

# Human Influences on Ecosystems

## Food Supply

### Increased food production

- Modern technology has improved food supplies in many parts of the world
- Arable farms use large agricultural machines to work very large fields
- Chemical fertilizers encourage the growth of crops
- Pesticides kill pests
- Herbicides kill weeds that compete with the plant for resources
- Selective breeding has increased yield and made crops more resistant to drought and disease
- Genetic engineering has transferred features to crops from unrelated species
- Intensive farming is using modern technology to achieve high yields of crop plants and livestock
- This involves growing crop plants over large areas at high densities and keeping livestock in large numbers
- In many intensive systems, animals are reared indoors in large numbers
- Intensive methods have negative effects on the environment
- Cattle produce methane which is a greenhouse gas
- Urine and faeces pollute lakes, waterways and seas where it can cause eutrophication
- The waste from animal farms can have serious effects on surroundings
- High densities of animals means that parasites and pathogens can spread easily
- This means using pesticides and antibiotics to treat animals and this could cause resistance to those chemicals
- A monoculture is growing the same crop on large areas, year after year
- This has an advantage of allowing farmers to concentrate on growing large quantities of a crop
- This also has negative effects on the environment
- Herbicides and pesticides kill harmless plant and insect species that may even help the plant
- Continuous use of these chemicals act as selective agents, resulting in the evolution of pests, weeds and pathogens
- The large scale use of chemical fertilizers can reduce the structure of the soil
- Reduces biodiversity of soil organisms that support crop growth
- The addition of organic matter, such as manure helps to maintain a good soil structure

### World Food Supply

- As the world population increased, farmers ability to produce enough food increased
- There is enough food to feed everyone, but many people die of starvation and malnutrition
- Shortage of food is caused by politics, economics, wars and poverty
- Many poorer countries produce enough food to feed their population but have to sell food or grow non-food cash-crops to gain foreign currencies
- Drought, flooding, pests and diseases may cause crops to fail
- Famine is most often caused by failure to supply food to those at risk of starvation
- Often there are problems transporting food to places where there is famine

### Social, environmental and economic implications

- Food production requires large areas of land

- This has meant that groups of people have been displaced, sometimes forcibly
- Land clearance for plantations and ranching has resulted in environmental damage
- As farming has become increasingly mechanized, there is not enough employment available
- This has driven people away from rural areas to cities for employment
- Intensive agriculture requires large input of energy from burning fossil fuels
- It also requires much investment by large corporations intent on profit making

### Habitat destruction

#### Reasons for habitat destruction

- The clearance of land for crop production and for the production of biofuels
- Space to build units for livestock production and cattle rearing
- Digging mines and quarries for the extraction of coal and mineral ores, such as iron ore and bauxite
- More people require more housing and associated infrastructure
- Space for long-term storage of waste and recycling of it
- Marine pollution. Major pollutants of the sea include fertilizers, which are thought to cause algal bloom in the sea, oil from oil wells and ships and industrial chemicals

#### Human influences on food chains and webs

- Killing of large predators- humans have killed many of these because they are dangerous
- Killing of large herbivores for food- there were many different species of these in large numbers
- Overfishing
- Removing species results in unbalanced food webs and unbalanced ecosystems that are further at risk of damage and other factors
- Top predators control the population of primary consumers
- Their removal means that population of herbivorous animals increases and so there is increased competition for the plant food that they eat
- The effect can be overgrazing and habitat destruction

### Deforestation

- Humans have cleared forests to grow food, to provide space and transport links
- There are now very few forests left
- Deforestation has resulted in a number of environmental problems:
  - The extinction of species
  - The loss of soil
  - An increase in flooding
  - The increase of carbon dioxide in the atmosphere
- When vegetation is removed from tropical forests, the soil is easily washed away causing erosion, formation of gullies and loss of plant nutrients
- The land is rapidly degraded after all trees are cut down
- Local weather patterns change with more frequent and severe storms
- Flooding happens more frequently as water runs off the land and is not absorbed and transpired by plants
- Forests act as stores of water, their leaves slow down the rate of evaporation and decrease the rate at which water reaches the soil

- Carbon dioxide is added to the atmosphere when vegetation is burnt
- There is increased decomposition that also releases more carbon dioxide which is not absorbed by plants
- Rainforests have no effect on maintaining the correct balance of carbon dioxide and oxygen in our atmosphere
- They produce about as much carbon dioxide as they use in photosynthesis
- There is no evidence that rainforests are the lungs of the earth
- Destruction of rainforests means the loss of many habitats and the extinction of many species
- There are many species in rainforests that are yet to be discovered and classified

## Pollution

- Pollution is the harm done to the environment by the release of substances produced by human activities

Pollutant	sources	Effects
Carbon dioxide	Burning fossil fuels	Enhancing greenhouse effects
Methane	Cattle; paddy fields; coal and oil extraction	Enhances greenhouse effect
Sewage	Human and livestock waste contains ammonia, urea, protein, carbohydrates, fats and pathogens	Reduces oxygen concentration in rivers; destruction of fresh water communities
Industrial chemical waste	Factories	Can be fatal to wildlife and humans; can accumulate in organisms
Fertilizers	Arable agriculture	Eutrophication in fresh water
Herbicides for killing weeds	Arable agriculture	Spray drift kills harmless plants; persists in the environment
Pesticides for killing pests and diseases	Arable agriculture	Accumulates in food chains; kills harmless species
Solid waste	Domestic and industrial use	Buried in landfills; left in rubbish tips; health hazard; leakage of toxic liquids; release of methane
Nuclear fall-out (Beta and Gamma radiation)	Nuclear bomb; accidents at nuclear power station; nuclear tests	Death with high exposure; cancers in humans; mutation in non-human species

## Waste Plastics

- Biodegradable materials are those when thrown away can be broken down in the environment by decomposers
- Some materials are unable to be broken down and are known as non-biodegradable
- Plastics are used for packaging because they last a long time and do not decay easily
- This becomes a problem when it comes to disposing of plastics
- Most plastic wastes go into landfills where they take up a lot of space

- Biodegradable plastics are designed to break down more quickly than non-biodegradable conventional ones
- We can recycle many thermoplastics by melting and molding them into new shapes
- Burning plastics in incinerators reduces volumes of waste but produces toxic gases when they burn
- Non-biodegradable plastics pose a threat to aquatic life too
- Animals can swallow plastic bags mistaken for food
- Aquatic animals can become entangled in discarded plastic wastes and other forms of plastic

## Water pollution

### Pollution of rivers and seas

Rivers empty toxic waste into the sea, resulting in the following:

- Fertilizers and sewage encourage the growth of algae that release toxins
- Pesticides are concentrated in the tissues of some mollusks
- Radioactive chemicals are found in higher concentration around coastal nuclear power stations
- Toxic metals, such as mercury, copper and lead are found in tissues of marine organisms
- Sewage is the biggest single pollutant
- It encourages the growth of algae and bacteria which use up a lot of oxygen killing fish and small invertebrates
- If raw untreated sewage is dumped in a river it encourages the growth of bacteria that feed on organic matter
- As water travels downstream, the water gradually improves as suspended waste settle out and are decomposed by bacteria
- If no more sewage is dumped in the river, the community recovers as the oxygen concentration of the water increases
- In many countries sewage is treated so that raw sewage is not deposited into rivers
- Fertilizers drain from the land into rivers and lakes
- Problems occur if a farmer uses too much fertilizer or if the fertilizer is added at the wrong time

### Eutrophication

- Water is enriched with plant nutrients
- This is the sequence of events:
  - Fertilizer can be washed through the soil into rivers and streams- this is called leaching. The rivers may flow into a lake
  - Once in the water, this stimulates population growth of algae. Nutrients in the fertilizers are usually low in concentration in the water and so limit the growth of algae
  - Animals that eat the algae do not multiply fast enough to control their growth
  - Algae cover the surface layers of water, reducing the light reaching plants at the bottom of the lake
  - These plants eventually die and rot on the river bed
  - Algae also die as there is competition for resources and many are shaded by the algae on the surface
  - Decomposers, such as bacteria, feed on dead plants and algae
  - Bacteria respire aerobically, multiply rapidly and use up the dissolved oxygen

- The concentration of oxygen decreases and this kills fish and invertebrates that cannot respire properly
- The same chain of events occurs if sewage gets into waterways
- Bacteria multiply quickly and use up the oxygen available
- The problems of eutrophication are caused by nitrate and phosphate
- These ions are in short supply in most aquatic ecosystems
- So they are the limiting factors to the growth of plants
- When they are added in the form of fertilisers, plant growth increases
- Farmers are encouraged to add appropriate amounts of fertilisers at appropriate times
- Removing phosphate from detergents has reduced the amount of phosphate in the soil
- Nitrate in the sea causes the growth of algae, many of which produce toxins and kill other marine life

### The effects of contraceptive hormones

- Many women take contraceptive pills containing oestrogen
- The hormone is excreted in urine and is found in sewage
- The active ingredient in contraceptive pills is synthetic oestrogen known as E2
- Oestrogens are not broken down in all sewage treatment plants
- They pass through unchanged into rivers and lakes
- Male fish and amphibians respond to this oestrogen in water by gaining certain female characteristics (intersex)
- This is also called feminisation
- This involves producing eggs inside their testes
- Having some female structures and making a protein found in egg yolk
- In addition their sperm cells do not develop properly
- An increase in oestrogens in drinking water has been linked to the decrease in sperm count in men
- There are other sources of oestrogen in the environment
- Many other synthetic chemicals have the same effect
- These chemicals are in plastics in waste from the agriculture industry
- E2 is removed from the waste water from some sewage works so the rest could be upgraded
- The use of charcoal filters is one way of doing this
- Upgrading sewage works and drinking water treatment works will be expensive

### The Greenhouse Effect

#### Greenhouse gases

- Some of the gases in the atmosphere act like a greenhouse to keep in heat
- Greenhouse gases are: carbon dioxide, water vapour and methane
- Some man-made air pollutants such as CFCs also are also greenhouse gases
- These greenhouse gases allow solar energy to pass through the earth's surface
- Some energy enters food chains and is eventually lost in the atmosphere as heat
- This is radiated away from the earth's surface
- Some heat energy escapes into space but much is reflected back towards the earth
- The greenhouse effect is a natural process which is essential to maintain suitable temperatures on earth

- Power station, factories, domestic heating and transport using fossil fuels has released large amount of carbon dioxide into the atmosphere
- After deforestation, roots and other remaining tree parts are decomposed by microbes in the soil, producing even more carbon dioxide
- There has also been a significant increase in methane due to rice paddy fields and cattle rearing
- Rotting material and the extraction of oil and natural gas are other sources of methane

### Climate Change

- Human activities are causing an increase in the concentration of greenhouse gases
- The atmosphere is getting warmer
- This is causing the enhanced greenhouse effect
- There is a fear that this warming is increasing
- If the temperature were to rise over 0°C then the polar ice would start to melt
- This would cause a rise in sea level and flooding in many low lying areas
- This could also cause a change in wind patterns and the distribution of rainfall leading to more extreme weather
- Some parts are expected to become very dry
- This could lead to a reduction of grain crops
- The pattern of the world's food distribution could be affected with economic and political consequences
- Measures to reduce the effect of climate change involve reducing carbon emissions
- This may be done by utilising public transport, using energy efficiently, recycling and altering the diet of cattle so they produce less methane

### The Greenhouse Effect

- Solar radiation passes through the atmosphere and warms the earth's surface
- The earth radiates heat energy back into space. This is mainly infra-red radiation
- Some of this heat is absorbed by the greenhouse gases
- This causes the air to warm up

### Acid Rain

- Sulfur dioxide is released when fossil fuels are burned
- Together with nitrogen oxides from exhaust fumes, they cause acid rain
- Rain is naturally acidic as the water dissolves carbon dioxide
- When sulfur dioxide and nitrogen oxide dissolve in water in the atmosphere and react with oxygen they produce sulfuric and nitric acid which lower the pH
- These gases can be carried over large distances by winds before being deposited as dry particles or dissolved in the rain
- When acid rain falls on trees it kills the leaves and reduces their resistance to disease
- Vegetation is affected by high concentrations of sulfur dioxide
- Some species of lichen are sensitive to sulfur dioxide and grow only where the air is free
- Some are able to tolerate high conditions
- Others can tolerate intermediate conditions
- By looking at the species growing in an area, you can deduce the average concentration of sulfur dioxide

- When acid rain falls on soils on limestone or on chalk it has little effect
- This is because the soils are alkaline and neutralizes the acid
- When it falls on soils on hard rock such as granite, the soil is already acidic and there is nothing to neutralize the acid
- Acid rain causes plant nutrients to become soluble and wash out of the soils leaving them infertile
- Aluminum compounds in soil become soluble at a pH lower than 5.5
- Acidified water that enters streams, lakes and rivers lowers the pH of these bodies
- The aluminum concentration also increases considerably
- Small invertebrates and fish cannot survive in such low pH conditions and aluminum ions are toxic
- There are measures that prevent acid rain such as:
  - Low sulfur fuels could be used. Crushing coal and washing it with a solvent that dissolves the sulfur compounds reduces its sulfur content
  - Flue gas desulfurization removes the sulfur from power stations by treating the waste gases with wet powdered limestone, neutralizing the acidic gases before they can escape
  - Catalytic converters can be fitted to reduce the nitrogen oxides in the exhaust fumes of cars

### Sustainable resources

- A resource is any substance, organism or source of energy that we take from the environment
- A sustainable resource is a resource which is renewed by the activities of organisms so that there is always enough to take from the environment without it running out
- Nonrenewable resources are those which cannot be regenerated or reproduced. These resources cannot be replaced

### The need to conserve fossil fuels

There are various ways to conserve fossil fuels for the future:

- Use fossil fuels more efficiently by burning them to make full use of the energy released on combustion
- Reduce wastage of energy
- Reducing the demand for petrol/gasoline
- Recycling materials
- Alternatives to fossil fuels: wind energy, solar energy, hydro electrical power, nuclear power, burning rubbish and wood from fast growing willow trees

### Sustainable timber production

- Timber is a valuable resource
- As soon as the trees are felled, they are replanted
- The replanting is an example of restocking so that resources can be harvested without depletion
- Some governments manage forests by issuing permits to logging companies
- They are given quotas so they do not take more trees than they can regrow

## Sustainable development

- Certain areas of the sea are declared off limits for fishing during the breeding season
- Quotas are issued by fishing authorities so that boats cannot take too many fish in each season
- Fishing nets have to be a certain minimum size so certain small fish can escape and survive and breed
- Some stocks of fish can be restocked if it is possible to breed them in captivity and raise them in hatcheries

## Sustainable development

- Sustainable development aims to provide the needs of an increasing human population without harming the environment
- Sustainable development requires: – management of conflicting demands – planning and co-operation at local, national and international levels

## Sewage treatment and recycling

### Sewage treatment

There are three main stages in the treatment of sewage:

- Primary treatment involves removing large solids by filters or screens. The grits and organic solids are allowed to settle out in large tanks
- Secondary treatment involves microbes, mainly bacteria decomposing material suspended in water. This happens in two ways:
  - The activated sludge process in which air is pumped through the sewage with a community of bacteria, fungi and protoeists which respire in aerobic conditions and break down carbohydrates, proteins and fats to carbon dioxide. Urea is broken down to ammonia and then converted to nitrate ions
  - Trickling filters are beds of gravel covered with microbes, the liquid from the primary treatment is sprayed over these beds from large rotating arms. As the liquid trickles through the gravel, the microbes break down the organic matter
- Tertiary treatment involves a period of settling. The liquid from the secondary process passes into large tanks. Here microbes and any remaining organic material settle out to form sludge. This sludge may be put back into the secondary stage to increase the population of microorganisms or it may go to an anaerobic stage in which bacteria break down waste matter to methane in anaerobic conditions. The methane is burned as a fuel in the sewage works to provide energy for operating the machinery. Sludge may also be dumped at sea or spread on the land as a soil conditioner
- The water leaving the plant will be treated in a variety of ways to make it safe

### Recycling waste

- Unless waste is handled and disposed of properly it may be hazardous
- The solution is to recycle useful materials

### Endangered species

- A species becomes extinct if there are no individuals left alive anywhere in the world
- Some species are kept alive only in captivity and they are described as extinct in the world



- When the numbers of a species decrease to such a level that it is at risk of becoming extinct the species is described as endangered
- The reasons for species become endangered and extinct are:
  - Habitat destruction
  - Climate change
  - Pollution
  - Overfishing
  - Hunting for food and sport
  - Competition with species that humans have moved from one part of the world to another
  - Predation by introduced or alien species

### Threats to the survival of species

- Climate change is occurring as a result of changes to the composition of the atmosphere
- The world is growing warmer, plants and animals associated with tropical regions are extending their ranges away from the equator
- Plants better able to survive in changing environments will outcompete other species
- Deforestation is not the only cause of habitat loss
- Wetlands are very important as they provide ecological services for us and also are feeding grounds for migrating birds
- Many wetlands across the world have been drained to provide land for farming, housing, industrial and leisure activities
- Pollution is occurring on a global scale
- Introduced species have been moved around the globe by humans
- Sometimes we have done this deliberately by introducing animals for sport or to control pests
- Hunting has caused the extinction of some species
- They have been hunted for food, sport, trade and as a deliberate policy to remove dangerous animals and pests
- Animals have been trapped and shot for their fur in the days before man-made material became available
- In some places animals are shot as a deliberate policy to protect farmland
- There is very little genetic variation in small population
- This makes rare and endangered species at particular risk of becoming extinct
- With few individuals alive, many of the alleles of the genes in that species are no longer left
- This reduces the chances of the population evolving in response to changes in the environment

### Conservation

- Endangered species have to be conserved
- Monitoring can involve labelling, radio tagging and counting flocks of bird and herds of animals
- No species lives in isolation so we have a duty to conserve ecosystems and habitats. Here are some ways in which this is done:
  - National Park-s large tracts of land set aside for wildlife but which may be occupied by people who are patrolled by wardens
  - Marine parks to protect areas of the sea from damage by fishing and pollution
  - Growing endangered plants in botanical gardens and re-establishing them in the wild
  - Reducing habitat destruction
  - Re-establishment of ecosystems that have been degraded

- Preventing the trade of endangered species
- Encouraging sustainable management of ecosystems. Trees removed from forests should be replaced by planting or allowing time for natural replacement of seeds
- Seed banks are cold stores that conserve seeds of endangered or valuable species. Their genes may be useful for crop improvement in the future or to produce valuable products such as medicinal products. Seeds are collected from plants in the wild and are put into long term storage
- Increasing people's knowledge and understanding of the way in which their actions affect wildlife will help to ensure the success of conservation programmes

### Reasons for conservation

- Ecosystems provide us with services such as treating waste, providing food and fuels and giving us areas for recreation. They provide us with useful substances such as medicine
- Ecosystems help to maintain the balance of life on the planet (nutrient cycle)
- Habitats support a wide variety of organisms that interact in ways we do not fully understand, often to continue life on this planet
- There are few foods, apart from some fish species that we can take directly from the wild in large quantities. There may be many more plants and animals that we could utilize as food sources
- Fuels- fossil fuels cannot last forever. We still need timber to provide fuels such as biomass fuels
- Drugs- drugs for treating cancer have been discovered in plants
- Genes- as a result of selective breeding there is very little genetic diversity in our three main staples. It is important to conserve any locally adapted varieties that exist as well as any wild relatives that have genes we could use in the future. These plants can be kept in botanic gardens and their seeds in seed banks
- Prevent species becoming extinct, especially those threatened directly by human activities