



DP IB Environmental Systems & Societies (ESS): SL



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Sustainability

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Sustainability

Sustainability

- **Sustainability** is the use and management of natural resources that allow full natural **regeneration** of the resources exploited and full recovery of the ecosystems affected by their extraction and use
 - Sustainable living involves using resources in a way that allows for their renewal and regeneration
- It is important to manage natural resources in a sustainable manner to avoid **depletion, degradation, or destruction** of these resources
- Sustainable practices include:
 - Reducing waste (e.g. recycling)
 - Reducing resource use (e.g. reducing water consumption)
 - Conserving energy (e.g. using public transport or cycling, eating locally grown foods)
 - Using renewable resources (e.g. solar or wind power)
 - Protecting biodiversity (e.g. nature reserves)
- **Sustainable fashion** is a good example of how sustainable practices can be **applied** to an industry (the clothing industry) that has traditionally been very wasteful, as well as very energy and resource intensive. Fashion and clothing can become more sustainable in several ways, including:

Use of sustainable materials

- The industry can use more sustainable materials such as organic cotton, hemp, recycled polyester, and lyocell, which have a lower environmental impact

Circular economy

- The industry can adopt a circular economy model where products are designed to be reused, recycled, or repurposed, reducing waste and extending the life of clothing

Reduce water usage

- The industry can reduce water usage during clothing production by using more efficient manufacturing processes, and using recycled water where possible

Sustainable packaging

- The use of sustainable packaging materials such as biodegradable and compostable materials can help reduce waste

Reduce carbon footprint



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- The industry can reduce its carbon footprint by using renewable energy sources such as wind and solar power, and by implementing energy-efficient practices in production

Ethical production

- Sustainable fashion also involves ethical production practices such as fair labour standards and ensuring worker safety

Reduce overconsumption

- Consumers can also contribute to sustainable fashion by reducing overconsumption, buying high-quality clothing that lasts longer, and supporting brands that prioritise sustainability
- Overall, sustainable fashion aims to reduce the environmental and social impact of the fashion industry while still providing consumers with fashionable and functional clothing



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The fashion industry can be made more sustainable by applying a combination of new approaches and practices



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Sustainable Development

Sustainable Development

- Sustainable development is a concept that aims to **balance** economic, social, and environmental factors to meet the needs of the present generation without compromising the ability of future generations to meet their own needs
- Examples of sustainable development include:
 - The use of renewable energy sources, such as wind, solar, or hydropower, instead of non-renewable energy sources, such as fossil fuels
 - Sustainable agriculture, which involves using techniques that minimise the negative impact of agriculture on the environment, such as crop rotation, soil conservation, and reduced use of pesticides and fertilisers
 - Sustainable urban planning, which aims to create cities that are more liveable, efficient, and environmentally friendly, such as through the use of public transportation, green spaces (e.g. public parks or green roofs), and energy-efficient buildings to mitigate climate change impacts
- Sustainable development requires a **long-term perspective** and a commitment to understanding the highly complex interactions between the economic, social, and environmental aspects of our growing and developing societies
- It is an ongoing process that requires the **cooperation** and involvement of individuals, organisations, and governments at all levels

Environmental, Social and Economic Aspects of Sustainable Development

Environmental	Society	Economy
<ul style="list-style-type: none"> ▪ Renewable energy ▪ Waste management ▪ Water treatment ▪ Reduce, reuse, recycle ▪ Nature reserves ▪ Urban wildlife 	<ul style="list-style-type: none"> ▪ Cultural diversity ▪ Social stability ▪ Education ▪ Healthcare ▪ Crime ▪ Personal freedom 	<ul style="list-style-type: none"> ▪ Economic growth ▪ Developing nations ▪ Cost of urban infrastructure ▪ Energy-efficient buildings ▪ Ecosystem services ▪ Economic policies



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Natural Capital

Natural Capital & Natural Income

What is Natural Capital?

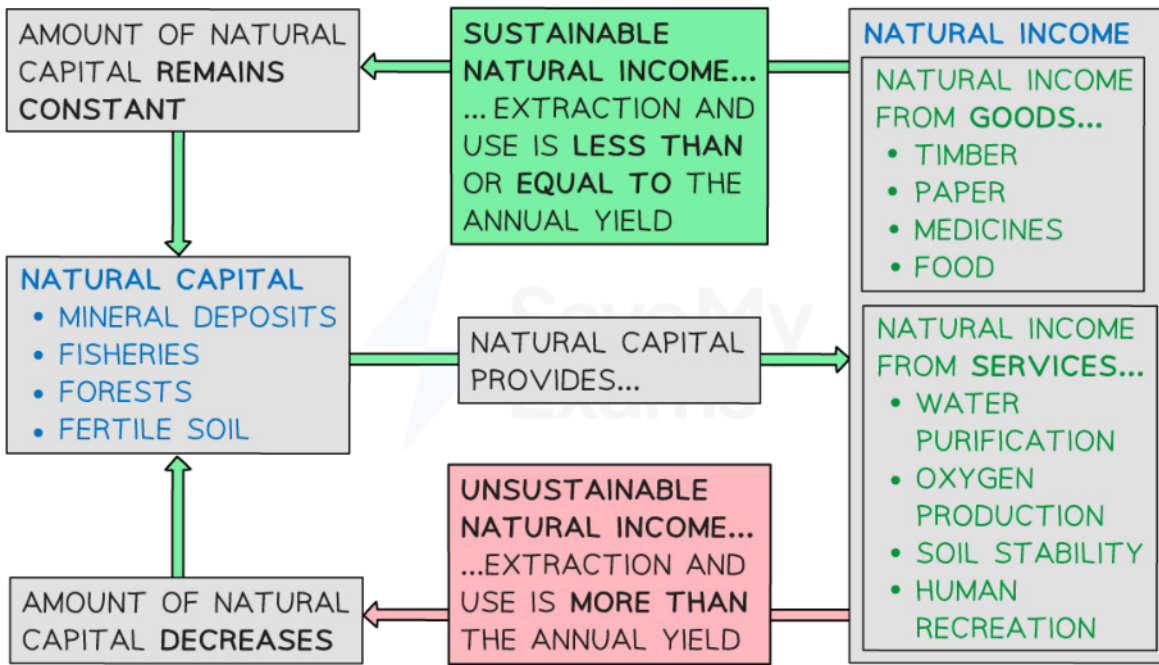
- The term natural resources applies to anything that comes from nature that can be used to **benefit humans**
 - Examples of natural resources include fresh water, soil, fossil fuels and oxygen in the air
- In the environmental sciences, these resources are sometimes referred to as **natural capital**
 - You can think of natural capital as resources from nature that are managed by humans because they provide **goods** or **services**
 - These natural goods and services can include directly marketable goods, such as timber and crops, or broader ecological services, such as the flood protection provided by mangroves, or the erosion prevention and climate regulation services that forests provide

Natural Income

- If sources of natural capital (i.e. these natural goods and services) are carefully and **sustainably managed**, they can provide even more resources over time
 - This is referred to as **natural income**
 - For example, if trees are cut down for timber but forests are also re-planted or left to recover, so that the rate of timber production is not greater than the rate of new tree growth, then timber production is a sustainable income that can be marketed and used to benefit humans
- In other words, natural income is the term used to describe the sustainable income produced by natural capital
 - Again, using the timber production example, our forests are the natural capital and the sustainable timber we can obtain from these forests is the natural income
- Non-renewable resources, such as fossil fuels (technically, they are non-renewable as they cannot regenerate faster than humans are using them) can be used to generate wealth but can only be used **once** and cannot be **sustainably managed**
 - Therefore, even if they can be considered as natural capital, non-renewable resources cannot produce sustainable natural income



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Natural capital can be used to generate natural income, but this can be done in a sustainable or unsustainable way

Ecosystem Services

- Ecosystem services usually fall into one of four main categories:
 - Supporting services
 - Regulating services
 - Provisioning services
 - Cultural services

Ecosystem Service	Description	Examples
Supporting	Essential ecological processes for supporting life	<ul style="list-style-type: none"> ▪ Primary productivity (photosynthesis) ▪ Soil formation



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		<ul style="list-style-type: none"> ▪ Cycling of nutrients (e.g. carbon cycle, nitrogen cycle)
Regulating	A diverse set of services that shape and stabilise ecosystems	<ul style="list-style-type: none"> ▪ Climate regulation ▪ Flood regulation ▪ Water quality regulation ▪ Air quality regulation ▪ Erosion control ▪ Disease and pest control
Provisioning	The goods and services humans obtain from ecosystems	<ul style="list-style-type: none"> ▪ Food ▪ Fibres ▪ Fuel ▪ Fresh water ▪ Timber
Cultural	These services derive from humans interacting with nature in a culturally beneficial way	<ul style="list-style-type: none"> ▪ Recreation and tourism ▪ Education ▪ Health benefits ▪ Sense of place, national identity and cultural heritage ▪ Employment



Worked Example

Using a named example of an ecosystem and the society living there, discuss the value of ecosystem services to that society.

Answer

The Sundarbans, located in India and Bangladesh, is an example of an ecosystem that provides essential services to the societies that live there. The Sundarbans is the largest mangrove forest in



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the world (covering an area of approximately 10,000 km²) and is home to over 4 million people, whose livelihoods depend on the ecosystem services the forest provides. Some examples of these ecosystem services include:

Fisheries:

The Sundarbans supports a diverse range of fish species that provide a source of food and income for the local population.

Coastal Protection:

The Sundarbans provides natural protection to the coast from cyclones and tidal surges. The mangrove forests act as a natural barrier, helping to reduce the damage caused by these natural disasters.

Timber and Other Forest Products:

The Sundarbans provides a range of timber and other forest products that are used by the local population for various purposes, such as fuelwood, construction materials, and medicinal plants.

Ecotourism:

The Sundarbans is home to over 100 Bengal tigers. The Sundarbans tiger is a major tourist attraction and its presence in the area attracts tourists from all over the world. The tourism industry provides a source of income for the local communities, contributing to their economic development.



Examiner Tips and Tricks

The terms natural capital and natural income are very easy to confuse. If you are finding this concept tricky, try to remember the following analogy: money in a bank (sometimes referred to as capital) may gain **interest** over time if it is **carefully managed**. Natural income is effectively the interest that humans can live off and benefit from, if natural capital is sustainably managed!

The Millennium Ecosystem Assessment



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The Millennium Ecosystem Assessment



- The Millennium Ecosystem Assessment (MA) was a major assessment of the human impact on the global environment

- It was called for by the United Nations in 2000, launched in 2001, and was published in 2005

Aims

- The MA gave a scientific appraisal of the condition and trends in the world's ecosystems and the **services** they provide
 - It used a variety of **environmental indicators** to assess these ecosystems, including factors such as biodiversity, pollution, population or climate, as these can be used **quantitatively** as indicators of sustainability
 - These factors can be used to assess sustainability on a range of scales, from local to global
 - In the case of the MA, this was done on a global scale
- One of the main aims of the MA was to assess how changes to ecosystems have affected, are affecting and will affect human health and wellbeing
- Another main aim of the MA was to assess the scientific basis for action to conserve and use ecosystems sustainably
- In summary, the Millennium Ecosystem Assessment reports evaluated:
 - The current condition of the planet's ecosystems and the services they provide
 - The importance of these ecosystems to human wellbeing
 - How we can restore, conserve and enhance the sustainable use of these ecosystems

Findings

- The main findings of the MA included:
 - In the last 50 years, humans have changed ecosystems at a **faster rate** than at any other time in history, which has led to substantial and largely **irreversible** losses of global biodiversity
 - These changes have led to substantial overall gains in wellbeing and economic development for many human societies, but at the cost of **degrading** many ecosystems and the services they provide
 - These changes have substantially increased the poverty experienced by some human societies
 - If not addressed, ecosystem degradation and the problems it causes will substantially reduce the benefits that **future generations** will be able to obtain from ecosystems
 - It is possible to restore ecosystems but this requires substantial changes in policies and practices



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Worked Example

Give an example of how environmental indicators (such as those used in the Millennium Ecosystem Assessment) can be used to evaluate the progress of a project to increase sustainability on a more local scale.

Answer

A city council launches a project to reduce pollution levels and increase the sustainability of its transportation system by expanding public transportation and creating bike lanes. Before starting the project, environmental indicators (such as air quality, greenhouse gas emissions, the number of people using public transport, and the number of cyclists) can be used to assess the current state of the system. This provides a baseline against which progress can be measured. These same environmental indicators can then be used to evaluate the effectiveness of the project over time. By monitoring these indicators, the government can identify areas for improvement and communicate progress to stakeholders (such as the public, policymakers, and investors).



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Environmental Impact Assessments



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Environmental Impact Assessments

- An Environmental Impact Assessment (EIA) is a systematic process for evaluating the potential environmental **impacts** of a proposed **development project**
 - The purpose of an EIA is to identify and evaluate the potential impacts of the project on the environment, and to develop strategies to **mitigate** or avoid those impacts
 - EIAs are used to inform decision-making by government agencies, developers, and other stakeholders, and to ensure that proposed projects are environmentally **sustainable**

Steps

- The EIA process typically involves the following steps:

1. Scoping

- Defining the scope of the EIA and identifying the key issues to be addressed

2. Baseline studies

- Collecting data on the **existing environment**
- The purpose of a baseline study is to understand the physical and biological environment **prior** to the commencement of the project so that it can be monitored throughout and after the development
- A number of variables should be measured as part of the baseline study, which includes the following:
 - Habitat type and abundance: the total area of each habitat type should be recorded
 - Species list: the number of species (flora and fauna) present should be noted
 - Species diversity: the abundance of each species should be estimated and the diversity of the community should be calculated
 - List of endangered species
 - Land use: the type of land use and its coverage should be assessed
 - Hydrology: the hydrological conditions in terms of volume, discharge, flows, and water quality should be evaluated
 - Human population: the current population should be assessed
 - Soil: the quality, fertility, and pH of the soil should be examined

3. Impact assessment



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- Evaluating the potential impacts of the project on the environment, including both **direct** and **indirect** impacts

4. Mitigation measures

- Developing strategies to mitigate or avoid the potential environmental impacts of the project

5. Public consultation

- Engaging with stakeholders and the public to gather feedback and input on the proposed project and the EIA

6. Review and approval

- Reviewing and approving the EIA by relevant authorities, such as government agencies or regulatory bodies

Projects Requiring EIAs

- Many development projects may require an EIA, depending on their potential environmental impacts
- Examples of projects that may require an EIA include:
 - Mining and mineral extraction
 - Infrastructure development, such as highways and airports
 - Energy projects, such as wind farms and hydroelectric dams
 - Industrial facilities, such as chemical plants and oil refineries
 - Land use changes, such as deforestation or wetland reclamation

Strengths and Limitations

- EIAs are a valuable tool for evaluating the potential environmental impacts of proposed development projects, but they also have some weaknesses

Strengths and Limitations of EIAs

Strengths	Limitations
EIAs provide a systematic process for evaluating direct environmental impacts and can help to identify and mitigate or avoid those impacts using adaptive management strategies , leading to more sustainable development	Not always effective in identifying or mitigating all environmental impacts, particularly when they are not conducted properly (e.g. if they are subject to bias or incomplete information) or when there is limited will to address environmental concerns



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<p>EIAs also assess the indirect impacts of a proposed project, including cumulative effects, indirect effects, and secondary effects, which can help ensure that the project is evaluated from a holistic perspective</p>	<p>Only assess the potential impacts of proposed projects and not the underlying social, economic, or political systems that may contribute to these impacts, which can limit their effectiveness in addressing systemic issues that may cause or exacerbate environmental problems</p>
<p>EIAs promote public consultation and engagement, which can help to ensure that stakeholder perspectives are considered in decision-making, as well as increase community involvement and awareness of environmental issues</p>	<p>Can be expensive and time-consuming - there may be limited technical or institutional capacity to conduct EIAs in some areas, particularly in developing countries or in areas where there is limited access to data or scientific expertise</p>

Case Study: Olympic Park, London

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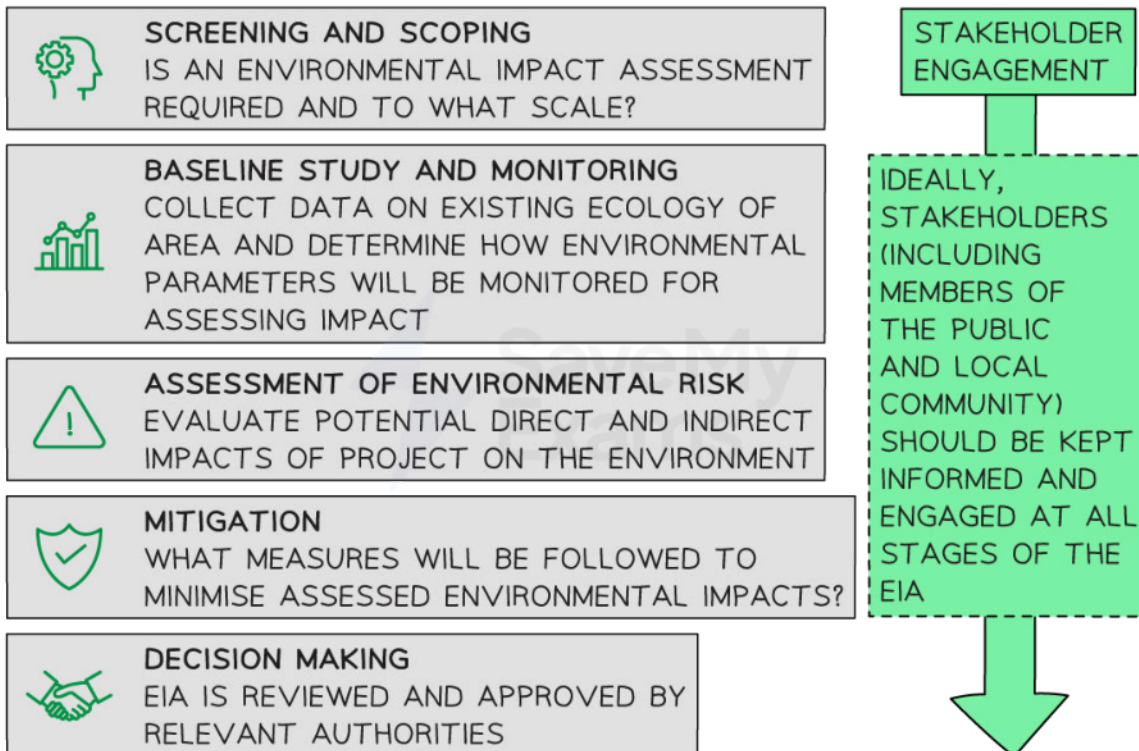
Olympic Park, London, the site of the 2012 Summer Olympics

- The construction of the Olympic Park in London for the 2012 Summer Olympics is an example of how an environmental impact assessment (EIA) was used to minimise the negative effects of a large-scale development project
- The EIA for the Olympic Park considered the potential environmental impacts of the development, such as:
 - Soil contamination
 - Habitat loss
 - Increased traffic congestion
- It also assessed the effects on nearby communities, including:
 - Noise pollution
 - Changes in air quality
- To minimise these impacts, various measures were implemented:
 - **Brownfield sites** were used for construction to avoid damage to natural habitats
 - Areas of green space were incorporated into the design to promote biodiversity



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- The use of sustainable materials and energy-efficient technologies was prioritised to reduce carbon emissions and waste
- During the construction phase, environmental monitoring was carried out to ensure that the project complied with the EIA
 - The monitoring included air and water quality testing, noise level measurements, and wildlife surveys
- The success of the EIA and subsequent mitigation measures was evident in the positive environmental outcomes of the Olympic Park:
 - The park boasts a diverse range of habitats, including wetlands and woodlands, which have encouraged the return of wildlife species such as otters and kingfishers
 - The park also uses renewable energy sources, such as solar panels and biomass boilers, to reduce its carbon footprint
- Overall, the Olympic Park is an example of how the use of EIA can lead to sustainable development that benefits both the environment and local communities



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The main stages of an environmental impact assessment

How to Reduce Ecological Footprints



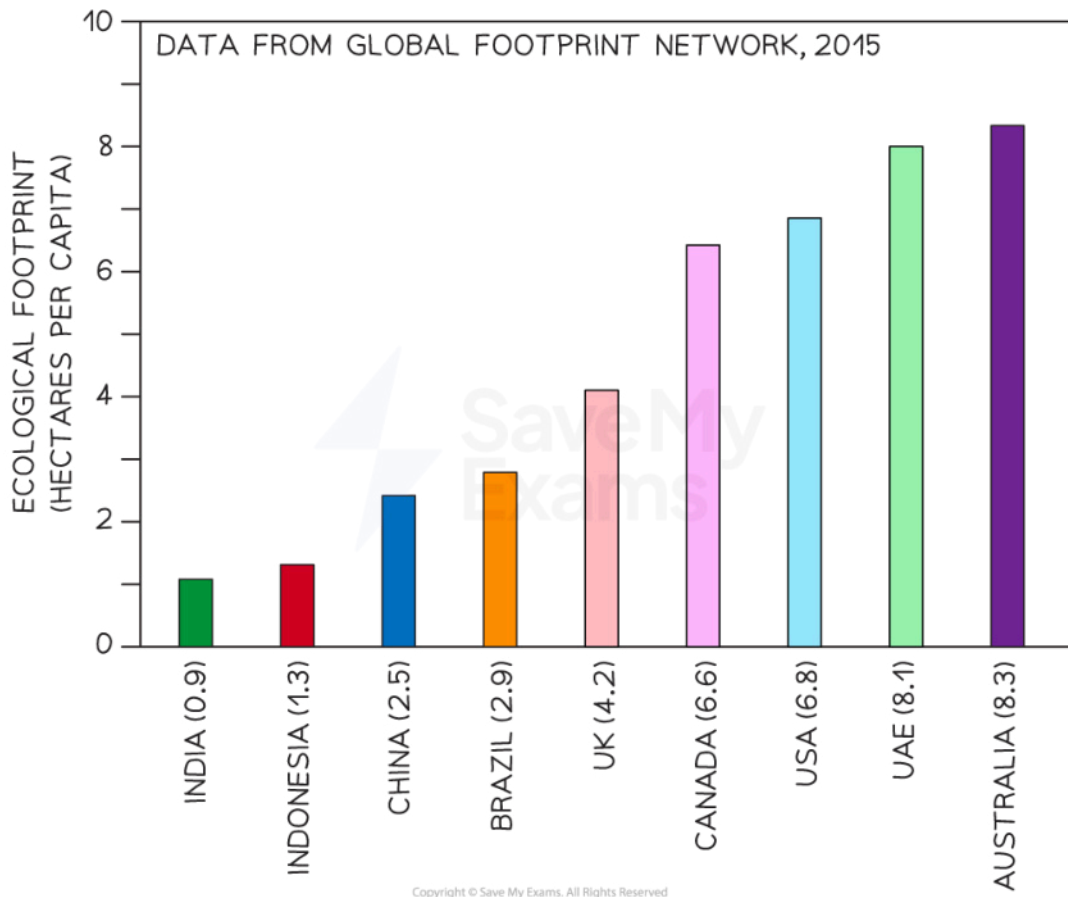
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Reducing Ecological Footprints

- Ecological Footprints (EFs) measure the impact of **human activities** on the environment
 - They do this by calculating the **area of land and water** needed to sustain a particular human population
 - An EF is measured in **global hectares** (gha) **per capita** (i.e. hectares per person)
- EFs take into account factors such as food consumption, transportation, and energy use
 - EFs can be used to compare the sustainability of different lifestyles, businesses, and even whole countries
 - If the EF of a lifestyle, business or country exceeds the area available to the population (also known as the **biocapacity** - the amount of resources that the planet can provide sustainably), it means that it is not sustainable in the long term
- To reduce an EF, it is important to adopt more sustainable practices such as reducing meat consumption, using renewable energy sources, and using public transport or walking instead of driving
- EFs are a useful **tool** for promoting sustainable development and for raising awareness about the impact of human activities on the environment



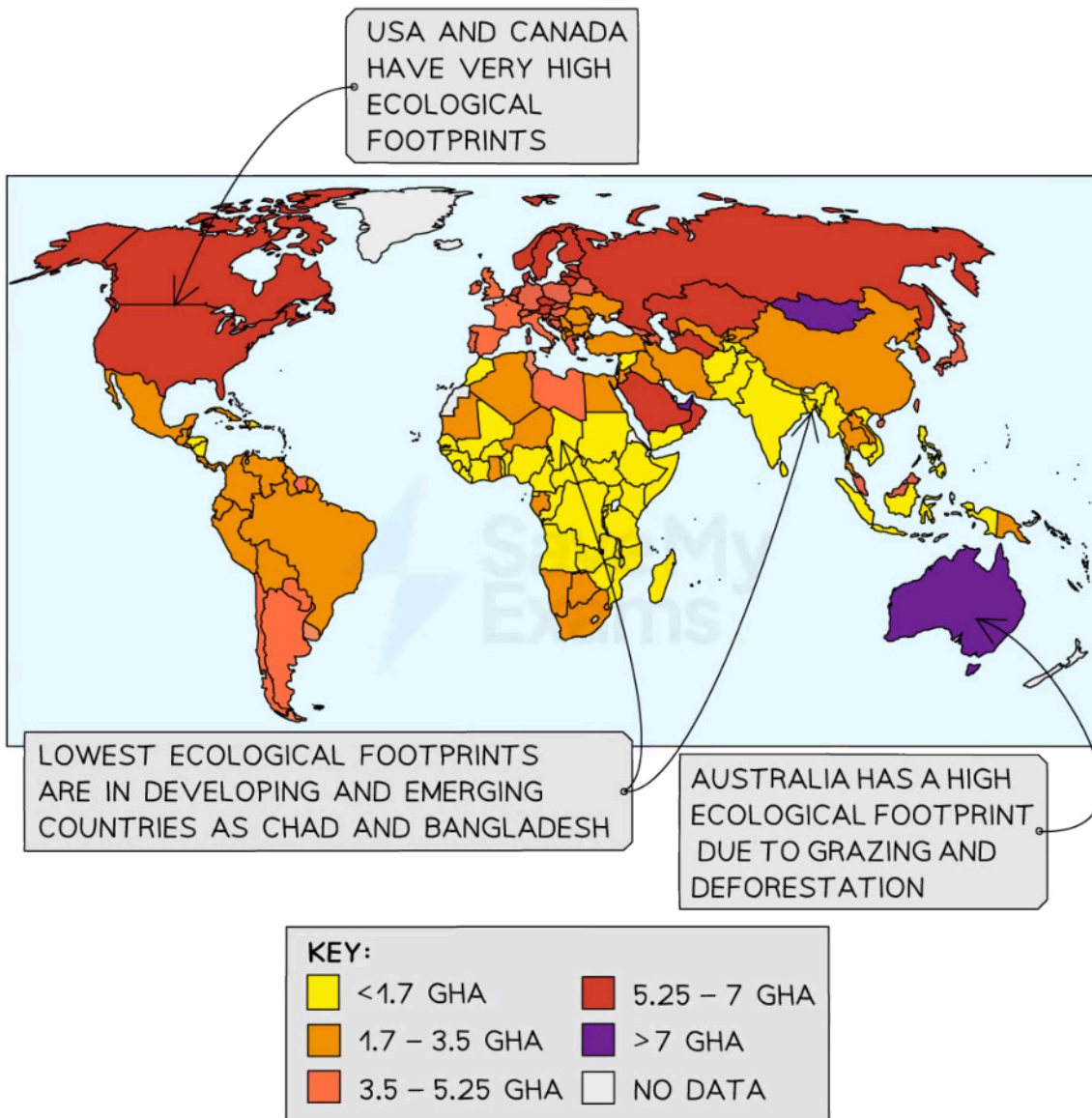
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The ecological footprint of various countries, expressed as the number of hectares of land required to sustain the current standard of living in that country - Elias, Scott (2015) Global Change Impacts on the Biosphere



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The ecological footprint of various countries can also be displayed in map-form