic migration** can cause a **demographic dividend** in the host country, but a **'brain drain'** and a large **dependency ratio** in the home country.
- **Sex composition** may change, as men are more likely to migrate than women, leaving more women than men in home countries (this has occurred in Poland, causing women to have to take over typically 'male' jobs, such as manual labour).
- **Age composition** may change, e.g. an **ageing population** may be left as the younger people migrate

Population Ecology

Population ecology is the study of how the **environment affects population** factors, such as size, distribution, density, age-sex composition etc. The concept of populations changing constantly is known as **population dynamics**.

An environment that supports a population can be of **optimum population**, or it could be **underpopulated** or **overpopulated**.

Overpopulation	**Optimum population**	**Underpopulation**
Too many people to be supported by the environment and its resources.	The **ideal** number of people for the environment and its resources.	**Too little** people to fully utilise the environment and its resources.

Populations rely on their **environment and its resources** in order to be supported. Overpopulation and underpopulation are not necessarily concerned with how many **people there are**, but rather how many **resources there are in order to support the people**.

Take these 3 populations for example.

= 1 person = the amount of food and resources needed for 1 person.

Community 1

Community 2

Community 3

If an area had this amount of resources:

...**then community 2 would be the optimum population**, community 1 would be overpopulated (as there are too many people compared to resources available), and community 3 would be underpopulated (as there are too few people to utilise the resources).

But if an area had this amount of resources:

...**then community 3 has an optimum population**, whereas community 1 and community 2 are both overpopulated.

It is important to consider that just because an area is **densely populated**, it does not mean that it is **overpopulated** if there are enough resources to support the population. This is the same for sparsely populated areas not necessarily being **underpopulated**.

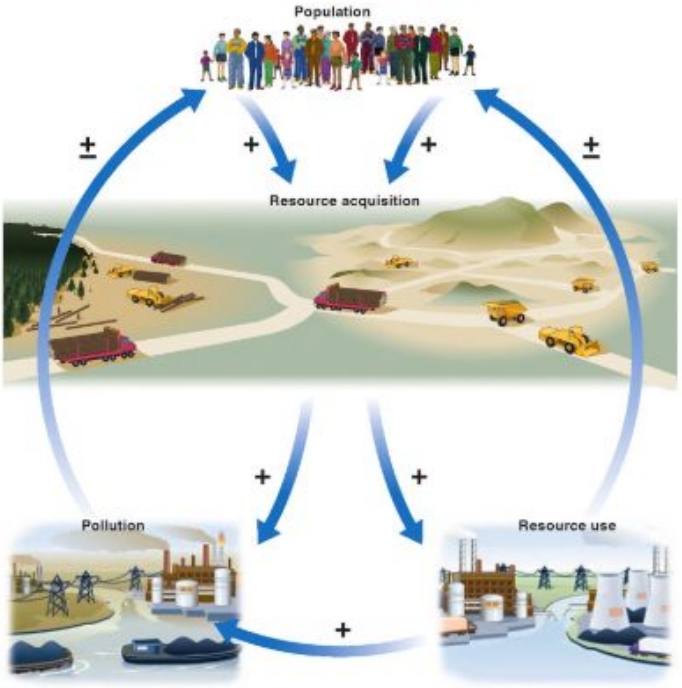
Carrying Capacity: The **maximum population** that can be supported in an environment without the **environment being severely degraded**.
If the carrying capacity is reached, it can have **effects on the population**, as resources are no longer available to support the population. This is thought to lead to **increase in death rates** and **fall in birth rates** until population numbers can be supported again (e.g. famines due to lack of food, causing deaths and lower fertility rates).

Ecological Footprint: A measurement of **how much of the Earth's resources are used** in relation to the **amount of the Earth's resources that are actually available.** The Earth Day website describes it as: **'how much biologically productive land and sea is used by a given population or activity, [compared] to how much land and sea is available'**

Ecological Footprint is measured in global hectares(gha).
1 gha = overall **annual** amount of **resource use** per hectare of **productive area available**.

If an Ecological Footprint is larger than 1, consumption is larger than available resources on Earth, which is clearly unsustainable. It is estimated that the global ecological footprint is **1.7gha**, meaning we are globally consuming 0.7 Earths **per year** more than is available. You can measure your Ecological Footprint here: www.earthday.org/take-action/footprint-calculator/

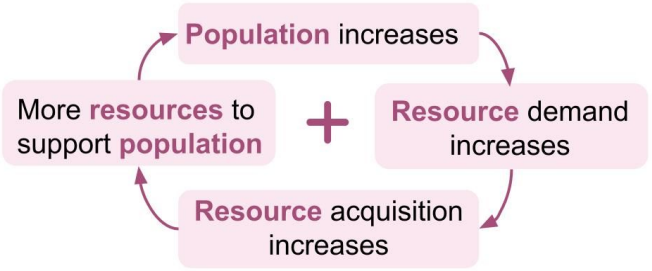
The Population, Resources and Pollution Model (PRP)

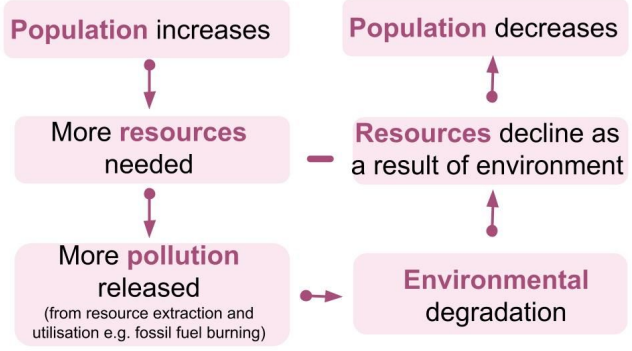


(Source: Chiras, D. (2013). *Environmental science*. Burlington, MA: Jones and Bartlett Learning.)

The model shows the relationship between **population, resources, and pollution,** and the positive (+) and negative (-) **feedback loops** that are created from these relationships.
In general, the population needs to **acquire and use resources in order to grow**, and this usage creates **pollution**, which in turn affects the **population**. The population is dependent on the environment and its resources.

For example, one of the positive feedback loops within the model is this relationship: the loop continues to grow the population as more resources are acquired every time there is a demand.





An example of negative feedback in the PRP model is: when the **population increases**, more resources are needed to support the population. This leads to more **pollution** being released, because of **resource extraction, fossil fuel combustion, plastic use** etc. In turn, the **environment degrades**, which affects natural resources (e.g. bees die due to pollution, affecting crop yields), causing the population to decrease as it cannot be sustained with fewer resources.

Population Perspectives

Malthusian (and neo-malthusian) perspectives

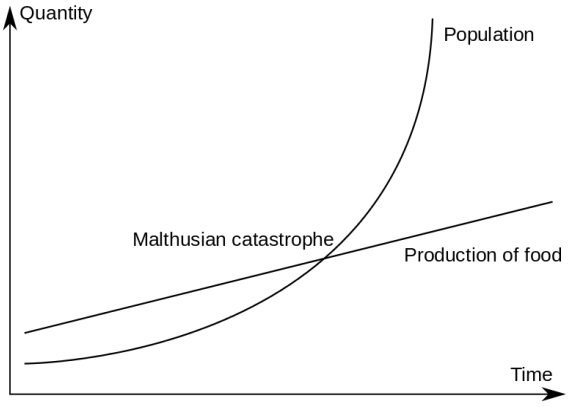
These are **negative** population perspectives, stating that the population **cannot** be sustained and will decline as a result of insufficient resources.

Malthus (1798): Population increases exponentially, but **resources only increase linearly**, meaning the population would eventually run out of food and resources, and decrease as a result. Malthus also described how the population will decrease due to a number of **positive** and **preventative** checks when population becomes too high.

Positive check: disease, war, famine - a disaster that significantly reduces a population.

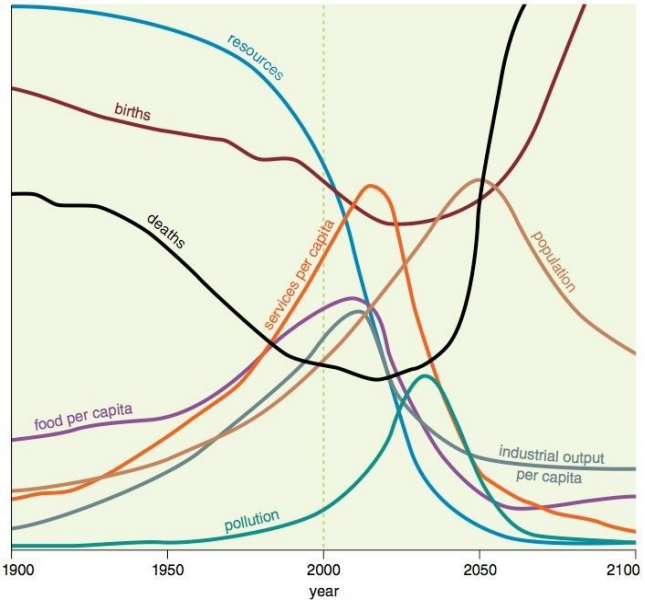
Preventative check: a cultural choice to lower population, such as choosing not to have children as you will not be able to support them.

(Source: commons.wikimedia.org/wiki/File:Malthus_PL_en.svg)



Club of Rome Limits to Growth (1972): An extended and more complicated version of Malthus' theory. Overall it shows that there is a **limit to the amount of people, pollution, services, food production** etc, eventually leading to a large increase in **death** rates.

(Source:www.financialsense.com/contributors/ugo-bardi/limits-to-growth-mit-study)



Non-malthusian perspectives

These are **positive** population perspectives, stating that the population **can** be sustained and will continue to find new ways to support the population.

- **Boserup**: Boserup's theory is that no matter how large population grows, the **population will always discover new ways to sustain food supplies**, such as new technologies and systems.
- **Simon**: Supporting of Boserup, Simon's theory is that **humans are 'the ultimate resource'**, and in spite of finite resources, humans will come up with new ways to sustain resources (e.g. finding new materials, recycling, new means of energy).

Environmental Change and Effects on Health

Although the future of the Earth's climate is uncertain, there are prospective changes in the environment that are thought to have negative impacts on the global population's **health**.

Ozone Depletion

The Earth's ozone has been **depleting as a result of pollution**, and has been observed since the 70s. The major cause of this depletion was due to the use of **chlorofluorocarbons (CFCs)** throughout the 20th century, which **break down ozone** when they enter the atmosphere and react. Although the 'hole in the ozone layer' is starting to stabilise and shrink, the effects of this depletion have increased.

Ozone Depletion allows more **UV radiation** to enter through the atmosphere, which has increased diseases caused by UV exposure:

- **Skin cancer** can be caused by **UV exposure**. 90% of all non-melanoma cases are associated with UV exposure.
- **Skin cancer** cases have **increased in the 21st century**, which is thought to be related to ozone depletion.
- Between 1992 - 2006, treatment of nonmelanoma skin cancers increased by nearly **77%**. The incidence of squamous cell carcinoma increased **200%** over the past three decades in the US. (Source:www.sunsaferx.com/health-and-wellness/effects-ozone-depletion-skin-eyes/)
- UV radiation is also thought to cause **cataracts**, and it is projected that cases of cataracts will continue to rise.

Climate Change

The projected effects of climate change are estimated to have primarily negative effects on **health**:

- **Thermal Stress** (**heat exhaustion** and **hyperthermia**): As global temperatures rise, so does the prevalence and risk of **intense heat waves**. **Overheating** can cause **heat stroke** and other forms of **hyperthermia**, which can quickly become **fatal**. **Elderly people** and those **subjected to high temperatures** (such as those in military training) are especially at risk.

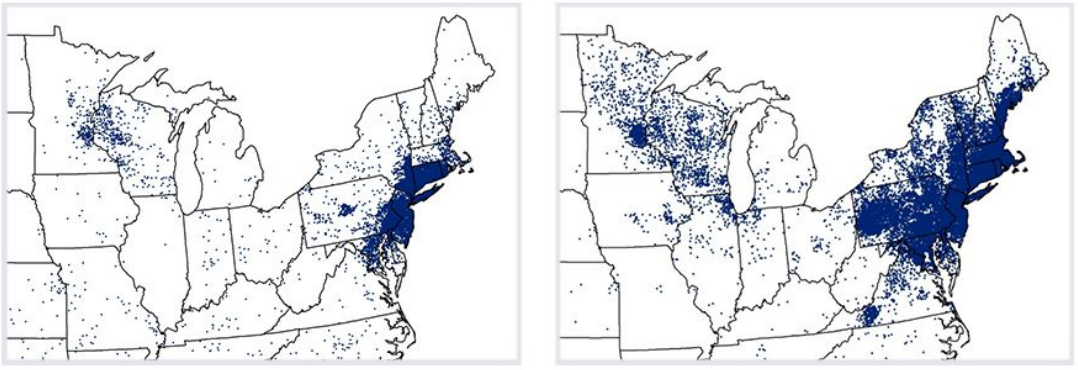
Deaths from heat waves in Australian cities are projected to double in 40 years.

- **Vector-borne diseases**: With climate change comes **altering weather patterns** and a rise in **extreme weather events**. Although every disease is different, a large amount of these diseases are becoming more **widely distributed**, and the **seasons** in which they are a risk have **lengthened**.

  Lyme disease is an example of a vector-borne disease being influenced by **climate change**. Lyme disease is a **tick-borne disease**, meaning it is carried by a tick and transferred to humans through tick bites. In North East USA especially, warmer temperatures have significantly influenced **tick behavioural patterns**, causing this vector-borne disease to become a greater risk to health.

The **effects of climate change** on Lyme disease:

- **Larger area at risk** - as temperatures and humidity change, a **larger area** of the NE becomes the perfect weather for tick breeding and development.



1996 2014

- Reported Lyme disease cases in 1996 and 2014 (each dot represents 1 case) (Source: www.cdc.gov/lyme/stats/index.html)

- **Active for longer** - warmer temperatures cause the nymphs to become **active earlier in the year**, meaning they are around for longer, and can pass the disease on for more months of the year. In some areas, the winters are so warm that ticks do not need to hibernate, meaning they can even be active on warm winter days, not just during tick season.
- **More hosts** - hosts for the tick, e.g. mice, have **better survival rates** than previous years due to the warmer temperatures. Therefore, there are more hosts for ticks to live on, causing a larger population of ticks during the season.

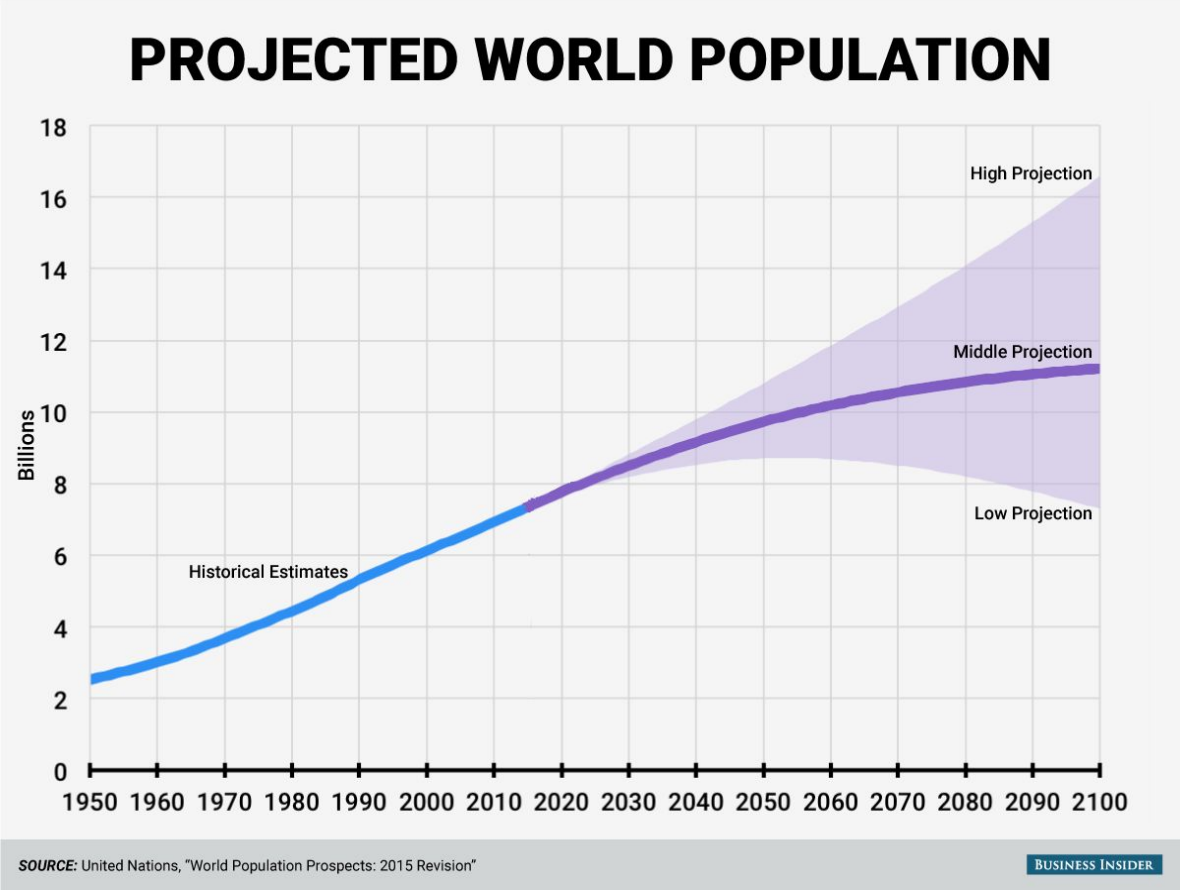
- **Agricultural productivity and nutritional standards**: The effects of **climate change** (altered precipitation, altered temperatures, altered weather events etc.) will have different effects across the globe on **agriculture**. Some places will become **more productive,** others will become **less productive**. In areas of **reduced productivity**, there will be multiple **negative effects on health** due to lowered **nutritional standards**:

- Due to the **lack of food available**, and also the **lack of variety of food** when crops fail, widespread **malnutrition** and **famines** are common.
- **Deficiencies** due to a lack in **variety** in food, causing diseases like rickets.
- People cannot afford to be picky when there is less food available, meaning many eat **poor quality food**, causing diseases such as **diarrhoeal diseases.**
- In areas where **biologically transmitted diseases are common**, malnutrition makes people **less able to fight the disease**, i.e. it is harder for the body to respond to - for example - malaria or diarrhoeal diseases when it is already malnourished.
- When agricultural yields fail, **food prices can increase dramatically** (as supply significantly decreases). For example, in 2016 maize prices in Malawi were **192% higher** than the five-year average (many crops failed due to the extreme climatic event El Niño). When food prices rise, people can no longer afford a **variety of food,** meaning nutritional standards decrease, causing ill health.

Future Global Population Prospects

Experts are able to **predict** future population sizes from **current trends and growth rates**. There are several predicted trends for the future population:

1. **Global population** will continue to **increase**, and will reach an estimated 11.2 billion by 2100 according to the UN. The graph below shows the projected growth of the world population (each projection - high, middle, low - is an indication of the **fertility rates**. High fertility rates = high projection, i.e. bigger population growth).



(Source: http://uk.businessinsider.com/un-world-population-projections-2015-7?r=US&IR=T)

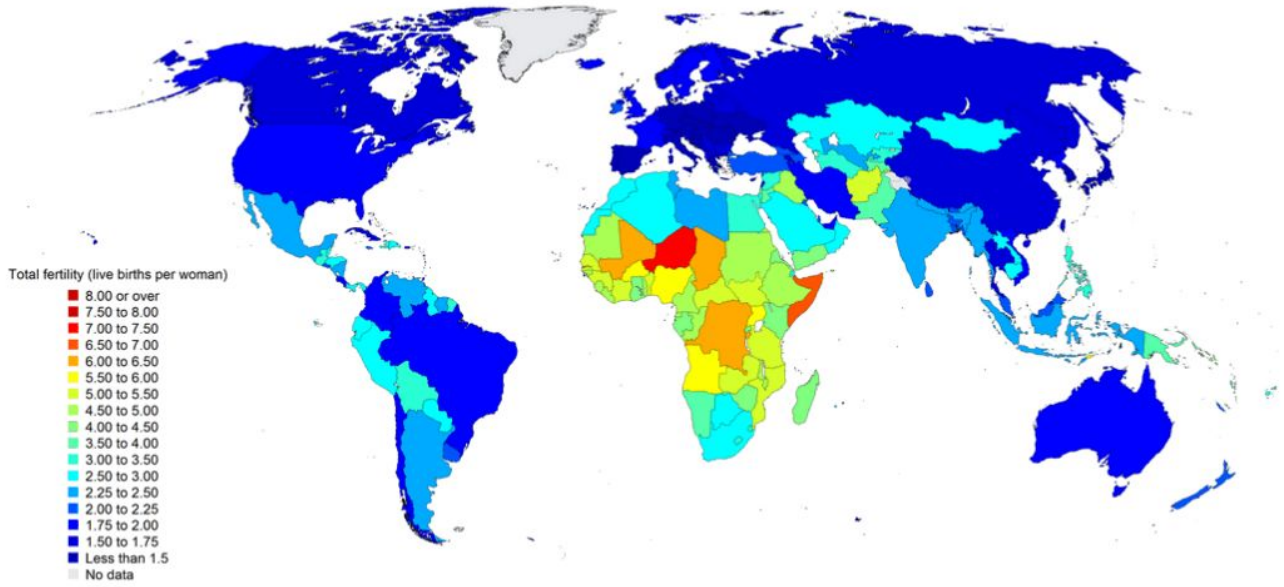
If fertility rates become **lower than projected**, there is potential for the population to stop growing, and then decline significantly by 2100. In one projection, population may stop growing at **8.7 billion in the 2050s**, then decline back to current levels by 2100.

Projections for population growth have a lot of 'wiggle room' as there is a lot of uncertainty regarding how population will change, especially regarding future threats like global warming. This is why graphs show a 'high projection' and a 'low projection'.

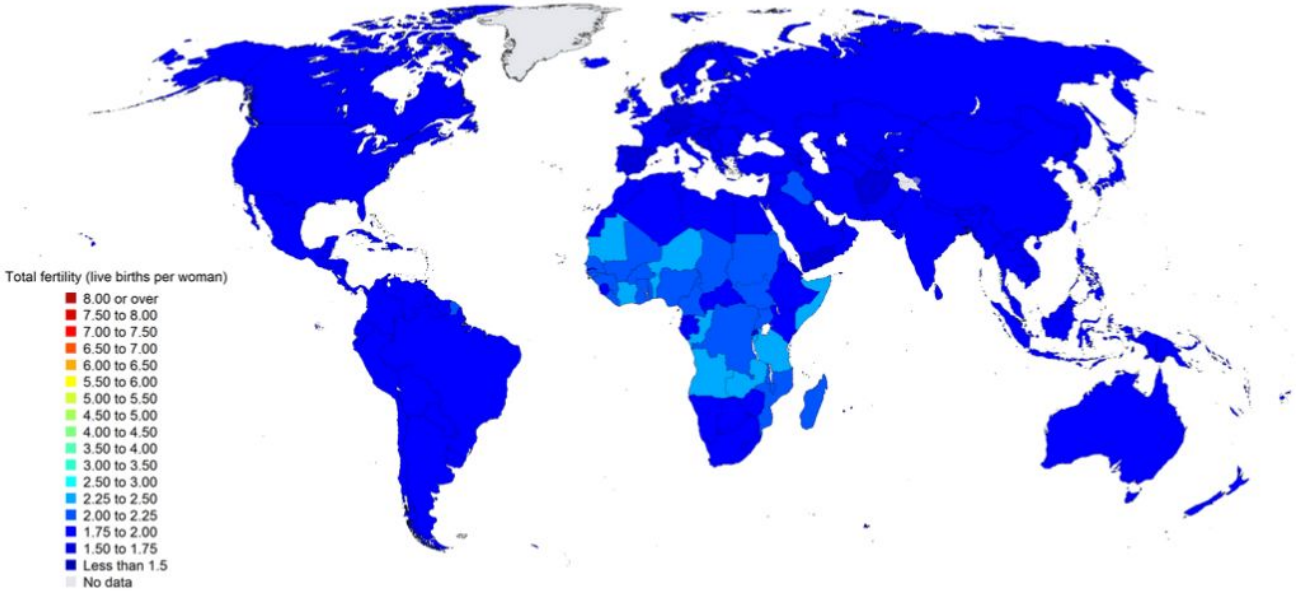
2. Population growth **rate** will **slow**, as it has already done. This is majorly due to the projected lowering **total fertility rate**.

Compare the two graphs showing **total fertility from 2010-2015**, and **projected total fertility from 2095-2100**. Notice how every country is projected to have a total fertility lower than 2.50 by 2095, but many countries, especially those in Africa, currently have a total fertility of over 4 live births per woman.

Total fertility, estimates, 2010-2015



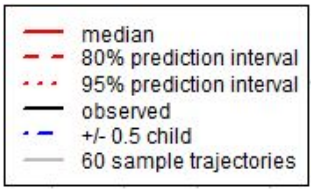
Total fertility, medium projection, 2095-2100

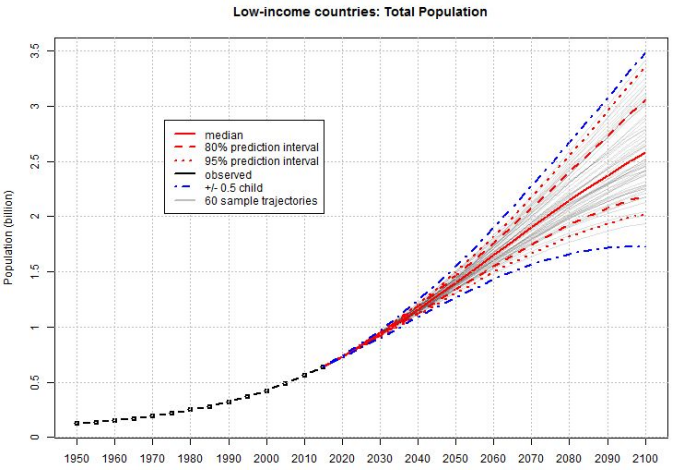


(Source: https://population.un.org/wpp/Maps/)

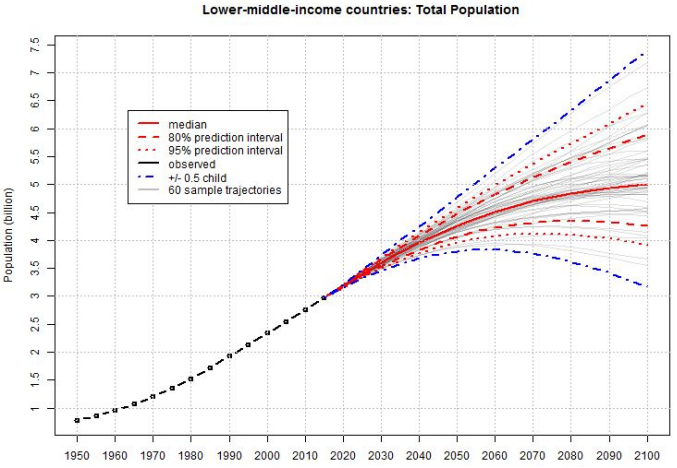
As fertility rate decreases, population growth will consequently **slow down**. There are less children being born per woman, thus the population increases by a smaller amount year upon year.

3. Population **distribution** is projected to change, because some countries **growth rates** are faster than others.



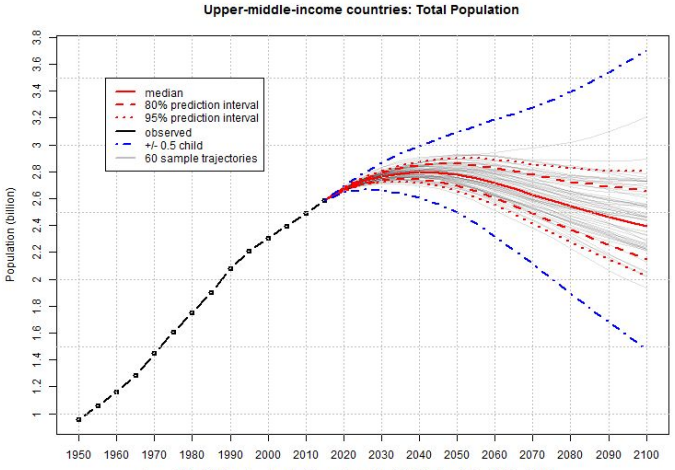


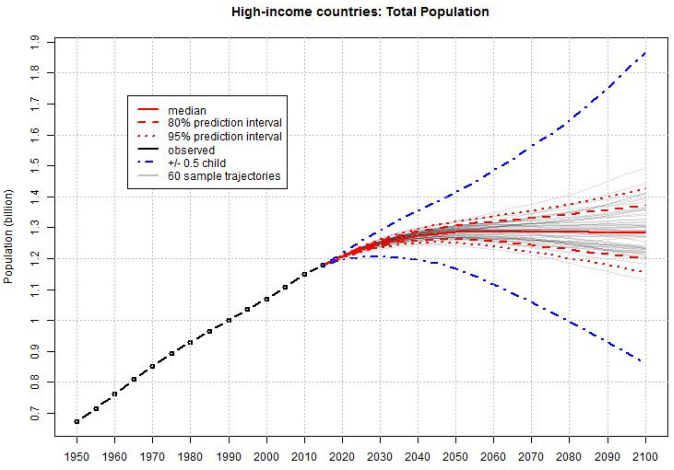
Low income countries are projected to have the highest growth rates. This can be explained by the **Demographic Transition Model**: LICs are typically in stage 2 and early stage 3 of the model, which has a high birth rate and lowered death rate, causing population to increase rapidly.



Lower-middle income countries will have high growth rates also, but they will begin to level off at the end of the century.

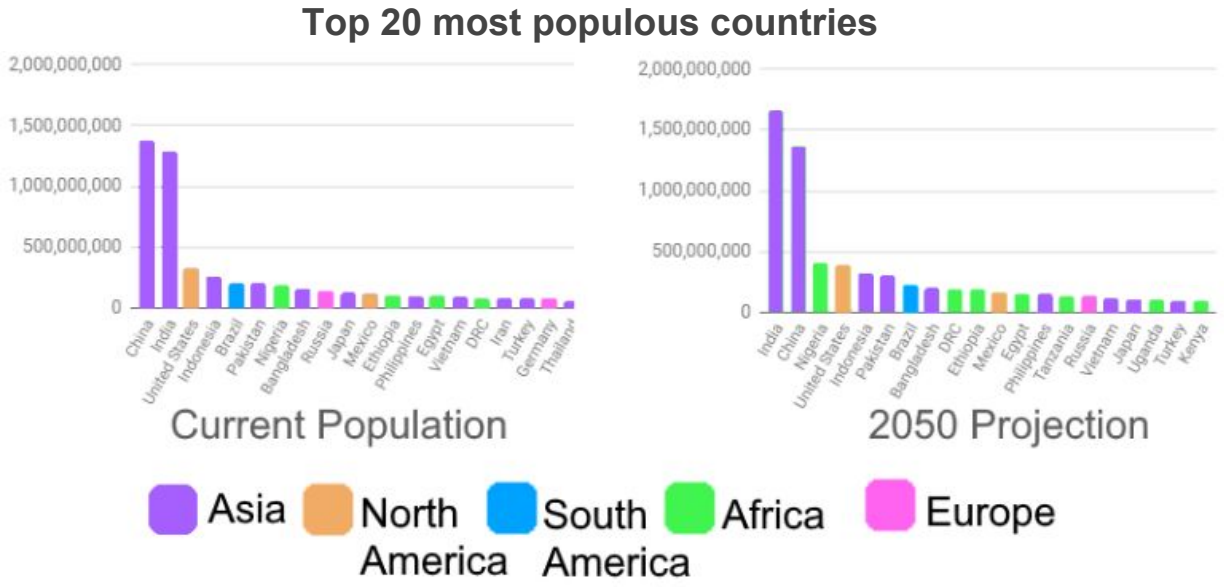
Upper-middle income countries are projected to have the largest decline in population, whereas population in **high income countries** is projected to level out, but possibly not decline noticeably between now and 2100.





(Source: https://population.un.org/wpp/Graphs/Probabilistic/POP/TOT/)

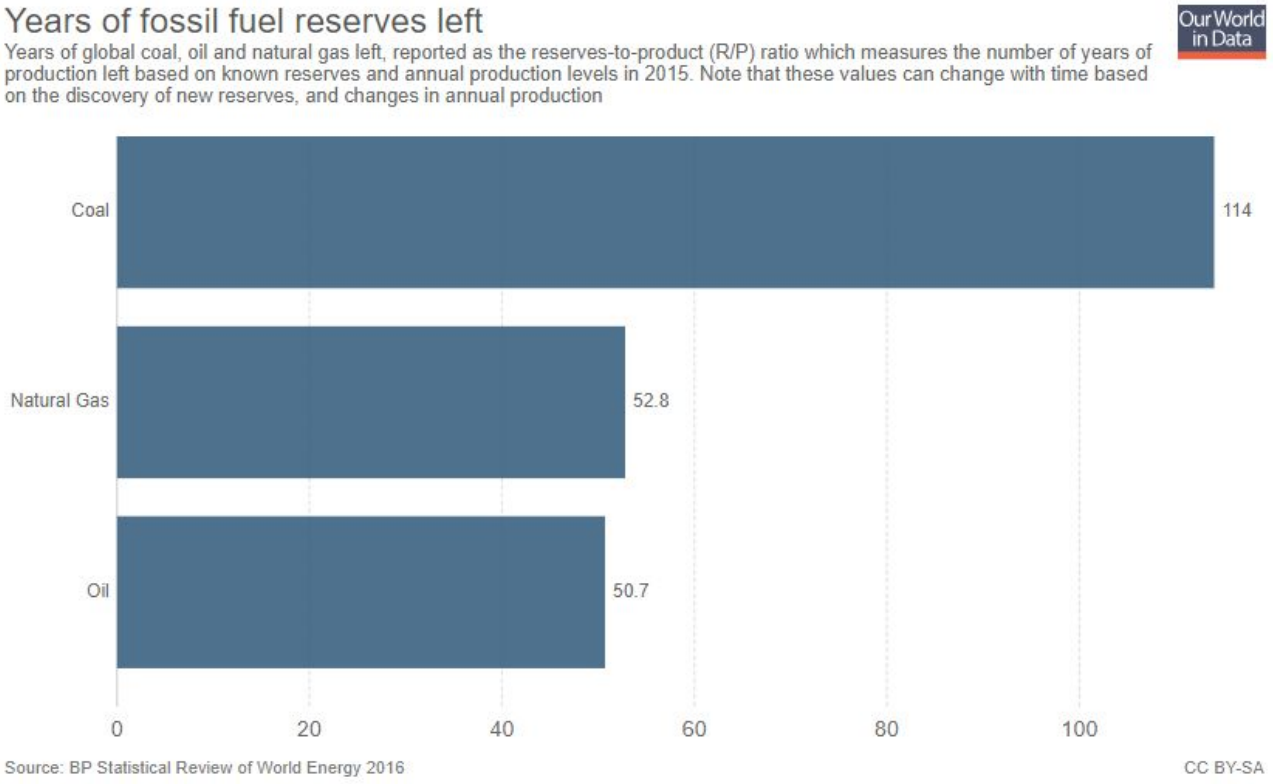
4. India is expected to overtake China as the most populated country, and Nigeria will grow from the 7th most populous country to the 3rd, overtaking the US.



Projected Population-Environment Relationships

As countries continue to grow **socio-economically**, so will **consumption of resources** (fuel, food, consumer goods etc.). The future relationship between the population and the environment will affect how severely both the population and the environment are affected.

- **Fuel:** Fossil fuels are finite, and are expected to **run out** in the future.



Presently, the population is heavily reliant on fossil fuels, whereas **renewable energy** is globally not used as much. The population may need to alter its reliance on fossil fuels with investments into renewable energy, and **environmental agreements**, as fossil fuels are not permanent.

- **Food and other resources:** **Technological advancements** in farming, mining, recycling etc. can lower the **negative effects of exploiting** the Earth's resources. The population must continue to develop ways to sustain population growth without degrading the Earth, or the population will simply not be able to be supported.

- **Pollution**: The growing population may struggle to be supported if pollution issues are not **resolved**. This current population-environment relationship is not a sustainable one. **CO_2 emissions, methane** from farming, **plastics** in the oceans, landfill and many other sources of pollution all degrade the Earth and its natural resources. As population grows, so does the **demand for pollution-causing resources** and goods. By 2050, it is said there will be more plastic than fish in the oceans. This relationship must be altered, through a 'greener' way of living, or the population will not be **supported**.