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Human Systems & Resource Use

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Resource Utilization And Human Systems

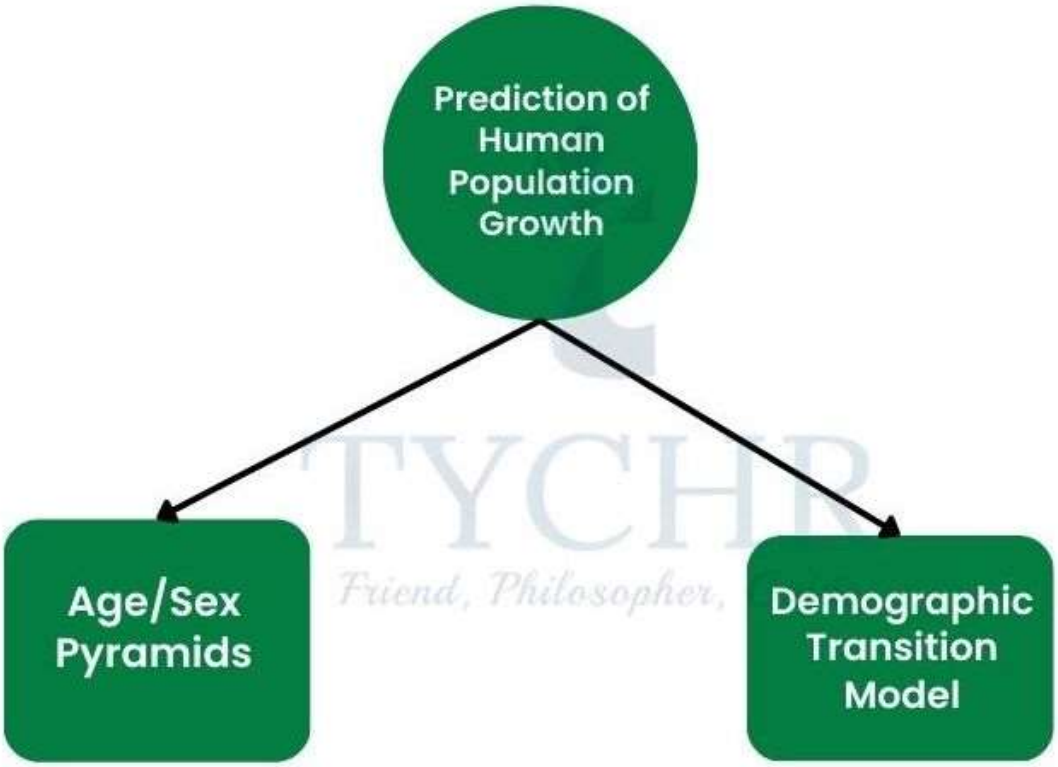

Figure 1 Age/sex pyramids and the demographic transition model (DTM) can be used in the prediction of human population growth.

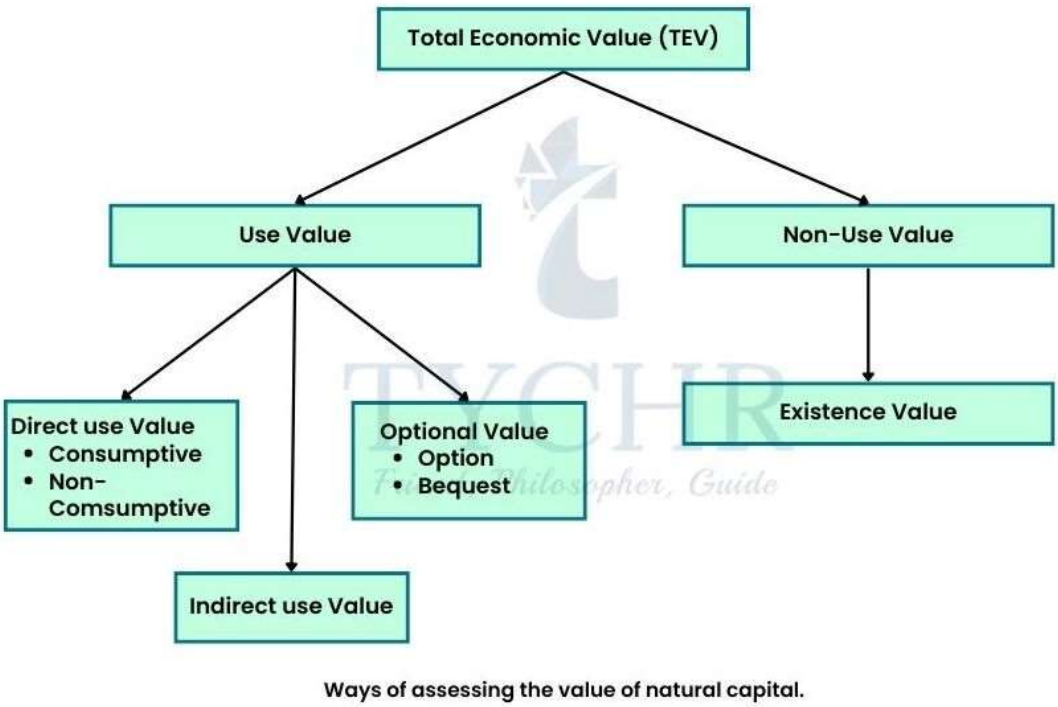

Figure 2 Renewable natural capital can be used sustainably or unsustainably. If renewable natural capital is used beyond its natural income, this use becomes unsustainable.

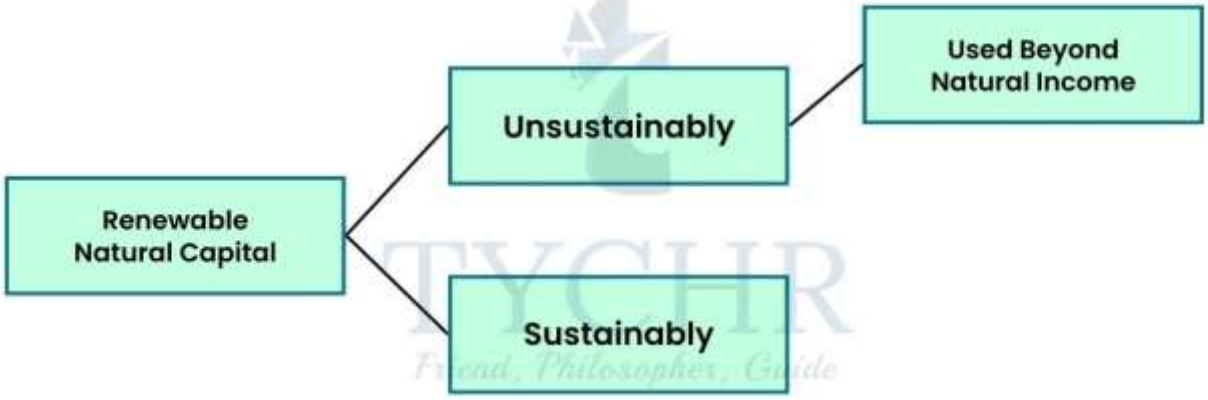

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Figure 3 Waste disposal options of solid waste include landfill, incineration, recycling, and composting.

8.1 Human Population And Dynamics

8.1.1 Demographic Variables

Demographic Tools

- Crude Birth Rate- is defined as the number of live births per thousand people in a population. The CBR is easy to calculate and the data is readily available. For example:
  $Total\ Number\ of\ BirthsCrude\ Birth\ Rate = Total\ Population \times 1000$
- Population Mortality- is the ratio of live births to the population's total number of people per thousand. The CBR is not difficult to ascertain and the information are promptly accessible. For example:
  $Total\ Number\ of\ DeathsCrude\ Death\ Rate = Total\ Population \times 1000$
- Total Fertility Rate- The total fertility rate is the average number of births per woman of childbearing age. In general, the highest fertility rates are found among the poorest countries, and few LEDCs have made the transition from high birth rates to low birth rates. By contrast, the birth rates have reduced in most MEDCs.
- Natural increase rate (NIR)- is the increase in population as a result of the birth rate exceeding the death rate.
- Doubling time (DT)-relates to the amount of time it takes for a population to double in size, assuming that its natural growth rate remains constant. The formula that follows can be used to get approximate values for it.:
  $Doubling\ Time\ (years) = 70/\ Growth\ Rate\ in\ Percentage$

8.1.2 Human Population Growth

The world's population is growing very rapidly. Up to 95% of population growth is taking place in less economically developed countries (LEDCs). However, the world's population is expected to stabilise at about 8.5 billion following a peak at 11 billion.

- Human population growth stresses water systems, agricultural systems, and energy systems.

- The impact of exponential growth is that a huge amount of extra resources are needed to feed, house, clothe, and look after the increasing number of people.
- However, the resource consumption of much of the world's poor population (i.e. those in LEDCs) is much less than the resource consumption of populations in MEDCs where population growth rates are much lower.

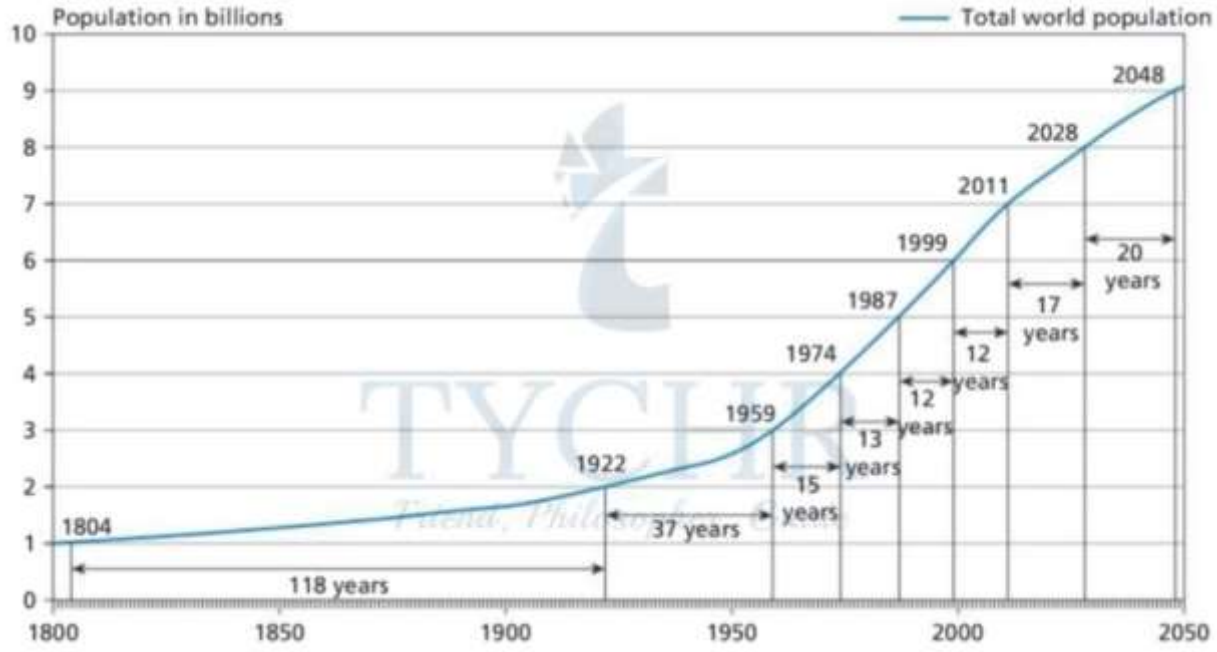

Figure 4 The world's population doubled between 1804 and 1922, between 1922 and 1959, and between 1959 and 1974. It is thus taking less and less time for the population to double, although growth has slowed down since 1999.

Age/ Sex Pyramids

A population pyramid is a bar or line graph on its side showing variations in the age structure and sex structure of a population. Population pyramids tell us a great deal of information about the age and sex structure of a population:

- A wide base indicates a high birth rate
- A narrowing base suggests falling birth rate
- Straight or near vertical sides reveal a low death rate
- Concave slopes characterise high death rates
- Bulges in the slope suggest high rates of in-migration
- Indentations in the pyramid may indicate out-migration or age-specific deaths.

Demographic Transition Model

The general demographic transition model (DTM) shows the change in population structure from LEDCs to MEDCs.

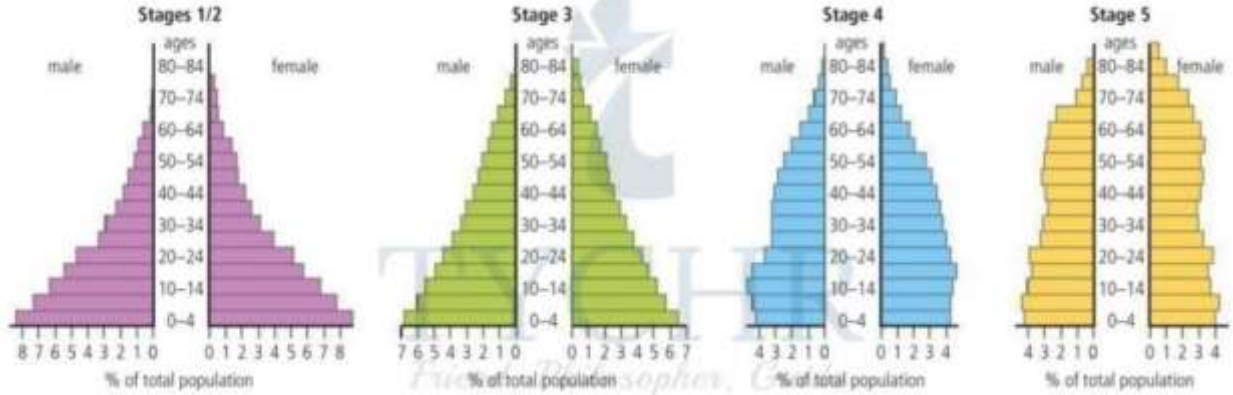

Figure 5 The Demographic Transition Model suggests that death rates fall before birth rates, and that the total population expands. However, it is only based on three countries.

Population Dynamics

- Factors influencing the birth rate- social, political, cultural, historical, religious, economic, and social factors. For example, in some cultures, especially agricultural ones, there is an advantage in having more children to work on the land. In contrast, in cultures where women are employed in the workforce, such as in Singapore, the birth rate may be very low.
- Factors influencing the death rate- include the age-structure of the population, availability of clean water, sanitation, adequate housing, reliable food supply, prevalence of disease, provision of healthcare facilities, type of occupation, natural hazards, civil conflict and war, and chance factors. Social and economic factors have a major influence on death rates – poor people are far more vulnerable to the risk of early death, due to a combination of poor living conditions, poor diet, lack of access to clean water, and sanitation.

National & International Development Policies

The most famous anti-natalist policy is China's one-child policy.

- It was introduced in 1979 and limited most Chinese families to one child.
- It is thought that China's population would now be 400 million people larger if the one-child policy did not exist.

- The prospect of an ageing society in which one worker is left to support two parents and four grandparents led China to relax the one-child policy.
- In 2015, amid fears that the size of the working population was set to decline, the Chinese government changed the policy to allow couples to have two children.

Singapore is an example of a country that had an anti-natalist policy and changed to a pro-natalist policy.

- It changed because its fertility rate had dropped to below 1.25 and the workforce was getting smaller.
- If a family could afford to have more than three children, the government offered incentives.
- Despite the incentives, Singapore's fertility rate has remained low.
- Women continue to play an active role in the workforce and are choosing jobs rather than having children.

International Policies that Affect Population Growth

- In 2000 the United Nations announced the Millennium Development Goals (MDGs) whose aim was to address issues of poverty and inequality.
- In 2015 the MDGs were replaced by the Sustainable Development Goals (SDGs). Goal 3 aims to ensure healthy lives and promote wellbeing for the whole population at all ages.
- One of its targets is improving reproductive, maternal, newborn, and child health.

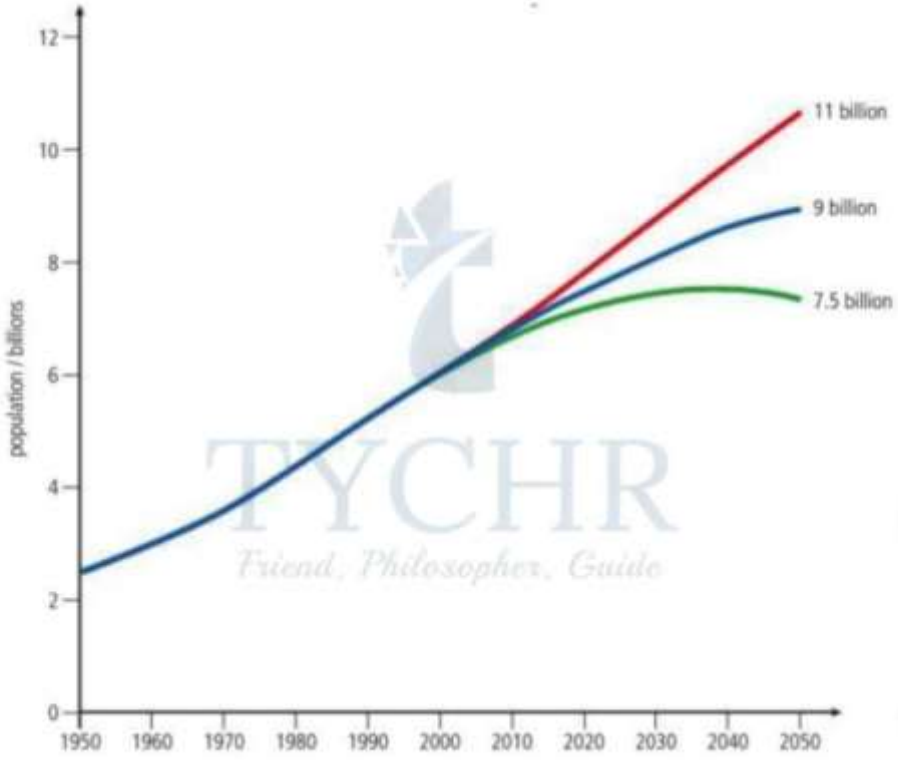

Figure 6 Range of UN population predictions 1950–2050.

8.2 Resource Use In Society

Renewable Natural Capital

- Natural Capital is the total quantity of natural resources. Some natural capital is non-renewable, for example fossil fuels, soils, and minerals. These can only be replaced or renewed over a very long timescale and millions of years in the case of fossil fuels.
- Although a resource may be harvested in a sustainable way, i.e. the amount harvested is less than the annual recharge; the way in which it is extracted, transported and processed may cause environmental and social damage, thereby making this type of harvesting of natural capital unsustainable.

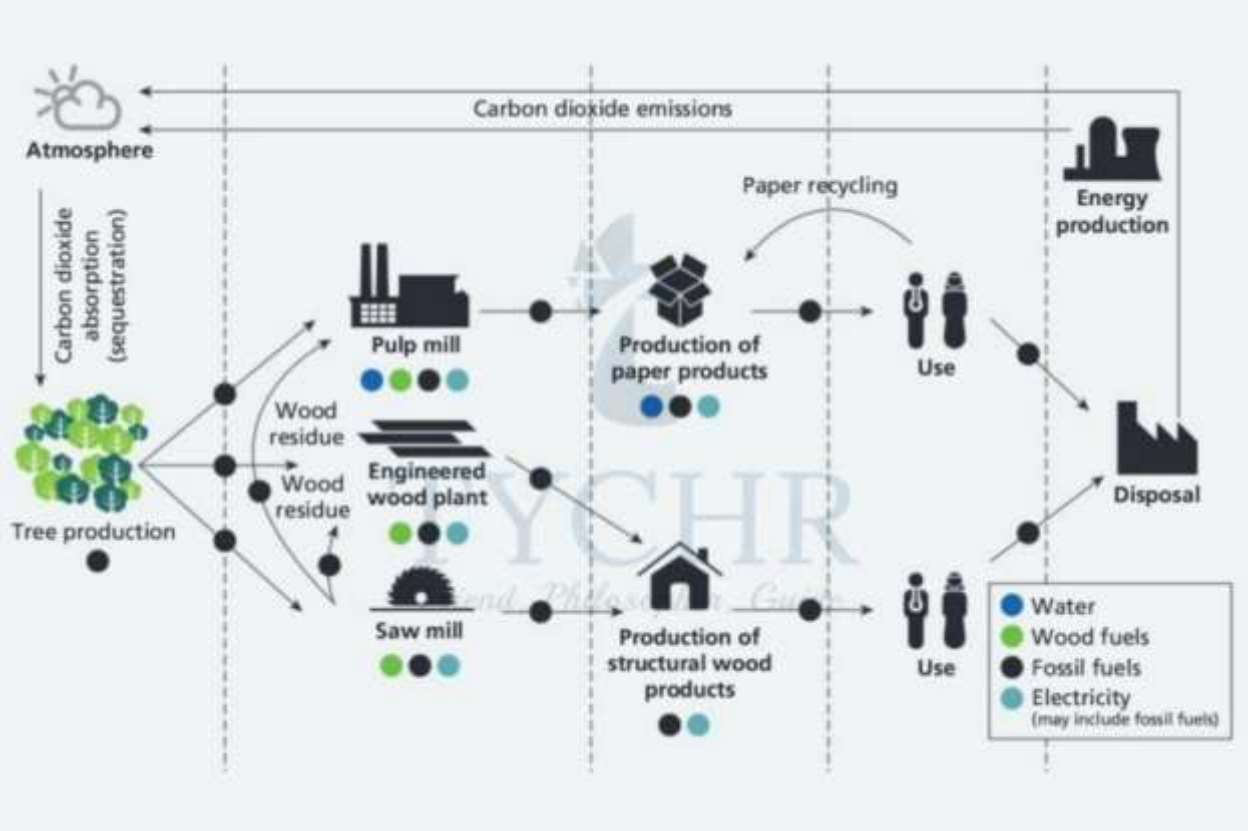

Figure 7 Environmental and social impacts in the forestry sector.

Sustainable & Unsustainable Use of Natural Capital

- Sustainability is ensuring that resources are not degraded (i.e., that natural capital is not depleted and/or polluted) so that future generations can continue to use the resource while living within the means of nature (i.e., on the "interest" or sustainable income generated by natural capital).

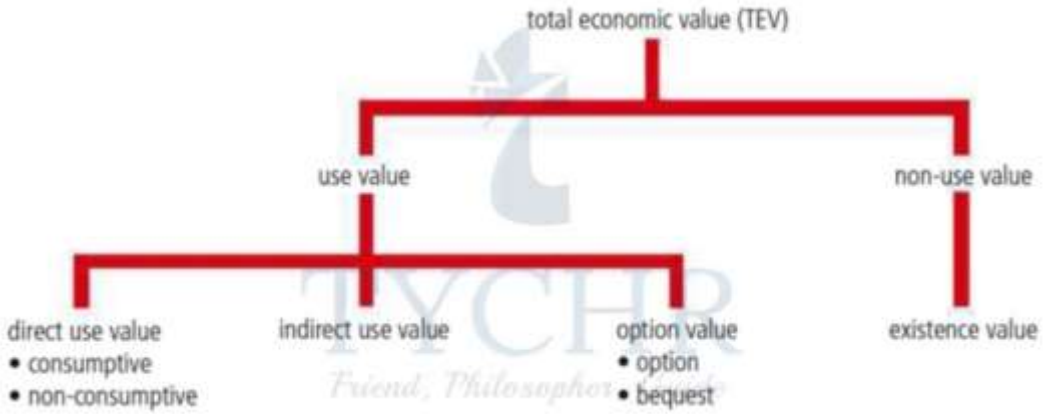

Figure 8 Ways of assessing the value of natural capital.

- An example of irresponsible use of a resource concerns groundwater. Pollutants from agricultural products and run-off from storage tanks,

landfills, and septic tanks are reducing the water quality. Unsustainable extraction from groundwater sources (aquifers) means that water tables are lowered, which can lead to the intrusion of saltwater in coastal areas and further contamination of the supply (e.g. the Gaza Strip).

- Water shortages can lead to tensions and conflict over the limited resource (e.g. the Israeli Palestinian Conflict).

Waste disposal options of solid waste include landfill, incineration, recycling, and composting.

Figure 8 Ways of assessing the value of natural capital.

Dynamic Nature and Concept of a Resource

Natural capital's value fluctuates over time. Resources change in value over time as new technology makes them more or less useful and therefore more or less valuable. In the Middle Ages oil was used to seal wounds, but in the 20th century it became the world's leading fuel.

8.3 Solid Domestic Waste

Types Of Solid Domestic Waste

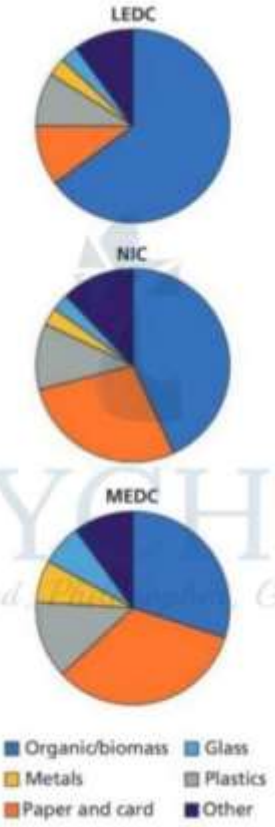

Figure 9 Typical composition of waste associated with LEDCs, NICs and MEDCs.

There are many types of solid domestic waste. In an MEDC solid domestic waste usually consists of the following:

- Organic waste from kitchen or garden, including waste wood
- (20–50%)
- Paper/packaging/cardboard (20–30%)
- Glass (5–10%)
- Metal (less than 10%)
- Plastics (5–15%)
- Textiles (less than 5%)
- Electrical appliances, e.g. computers/fridges etc. (less than 5%).

With increasing wealth there is:

- A decrease in organic waste/biomass waste

- An increase in paper and cardboard
- An increase in plastic waste
- An increase in metal and glass waste.

Non-Biodegradable Pollution

Plastic	Batteries	Electronic Waste
• 4.8 and 12.7 million tonnes of plastic enter the oceans each year. Much of it was concentrated in the Great Pacific Garbage Patch, a region containing as much as 100. • It can take centuries for plastic to decompose. • Turtles, seals, and birds inadvertently eat it, and not just in the Pacific. • A Dutch study of 560 fulmars (seabirds) picked up dead in countries around the North Sea found that 95%	• The increasing global demand for batteries is because of increasing consumer culture and the demand for mobile phones and laptops. • Each year billions of batteries, containing toxic or corrosive materials, are disposed of. • Production, transport and distribution of batteries use fossil fuels, thereby contributing to global warming. • Potential risks are associated with emissions of chemicals	• In 2012 China generated over 11 million tonnes of e-waste, followed by the USA with around 10 million tonnes. • Guiyu in China has been described as the e-waste capital of the world. • The industry is worth $75 million to the town each year, but Guiyu's population has high rates of lead poisoning, cancer-causing dioxins, and miscarriages. In 2018 China banned the import of e-waste.

had plastic in their stomachs.	into aquatic ecosystems. Disposal of batteries into landfill may release toxic substances into groundwater.

Disposal Options For SDW

- Recycling- Recycling is the processing of household and industrial waste so that it can be used again.
- Composting- Composting is the decomposition of biodegradable material and its use as a fertiliser in soil.
- Landfill- Landfill is the dumping of material in a hole in the ground or on the ground.
- Incineration- Incineration is the burning of household and industrial waste so that it is reduced in volume.
- Reduction- Reduction of waste means using fewer resources to meet the needs of the population.

Strategies For Managing SDW

- Altering human activity-includes food waste composting and consumption reduction.
- Controlling release of pollutants – In order to encourage recycling and reuse initiatives, governments enact legislation, tax SDW collection, and tax disposable items.
- Utilising SDW in trash-to-energy programs, reclaiming landfills, and carrying out initiatives to eliminate plastics from the Great Pacific Garbage Patch (cleanup and restoration)
  The Great Pacific Garbage Patch

The Great Pacific Garbage Patch

Figure 10 The Great Pacific Garbage Patch.

The Great Pacific Garbage Patch is an area of marine debris that shifts its exact position every year. It remains within the North Pacific Gyre as ocean currents confine it.
Estimates of its size vary from 7,00,000 km2- 1,50,00,000 km2 – between 0.41% and 8.1% of the size of the Pacific Ocean. Plastics never biodegrade. They do not break down into natural substances. Instead they go through a photodegradation process, splitting into smaller and smaller particles that are still plastic.

Problems Caused By Plastic:

- Plastic fouls beaches throughout the world and reduces potential income from tourism and recreation.

- Plastic entangles marine animals and drowns them, strangles them, and makes them immobile.
- Plastic garbage when washed ashore destroys habitats.
- Marine animals are entangled in plastic, drowned, strangled, and rendered immobile.
- Plastic gets inside ships propellers and keels making ship maintenance more expensive.
- Plastic does not degrade; it also makes an ideal medium for the transfer of invasive species.

Figure 11 Marine animals getting stuck in plastic nets, and possibly dying because of immobility.

Figure 12 A seal getting trapped in plastic debris.

Figure 13 Direct Harm to Species- Of the 1.5 million Laysan albatrosses that inhabit Midway Atoll, nearly all are likely to have plastic in their gastrointestinal tract. Fish and whales may

also mistake the plastic as a food source.

Indirect Harm via the Food Chain- On the microscopic level, debris can absorb organic pollutants from seawater, including PCBs, DDT and PAHs. Aside from toxic effects,some of these are mistaken by the endocrine system as estradiol, disrupting hormone levels in affected animals. These toxin-containing plastic pieces are also eaten by jellyfish, which are then eaten by fish and then by humans.

8.4 Carrying Capacity & Ecological Footprints

Carrying Capacity

Carrying capacity is the maximum number of a species or "load" that can be sustainably supported by a given environment. Although it is possible to estimate the carrying capacity of an environment for a given species, based on its size and the food and water supply it contains, it is difficult to apply to human populations for many reasons.

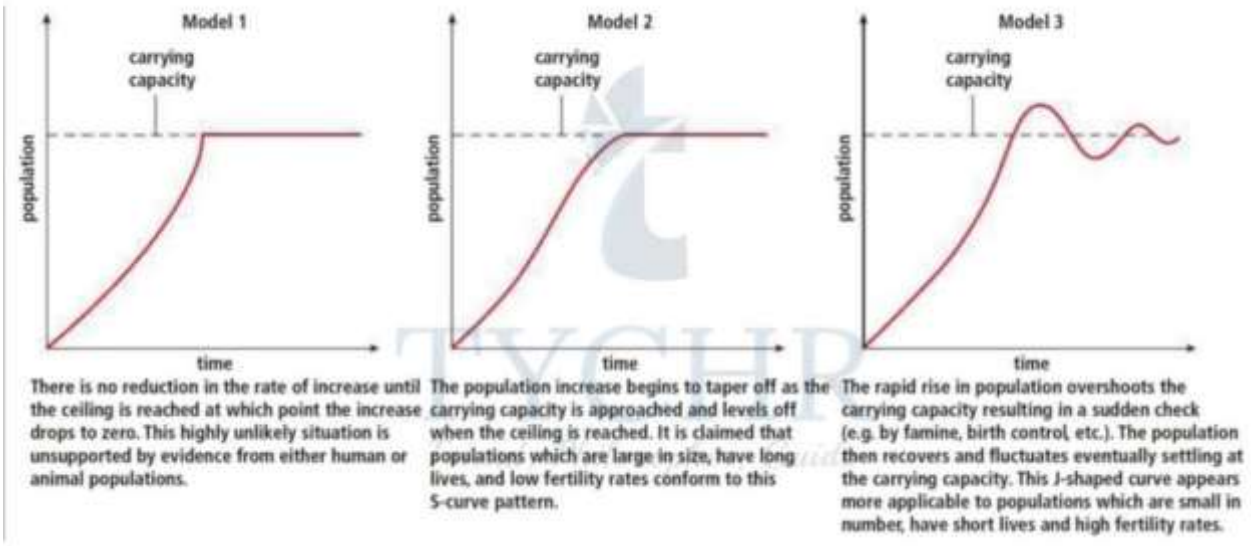

Figure 14 Population growth and carrying capacity.

Optimum, Over And Under Population

- Optimum population is the number of people who, when using all the available resources, will produce the highest per capita economic

return. It is the point at which the population has the highest standard of living and quality of life.

- Overpopulation occurs when there are too many people relative to the resources and technology locally available to attain the optimum standard of living. They suffer from natural disasters such as drought and famine and are characterised by low incomes, poverty, poor living conditions, and a high level of emigration.
- Under-population occurs when there are far more resources in an area (e.g. food production, energy and minerals) than can be used by the people living there in order to reach the optimum population.

Population Growth And Food Resources

Thomas Malthus's Essays on the Principle of Population Growth
He was of the opinion that the optimal population size in terms of food supply was limited, and that any population growth beyond this point would result in a decline in standard of living, war, famine, and disease. His theory was based on two principles:

- In the absence of checks, the population would grow at a geometric or exponential rate and could double every 25 years.
- Food supplies at best increase at an arithmetic rate.

These principles state potential and not the actual growth of population and food production. Thus, the limit of food production creates a block or ceiling to the population growth in a given country.

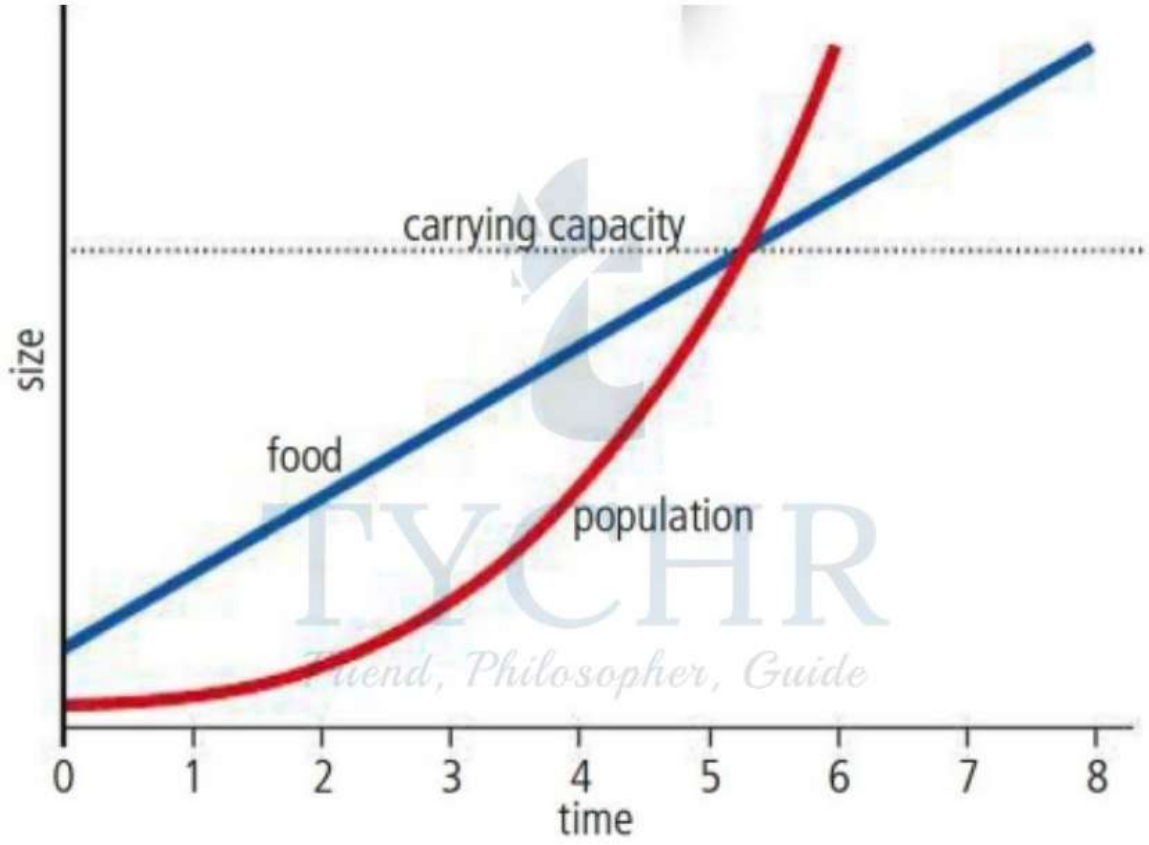

Figure 15 The Malthus's views on population growth and growth of food resources.

Changing Carrying Capacities

Human carrying capacity of the environment is determined by:

- Rate of energy and material consumption
- Level of pollution
- Interference with environmental life- support systems.

Ecological Footprints

The area of land needed to accommodate all of a population's waste and provide all of its resources is known as its ecological footprint. Instead of referring to the population that a given area can sustainably support, it means the area needed to support a given population.. It is measured in global hectares (gha).

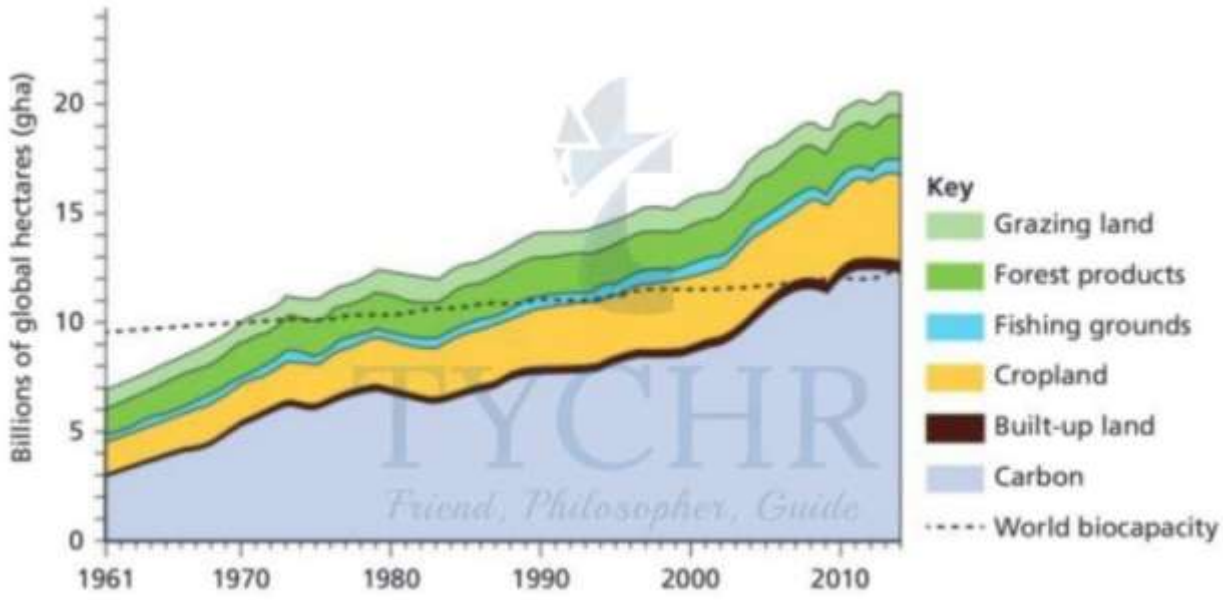

Figure 16 The world's ecological footprint 1961- 2010.

Advantages and Disadvantages of Using Ecological Footprint as a Model

The two broad categories that contribute to a person's or a nation's ecological footprint are:

- Land required to provide necessary resources, e.g. food, agriculture, housing, urbanisation, industry, water supply
- Land required for assimilation of wastes, e.g. vegetation that provides a sink for carbon waste and areas of landfill.

Advantages	Disadvantages
• They are a useful snapshot of the sustainability of a population's lifestyle. • They provide a means for individuals or governments to measure their impact and to identify potential changes in lifestyle. • They are a symbol for raising awareness of environmental issues.	• Ecological footprints do not include all information on the environmental impacts of human activities. • They are only a model so they are a simplification and lack precision. • They use approximations of actual figures which cannot be accurately calculated.

Ecological Footprint in LEDCs & MEDCs

LEDCs	MEDCs
• LEDCs tend to have smaller ecological footprints because of their much smaller rates of resource consumption. • People in LEDCs have less to spend on consumption and the informal economy in LEDCs is responsible for recycling many resources. • However, as LEDCs develop, the size of their ecological footprint increases.	• In MEDCs, people have more disposable income, leading to greater demand for and consumption of energy resources. • The resource use of MEDCs is often wasteful and MEDCs produce far more waste and pollution.

Unsustainable Footprints

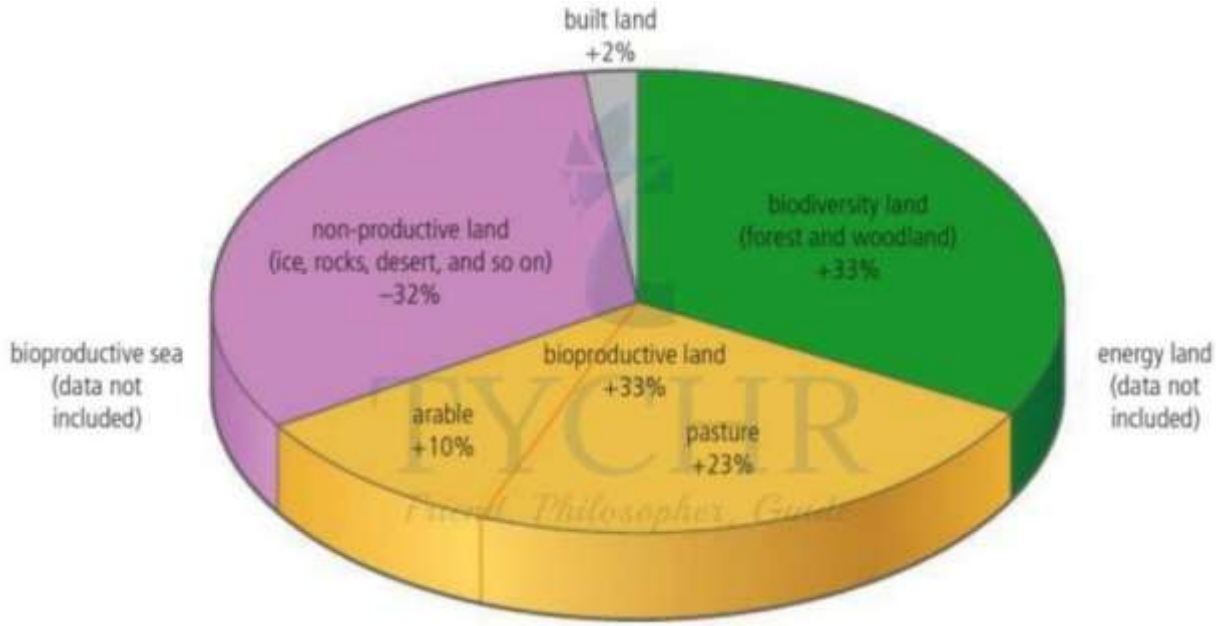

Figure 17 Some of the factors used to calculate a full ecological footprint.

- The demand for consumer goods has increased dramatically since the 1960s, putting the world's resources under great pressure.
- The world is reaching its carrying capacity.
- Many have argued that the over-consumption of resources, pollution, and degradation of the environment will lead to a decline in the population from around 2040.
- The limits to Growth model has a pessimistic view of population and resources. It predicts that the human population would outstrip the ability of the Earth to provide sufficient resources for the population.
- However, many people believe that human carrying capacity can be increased through technological developments. They argue that the Earth can hold more people if we learn to use energy and resources more efficiently. Technological improvements include irrigation and fertilisers. Crops could be grown in nutrient- enriched water. This is known as hydroponics. High-yielding varieties (HYVs) of plants could be used.

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