



Net Zero Wales | Module 3 | A Greener Lifestyle



This module is about how humans impact our environment. We will look at the 'planetary boundaries', measures of the health of our Earth, and how human activities have brought us close to or beyond these boundaries. We will also discover what we can do to help move towards a net zero future, and help our planet to recover. This module builds upon the knowledge you will have developed from module 1 (Net Zero and Climate Change: An Introduction), and module 2 (Alternative Energies).

Learning Outcomes:

By the end of this module you will be able to:

1. Understand the impact of human activities on the environment.
2. Understand the 9 planetary boundaries.
3. Understand how human activities in the future can help to recover and protect the environment.
4. Understand the Welsh Government's role in supporting people to reduce their impact on the environment.
5. Identify changes you can make to improve the environment on an individual level.

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Introduction to greener lifestyles

How do humans impact the environment?

How can we reduce our impact?

Key responses

From learning to action

Introduction to greener lifestyles

Learning Objectives

- To understand how the human species evolved and adapted to the environment.

How have humans changed the environment to suit their needs?



It is hard to imagine a time before human development, around 2 million years ago, where there were no roads, buildings, pylons, or dams.

Humans have always impacted the environment in a far more visible and drastic way than other organisms. Thanks to the development of our large brains, which coincided with enhanced cognitive function, problem solving, and planning ahead, we have moulded the landscape to suit our needs.

3.2 MYA (million years ago)

In Ethiopia in 1974, fossilised remains were found of an organism thought to be the 'earliest human'. The fossil belonged to a species called *Australopithecus afarensis* and was nicknamed 'Lucy'.



2.5 MYA

The first of the species *Homo habilis* appeared. This species had a brain volume of around 600 cm³, about half that of a modern human. *Homo habilis* used stone tools regularly for hunting, foraging and other uses. Some populations developed a diet rich in meats, which may have contributed to the evolution of larger brains over time.



1.8 MYA

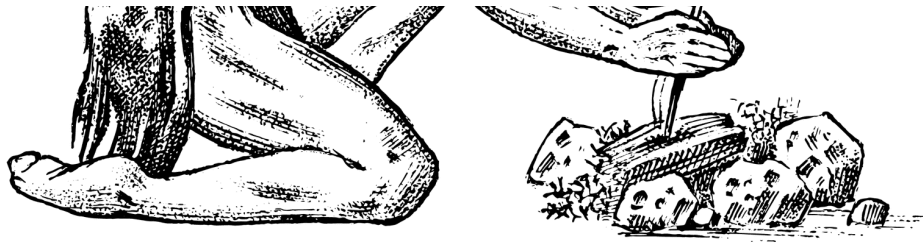
Homo erectus, the first true hunter-gatherer ancestor of modern humans appeared. They continued to use stone tools for more efficient hunting and foraging.



1.5 MYA

The first opportunistic use of fire is thought to have occurred around this time. It is generally agreed that early humans took a long time to learn how to move on from conserving naturally occurring fires to making their own using kindling. Naturally occurring fires would have made valuable resources like small rodents and lizards, birds etc. easier to find. It is likely that humans started to become attracted to fire and began to work out how to control it.





400,000 – 280,000 YA (years ago)

Humans developed more complex tools such as spears, stone blades and grinding stones, to improve hunting ability.

Humans started to deplete some populations of animals.



50,000 YA

Homo sapiens, which appeared 195,000 YA, developed complex and strategic hunting strategies. Populations of hunted animals in some areas started to reduce but were still fairly resilient.



10,000 YA

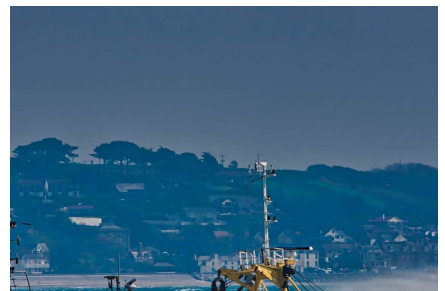
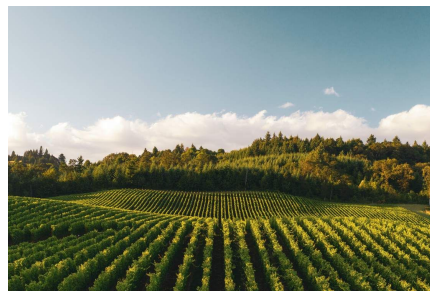
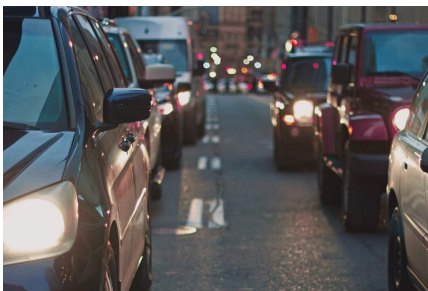
First true villages appeared. Agricultural practices were developed to grow desired plants for food and structures, changing the natural plant communities.





Present day

Humans have developed complicated agricultural and animal agricultural practices to mass produce both plant-based and animal-derived foods using monocultures and intensive farming techniques. These practices have resulted in a need to repurpose previously green lands through deforestation and other means to create space for our ever-growing food needs. In many countries, extensive networks of roads connect people to their places of work and to the resources we need to survive. We traverse these roads using fossil-fuel powered vehicles.





Driving



Farming



Fishing



Complete the content above before moving on.

How do humans impact the environment?

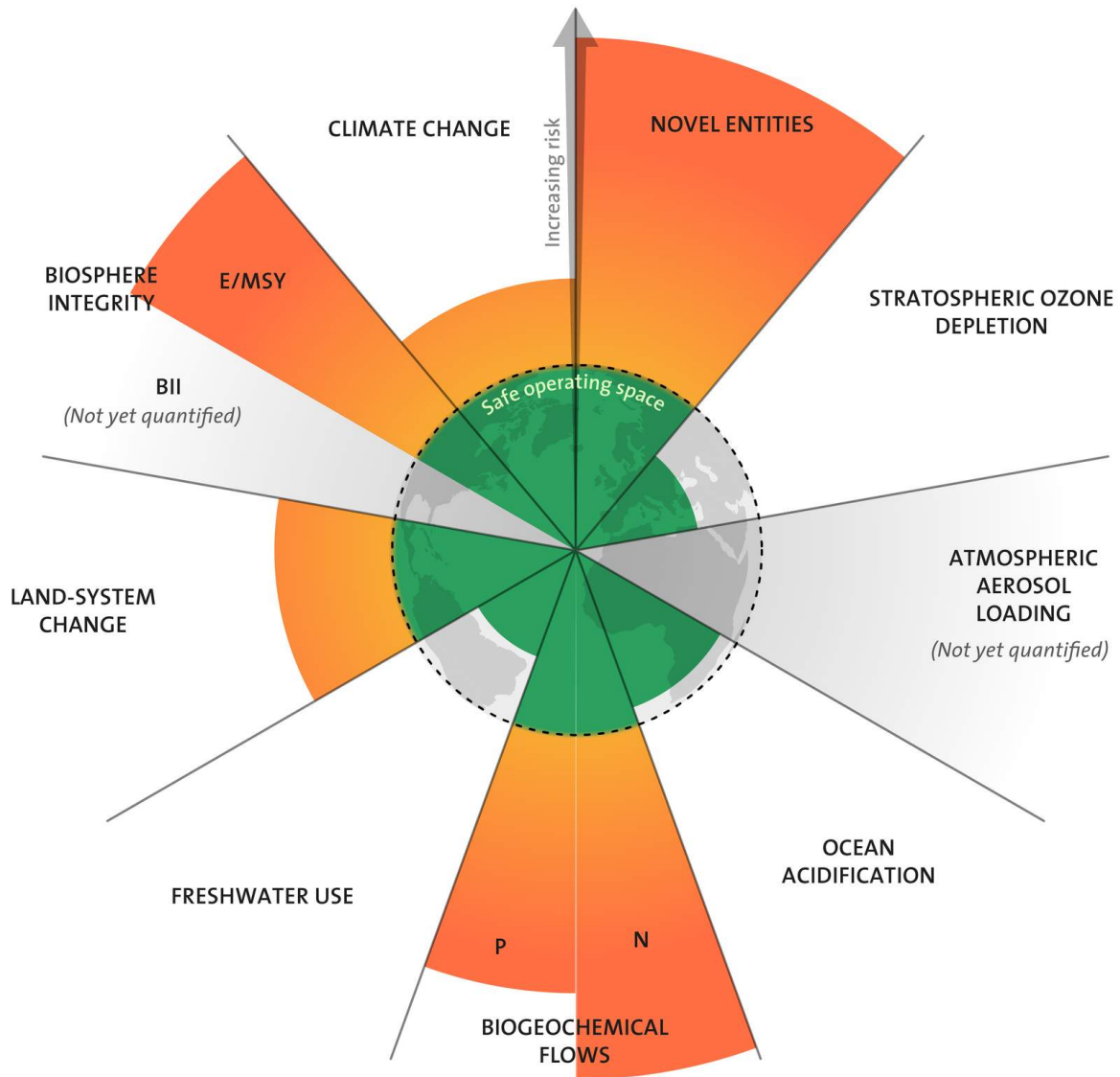
Learning Objectives

- To understand the impact of human activities on the environment.
- To understand the 9 planetary boundaries.

In the introduction we learned that humans have a very obvious and often negative impact on the environment due to reliance on polluting fossil fuels, over-hunting, over-farming, over-fishing etc. To understand the extent of the impact humans have had, we can look at the nine planetary boundaries of the Earth.

Planetary boundaries are a series of ranges within which the planet can operate safely. Upper and lower values for the processes of these boundaries have been estimated by scientists, within which it is thought that changes, e.g. to severity of climate change, are gradual and may fluctuate. Moving beyond these boundaries however is predicted to result in large-scale changes that may be irreversible and have a huge negative impact on our environments.

The nine boundaries are shown in the diagram below from Stockholm University.



Designed by Azote for Stockholm Resilience Centre, based on analysis in Persson et al 2022 and Steffen et al 2015.

Credit Source: [J. Lokrantz/Azote based on Steffen et al. 2015](#)

CLIMATE CHANGE BOUNDARY	BIOSPHERE INTEGRITY BOUNDARY	LAND-SYSTEM CHANGE BOUNDARY	BIOCHEMICAL FLOWS BOUNDARY	STRATOSPHERIC OZONE DEPLETION BOUNDARY
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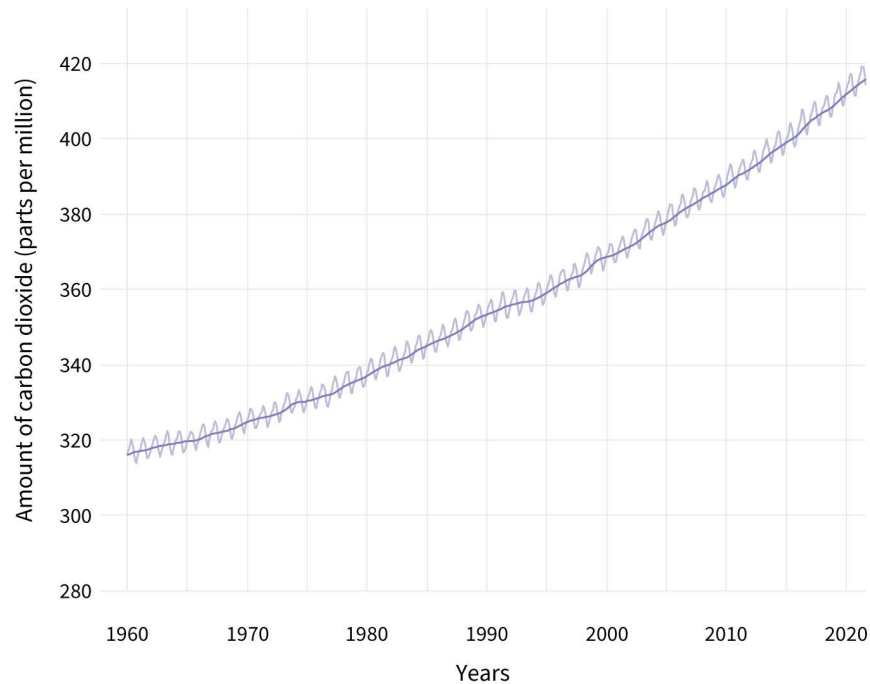
The climate change boundary is measured using atmospheric carbon dioxide concentration, with the maximum acceptable concentration at 350 ppm (parts per million).

Problem: Since 1993, sea levels have risen by 0.3-0.4 cm per year. It is predicted that levels will rise by up to 7 metres by the year 2100 as a result of increased temperatures causing polar ice to melt.

Crossed?: Yes, in 1988 thanks to an increase in carbon emissions from human activity.

Credit Source: <https://www.climate.gov/news-features/understanding-climate/climate-change-atmospheric-carbon-dioxide>

ATMOSPHERIC CARBON DIOXIDE (1960-2021)



CLIMATE CHANGE
BOUNDARY

BIOSPHERE
INTEGRITY
BOUNDARY

LAND-SYSTEM
CHANGE
BOUNDARY

BIOCHEMICAL
FLOWS BOUNDARY

STR
OZON

This boundary is measured in the number of species per million species per year that become extinct.

In Earth's history, there have been five major extinction events, each with a different natural cause.

The **natural** 'background extinction rate' is 10-100 species a year. The current rate of extinction is nearer 100 species per million per year. It has been predicted that there will be a sixth extinction event because of human impacts on the environment.

Crossed?: Yes!

Credit Source: [5 mass extinctions](#) by livearevolution is licensed under [CC BY](#).



CLIMATE CHANGE
BOUNDARY

BIOSPHERE
INTEGRITY
BOUNDARY

LAND-SYSTEM
CHANGE
BOUNDARY

BIOCHEMICAL
FLOWS BOUNDARY

STR
OZON

Land system change includes activities whereby an area of land is changed in some way in terms of its structure and purpose. Large areas of forest have been cleared to grow crops specifically to make biofuels, a supposedly green energy source, as well as to feed cattle or to export for food. Changes in land use have resulted in habitat destruction, reduction in biodiversity and pollution of once 'healthy' soils with pesticides and fertilisers.

Crossed?: Thought to have been crossed sometime before 2015, but difficult to measure.

Credit Source - "Green trees or brown soil", by "griffyn m", licensed under [CC BY](#)



<p>CLIMATE CHANGE BOUNDARY</p>	<p>BIOSPHERE INTEGRITY BOUNDARY</p>	<p>LAND-SYSTEM CHANGE BOUNDARY</p>	<p>BIOCHEMICAL FLOWS BOUNDARY</p>	<p>STR OZON</p>
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Biochemical flow is the cycling of elements in the environment. The carbon and nitrogen cycles for example are vital to ensure that an appropriate level of nutrients is retained in soils to allow plant growth, which maintains food webs in natural communities.

Crossed?: Yes! Intensive use of fertilisers in farmland means that the boundaries for Nitrogen and Phosphorus have both been crossed.

Credit Source - Green and blue abstract painting photo", by "Liz Harrell", licensed under [CC BY](#)



CLIMATE CHANGE BOUNDARY	BIOSPHERE INTEGRITY BOUNDARY	LAND-SYSTEM CHANGE BOUNDARY	BIOCHEMICAL FLOWS BOUNDARY	STR OZON
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The stratosphere is the second layer of our atmosphere and holds around 90% of the Earth's ozone (O₃). Chloro-fluorocarbons (CFCs) were once widely used. When released from spray cans, fridge coolants and old food packaging, CFCs would climb into the stratosphere, displacing ozone molecules and creating holes in the ozone layer. Because ozone usually absorbs UV-B light, the holes resulted in an increase in cancer rates in the 1970s due to increased exposure to radiation.

Crossed?: Avoided thanks to a ban on CFCs in 1978!

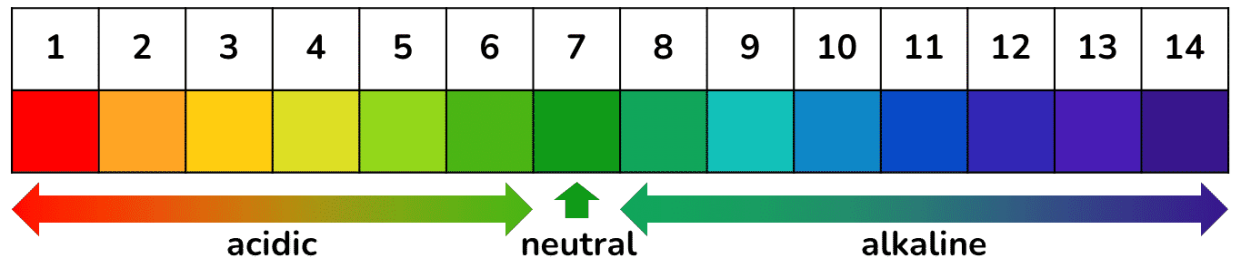
CLIMATE CHANGE BOUNDARY	BIOSPHERE INTEGRITY	LAND-SYSTEM CHANGE	BIOCHEMICAL FLOWS BOUNDARY	STR OZON
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BOUNDARY

BOUNDARY

Carbon dioxide in the air can dissolve in seawater and react with water molecules to form carbonic acid (H_2CO_3), making seawater more acidic. Acidic seawater can cause calcium to leach out of the shells of molluscs and coral, and the exoskeletons of some crustaceans. This softens them, making them more vulnerable to damage. In fish acidic water can result in damage to gill structures, which prevents them from getting the oxygen they need.

Crossed?: Not yet, but is near its upper value.



CLIMATE CHANGE
BOUNDARY

BIOSPHERE
INTEGRITY
BOUNDARY

LAND-SYSTEM
CHANGE
BOUNDARY

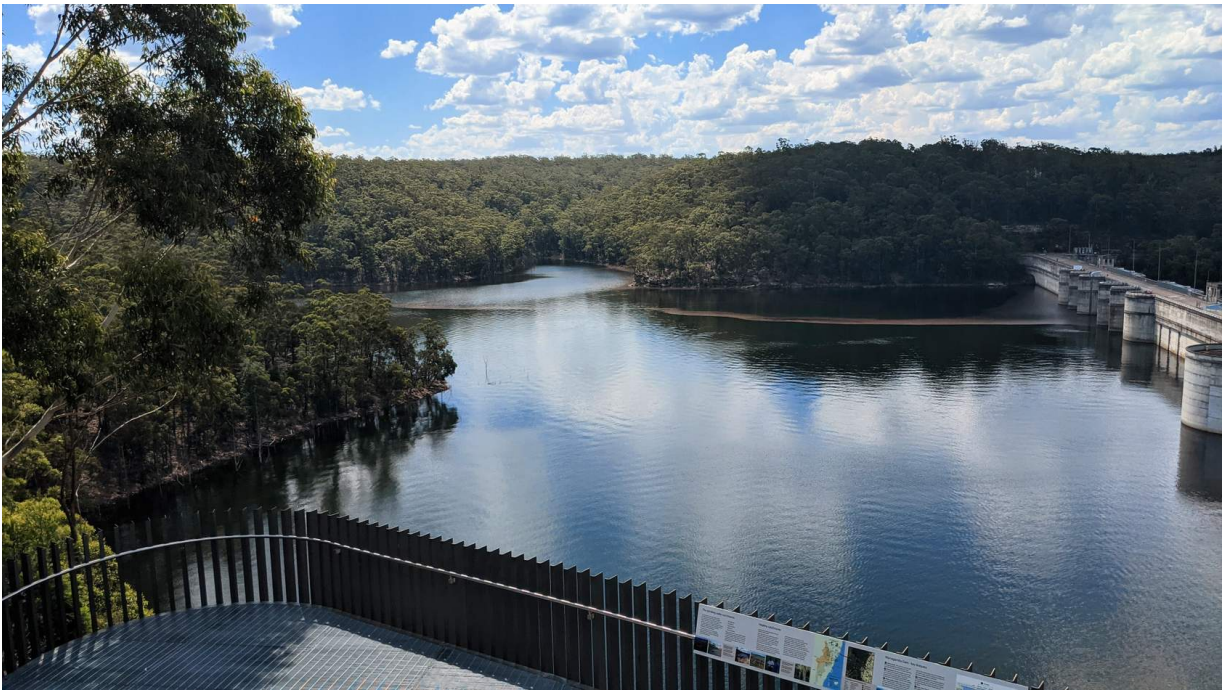
BIOCHEMICAL
FLOWS BOUNDARY

STR
OZON

This boundary is measured by the amount of freshwater removed from natural sources per year and has an upper boundary limit of 4000 km^3 per year. At present, we are removing over 2600 km^3 per year, so the boundary remains avoided for now. It has been predicted that 14% of the human population will have insufficient water by 2025, impacting food production and the sanitation and health sectors.

Crossed?: Not yet, but the demand for freshwater will continue to increase in line with increases in human population size.

Credit Source - bedside river under blue sky during daytime photo", by "Deeva Sood", licensed under [CC BY](#)



**CLIMATE CHANGE
BOUNDARY**

**BIOSPHERE
INTEGRITY
BOUNDARY**

**LAND-SYSTEM
CHANGE
BOUNDARY**

**BIOCHEMICAL
FLOWS BOUNDARY**

**STR
OZON**

Atmospheric aerosols are airborne microscopic particles released into the atmosphere cause air pollution. These can be natural, like ash emitted from a volcano, or unnatural, such as those released through burning fuels.

The 'Asian brown cloud', a swirling cloud that exists over China and southern Asia annually, is formed of particles from industrial activity. The cloud blocks out around 10% of sunlight so reduces the temperature and rainfall in the region, leading to droughts and monsoons.

Crossed?: We don't know as it is difficult to measure with such a variety of chemicals.

Credit Source - arial photography of city buildings during daytime photo", by "Alex Gindin", licensed under [CC BY](#)



**CLIMATE CHANGE
BOUNDARY**

**BIOSPHERE
INTEGRITY
BOUNDARY**

**LAND-SYSTEM
CHANGE
BOUNDARY**

**BIOCHEMICAL
FLOWS BOUNDARY**

**STR
OZON**

'Novel entities' are radioactive materials, nanomaterials, microplastics and organic pollutants. This includes several very toxic chemicals such as dichloro-diphenyl-trichloroethane (DDT), an insecticide developed in the 1940s which was widely used before it was discovered that it was dangerous for human health and for animals high up in food chains (bioaccumulation).

Crossed?: We don't know because this boundary includes over 100,000 chemicals.

Knowledge Check

Which of these planetary boundaries have already been crossed? (Select more than one)

- Aerosol loading
- Biogeochemical flows
- Biosphere integrity
- Climate change

SUBMIT

Which of the following can lead to softening of exoskeletons and shells?

- Introduction of novel entities
- CFC use
- Ocean acidification

SUBMIT

What is the only planetary boundary that has been successfully avoided?

- Land system change
- Freshwater use
- Stratospheric ozone

SUBMIT



Complete the content above before moving on.

How can we reduce our impact?

Learning Objectives

- To understand the Welsh Government's role in reducing our impact on the environment

Human activities have shaped the planet. There are however a number of things we can do to help our forests, seas, and land recover.

Deforestation





Forests have always been exploited by humans. Trees are a valuable and multi-purpose resource, used for fire kindling, building material etc.



Sustainable methods of timber management that do not require clearing an entire forest need to be put into place to allow normal succession i.e. the change in plant community over time to take place. One such method of conservation is coppicing, where trees are cut down to their stumps in small forest sections which are rotated to allow trees to regrow.



Protecting areas of woodland as Sites of Special Scientific Interest or with other legislation can help to preserve native species and reduce forest clearing.



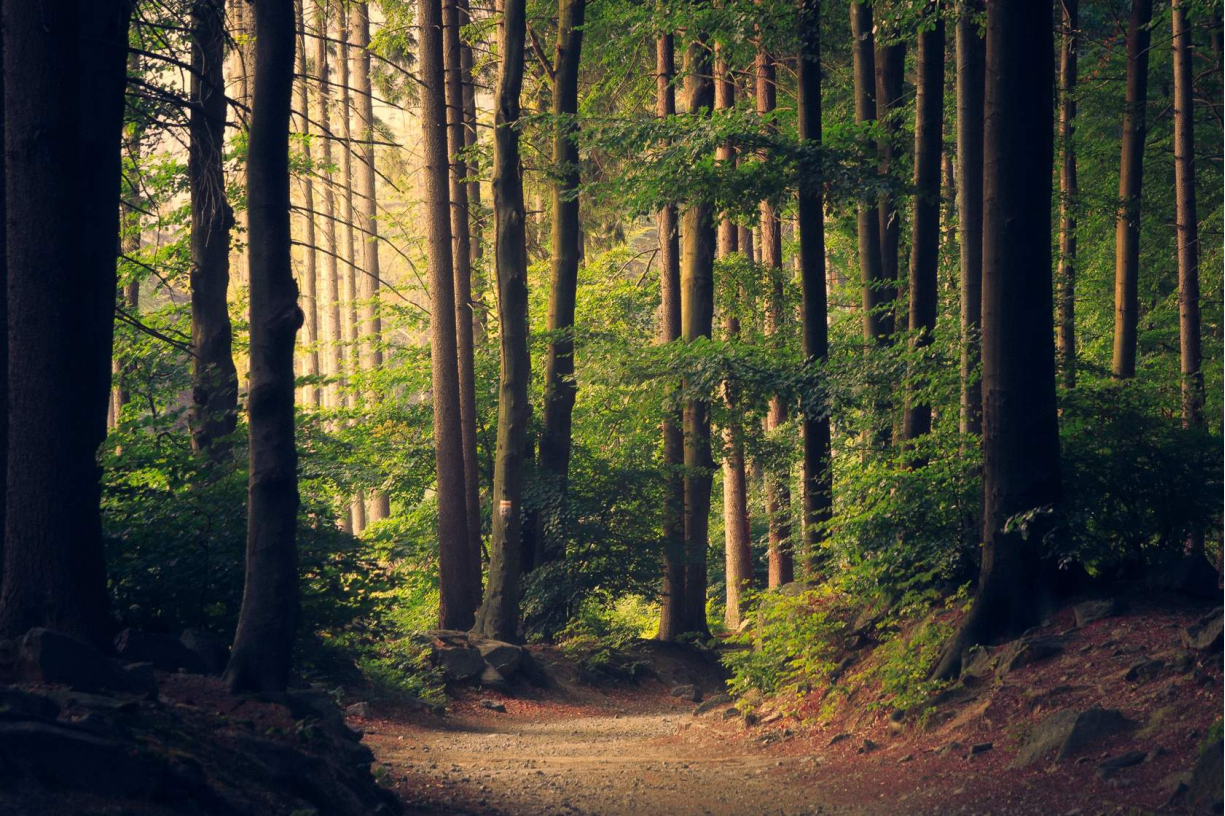
In recent years, the rates of deforestation have increased as large areas of forest are cleared to grow crops or raise livestock. Palm oil plantations make up a large area of the land cleared for crops. Between 2000 and 2020 10% of the Earth's tropical forest cover was lost.



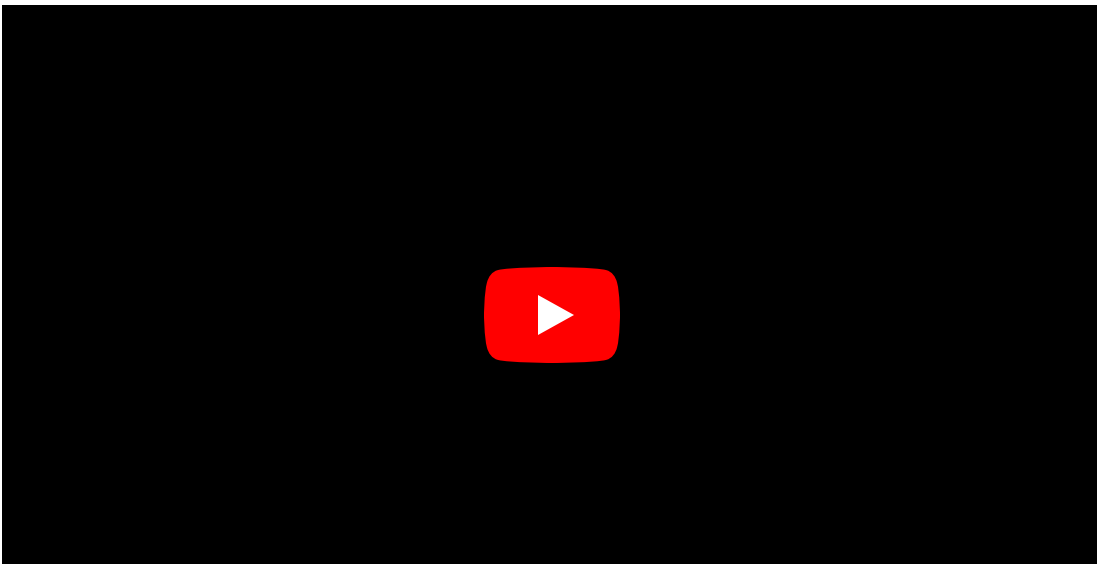
Deforestation results in habitat destruction, decreased biodiversity, increased soil erosion and has a range of other negative impacts.

Credit Source - forest trees photo", by "Lukasz Szmigiel", licensed under [CC BY](#)

Forests have always been exploited by humans. Trees are a valuable and multi-purpose resource, used for fire kindling, building material etc. In recent years, the rates of deforestation have increased as large areas of forest are cleared to grow crops or raise livestock. Palm oil plantations make up a large area of the land cleared for crops. Between 2000 and 2020 10% of the Earth's tropical forest cover was lost. Deforestation results in habitat destruction, decreased biodiversity, increased soil erosion and has a range of other negative impacts. To reduce the impact of deforestation, sustainable methods of timber management that do not require clearing of an entire forest need to be put into place. These methods would allow normal succession i.e. the change in plant community over time to take place. One such method of conservation is coppicing. Coppicing is repeatedly felling trees at the base and allowing them to regrow. Protecting areas of woodland as Sites of Special Scientific Interest (SSSIs) or with other legislation can help to preserve native species and reduce forest clearing.



Overfishing and intensive farming





Credit Source - "[David Attenborough Explains What We Need to Do to Stop Over-Fishing](#)" by World Economic Forum is licensed under [CC BY](#).

Fish populations are renewable to an extent, but humans have over-fished the seas using intensive fishing methods which deplete populations more quickly than they can reproduce. Some common methods that have been more widely used to reduce the impact of fishing are restrictions on when and how much trawlers are allowed to catch – quotas. There are some zones in the oceans where fishing is completely banned called exclusion zones, where fish populations are allowed to remain large. There has also been an increase in fish farming to reduce depletion of wild fish populations. However, this comes with its own array of negative environmental impacts.



Credit Source - Free RJ Image", by "Stefano Girardelli", licensed under [CC BY](#)

Intensive farming methods include monoculture, where one crop species is grown across a large area, thus reducing biodiversity in that area, and intensively raising livestock. Animal agriculture is responsible for around 15% of global greenhouse gas emissions, with large amounts of methane reaching our atmosphere as a result. In 2018-19 62% of all cereal crops were used to feed animals with only 23% going to feed people. A shift to less intensive farming methods is key to reducing the impact of agriculture. Some crop farmers opt to grow crops on a rotation, allowing some of their land to grow wild for portions of the year to increase biodiversity. Others use native plants to buffer their crops and reduce the impact of monoculture. There has been an increase in the number of people opting to follow a plant-based diet in recent years, and this seems to be a trend set to continue. Shifting the focus of farming to plant-based rather than large portions of crops being used to feed cattle will help to reduce greenhouse gas emissions and land-use.

Reducing farming intensity

- Some farmers grow crops on a rotation, allowing some of their land to grow wild for portions of the year to increase biodiversity.

Reducing the need for animal agriculture

Shifting the focus of farming to plant-based rather than large portions of crops being used to feed cattle will help to

reduce greenhouse gas emissions and land-use,



Credit Source - grass field photo", by "Dan Meyers" licensed under [CC BY](#)

What can we all do to reduce our environmental impact?

- Rather than everyone

Travel

driving to a destination in their own car, lift-sharing or using public transport can reduce the number of

1 of 4

Home

- In battery-powered devices, using rechargeable batteries reduces the number that end up in landfill.
- Turning off electrical devices when not in

2 of 4

Gardening

- Using large barrels to collect rainwater to use to water plants saves a lot of water.

- Composting food waste in the garden

3 of 4

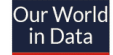
Food

Reducing or stopping consumption of meat, fish and dairy is an effective and relatively simple way to reduce your environmental impact.

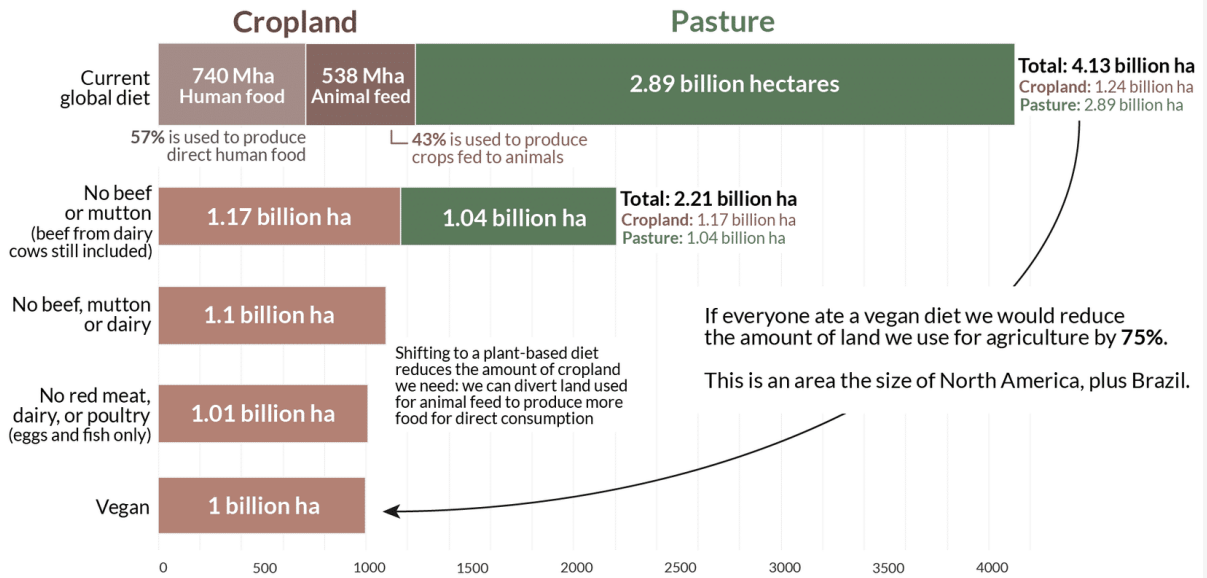
As we have already seen

4 of 4

Global land use for agriculture across different diets



Global agricultural land use is given for cropland and pasture for grazing livestock assuming everyone in the world adopted a given diet. This is based on reference diets that meet calorie and protein nutritional requirements.



Data Source: Joseph Poore & Thomas Nemecek (2018). Reducing food's environmental impacts through producers and consumers. *Science*. OurWorldinData.org – Research and data to make progress against the world's largest problems. Licensed under CC-BY by the author Hannah Ritchie.

Knowledge Check

The global forest cover has been reduced from 80% to just over 30% in the last 2000 years.

- True
- False

SUBMIT

A vegan diet uses more agricultural land than a diet containing meat and dairy.

True

False

SUBMIT

It is possible for wild fishing to be a sustainable method of food production, if using conservation methods alongside.

True

False

SUBMIT



Complete the content above before moving on.

Key responses

Learning Objectives

- To understand the Welsh Government's role in reducing our impact on the environment



The Welsh Government has implemented many initiatives to support people in reducing their carbon footprint and their impact on the environment'. These include accelerating the deployment of renewable energy, making homes more energy efficient, transforming Wales into one of the top three recycling nations in the world and planting over 800,000 trees.

In Wales, The Environment Act (Wales) 2016 lays out a method to sustainably manage the natural resources available in Wales. The plan emphasises the need for research and evidence-based strategies as well as the importance of public involvement in protecting and improving the environment in Wales. The Environment (Wales) Act 2016 Act was updated in March 2021 to set a net zero target for 2050. The Act requires a system of 5 yearly carbon budgets and interim targets; these serve as stepping stones to ensure that regular progress is made towards this long-term target. Interim emission targets have been set for 2020, 2030 and 2050.

Here are the top 8 things the Welsh Government is doing to tackle the climate emergency in Wales:

1. Setting ambitious targets to cut carbon emissions.
2. Making it easier for people to use their car less.
3. Banning some single use plastics.
4. Tackling the nature emergency by creating a National Forest and investing £500,000 in community-led projects to improve biodiversity and minimise waste.
5. Investing in the circular economy by supporting businesses in Wales to reuse existing materials and minimise waste.
6. More electric vehicle charging points.
7. Establishing world-leading renewable industries.
8. Promising to keep the conversation going especially with young people through our eco-schools and Size of Wales programmes, and the new curriculum.



Complete the content above before moving on.

From learning to action

Learning Objectives

- To identify changes you can make to improve the environment on an individual level.

The power of the individual can be easily underestimated, and we can often feel like the changes we make may not make much difference. However, when several individuals make similar changes to reduce their environmental impact, it all adds up.

In this module what small changes could you make in your regular day-to-day life to have a more positive impact on the environment?

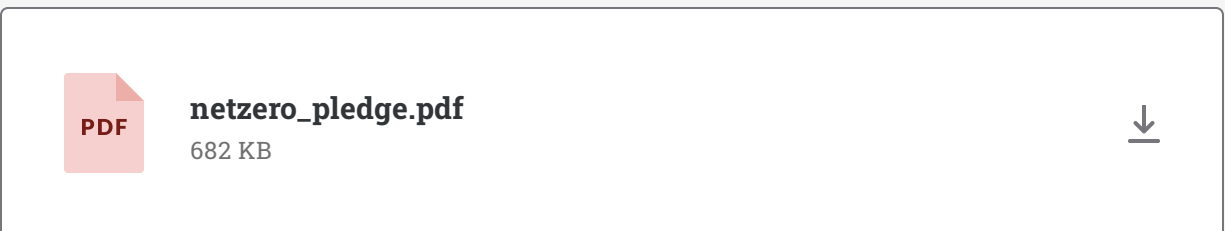
- Could you make sure that you always switch off lights and devices when not in use?
- Maybe you can introduce a plant-based day into your daily routine?
- Could you investigate careers in the conservation sector?
- Could you find an eco-friendlier way to get to and from college?

There are so many ways you can help our planet, and every small change makes a cumulative difference for the better.

So, it's over to you.

You have the opportunity to make an extraordinary contribution to tackling the climate and ecological emergencies. You have the power to make a difference through your career path. You have the power to be a changemaker who touches the lives of people all around you and makes the world a much better place for all.

Click below to download your pledge card...



Take a few minutes to reflect on what you have learned and how it made you feel - write down a few brief notes.

Now write your personal pledge/statement ...what action(s) will you take? Try and be specific.

Here are a few pointers:

- Identify personal purchasing decisions and the impacts (positive and/or negative) that this may have on the environment and people
- Identify and take actions that help halt and reverse the loss of nature
- Help inform others of what you have learned and encourage them to take action
- Gain a deeper understanding of the opportunities available through a greener career

I'm sure that you have your own ideas.



Recycling Officer

[FIND OUT MORE](#)

Sustainability Manager

[FIND OUT MORE](#)

Engineering Technician

[FIND OUT MORE](#)

Flood Risk Engineer

[FIND OUT MORE](#)

Useful links and resources:

- [Lucy Discovered in Africa?](#)
- [Timeline: The evolution of life.](#)
- [The discovery of fire by humans: a long and convoluted process.](#)
- [Climate Change: Atmospheric Carbon Dioxide.](#)
- [What Are Planetary Boundaries, And Why Are They Significant?](#)
- [Planetary boundaries 6 – Aerosols](#)
- [Asian Brown Cloud](#)
- [Green Deal: energy saving for your home](#)
- [At a glance: summary of targets in our 25 year environment plan UK Government](#)
- [Environment and Climate Change - The Welsh Government.](#)
- [Environment \(Wales\) Act 2016: factsheets](#)

COMPLETE MODULE