



# Cambridge (CIE) IGCSE Biology



Your notes

## Human Impact: Biodiversity, Pollution & Conservation

### Contents

- \* Ensuring Food Supply
- \* The Importance of Biodiversity
- \* Water Pollution
- \* Other Pollution
- \* Sustainability
- \* Endangered Species
- \* Reasons for Conservation

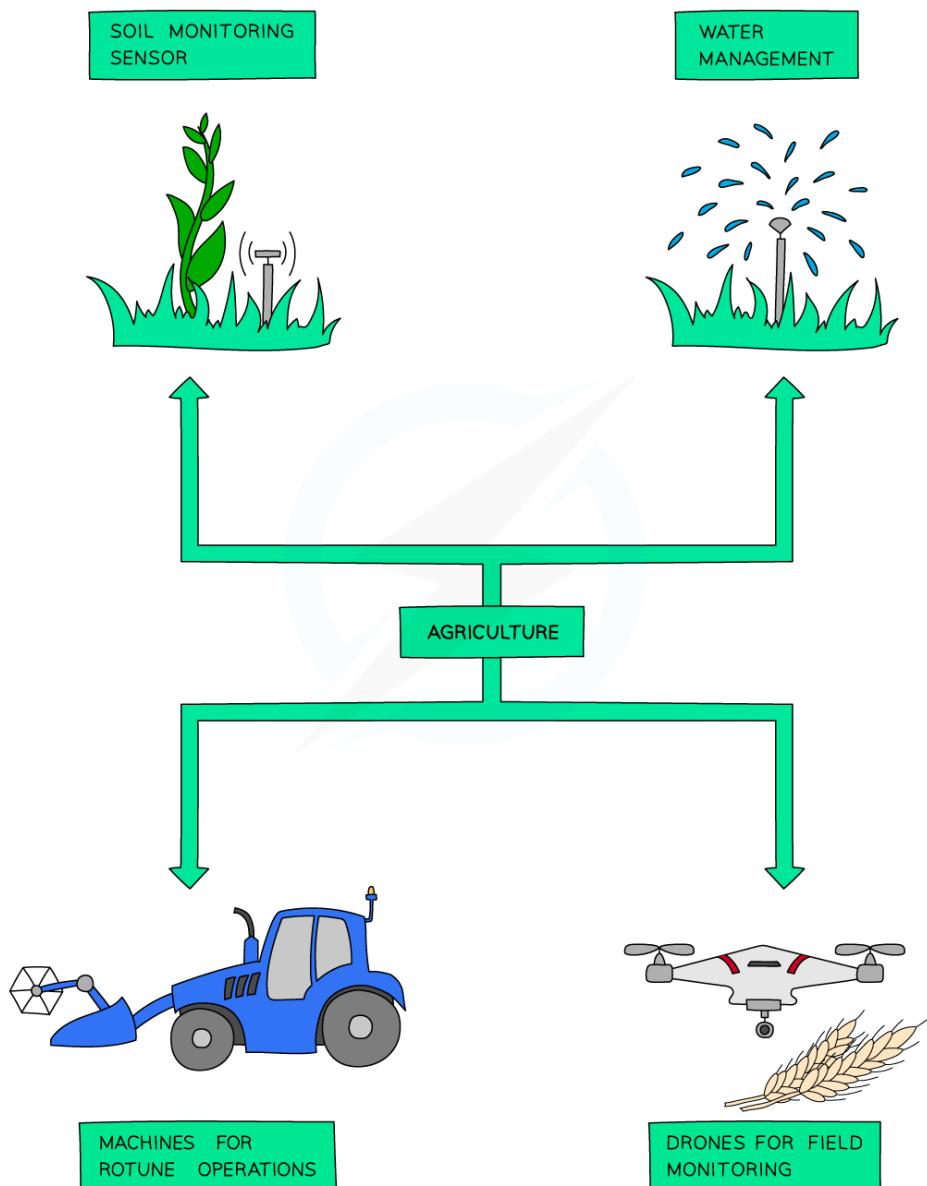


# Intensive food production

- Making food production more **intensive** means producing food more **efficiently** with a finite amount of land and other resources
- Modern technology has increased food supply substantially:
  - **Agricultural machinery** has replaced humans and **improved efficiency** due to the ability to farm **much larger areas** of land
  - **Chemical fertilisers improve yields** by increasing the availability of soil nutrients, meaning that plants can grow larger and produce more fruit
  - **Insecticides and herbicides** kill off unwanted insects and weed species, meaning that there is **less damage done** to plants by insects, and **reduced competition** from other plant species
  - **Selective breeding** produces breeds of animal and crop varieties that **reliably produce high yields**



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**Modern agricultural processes allows for cultivation of much larger areas of land for crop plants**

## Intensive livestock farming

- Intensive farming of livestock increases energy efficiency by reducing energy inputs in relation to yield, e.g. by
  - keeping livestock in a **small area**, so reducing the energy that animals put into movement; this energy can instead be used for growth
  - feeding animals on **high energy foods**, so more energy is gained per unit of food digested



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- regularly giving medication such as **antibiotics** as a preventative measure against disease
- keeping animals in **artificially warm environments** so that animals expend less energy regulating body temperature

## Advantages of intensive livestock farming

- Less land is required to produce large amounts of food
- Food can be produced all year round in controlled environments
- The cost of production is lower, so food can be sold at cheaper prices

## Disadvantages of intensive livestock farming

- Ethical issues associated with cruel treatment of animals in intensive farms
- Natural habitats may be destroyed to maximise land available for keeping livestock
- Ecological issues with intensive farming include:
  - **reduction in biodiversity** in areas where large amounts of land are used to graze cattle (as only grass is grown so in effect it becomes a monoculture)
  - overgrazing can lead to **soil erosion**
  - large numbers of cattle produce large amounts of **methane**, a greenhouse gas
  - the waste excreted by livestock can be washed into waterways, causing **water pollution**

## Monocultures

- Monoculture farming means that **only one type of crop is grown** on an area of farmland
  - E.g. trees for palm oil grown in the Indonesian rainforest

## Advantages of monocultures

- Monoculture farming allows for the use of **specialised machinery** for planting, weeding, and harvesting, leading to **increased efficiency** and **reduced labour costs**
- Focusing on a single crop can allow farmers to optimise conditions for that specific crop, resulting in **higher yields**

## Disadvantages of monocultures

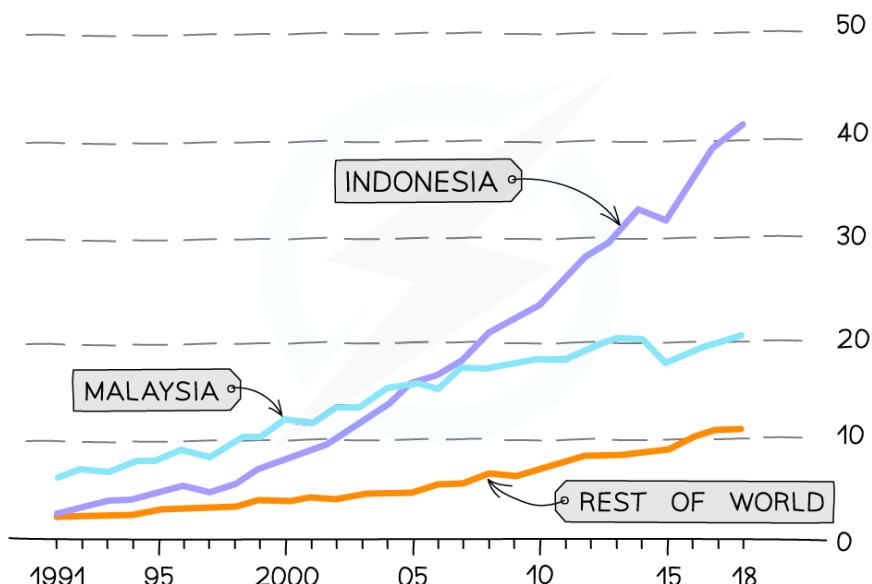
- Monocultures **reduce biodiversity**
  - Crop monocultures only contain **one variety** of plant, so provides food for **few species of herbivore**, which in turn cannot support more than a **few predator species**
- Another issue with monocultures is the **increase in pest populations**; if a particular pest feeds on a crop, farming it in large areas repeatedly means there is an ample supply of food for the pest, causing the population to increase

- Often farmers will spray **insecticides** onto crops to control the pests; this leads to:

- harmless insects being killed as well
- pollution** by pesticides
- pesticide resistance**; where the same chemicals are used repeatedly for specific pests, the pests may eventually become **resistant** to them, reducing their effectiveness



### PALM-OIL PRODUCTION, TONNES, m



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Palm oil is often grown in a monoculture; production has increased rapidly over the last 30 years



# Human Pressures on Other Species

## Biodiversity

- Is defined as the **number of different species** that live in a particular area
- Human activities have tended to **force biodiversity downwards**, whereas, high biodiversity is needed for stable ecosystems
- Habitat destruction** by humans is a major downward pressure on biodiversity

## Reasons for Habitat Destruction

- The increasing human population of the planet is causing destruction of many habitats from rainforest to woodland to marine
- Many habitats are destroyed by humans to make space for other economic activities, or by pollution from these activities, and this reduces the biodiversity of these areas
- This interrupts food chains and webs, meaning that more species may die because their prey is gone
- The main reasons for habitat destruction include:

REASON	EXPLANATION
CLEARING LAND FOR FARMING AND HOUSING	<ul style="list-style-type: none"><li>- CROPS, LIVESTOCK AND HOMES ALL TAKE UP A LARGE AMOUNT OF SPACE</li><li>- AS THERE IS AN INCREASING POPULATION AND DEMAND FOR FOOD, THE AMOUNT OF LAND AVAILABLE FOR THESE THINGS MUST BE INCREASED BY CLEARING HABITATS SUCH AS FORESTS (DEFORESTATION)</li></ul>
EXTRACTION OF NATURAL RESOURCES	<ul style="list-style-type: none"><li>- NATURAL RESOURCES SUCH AS WOOD, STONE AND METALS MUST BE GATHERED TO MAKE DIFFERENT PRODUCTS.</li><li>- THEREFORE MANY TREES ARE CUT DOWN, DESTROYING FOREST HABITATS. IN ADDITION, SOME RESOURCE EXTRACTION TAKES UP A LARGE AMOUNT OF SPACE</li><li>- FOR EXAMPLE: MINING, WHICH MEANS THAT THE LAND MUST BE CLEARED FIRST</li></ul>
MARINE POLLUTION	<ul style="list-style-type: none"><li>- HUMAN ACTIVITIES LEAD TO THE POLLUTION OF MARINE HABITATS</li><li>- IN MANY PLACES, OIL SPILLS AND OTHER WASTE POLLUTES THE OCEANS, KILLING SEA LIFE</li><li>- IN ADDITION, EUTROPHICATION CAN OCCUR WHEN FERTILISERS FROM INTENSIVELY FARMED FIELDS ENTERS WATERWAYS</li><li>- THIS CAUSES A HUGE DECREASE IN BIODIVERSITY IN THESE AREAS AS MOST AQUATIC SPECIES LIVING IN THESE WATERWAYS DIE FROM LACK OF OXYGEN</li></ul>

## Deforestation



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- Deforestation is the **clearing of trees** (usually on a large scale)
- If trees are replaced by replanting it can be a **sustainable** practise
- Generally the trees are being cleared for the **land to be used in a different way** (for building, grazing for cattle, planting of monocultures such as palm oil plantations etc) and therefore it is not sustainable
- As the amount of the Earth's surface covered by trees decreases, it causes increasingly negative effects on the environment and is a **particularly severe example of habitat destruction**
- Undesirable effects of deforestation include:
  - **Extinction** of species
  - Loss of **soil**
  - **Flooding**
  - Increase of **carbon dioxide** in the atmosphere



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EFFECT	CONSEQUENCE
EXTINCTION / LOSS OF BIODIVERSITY	<ul style="list-style-type: none"><li>– FOREST HABITATS, ESPECIALLY TROPICAL RAINFORESTS, HAVE A HUGE RANGE OF BIODIVERSITY AND AS HABITAT IS DESTROYED IT CAUSES THE LOSS OF LARGE NUMBERS OF PLANT AND ANIMAL SPECIES</li><li>– MANY OF THESE SPECIES ARE ONLY FOUND IN THESE AREAS AND THEREFORE WILL BECOME EXTINCT</li></ul>
SOIL EROSION	<ul style="list-style-type: none"><li>– TREE ROOTS HELP TO STABILISE THE SOIL, PREVENTING IT FROM BEING ERODED BY RAIN</li><li>– TREES WILL USUALLY TAKE UP NUTRIENTS AND MINERALS FROM THE SOIL THROUGH THEIR ROOTS</li><li>– WITHOUT TREES, NUTRIENTS AND MINERALS WILL REMAIN UNUSED IN THE SOIL SO WILL BE WASHED AWAY INTO RIVERS AND LAKES BY RAIN (LEACHING)</li><li>– THIS LOSS OF SOIL NUTRIENTS IS PERMANENT AND MAKES IT VERY DIFFICULT FOR FOREST TREES TO REGROW, EVEN IF THE LAND IS NOT CULTIVATED WITH CROP PLANTS OR GRASS FOR CATTLE</li></ul>
FLOODING	<ul style="list-style-type: none"><li>– WITHOUT TREES THE TOPSOIL WILL BE LOOSE AND UNSTABLE SO WILL BE EASILY WASHED AWAY BY RAIN, INCREASING THE RISK OF FLASH FLOODING AND LANDSLIDES</li></ul>
INCREASED CARBON DIOXIDE IN ATMOSPHERE	<ul style="list-style-type: none"><li>– TREES CARRY OUT PHOTOSYNTHESIS DURING WHICH THEY TAKE IN CARBON DIOXIDE AND RELEASE OXYGEN</li><li>– THE REMOVAL OF SIGNIFICANT NUMBERS OF TREES MEANS LESS CARBON DIOXIDE IS BEING REMOVED FROM THE ATMOSPHERE (AND LESS OXYGEN RELEASED)</li><li>– WHEN AREAS OF LAND IN FORESTS ARE CLEARED FOR LAND USE, THE TREES ARE OFTEN BURNED AS OPPOSED TO BEING CUT DOWN. THIS RELEASES CARBON DIOXIDE (IT IS AN EXAMPLE OF COMBUSTION), FURTHER INCREASING CARBON DIOXIDE LEVELS IN THE ATMOSPHERE AND CONTRIBUTING TO GLOBAL WARMING</li></ul>



## Untreated Sewage & Excess Fertiliser

- Human activities have led to the pollution of land, water and air
- Pollution comes from a variety of sources, including industry and manufacturing processes, waste and discarded rubbish, chemicals from farming practices, nuclear fallout, and untreated sewage

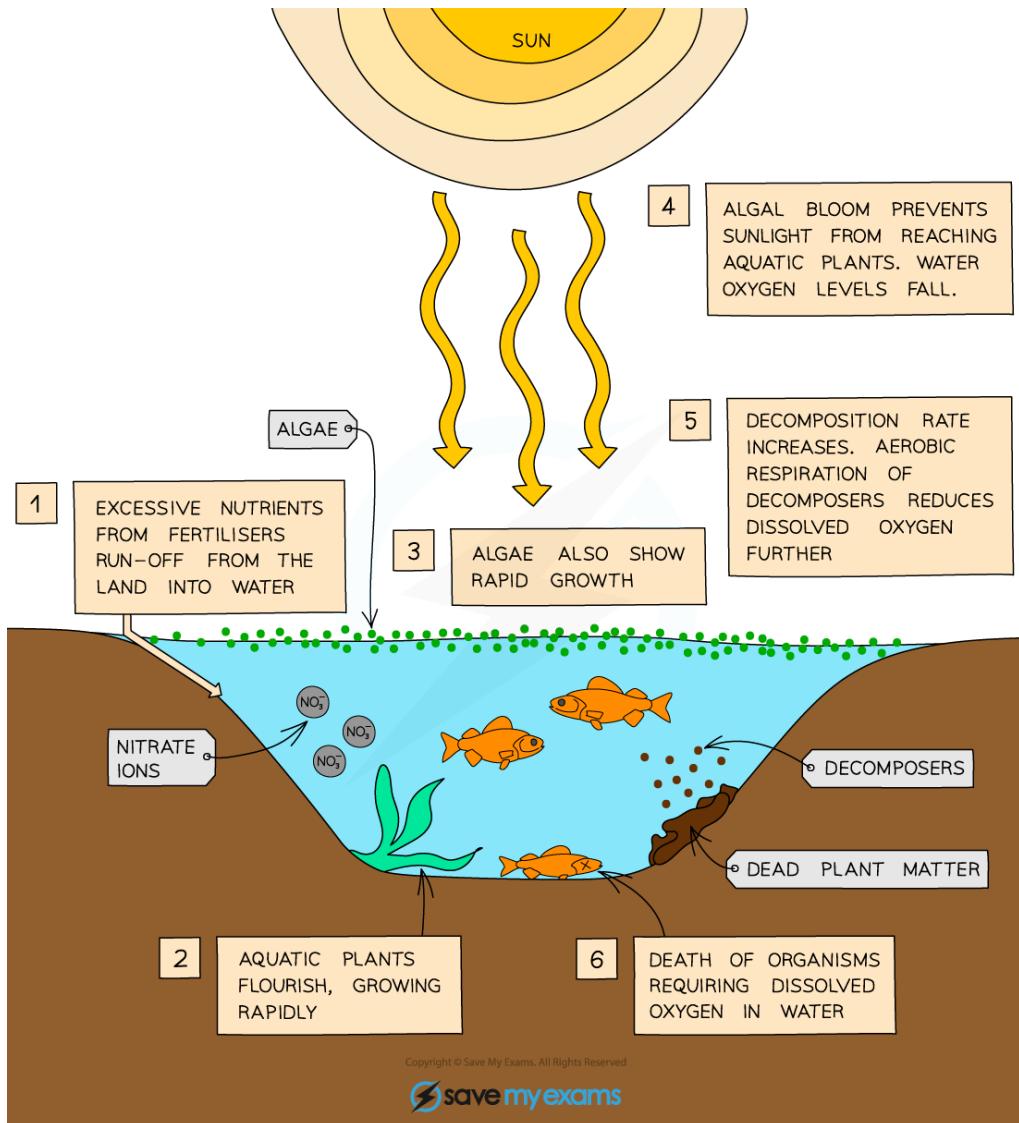
Pollutant	Source / Cause	Effect
Untreated sewage	Lack of sewage treatment (poor infrastructure/funding) means sewage enters rivers or streams.	Increases bacteria → reduces oxygen in water → kills aquatic life. This process is known as <b>eutrophication</b> .
Fertilisers	Runoff from farmland when used in excess.	Causes algal blooms → bacteria feed → oxygen depletion → death of aquatic organisms. Another case of <b>eutrophication</b> .
Methane	Released by cattle farming, rice paddies, and landfills.	Potent <b>greenhouse gas</b> , contributes to climate change.
Carbon dioxide	Produced by burning fossil fuels or trees (land clearance).	Also a <b>greenhouse gas</b> , contributing to <b>global warming and climate change</b> .

## Eutrophication: Extended

- Runoff of fertiliser from farmland enters the water and causes **increased growth of algae** and water plants
- The resulting 'algal bloom' **blocks sunlight** so water plants on the bottom start to die, as does the algae when competition for nutrients becomes too intense
- As water plants and algae die in greater numbers, **decomposing bacteria increase in number** and **use up the dissolved oxygen** whilst respiring aerobically
- As a result there is less oxygen dissolved in water, so **aquatic organisms such as fish and insects may be unable to breathe** and would die



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### Sequence of events causing eutrophication in lakes and rivers



# Plastic Pollution

- Plastics have a large negative impact on both land and water habitats due to their non-biodegradability
- In marine habitats:
  - Animals often try to **eat plastic** or **become caught in it**, leading to injuries and death
  - As the plastic breaks down it can **release toxins** that affect marine organisms
  - Once it has broken down into **very small particles**, it is commonly ingested by animals and **enters the food chain**

On land:

- Plastic is generally disposed of by **burying in landfills**
- As it breaks down, it releases **toxins** into the surrounding soil and as such the **land is no good for growing crops or grazing animals** and can only be used for building on several decades after burial

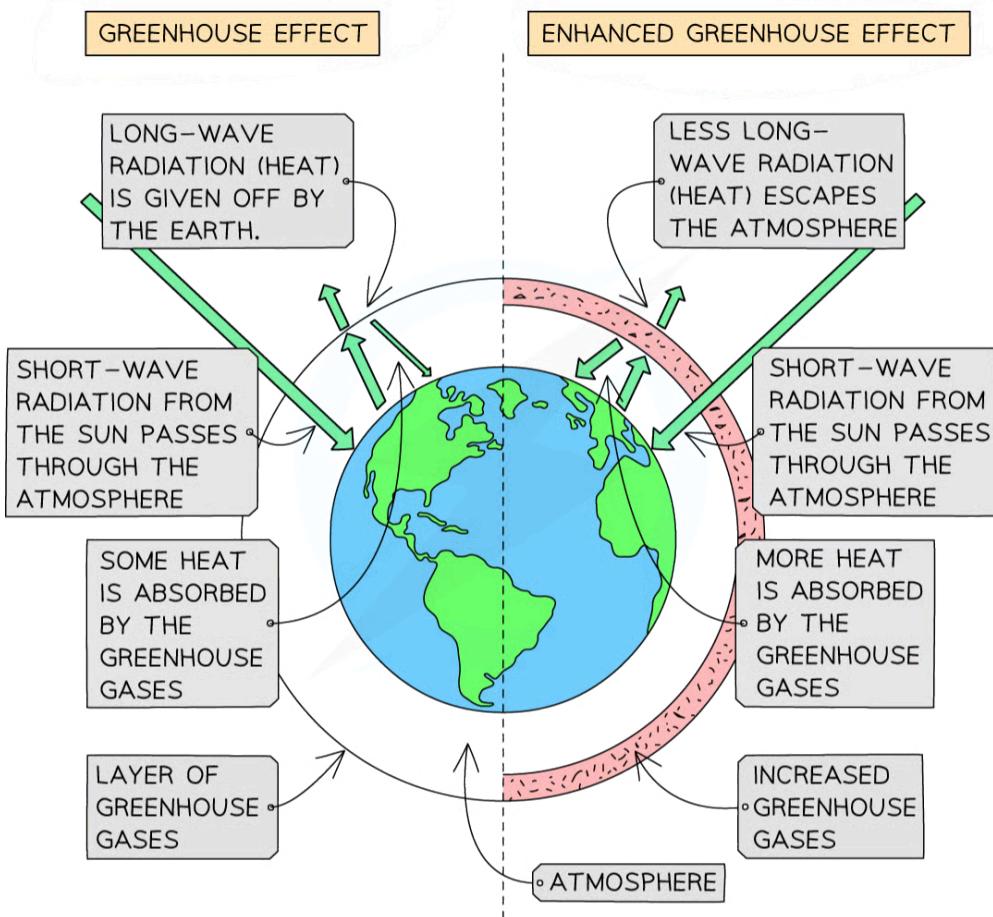
# Air Pollution

## Methane and Carbon Dioxide

- Both gases insulate the Earth and act as a 'blanket' around the atmosphere
- Higher levels of both have led to global warming and climate change
- Human activity has increased levels of both gases in the atmosphere
  - Burning fossil fuels increases carbon dioxide
  - Keeping livestock generates methane gas
  - Global warming melts the permafrost in sub-polar regions, which results in even more trapped methane being released into the atmosphere



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# Sustainable Use of Resources

- We use many resources from the Earth; some, such as food, water and wood, are **sustainable resources**
- A sustainable resource is one which is **produced as rapidly as it is removed from the environment so that it does not run out**
- Some resources, such as **fossil fuels** (coal, oil and natural gas), are **non-renewable** because what we use cannot be replaced
- These resources, once used, cannot be produced anymore and so they need to be **conserved** by **reducing the amount we use** and finding other, **sustainable resources to replace them**
- Fossil fuels are being used as an **energy source** in increasing amounts
- In addition, they are the **raw materials** for many other products we make - eg almost all **plastics** that are made start with **oil** as a raw material
- Some products, especially those made from **paper, plastic, glass or metal**, can be **reused and recycled** - this reduces waste in the environment and reduces the amounts of raw materials and energy needed to make new products
- Some resources, such as **forests and fish stocks**, can be maintained - enabling us to **harvest them sustainably** so that they will **not run out in the future**

## Sustainable Production Examples: Extended

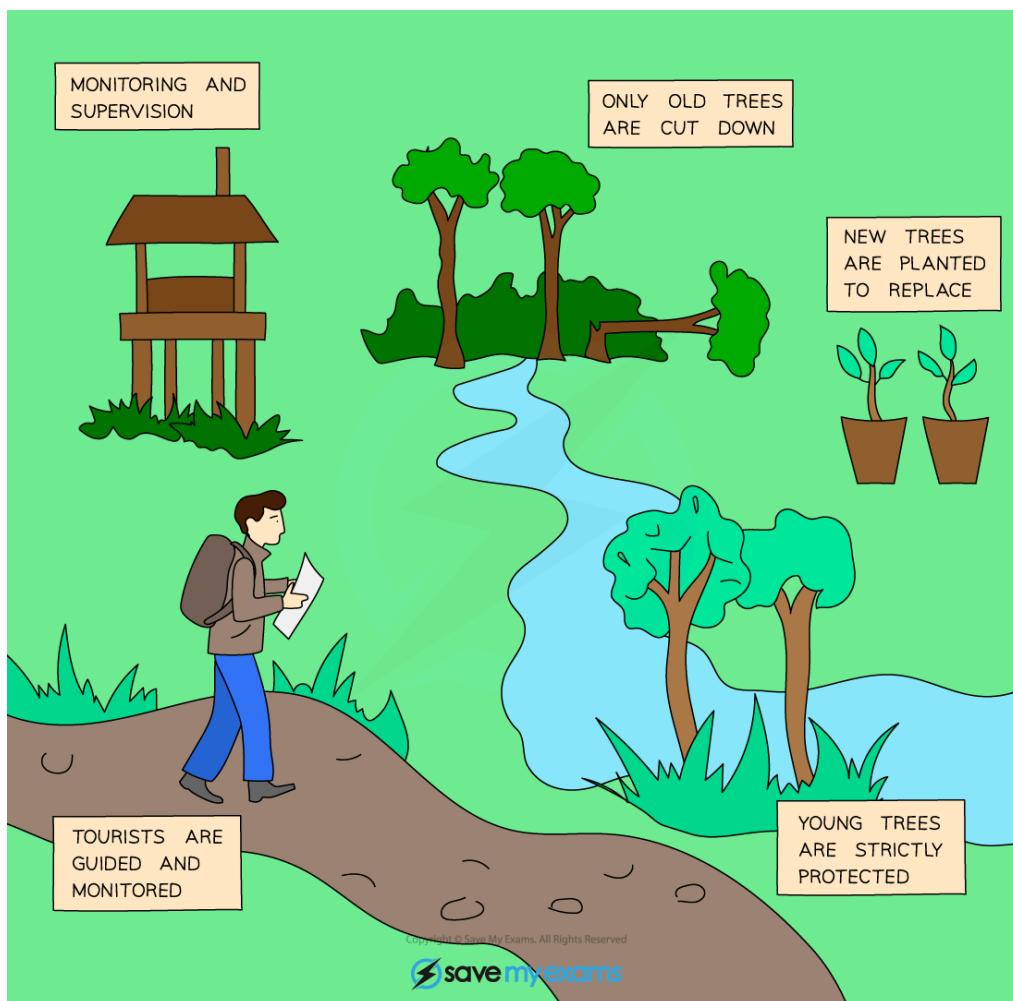
- Sustainable development is defined as **development providing for the needs of an increasing human population without harming the environment**
- When developing the way in which we use resources to manage them sustainably, we have to **balance conflicting demands** - eg:
  - the need for **local people** to be able to utilise the resources they have in their immediate environment with the needs of **large companies** to make money from resources such as forests and fish
  - the need for balancing the **needs of humans for resources** with the **needs of the animals and plants** that live in the areas the resources are taken from (preventing loss of habitat and extinction)
  - the need to balance what **current populations need** with what **future populations might need** - for example if we harvest all the fish we need to feed people now, this might lead to overfishing which would deplete stocks for future generations
- For development to occur sustainably, **people need to cooperate at local, national and international levels** in the planning and management of resources

## Sustaining Forests



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- Forests are needed to produce **paper products** and provide wood for timber
- Much of the world's paper is now produced from forests which **replant similar trees when mature trees are cut**, ensuring that there will be adequate supply in the future
- Tropical hardwoods such as teak and mahogany take many years to regrow but are highly desirable for furniture
- Using these types of wood has now been made more sustainable due to the **introduction of several schemes** designed to **monitor logging companies** and track the wood produced (eg the Forestry Stewardship Council)
- Education** helps to ensure logging companies are aware of sustainable practices and consumers are aware of the importance of buying products made from sustainable sources



More efforts are being made to manage forests sustainably so consumers know they are not causing damage to forests

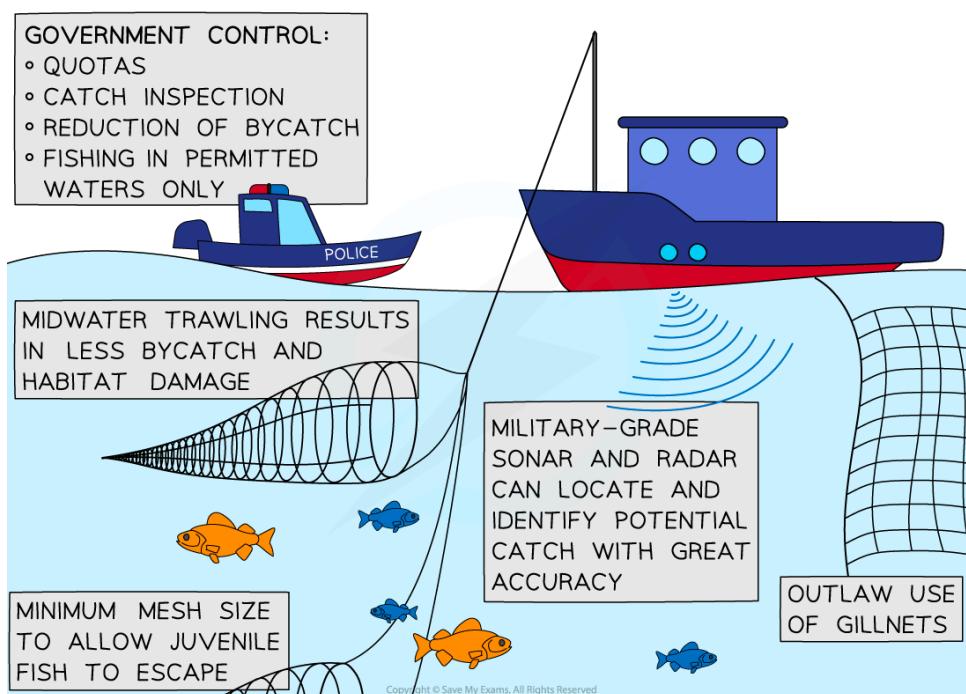
## Sustaining Fish Stocks

- Managing fish stocks sustainably includes:

- Controlling the **number of fish** caught each year (quotas)
- Controlling the **size of fish** caught (to ensure there are enough fish of a suitable age for breeding remaining)
- Controlling the **time of year** that certain fish can be caught (to prevent large scale depletion of stocks when fish come together in large numbers in certain areas to breed)
- **Restocking** (breeding and keeping offspring until they are large enough to survive in their natural habitat then releasing)
- **Educating fishermen** as to local and international laws and **consumers** so they are aware of types of fish which are not produced sustainably and can avoid them when buying fish



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### Ways of controlling fishing to make it more sustainable



# Conservation for Endangered Species

## Endangered Species

- An endangered species is at risk of becoming **extinct**
- There are several reasons why a species can become endangered - the **population of the species may fall below a critical level** due to
  - **hunting**
  - **climate change**
  - **pollution**
  - **loss of habitat**
  - **introduction of non-native species** that outcompete native species
- Endangered species can be helped by **conservation measures** such as:
  - **education** programmes
  - **captive breeding** programmes
  - **monitoring and legal protection** of the species and of their habitats
  - **seed banks** as a conservation measure for plants - seeds of endangered plant species are carefully stored so that new plants may be grown in the future
- A species may be at risk of becoming extinct if **there is not enough genetic variation in the population** as random changes in the environment may quickly cause extinction because the **remaining organisms are all very similar and may not have the adaptations to survive such changes**
- There are moral, cultural and scientific reasons for conservation programmes, including:
  - **reducing extinction rates** of both plant and animal species
  - keeping damage to food chains and food webs to a minimum and **protecting vulnerable ecosystems** (eg the rainforests)
  - **protecting our future food supply** and maintaining nutrient cycles and possible sources of future medical drugs and fuels



# Reasons for Conservation: Extended

## Extended Tier Only

- There are numerous reasons why **conservation programmes are important**
  - Maintaining or increasing biodiversity
    - Which allows ecosystems to remain stable
  - Reducing extinction
    - Helps to retain iconic species and maintain biodiversity
  - Protecting vulnerable ecosystems which would have been quickly lost to human activity
  - Maintaining ecosystem functions
    - Nutrient cycling eg. carbon cycling to hold back climate change
    - Resource provision, such as
      - Food - making sure we have enough for the population
      - Drugs - having access to plants for plant-based remedies
      - Fuel - for important activities such as cooking
      - Genes - so the gene pool remains wide and variety exists in all species

# Conservation Techniques: Extended

## Extended Tier Only

- Certain conservation techniques can be used to **Maintain biodiversity**
- Examples include
  - **Artificial insemination** (AI) in captive breeding programmes
    - This process involves inserting sperm from a male into the reproductive tract of a female, e.g. using a syringe
    - The advantage of this is that sperm can be transported around the world between different zoos, for use in AI, reducing the need to transport animals
  - **In vitro fertilisation** (IVF) in captive breeding programmes
    - IVF involves using sperm to fertilise egg cells in a lab; the resulting fertilised egg cell can then be implanted into a female for development
    - This allows gametes with **known alleles** to be used, ensuring that the next generation remains genetically diverse

## Risks to a species

- If its population size decreases, a species will experience **reduced genetic variation**
- This renders the species **more susceptible** to environmental change
- The species is **less resilient** and has a greater **risk of extinction**



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