ENVIRONMENTAL SYSTEMS AND SOCIETIES · TOPIC 1.3

Sustainability

What is sustainability, how can it be measured, and how is it linked to environmental justice?

Based on: Rutherford & Williams, ESS Course Companion, Oxford University Press (2024), pages 32–55

Guiding questions

1. What is sustainability and how can it be measured?

2. To what extent are challenges of sustainable development also ones of environmental justice?

Understandings (1–5)

1. Sustainability is a measure of the extent to which practices allow for the long-term viability of a system. It is generally used to refer to the responsible maintenance of socio-ecological systems such that there is no diminishment of conditions for future generations.

2. Sustainability is comprised of **environmental**, **social** and **economic** pillars.

3. Environmental sustainability is the use and management of natural resources that allows replacement of the resources, and recovery and regeneration of ecosystems.

4. Social sustainability focuses on creating the structures and systems, such as health, education, equity, community, that support human well-being.

5. Economic sustainability focuses on creating the economic structures and systems to support production and consumption of goods and services that will support human needs into the future.

Understandings (6–9)

6. Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development applies the concept of sustainability to our social and economic development.

7. Unsustainable use of natural resources can lead to ecosystem collapse.

8. Common indicators of economic development, such as gross domestic product (GDP), neglect the value of natural systems and may lead to unsustainable development.

9. Environmental justice refers to the right of all people to live in a pollution-free environment, and to have equitable access to natural resources, regardless of issues such as race, gender, socio-economic status, nationality.

Understandings (10–14)

10. Inequalities in income, race, gender and cultural identity within and between different societies lead to disparities in access to water, food and energy.

11. Sustainability and environmental justice can be applied from the individual to the global scale.

12. Sustainability indicators include quantitative measures of biodiversity, pollution, human population, climate change, material and carbon footprints, and others. These indicators can be applied on a range of scales, from local to global.

13. The concept of ecological footprints can be used to measure sustainability. If these footprints are greater than the area or resources available to the population, this indicates unsustainability.

14. The **carbon footprint** measures the amount of greenhouse gases (GHGs) produced, measured in carbon dioxide equivalents (in tonnes). The **water footprint** measures water use (in cubic metres per year).

Understandings (15–18)

15. Biocapacity is the capacity of a given biologically productive area to generate an ongoing supply of renewable resources and to absorb its resulting wastes.

16. Citizen science plays a role in monitoring Earth systems and whether resources are being used sustainably.

17. There is a range of frameworks and models that support our understanding of sustainability, each with uses and limitations.

18. The UN **Sustainable Development Goals (SDGs)** are a set of social and environmental goals and targets to guide action on sustainability and environmental justice.

Understandings (19–21)

19. The **planetary boundaries model** describes the nine processes and systems that have regulated the stability and resilience of the Earth system in the Holocene epoch. The model also identifies the limits of human disturbance to those systems, and proposes that crossing those limits increases the risk of abrupt and irreversible changes to Earth systems.

20. The **doughnut economics model** is a framework for creating a regenerative and distributive economy in order to meet the needs of all people within the means of the planet.

21. The **circular economy** is a model that promotes decoupling economic activity from the consumption of finite resources. It has three principles: eliminating waste and pollution, circulating products and materials, and regenerating nature.

“

The ultimate test of a moral society is the kind of world that it leaves to its children.

Dietrich Bonhoeffer (1906–1945), German theologian

“

He who slaughters his cows today shall thirst for milk tomorrow.

Muslim proverb

Sustainability

Being **sustainable** means living within the means of nature, on the interest or sustainable **natural income** generated by **natural capital**. This means, for example, not overfishing.

Humans consume natural resources all the time. You use electricity to power machines, heat or cool homes, you eat and drink, wear clothes, use transport.

But sustainability is a word that may mean different things to different people and sustainability may be **environmental**, **social** or **economic**.

The word “sustainable” is often used as an adjective in front of words such as *resource*, *development* and *population*.

Key terms

Sustainability is a measure of the extent to which human activities allow for the long-term viability of a system. It is generally used to refer to the responsible maintenance of socio-ecological systems such that there is no diminishment of conditions for future generations.

Natural income is the yield or harvest from natural resources.

Natural capital is the stock of natural resources on Earth. This includes rocks, soil, water, air and all living things. It also includes the services that support life such as photosynthesis and the water cycle.

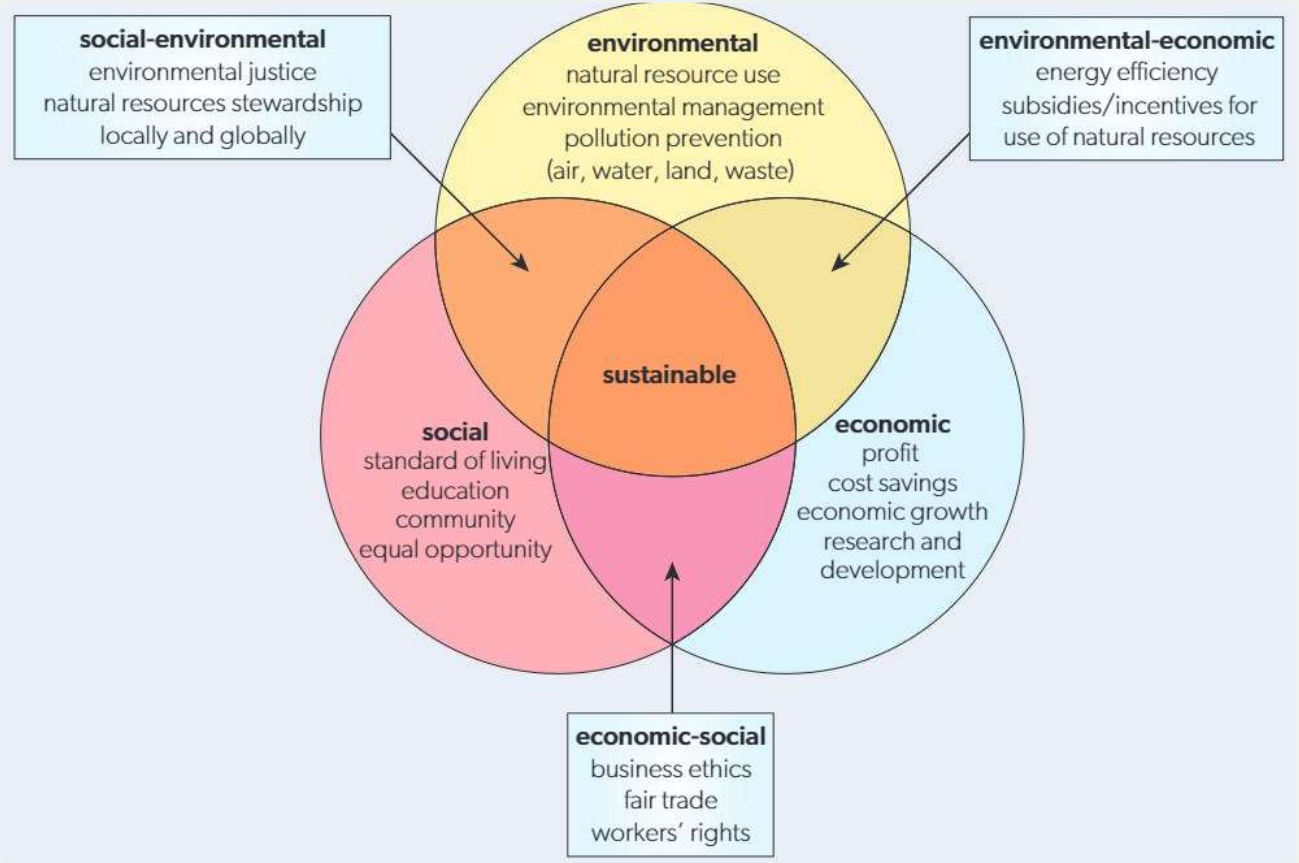
Key terms: the three types of sustainability

Environmental sustainability is the use and management of natural resources that allows replacement of the resources, and the recovery and regeneration of ecosystems.

Social sustainability focuses on creating the structures and systems that support human well-being, including health, education, equity, community and culture such as belief systems and language.

Economic sustainability focuses on creating the economic structures and systems to support production and consumption of goods and services that will support human needs into the future.

Figure 1: The spheres of a sustainable model



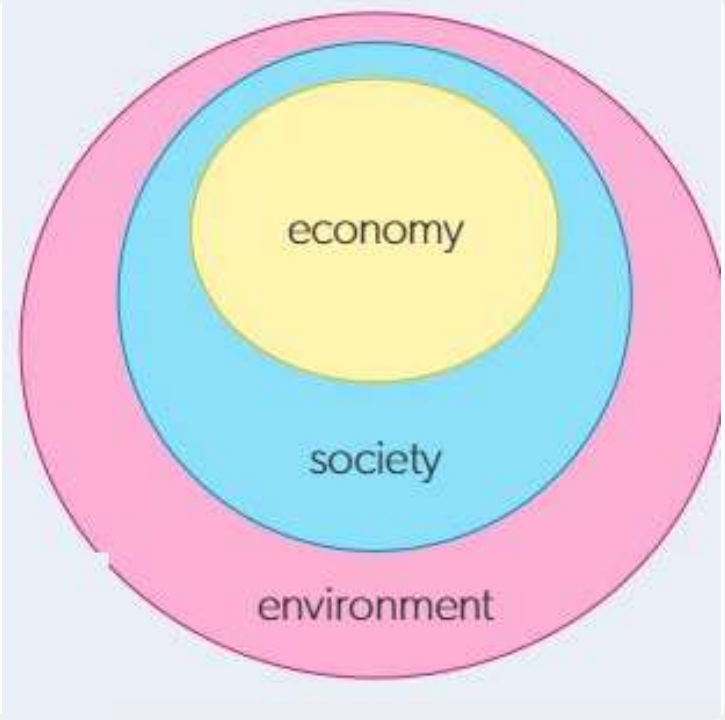
Only when all three overlap is there sustainability.

Social–environmental: environmental justice; natural resources stewardship locally and globally

Environmental–economic: energy efficiency; subsidies / incentives for use of natural resources

Economic–social: business ethics; fair trade; workers' rights

Figure 2: An alternative model of sustainability



All other systems sit within the environmental system.

Activity 12

ATL skills: thinking, research. Compare the two models in Figures 1 and 2.

1. Why do the social and economic circles of the Venn diagram overlap the environmental circle?

2. Is culture relevant to these models of sustainability? Where would you draw it in?

3. Does the choice of model change how we treat our environment?

4. Evaluate these models. (Consider their strengths and weaknesses.)

Why sustainability?

Economists may have a different view from environmentalists on what “sustainable development” means. You make judgements and decisions all the time about the actions you take: what you eat, what you do, what you use, how you behave to others.

A sustainable society tries to ensure that it is a fair and just one, a healthy one and one that leaves a healthy environment with enough natural income to provide for future generations.

Any society that supports itself in part by depleting essential forms of natural capital is **unsustainable**. There is a finite amount of materials on Earth and we are using much of it unsustainably. In economic terms, **we are living on the capital as well as the interest**.

Renewable and non-renewable natural capital

Our societies and economies cannot grow or make progress outside environmental limits. Sensible use of renewable natural capital is sustainable. Mining non-renewable natural capital (e.g. coal, metal ores) to supply resources is not sustainable and the capital will eventually run out.

Renewable natural capital can be generated or replaced as fast as it is being used. This includes all life and ecosystems as well as non-living systems such as the ozone layer or groundwater.

Non-renewable natural capital is either irreplaceable or can only be replaced over geological timescales (e.g. fossil fuels, soil, water in aquifers and minerals).

The three pillars must be in balance

Social sustainability	Economic sustainability	Environmental sustainability

Only when these three pillars are in balance can true sustainability be achieved (Figure 1).

Environmental sustainability is managing resources to conserve biodiversity, reduce or remove pollution and avoid depleting resources. Enhancing resilience of systems enhances sustainability.

But environmental improvement is **not** sustainability unless it includes economic and social factors.

Social and economic sustainability

Social and human

Investing in social and human sustainability improves the **human capital** of society.

This means better health programmes, better nutrition, skills and knowledge. It also means preserving the rights of future generations to these.

Economic

Economic sustainability is about efficient production of goods and services and maintaining this over time.

Indicators of economic development usually measure monetary value and **neglect the value of natural systems**.

GDP and Green GDP

GDP

A common indicator of economic development is **gross domestic product (GDP)**: the total value of goods and services produced by a country over a period of time.

But the challenge is to add the monetary value of natural goods and services to GDP for a true measure of sustainability.

Green GDP

Green GDP is an indicator of economic growth with environmental factors taken into account alongside the standard GDP of a country.

Green GDP factors include biodiversity losses and costs attributed to climate change.

Is it possible to balance these three pillars of sustainability? That is what society is trying to do now.

Activity 13: Circles of sustainable positivity

There are some hard facts here. Is it all bad? No; it is up to you to make a difference. Work in groups of three or four. Each person chooses a sustainable area. Examples are:

> **Social:** good nutrition, good healthcare, good education, good housing, aesthetics, cultural opportunities
>
> **Economic:** increased wealth in a society, increased equity, decent employment opportunities, public infrastructure improvements, renewable energy supplies
>
> **Environmental:** conserving biodiversity, habitat restoration, cleaner air, cleaner water, improving soils

Each person draws a large circle on a piece of paper. Do some research and fill your circle with positive news, facts and images (nothing negative). Think creatively. Pass your circle to the next person so they can add to it. Repeat so each person has added something positive to each circle. Finally, share your ideas with the class.

The Brundtland Report (1987)

The term **sustainable development** was introduced in the Brundtland Report *Our Common Future* (1987): “development that meets the needs of the present without compromising the ability of future generations to meet their own needs”.

It took three years for the commission to investigate and write the report. It stated that “critical global environmental problems were primarily the result of the enormous poverty of the South and the non-sustainable patterns of consumption and production in the North”.

It was a crucial publication because it recognized that human resource development (socio-economic development) and environmental conservation were both necessary: **in reducing poverty** and **in promoting equity of wealth, gender and justice**. It also recognized **limits to growth** in industrialized countries.

Activity 14: From Brundtland to the Earth Summit

Following on from the Brundtland Report came the **Earth Summit of 1992**, which led to **Agenda 21**, the **Rio Declaration** and documents on forest conservation, biodiversity and climate change.

1. Look up and make brief notes on the Brundtland Report.
2. Who was Brundtland?
3. What are the three principles of sustainability outlined in the report?
4. Were any results of subsequent actions legally binding on countries?
5. How many countries signed the Rio Declaration?
6. How relevant is the Brundtland Report today?

Ecological overshoot

The World Wide Fund for Nature (WWF), an NGO, notes that “humanity’s annual demand on the natural world has exceeded what the Earth can renew in a year since the 1970s”. This “ecological overshoot” has continued to grow over the years.

50%

deficit in 2008

75%

deficit in 2018

1.75 years

for the Earth to regenerate the renewable resources that people use, and absorb the CO_2 waste they produce, in one year

How is overshoot possible with only one Earth?

Renewable resources can be harvested faster than they can be re-grown.

> **The bank account analogy:** it is possible to withdraw money from a bank account faster than waiting for any interest this money generates. Just like overdrawing from a bank account, using a renewable resource faster than it can regenerate leads to **depletion** of the resource.

At present, people are often able to shift their sourcing when this happens. However, at current consumption rates, the new sources will also run out of resources. And some ecosystems will collapse even before the resource is completely gone.

This overshoot is due to the level of overall consumption and per capita consumption. It is more in some parts of the world and cannot continue indefinitely.

Earth Overshoot Day

Earth Overshoot Day marks the date when humanity's demand for ecological resources and services in a given year exceeds what the Earth can regenerate in that year.

We, as a global population, at present consume resources as if we had **1.75 planets**. Some use more than others (Figures 3 and 4).

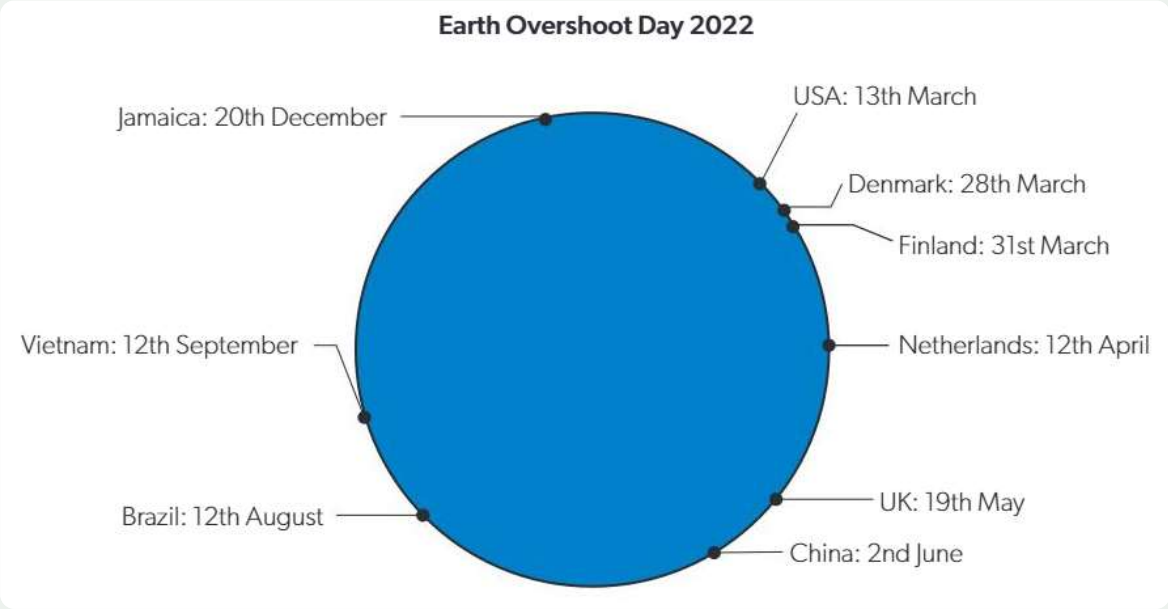
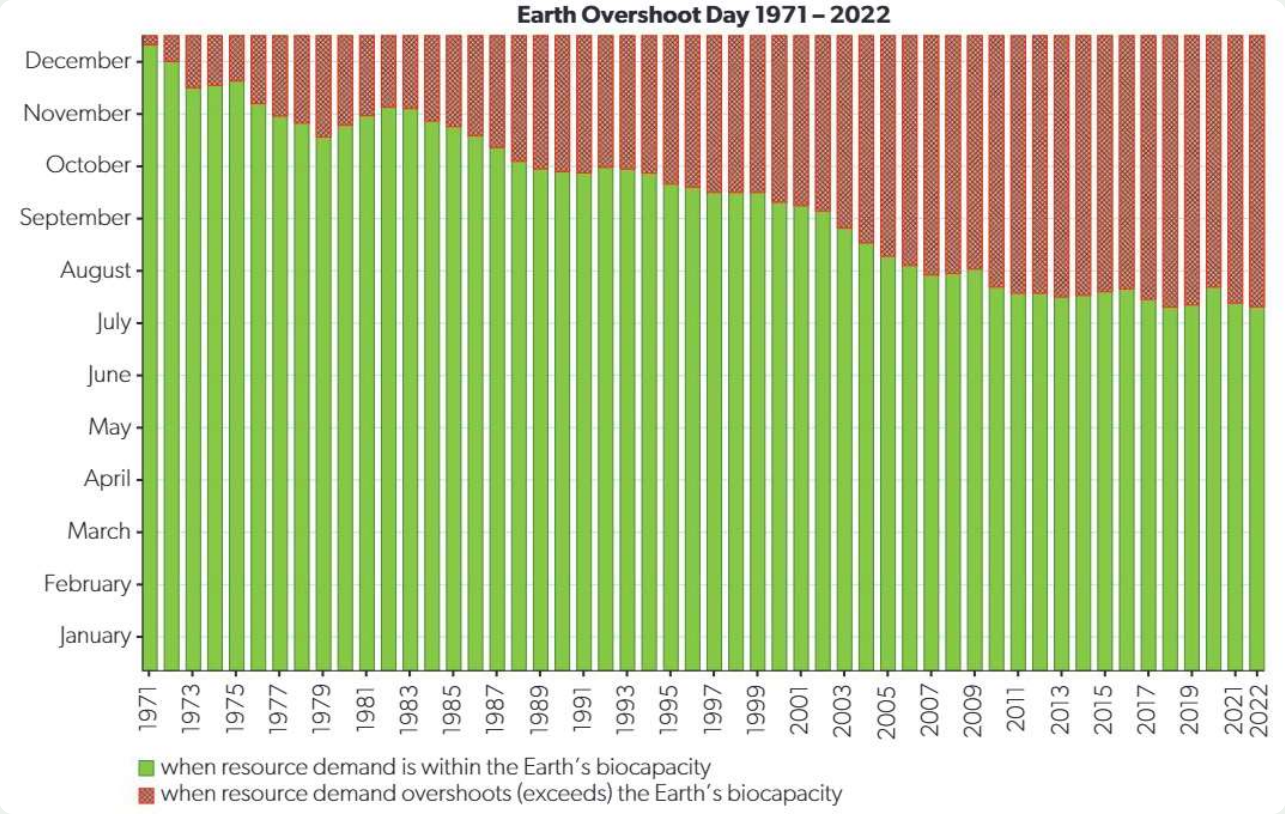


Figure 3: Earth Overshoot Day 2022 for selected countries (Global Footprint Network data)

2022: USA 13 March · Denmark 28 March · Finland 31 March · Netherlands 12 April · UK 19 May · China 2 June · Brazil 12 August · Vietnam 12 September · Jamaica 20 December

Figure 4: Earth Overshoot Day 1971–2022



Green = resource demand within the Earth's biocapacity; red = demand overshoots (exceeds) biocapacity

Earth Overshoot Day is the estimated date each year when the GFN calculates that all the natural income for the year has been used. In 2022 it was on **28 July**.

It is an estimate, but we know that globally humans are not living within sustainable limits. Some of us are; some use far, far more. There is **huge inequality** globally in use of natural resources.

Task: look up the GFN site and find out what the Earth Overshoot Day is now.

Environmental justice

Key term

Environmental justice is the right of all people regardless of race, gender, socio-economic status or national origin to:

- live in a pollution-free environment free from hazardous waste
- have equitable access to natural resources
- have fair treatment through laws and regulations.

Environmental justice is also known as **“distributive justice”**. This means that the risks and benefits of environmental exploitation are equally distributed.

The global environmental justice movement developed in the **1980s**, following many cases in which local peoples were impacted by multinational corporations extracting resources or creating industrial complexes that caused harm.

Types of environmental injustice

Sadly, there are many examples of environmental injustice. They can be classified as examples of:

- **Hazardous waste dumping**
- **Insufficient safety measures**
- **Resource extraction**
- **Land appropriation**
- **Climate justice issues**

You have already read about the **Bhopal**, **Minamata** and **Deepwater Horizon** disasters. These all have environmental justice implications.

Other examples of environmental injustice

- Landfill or incinerator sites for domestic or industrial waste situated near communities of low income (e.g. **Ghazipur in Delhi, India**)
- Waste plastic disposal from high-income countries (HICs) to low-income countries (LICs) and associated pollution of water and air (e.g. to **Malaysia, Thailand, Vietnam**)
- Mining tailings dams (e.g. in **Chile**)
- **Maasai land rights** in Tanzania and Kenya (see Case study 5)
- Indigenous land rights in **Australia** and **North America**
- Indigenous property rights in the **Amazon**
- Disparity in energy, electricity or water supplies for different groups in a society

CASE STUDY 5

Maasai land rights

There are over **one million** indigenous Maasai people who live in the African Great Lakes region of southern **Kenya** and northern **Tanzania** (Figure 5).

They are traditionally **transhumance nomadic pastoralists** who live by herding their livestock (mostly cattle) over vast areas of land in search of grazing and water.

Transhumance is the practice of moving livestock seasonally from one grazing area to another. Maasai people mostly live on the blood and milk of their animals and rarely kill them for meat.



Figure 5: Maasai area

CASE STUDY 5

How the Maasai lost their land

During colonization by the British empire there was a view that the Maasai way of life was not compatible with wildlife in the area, and national parks were created with **no consideration for local peoples**.

It is easier for authorities to regulate and know about a sedentary population who stay in one place (for example, farmers) than nomads. Also, land was privatized and rancher colonists moved in to displace the Maasai.

Parks and animal reserves have proliferated as governments encourage tourism, development and sedentary lifestyles in towns, and Maasai traditional lands have been taken from them.

CASE STUDY 5

Wildlife and tourism before people

The British and, after independence, the Kenyan governments valued wildlife for the income from tourism more than the indigenous Maasai. Various land exchanges moved the Maasai from their traditional grazing areas to smaller land areas which were not compatible with pastoralism. The belief was that Maasai herds would overgraze to the detriment of wildlife.

The **Serengeti**, with its iconic wildebeest herds, was mostly lost to the Maasai, and in the 1950s they were moved to the **Ngorongoro Conservation Area (NCA)** in Tanzania. Here is the highest concentration of wildlife on Earth during the annual migration of more than one million wildebeest, half a million gazelles and a quarter of a million zebras from the Serengeti. It has many lions and cheetahs and is a refuge for elephants and black rhinos.

Management plans were supposed to protect the Maasai, but their lives became **worse, not better**, as the plans prioritized wild animals, and thus tourism income, not the Maasai.

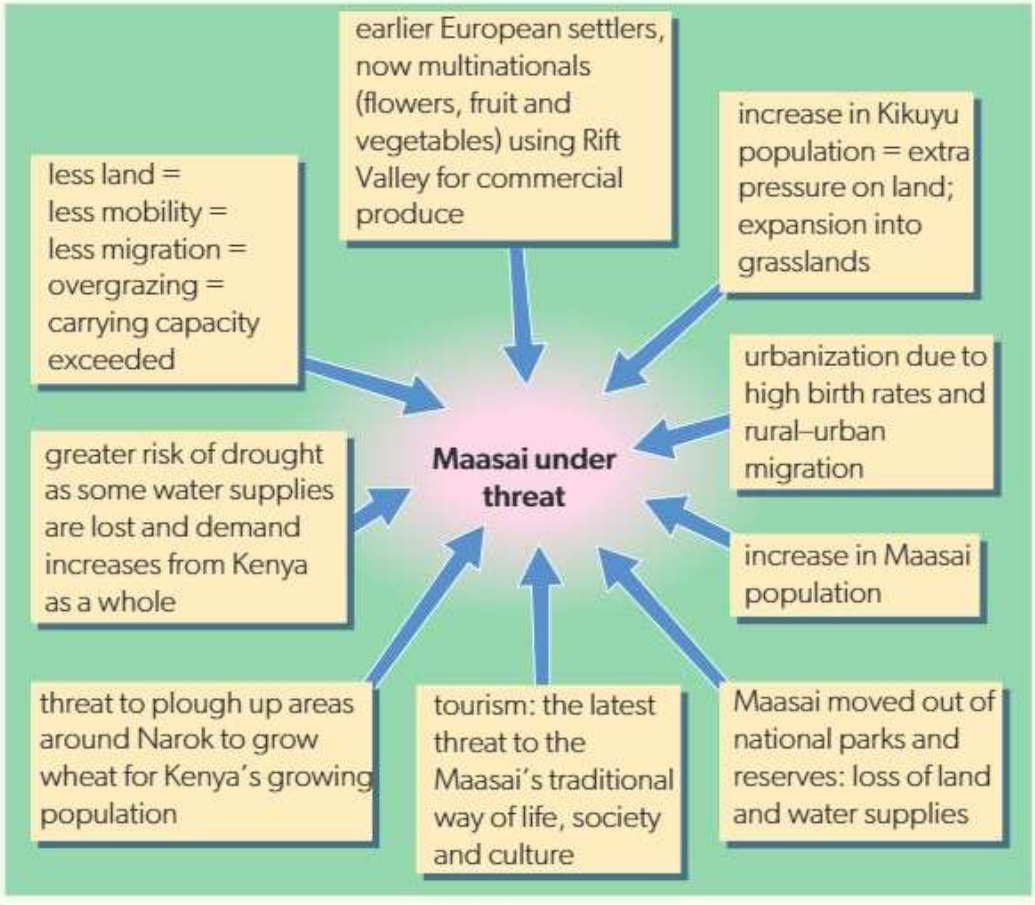
CASE STUDY 5

The Maasai today: the issues

The Maasai have practised pastoralism for at least 200 years and adjust their herd numbers in order to live sustainably. But various threats are damaging them and driving them to more poverty, not less (Figure 6). Recently, they have begun to organize their struggle for land rights. This has not happened earlier because the nature of their way of life means they have no single leader; nor is there any international advocate for their case.

- scale of tourism industry
- lack of income from tourism to Maasai communities
- cultural differences between various groups
- lack of inclusion of Maasai in decision-making
- lack of communication between groups
- land grabs by various groups
- climate change causing droughts
- increasing populations

Figure 6: Threats to the Maasai



- Less land = less mobility = less migration = overgrazing = carrying capacity exceeded
- Earlier European settlers, now multinationals (flowers, fruit and vegetables) using Rift Valley for commercial produce
- Increase in Kikuyu population = extra pressure on land; expansion into grasslands
- Urbanization due to high birth rates and rural–urban migration
- Increase in Maasai population
- Greater risk of drought as some water supplies are lost and demand increases from Kenya as a whole
- Threat to plough up areas around Narok to grow wheat for Kenya's growing population
- Tourism: the latest threat to the Maasai's traditional way of life, society and culture
- Maasai moved out of national parks and reserves: loss of land and water supplies

Activity 15: Environmental justice research

Read Case study 5 on Maasai land rights. Research **one local** and **one global** example of an environmental justice issue. Make a display of your choice to show:

- the issue
- the stakeholders, such as companies, peoples, governments, local authorities, NGOs and pressure groups
- the impacts of the activity
- the actions taken by all parties
- the results.

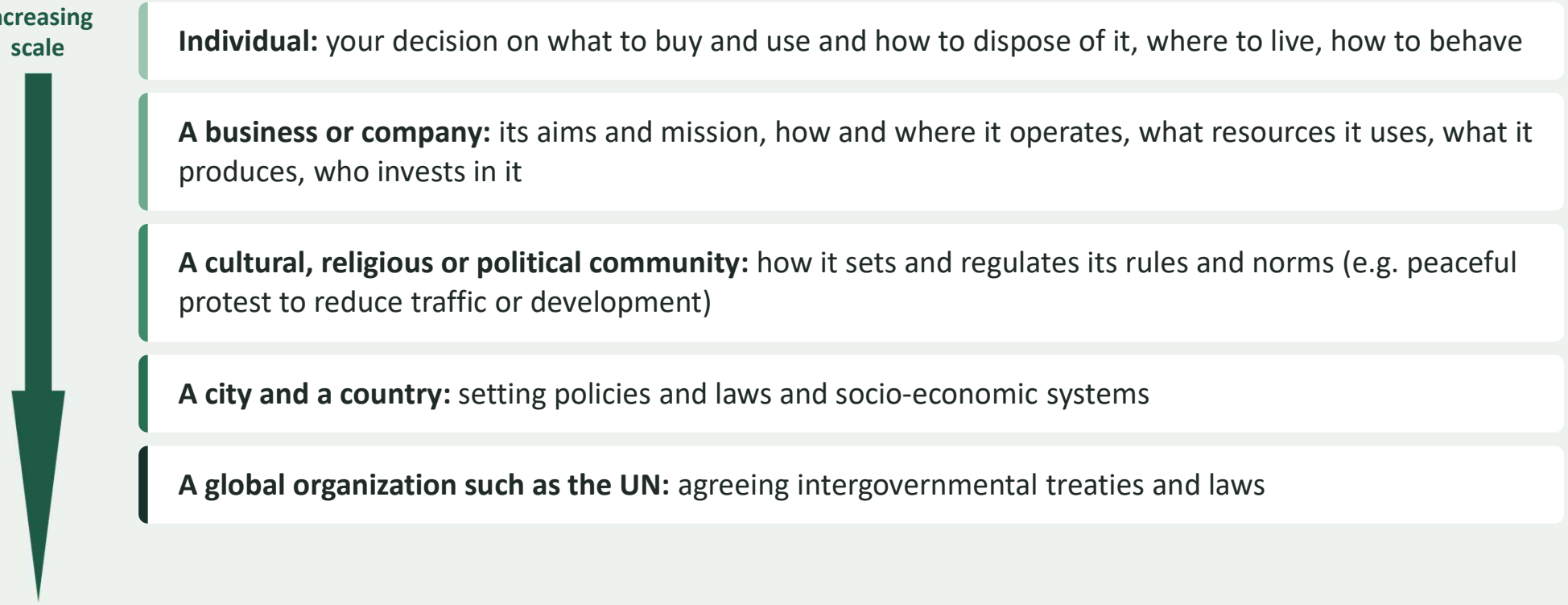
Sustainability indicators

How we measure sustainability is crucial, and there are many ecological and socio-economic indices we can use. These could be anything from air quality, environmental vulnerability and water poverty to GDP per capita (per head of population), life expectancy or gender equity.

We can also measure sustainability on scales from **local to global**. The smaller the scale, the more accurate it can be, but we need a global measurement to get the whole picture.

Both environmental justice and sustainability can be viewed at operating scales ranging from the **individual** to **intergovernmental organizations** (Figure 7).

Figure 7: Scales of sustainability and environmental justice



Sustainability indicators include:

- **Biodiversity**
- **Pollution levels**
- **Human population size, health and income**
- **Energy production and consumption**
- **Climate change**
- **Ecological and carbon footprints**

Key terms: footprints and capacity

An **ecological footprint (EF)** is the area of land and water required to sustainably provide all the resources required at the rate of consumption and to assimilate all wastes at the rate of production by a given population.

Carrying capacity is the maximum number of individuals of a species that the environment can sustainably support.

Biocapacity is the capacity of a biologically productive area to generate a supply of renewable resources and to absorb its waste.

Ecological footprints

An ecological footprint (EF) is a **model** used to estimate the demands that human populations place on the environment. The measure takes into account the area required to provide all the resources needed by the population, plus the assimilation of all wastes.

When the EF is greater than the area available to the population, the situation is **unsustainable**: the population exceeds the carrying capacity (see subtopic 8.4) of the environment.

EFs may vary significantly from country to country and person to person and include aspects such as lifestyle choices (EVS), productivity of food production systems, land use and industry.

The EF indicator can be applied at an individual to global scale, and it is **visual** so can be interpreted easily.

Other footprints, carrying capacity and biocapacity

Carbon footprint

The amount of greenhouse gases produced, measured in carbon dioxide equivalents.

Water footprint

Measures water use.

Carrying capacity is the inverse of EF. Carrying capacity is the number of a population that a unit of land can support. EF is the area of land that is needed to support that population.

Biocapacity and ecological footprints are methods of measuring human impact on the environment.

If an area's EF is greater than its biocapacity, the situation is unsustainable.

Activity 16: Your ecological footprint

1. Measure your EF at www.footprintcalculator.org/home
2. In what ways does your EF differ from those of your classmates and why?
3. Plot your class EFs graphically. Comment on the graph.
4. How might you reduce your EF?
5. How might the EF of other socio-economic groups differ?
6. Evaluate the accuracy of using an EF calculator.

Practical: design an EF questionnaire

Produce a questionnaire of your own to calculate the EF of a person. You can use the ideas in Figure 8 to help you.

Skills:

- Tool 1: Experimental techniques
- Tool 2: Technology
- Inquiry 1: Exploring and designing

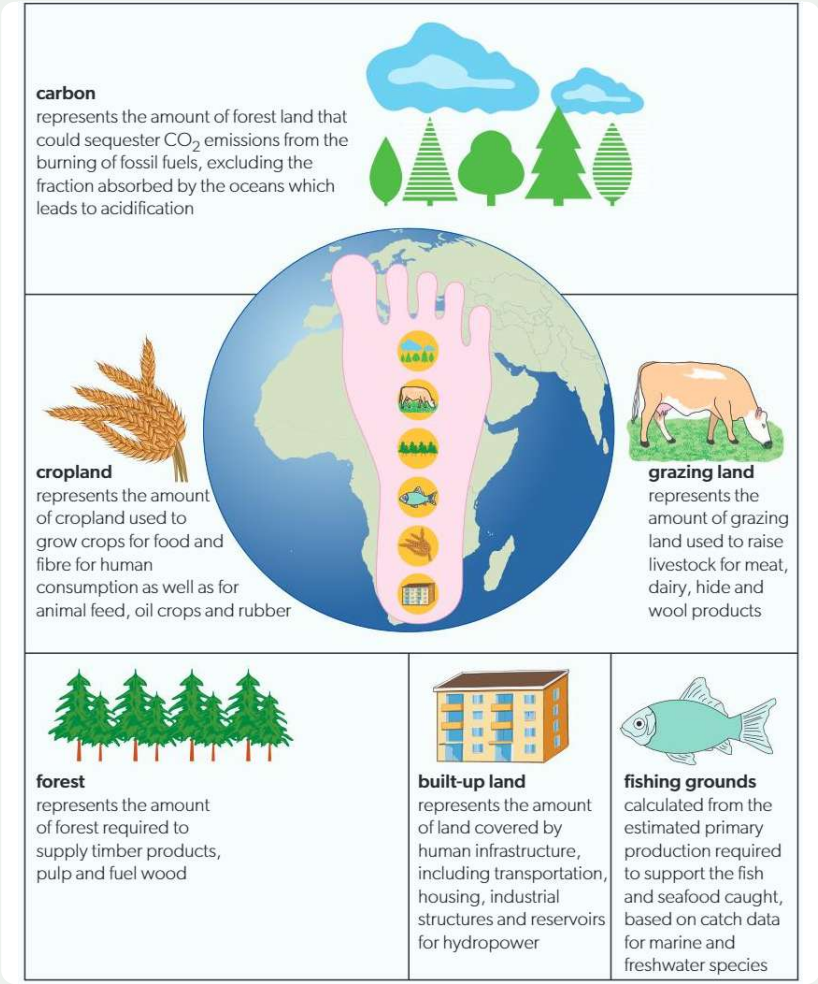


Figure 8: Ecological footprint calculator

The six parts of an ecological footprint (Figure 8)

Carbon: the amount of forest land that could sequester CO_2 emissions from the burning of fossil fuels, excluding the fraction absorbed by the oceans which leads to acidification

Grazing land: the amount of grazing land used to raise livestock for meat, dairy, hide and wool products

Built-up land: the amount of land covered by human infrastructure, including transportation, housing, industrial structures and reservoirs for hydropower

Cropland: the amount of cropland used to grow crops for food and fibre for human consumption as well as for animal feed, oil crops and rubber

Forest: the amount of forest required to supply timber products, pulp and fuel wood

Fishing grounds: calculated from the estimated primary production required to support the fish and seafood caught, based on catch data for marine and freshwater species

The global ecological footprint

1961

0.72 gha

EF of all people on Earth per person (global hectares). The biocapacity of the Earth was then within sustainable limits.

2018

2.8 gha

per person, equivalent to **1.75 Earths**. It would take **21 months** to regenerate one year's worth of resources that humans use.

Since the 1970s, we have been in **ecological overshoot**: our annual demand on the natural world exceeds what it can supply.

Data-based questions: Figure 9

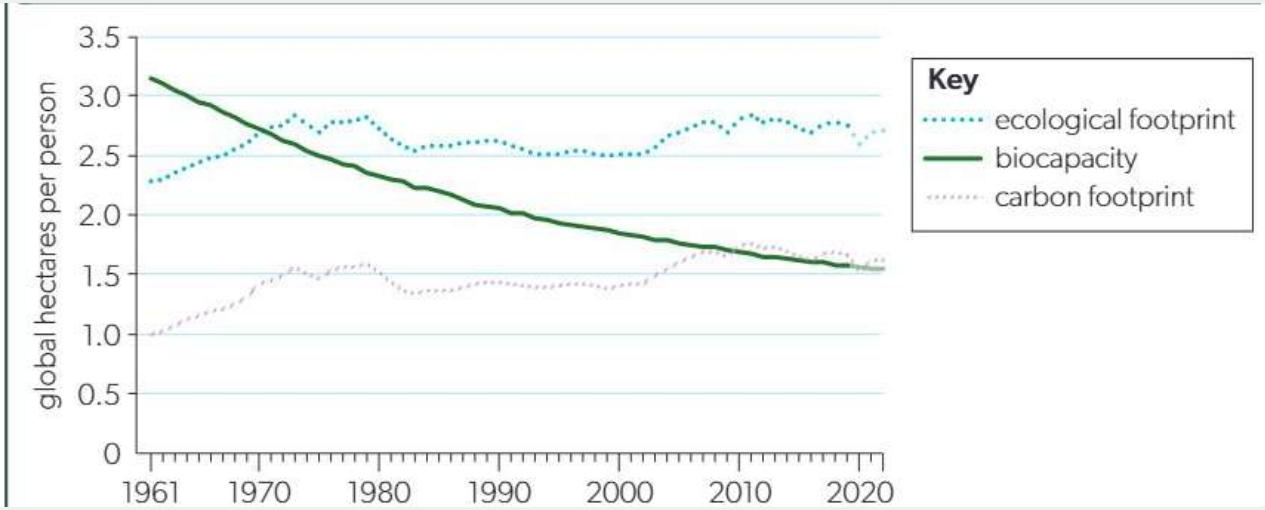


Figure 9: Global EF and biocapacity 1961–2022 (WWF Living Planet Report 2022, GFN data)

1a. Explain why the biocapacity has fallen but global EF remained about the same.

1b. List reasons for the uneven distribution of natural resources across the Earth.

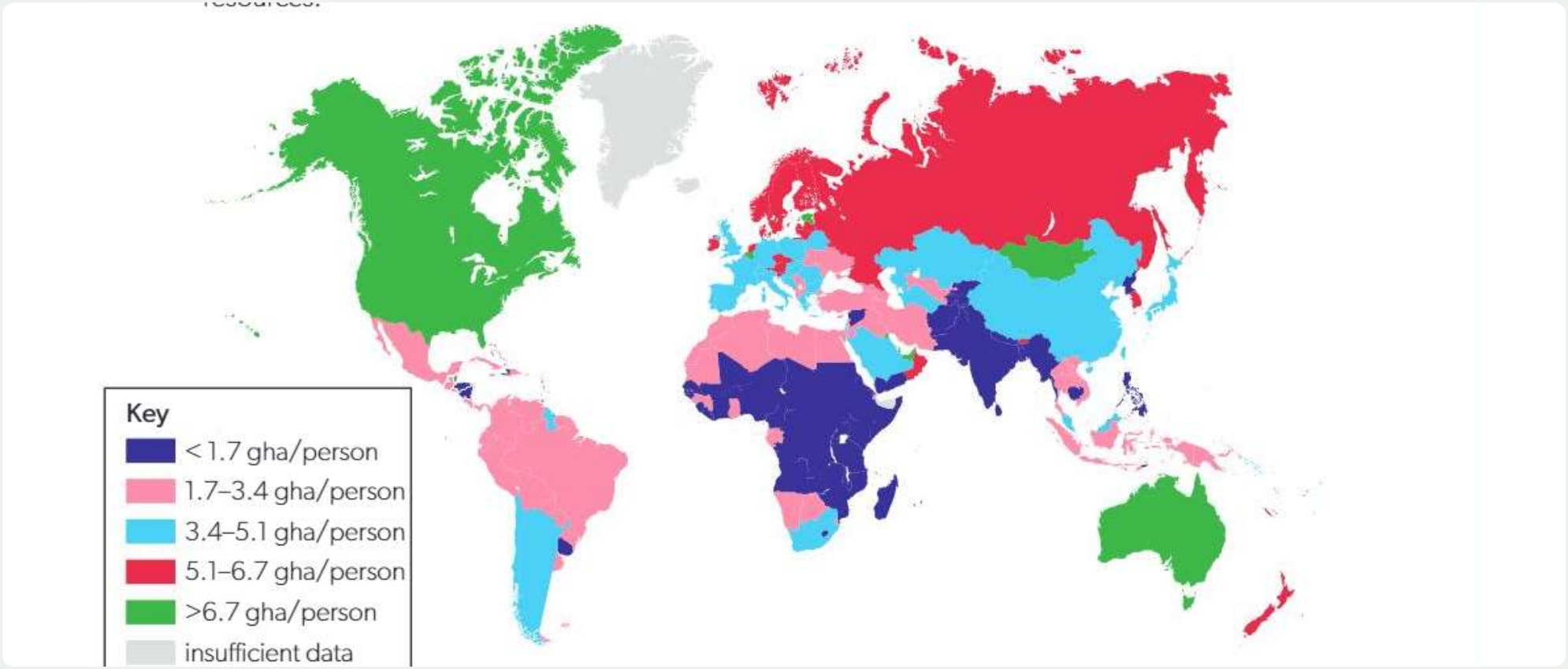
1c. List reasons for the uneven consumption of natural resources.

1d. Explain how some countries increase their carrying capacity.

1e. Describe the change in carbon footprint from 1961 to 2022.

1f. Explain why this has risen slightly.

Figure 10: Global EF per person



1.3 Sustainability · Book p. 43 · Source: WWF (2022) Living Planet Report 2022

Data-based questions: Figure 10

2. The Earth's biocapacity was **1.6 gha per person** in 2022.

a. List the regions on Earth in which the EF per person is lower than global biocapacity.

b. Describe possible reasons for high EFs in North America, Australia and Mongolia.

c. Where else in the world is EF very high? Explain why.

d. State possible reasons for insufficient data from Greenland and Iceland.

e. State possible reasons for insufficient data from the country at the Horn of Africa.

The ecological footprint of a country depends on several factors: its **population size** and **consumption per capita** (how many people and how much land each one uses). It includes the cropland and other land needed to grow food, grow biofuels, graze animals for meat, produce wood and dig up minerals, and the area of land needed to absorb wastes: not just solid waste but wastewater, sewage and carbon dioxide.

Sustainability models

Sustainability models, like all models, are simplified versions of reality and therefore have both **uses** and **limitations**. Here we look at four sustainability frameworks and models:

1. **Sustainable Development Goals (SDGs)**
2. **Planetary boundaries model**
3. **Doughnut economics model**
4. **Circular economy**

Activity 17: The Millennium Ecosystem Assessment

The **Millennium Ecosystem Assessment (MEA)** is funded by the UN and started in 2001. It is a research programme that focuses on how ecosystems have changed over the last decades and predicts changes that will happen.

In 2005, it released the results of its four-year study of the Earth's natural resources. It was not happy reading.

> The report said that natural resources (food, freshwater, fisheries, timber, air) are being used in ways that degrade them so as to make them **unsustainable in the longer term**.

MEA: key facts reported in 2005

- **60%** of world ecosystems have been degraded
- about **25%** of the Earth's land surface is now cultivated
- we use between **40% and 50%** of all available freshwater running off the land, and water withdrawals have doubled over the past 40 years
- over **25%** of all fish stocks are overharvested
- since 1980, about **35%** of mangroves have been destroyed
- about **20%** of corals have been lost in 20 years and another 20% degraded
- nutrient pollution has led to eutrophication of waters and dead coastal zones
- species extinction rates are now between **100 and 1,000 times** above the background rate
- we have had more effect on the ecosystems of the Earth in the last 50 years than ever before

Some recommendations were to:

- remove subsidies to agriculture, fisheries and energy sources that harm the environment
- encourage landowners to manage property in ways that enhance the supply of ecosystem services, such as carbon storage and the generation of freshwater
- protect more areas from development, especially in the oceans.

Table 1: Key indicators

Indicator	2005	Current year
Degraded ecosystems	60%	
Land surface cultivated	25%	
Freshwater use	40–50%	
Fish stocks overharvested	25%	
Mangroves destroyed	35%	
Corals lost	20%	
Species extinction rates	100–1,000× background	

Tasks

1. Research statistics for the key indicators listed and attempt to complete Table 1.

2. Add other data to the key indicators that you think is relevant.

3. Compare your data with others in the class.

Sustainable Development Goals (SDGs)

Sustainable Development Goals (SDGs) are **17 goals** formulated by the UN in **2015** which run until 2030 or beyond. They are assessed each year.

They followed on from the **Millennium Development Goals (MDGs)**, which ended in 2015.

The MDGs were eight goals to be achieved by 2015 that responded to the world's main development challenges. They were designed for low-income countries (LICs) and middle-income countries (MICs) only.

TOK

To what extent are you optimistic about the results of the impact of humans on Earth? Use examples to support your ideas.

To what extent do governments have the responsibility to take steps to safeguard the environment and protect humans from suffering? Support your ideas with examples.

The eight Millennium Development Goals (MDGs)

1. Eradicate extreme poverty and hunger
2. Achieve universal primary education
3. Promote gender equality and empower women
4. Reduce child mortality
5. Improve maternal health
6. Combat HIV/AIDS, malaria and other diseases
7. Ensure environmental sustainability
8. Develop a Global Partnership for Development

MDGs: successes, but mixed results

Successes

- up to **471 million** people lifted out of poverty, halving the total number
- gender disparity reduced
- more clean drinking water worldwide
- **21 million** lives saved.

But…

- greater progress among LICs than MICs
- the global economic crisis of 2008 reduced funding
- environmental progress was low
- above all, the goals were created **top-down**: planning did not involve the people the goals were meant to help
- critics said that reduction in poverty would have happened anyway due to economic growth.

Figure 11: The 17 Sustainable Development Goals



The SDGs have followed on from the MDGs and aim to build on the work already done by the MDGs. But there is quite a lot of disagreement on whether this is the best way to go about it.

How the SDGs are measured

17
goals

8–12
targets per goal (typically)

1–4
indicators per target, in three tiers

The targets are either **outcomes** or **means of implementation**. Some targets have internationally recognized methodologies for assessing whether or not they are reached. Some do not. This complex arrangement was reviewed in 2020 with some changes.

There is no question that these are admirable and necessary goals for the world, and progress is being made. But the challenges are huge. Compare the goals in Figure 11 with the comments on the next slides.

SDG progress and challenges (Goals 1–6)

1. Extreme poverty means living on less than USD 2.15 per day (2017 prices). In 2021 this included 9% of the world's population (700 million people). Most were in South Asia or Sub-Saharan Africa.

2. Around the world, one in nine people are undernourished, mostly in LICs.

3. Healthcare is improving and life expectancy mostly increasing.

4. Major progress has been made in primary education and reducing discrimination in education.

5. Gender equality, reduction in female genital mutilation (FGM) and empowering women are mostly happening.

6. Water stress (see subtopic 4.2) limits access to clean water for 2.2 billion people.

SDG progress and challenges (Goals 7–12)

7. Progress on clean energy has happened in India, Bangladesh and Kenya but 840 million people do not have access to electricity.

8. Economic growth and decent work are variable, with trafficking and exploitation of youth.

9. Decoupling of carbon emissions from economic growth is improving but only 53% of the world's population use the internet.

10. Reducing inequality and discrimination against women, minorities and those with disabilities has had mixed progress.

11. About 3.9 billion people globally live in cities and about 25% of these live in slums.

12. Reducing plastic waste, increasing recycling and removing fossil fuel subsidies are all happening.

SDG progress and challenges (Goals 13–17)

13. A just transition to combating climate change and reducing risks is the goal, but wildfires, droughts, floods and hurricanes appear to be more frequent and those in vulnerable conditions suffer more.

14. Reducing marine plastic pollution and illegal fishing are key, but three billion people rely on marine life for their livelihood.

15. Deforestation and desertification increase biodiversity losses; poaching, illegal logging and soil acidification add to the issues. Species extinctions are increasing.

16. Reducing violence, abuse, exploitation, crime and corruption are clear goals.

17. International cooperation is essential for any of these goals to be met: cooperation, not competition.

> According to the World Bank in 2019, **659 million** people on Earth lived below the poverty line of USD 2.15 per day. This was a reduction but may have been due to economic growth, which takes people out of poverty. Many people still live in conditions that do not meet their fundamental daily needs, and that is unacceptable.

Uses of the SDGs

A collective agenda with common ground

A global agenda for sustainable development at the highest level means that governments can use political pressure on challengers or each other.

Universal goals for all countries

Not only LICs: all countries are working towards the same goals.

A galvanizing agenda

While the goals are not legally binding, there is more freedom for countries to address inequalities within and between countries.

A tangible goal

The goal of ending poverty is tangible, and the MDGs made progress towards it, which the SDGs continue.

Limitations of the SDGs (1)

The goals do not go far enough or fast enough. The targets move slowly up to 2030 but unanticipated things (conflict, famine, floods) happen each year to deflect the course.

Top-down and bureaucratic: there are some 169 targets and much reporting and gathering of necessary evidence, but on the ground progress may be small.

Ignoring local contexts: while there must be a balance between respecting local context and working at the international level, it is hard to find this balance.

Limitations of the SDGs (2)

Lack of reliable data: the wider the data collection, the less reliable it may be, yet data is crucial to know if progress is being made.

The goals are not binding: therefore there are no penalties for not acting and no accountability. It is up to individual governments to create the systems.

Ignoring underlying inequalities: economic theory is based on financial values of companies and GDP of countries. If mainstream economics is fundamentally the wrong measure for all types of sustainability, that has to change.

Why does this continue if we all know it?

It is perhaps due to many factors, including the following:

Inertia

This is when changing what we do seems too difficult to achieve.

Tragedy of the commons (subtopics 3.2, 6.3)

When so many individuals act in their own interest to harvest a resource that they destroy the long-term future of that resource, so there is none for anyone. It may be obvious that this will happen, but because each individual benefits from taking the resource they continue to do so. For example, you may know that hunting an endangered species will result in its extinction. But if your family are starving and it is the only source of food, you will probably hunt it to eat it.

Some people think that the real worth of natural capital is about the same as the value of the gross world product (total global output): about **USD 65 trillion per year**. But we are only just beginning to give economic value to soil, water and clean air, and to measure the cost of loss of biodiversity. At the same time, the average person alive now is in a better situation than anyone in history.

The planetary boundaries model

In **2009**, **Johan Rockström** and 28 internationally renowned scientists identified **nine key processes** that regulate the stability and resilience of our planet. They proposed quantitative “planetary boundaries” within which humanity can continue to develop and thrive for generations to come. Crossing these boundaries increases the risk of generating large-scale abrupt or irreversible environmental changes.

The model attempts to answer the question: **up to what limits will the Earth system be able to absorb human activities without compromising the living conditions of species?**

The models from 2009 (Figure 12) and 2022 (Figure 13) describe the nine processes and systems that regulate the stability and resilience of the Earth in the Holocene Epoch. A traffic light system shows how human activity has moved a process into a danger zone with risk of fast and irreversible change: **green** is within the boundary, **yellow** is the zone of uncertainty and **orange** is high risk.

The nine planetary boundaries: 2009 and 2022

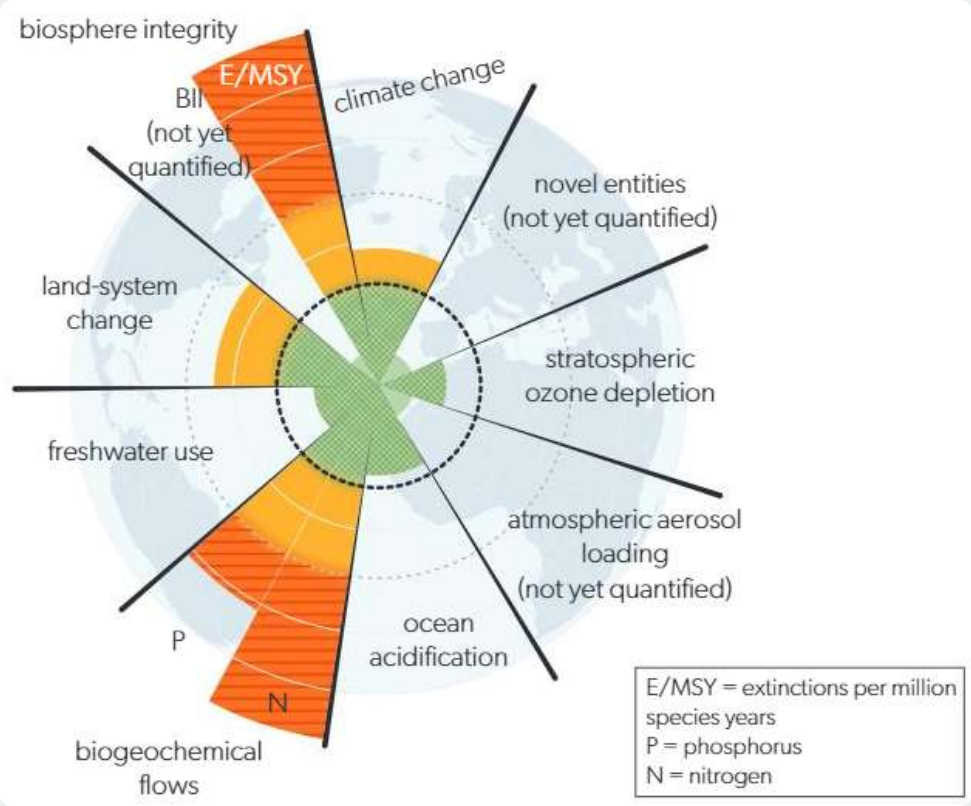


Figure 12: the model in 2009

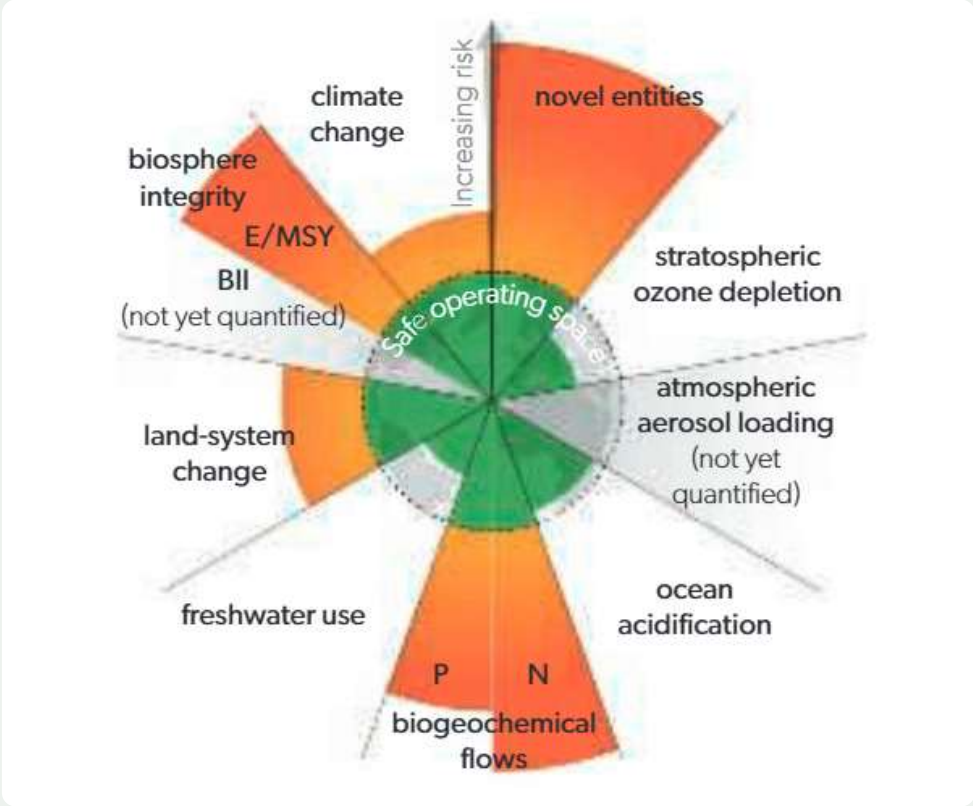


Figure 13: the model in January 2022

Planetary boundaries: uses and limitations

Uses

- Identifies science-based limits to human disturbance of Earth systems.
- Focuses on more than just climate change (which dominates discussion).
- Alerts the public and policymakers to the urgent need for action.

Limitations

- Focuses only on ecological systems and does not consider the human dimension necessary to take action for environmental justice.
- Is a work in progress: assessments of boundaries are changing as new data becomes available.
- The focus on global boundaries may not be a useful guide for local and country-level action.

Novel entities = chemical pollution

350,000

different manufactured chemicals on the market today

+79%

increase in plastic production between 2000 and 2015

2×

the total mass of plastics on the planet is now more than twice the mass of all living mammals

80%

of all plastics ever produced remain in the environment

Plastics contain more than **10,000 other chemicals**, so their environmental degradation creates new combinations of materials and unprecedented environmental risks.

Activity 18: Crossed planetary boundaries

1. State which planetary boundaries in this model were crossed in 2009.

2. Describe the differences between the 2009 and 2022 models.

3. In May 2022 it was reported that the boundary for freshwater use had been crossed. Research the state of the boundaries model now and redraw the model to show this.

4. Use the paragraphs on the next two slides as a guide to explain crossed planetary boundaries.

Loss of biosphere integrity (biodiversity loss and extinctions)

BII stands for **Biodiversity Intactness Index**. Similar to the extinction rate, this measures how well the biodiversity of a given area has been maintained. A well-functioning and resilient ecosystem has a BII of **over 90%**. At-risk ecosystems have a BII of **less than 30%**.

The Millennium Ecosystem Assessment of 2005 concluded that changes to ecosystems due to human activities were more rapid in the past 50 years than at any time in human history, increasing the risks of abrupt and irreversible changes.

The main drivers of change are the demand for food, water and natural resources, causing severe biodiversity loss and leading to changes in ecosystem services. These drivers are either steady, showing no evidence of declining over time, or are increasing in intensity.

The current high rates of ecosystem damage and extinction can be slowed by efforts to protect the integrity of living systems (the biosphere), enhancing habitat, and improving connectivity between ecosystems while maintaining the high agricultural productivity that humanity needs.

Biogeochemical flows: nitrogen and phosphorus to the biosphere and oceans

The biogeochemical cycles of nitrogen and phosphorus have been radically changed by humans as a result of many industrial and agricultural processes. Nitrogen and phosphorus are both essential elements for plant growth, and production and application of **fertilizers** is the main concern.

Human activities now convert more atmospheric nitrogen into reactive forms than all of the Earth's natural processes combined. Much of this new reactive nitrogen is emitted to the atmosphere rather than taken up by crops. When it rains, it pollutes waterways and coastal zones or accumulates in the terrestrial biosphere.

A relatively small proportion of phosphorus fertilizers applied to food production systems is taken up by plants; much of the phosphorus mobilized by humans also ends up in aquatic systems. These can become depleted of oxygen when bacteria consume algal blooms that grow in response to the high nutrient supply.

A significant fraction of the applied nitrogen and phosphorus makes its way to the sea and can push marine and aquatic systems across ecological thresholds of their own.

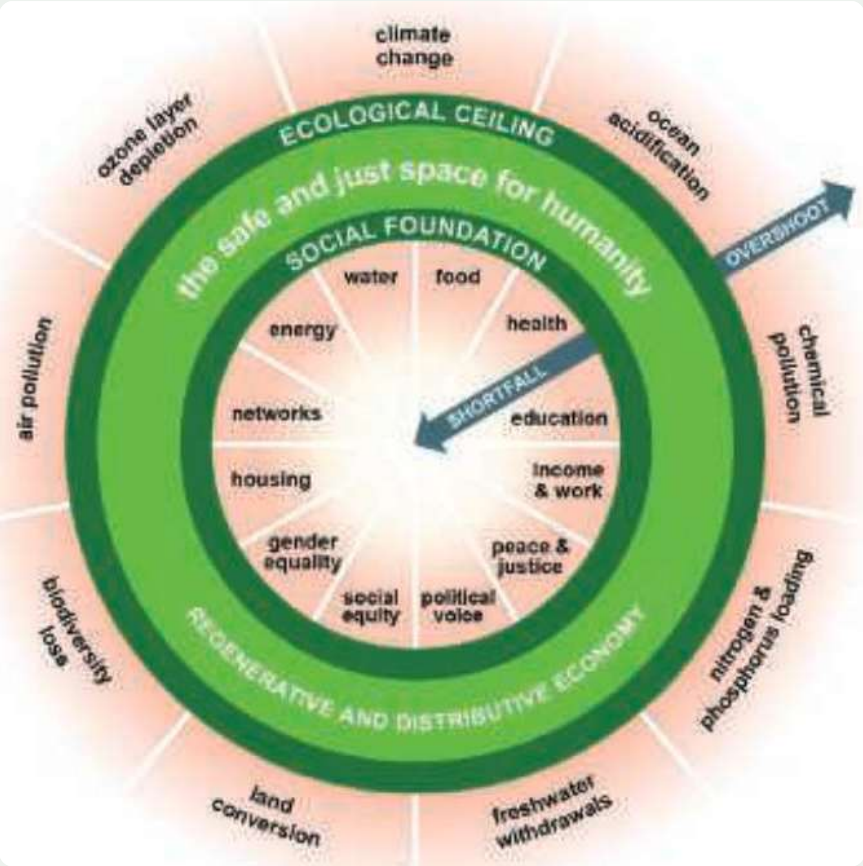


Figure 14: Model of doughnut economics

The doughnut economics model

A framework for creating a **regenerative** and **distributive** economy that meets the needs of all people within the means of the planet.

Figure 14 shows two concentric rings:

- a **social foundation**, to ensure that no one is left falling short on life's essentials
- an **ecological ceiling**, to ensure that humanity does not collectively overshoot the planetary boundaries that protect Earth's life-support systems.

Search the web for Kate Raworth's 2018 TED talk on doughnut economics.

Key terms: regenerative and distributive design

Regenerative design is a principle in which products or services contribute to systems that renew or replenish themselves. This means the materials and energy that go into a product or process can be reintroduced into the same process or system, requiring little to no inputs to maintain it. At the heart of regenerative design is a strong connection to the place in which a product or process is extracted, produced, used and disposed of at end of life.

Distributive design is about designing our activities in such a way that they share the value from the start, instead of redistributing it afterwards. This value could be money, but also land, companies and the ability to create money. **Distributive economics** is an economic paradigm which promotes the equitable distribution of wealth through a combination of open design, flexible fabrication, and open business models, towards replicability.

Inside the doughnut: safe and just

According to the Doughnut Economics Action Lab website, between the two rings is a “doughnut-shape space that is both ecologically safe and socially just: a space in which humanity can thrive”.

The **social foundation** (inner boundary) is based on the social SDGs. The **ecological ceiling** (outer boundary) is based on planetary boundaries science. Together they represent the minimum conditions for an economy that is ecologically safe and socially just.

Today, billions of people still fall short of the social foundation, while humanity has collectively overshot most of the planetary boundaries. The goal is to move into the doughnut and create an economy that enables humanity to thrive in balance with the rest of the living world.

This will only be achieved if economies become regenerative and distributive by design. A **regenerative economy** works with and within the cycles and limits of the living world. A **distributive economy** shares value and opportunity far more equitably among all stakeholders.

Doughnut economics: uses and limitations

Uses

This model has both ecological and social elements, so it:

- supports the concept of environmental justice
- has reached popular awareness
- is being used at different scales (e.g. countries, cities, neighbourhoods, businesses)
- supports action on sustainability.

Limitations

- Is a work in progress.
- Will not work as long as individuals are focused on their comparative wealth and income levels.
- Advocates broad principles of regenerative and distributive practice.
- Does not propose specific policies.

Activity 19: Doughnut economics

Visit the Doughnut Economics Action Lab (DEAL) website or find a copy of the book *Doughnut Economics* by Kate Raworth.

1. State the five principles of doughnut economics in practice.

2. Describe the mindset suggested in the website or book for a 21st century economist.

3. Figure 15 combines the planetary boundaries model and the doughnut economics model. **a.** Several of the shortfalls are large. Choose three and explain why they are so large, giving an example for each one. **b.** Evaluate the benefits and disadvantages of combining the two models.

4. Look at doughnuteconomics.org/tools/173, a visualization of the doughnut model for different countries. **a.** List the data sets used to create this model. **b.** Select four countries and comment on the overshoot of planetary boundaries and shortfall of life essentials. **c.** Explain reasons for these differences.

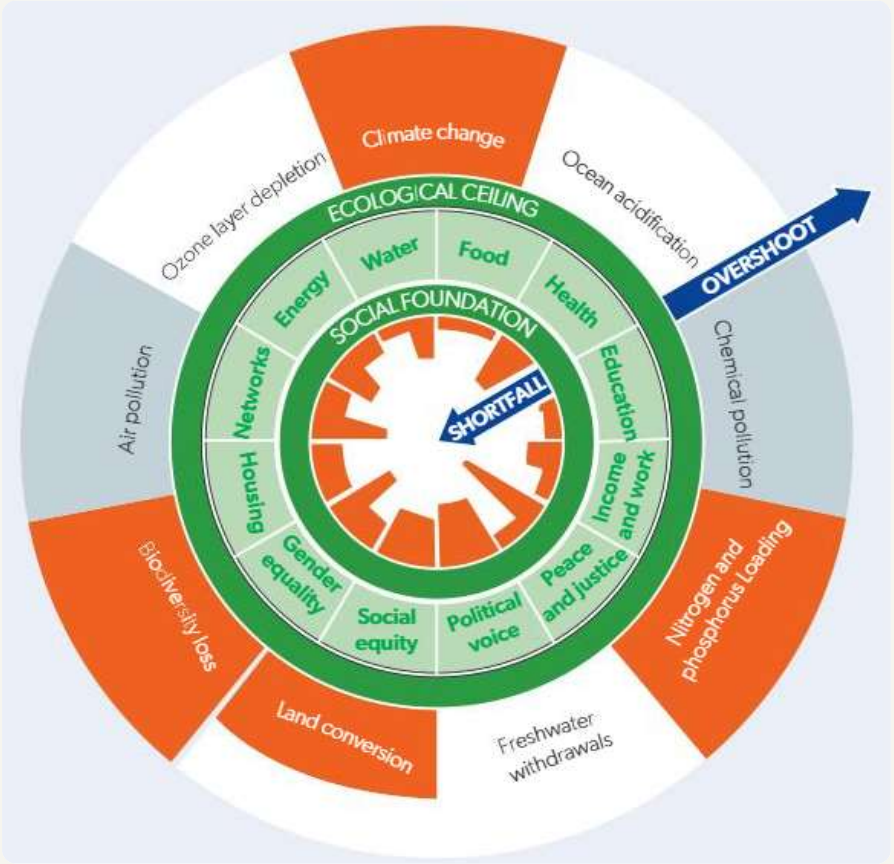


Figure 15: Combining the planetary boundaries and doughnut models (Steffen et al. 2015 in Folke et al. 2021)

The circular economy model

After her solo voyage, **Ellen MacArthur** realized how the Earth is like a ship. It has all the resources on board but no more, and we cannot get more.

Linear economy

take → make → use → dispose

Circular economy

take, make and use, but then reuse, repair, remake, remove waste and regenerate natural systems

The circular economy is based on **three principles, driven by design**:

1. Eliminate waste and pollution

2. Circulate products and materials

3. Regenerate nature

PRINCIPLE 1

Eliminate waste and pollution

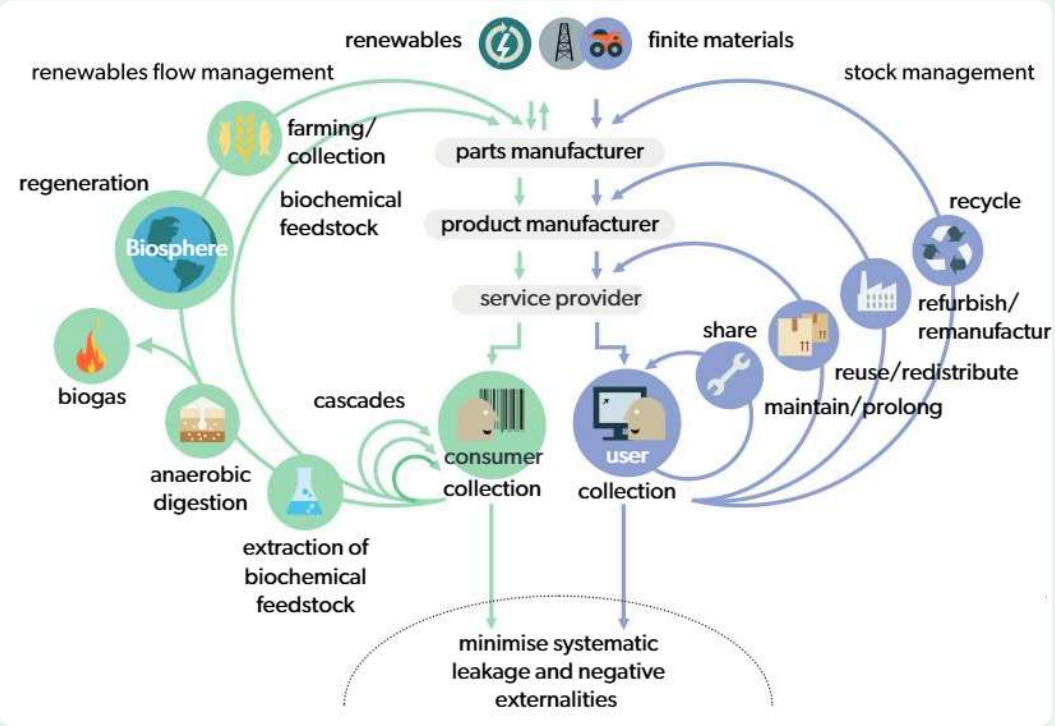
In our **linear economy**, raw materials are extracted, processed into products, used and mostly then become waste. Waste is recycled, incinerated or goes to landfill or the oceans. As natural resources are finite, this is not sustainable.

If product design was such that materials re-entered the economy at the end of their use, waste could be eliminated or very much reduced.

> **Example:** a crisp packet is used once and may be made of various materials which cannot be recycled. If it were designed to enter the circular economy, it could be remade into another crisp packet or other product.

PRINCIPLE 2

Circulate products and materials (at their highest value)



This can be in a **technical** or a **biological** cycle.

Figure 16: the **butterfly model** systems diagram of the circular economy.

Left wing (renewables): the biological cycle, returning materials to the biosphere.

Right wing (finite materials): the technical cycle: share, maintain / prolong, reuse / redistribute, refurbish / remanufacture, recycle.

PRINCIPLE 2

The technical and the biological cycle

Technical cycle

It is most efficient to maintain and reuse entire products. For example, a phone is useful as a phone, not as a pile of components. Sharing instead of owning is efficient, while resale or donation of unwanted goods is excellent. Eventually the product can be deconstructed into its raw materials which are used, not wasted.

Biological cycle

Food by-products which are biodegradable can be composted or anaerobically digested, with the nutrients captured and used to regenerate soil or grow more food.

PRINCIPLE 3

Regenerate nature

Shift the focus from **extraction** to **regeneration** and build natural capital. There is no waste in nature, so we emulate that.

For example, the food industry works regeneratively, restoring soil fertility and resilience and biodiversity.

Agroforestry	**Conservation ecology**	**Organic farming**

…all have a place here.

Circular economy: uses and limitations

Uses

- Regeneration of natural systems
- Reduction of greenhouse gas emissions
- Improvement of local food networks and supporting local communities
- Reduction of waste by extending product life cycle
- Changed consumer habits

Limitations

- Lack of environmental awareness by consumers and companies
- Lack of regulations enforcing recycling of products
- Some waste not recyclable, and technical limitations
- Lack of finance

TOK: models change through time

Human science and natural science models change through time.

1. What role do paradigm shifts play in the progression of models?

2. Is it possible to eliminate the effect of the observer in the pursuit of constructing models?

3. To what extent can a single model provide a good basis to make decisions about sustainability and justice?

Check your understanding

In this subtopic, you have covered:

- what sustainability is and different uses of the term
- what sustainable development means
- measuring sustainability and economic development
- environmental justice issues
- ecological footprints
- models used to measure sustainability: SDGs, planetary boundaries, doughnut economics and circular economy.

Review questions

What is sustainability and how can it be measured?

1. List and define the three types of sustainability.

2. Explain why sustainability is so important.

3. List five sustainability indicators.

4. Explain the concept of an ecological footprint.

To what extent are challenges of sustainable development also ones of environmental justice?

5. Define sustainable development.

6. Define environmental justice.

7. Describe one example of environmental injustice.

8. List and evaluate SDGs which involve environmental and social justice.

Taking it further

- Present research on examples of environmental injustice and inequalities leading to problems of access to resources.
- Promote the doughnut economic model or circular economy strategies for the school community.
- Use an SDG to advocate for a particular issue.
- Investigate the whole-school carbon footprint and produce a plan to reduce the school's carbon emissions.
- Design a sustainability walk to highlight sustainable options locally.