SL IB Geography

Your notes

6.4 Extreme Environment Futures

Contents

6.4.1 Desertification

Your notes

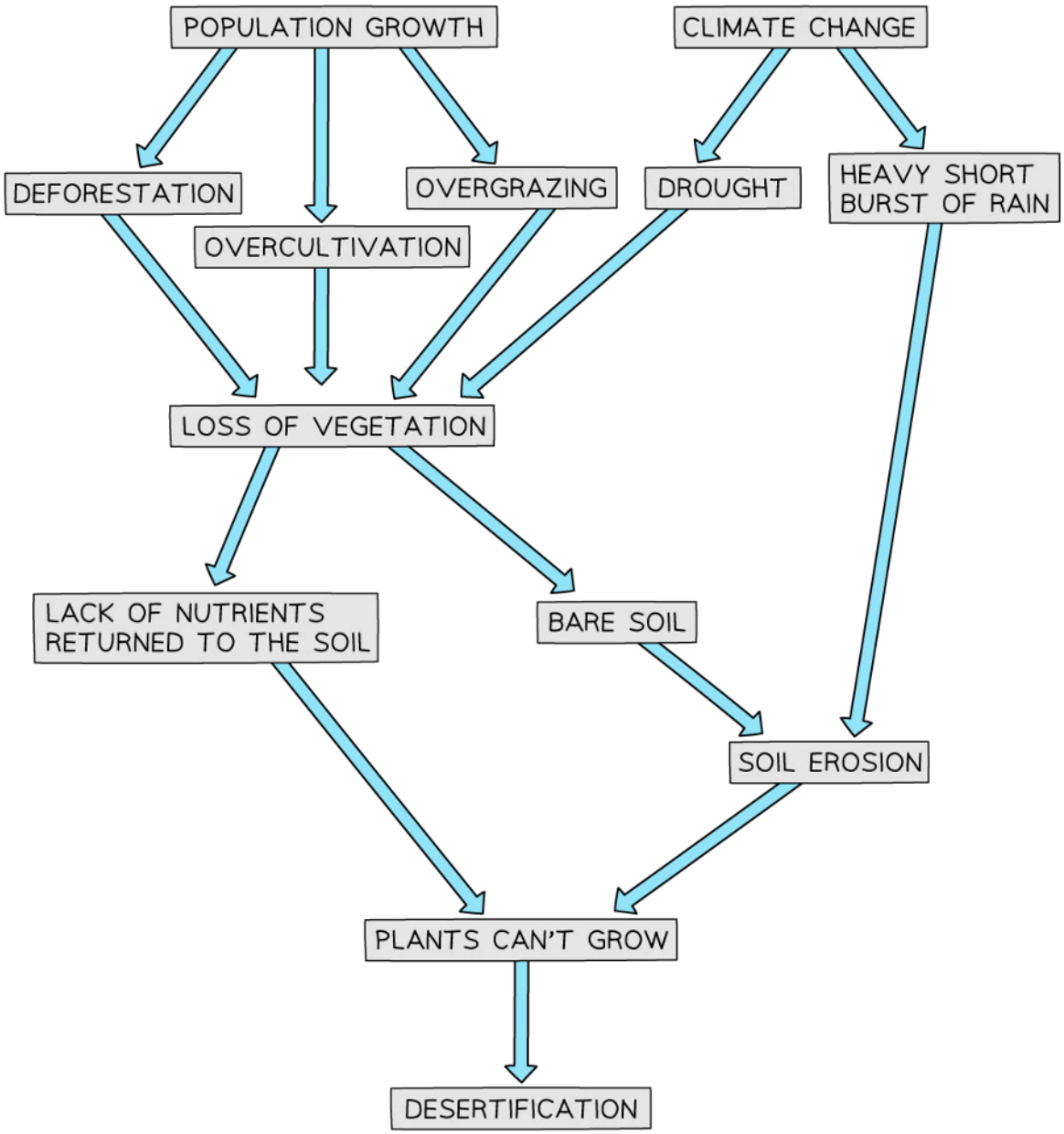
Causes of Desertification

- Desertification is:
  The process of desert-like conditions spreading into what were previously semi-arid areas, as the quality of soil and its fertility decline over time
- It is possible to argue that human activity and climate change may make many of the natural causes worse

Comparison Between Natural and Human Causes

Natural causes	Human causes
Soil erosion leads to the loss of nutrients. Plants are unable to establish and grow	Overgrazing means the vegetation has all gone due to the numbers of animals or the land does not have chance to recover
Rainfall patterns have become less predictable, leading to drought and any vegetation dying due to lack of water	Over-cultivation leads to all the nutrients being taken up by crops, leaving none for future vegetation to grow
Reduced vegetation means that nutrients are not added to the soil through the decomposition of dead organic matter	**Deforestation** removes shade for the soil and means there are no roots which bind the soil together. This increases soil erosion, whilst decreasing infiltration and interception
Any rain that does fall is often in short, intense bursts, leading to increased surface run off and soil erosion	**Population growth** puts increased pressure on the land as people raise more animals and grow more crops

Your notes



Natural and human causes of desertification

- In areas such as Kenya, both human and natural factors lead to desertification
- **Grazing patterns** and traditional lifestyles mean that:
  - **Nomadic Masai farmers** have been forced to use smaller and smaller areas of land for grazing
    - This results in **overgrazing**, which removes the vegetation
    - The soil no longer has protection from the wind and rain, which leads to **soil erosion** and **desertification**

- **Population growth** increases the demand for food and fuelwood
  - This leads to **over-cultivation** and **deforestation**
  - Deforestation:
    - Reduces the amount of nutrients returned to the soil
    - Exposes the soil to wind and rain
  - This further increases soil erosion, leading to desertification
- In Kenya **increasing temperatures** and more **irregular rainfall** are **natural causes** of desertification
- However, these could be the result of the enhanced greenhouse effect (human cause) leading to climate change

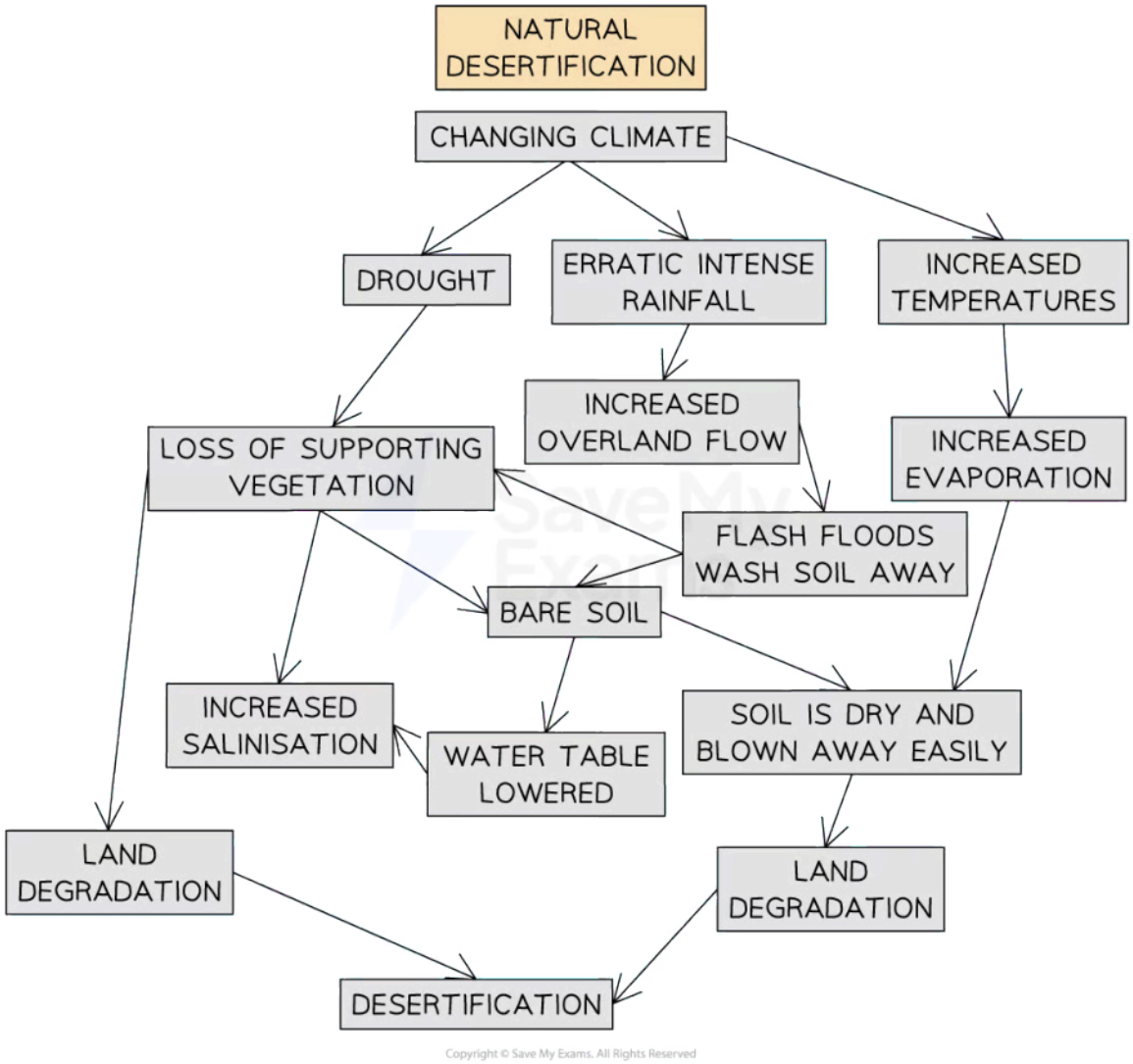

Your notes

Consequences of Desertification


Your notes

- **Desertification** is a **form** of **land degradation**
- Land degradation indirectly affects about 350 million people in the developing world
- Land degradation **occurs** through **changes** in **soil character, wind erosion, or water shortages (droughts),** which **leaves the land unproductive or lost**
- **Soils** in arid and semi-arid regions are **potentially** very **fertile**, as there is insufficient water to leach minerals from the soil
- These soils have **high pH values** and **intense evaporation** at the surface results in the **capillary rise of soil moisture and minerals;** this is **salinisation**
- **When irrigation water is added** to land and **allowed to evaporate**, this has the effect of **increasing salinisation**
- **This process** has made a **lot of land** in the hot deserts **infertile**
- Increased soil salinity restricts most plant growth and is also phytotoxic when there are high concentrations of sodium in the soil
- **Soil erosion** is the washing away or blowing away of topsoil, which greatly reduces the fertility of the remaining soil
- This is a **natural process made worse through human activity**
- There is a link between soil erosion and desertification

Your notes



A changing climate is a natural 'physical' cause of desertification

- Once desertification starts, a pattern follows in a downward spiral that not only affects the physical but also the human aspect
- Soil degradation → soil erosion → reduced agricultural output → malnutrition, famine → migration → conflict → soil degradation etc.
- **The consequences of desertification** include:
  - Loss of topsoil through exposure to wind and rain
  - Over-exploitation of biodiversity through agricultural practices
  - Vegetation is destroyed, leading to the migration of animals (and people)
  - Water sources are depleted through over-abstraction and/or lack of precipitation, and biodiversity is lost

- Increased levels of soil salinity through poor irrigation practices
- Desertification changes the landscape:
  - Reduced sand dune formation as less vegetation to trap loose material
  - Landslides on destabilised slopes where vegetation is removed
  - Vegetation slows wind speeds - as vegetation reduces, wind speeds increase leading to more frequent sandstorms
  - Soil moisture evaporation increases; the soil dries quickly
  - Plant root mat is lost; soil becomes unstable
  - Increased erosion eventually exposes bedrock
  - A combination of higher wind speeds and mobile sediment, transports sand, etc. into other areas, burying vegetation and soil
- Soil and sand encroachment impacts the ecosystem:
  - Land becomes less fertile, impacting flora and fauna as less organic matter is returned to the soil, further reducing growth and biodiversity decreases
  - Distribution of species has/is changing - flora and fauna populations that were present before desertification have either died out or migrated to less degraded areas
  - The process of species adaptation is slow, and inward-moving, already adapted species outcompete native species
  - Desertification destroys soil and vegetation carbon sinks, releasing it back into the atmosphere, enhancing global warming and further changes in climate conditions


Your notes

Impacts on People in the Desert

- Changes to hot desert ecosystems and landscapes have a knock-on effect on human populations

Social impacts

- Dust clouds (from soil erosion) affect air quality and health
- Reduction in clean water supplies creates hygiene issues and increases water-borne diseases
- People are forced to migrate, with many people—young men in particular—leaving to work in cities and towns
- This adds pressure on already limited urban resources
- Disputes occur over land between herdsmen and farmers
- Food shortages lead to malnutrition and famine, e.g. in Ethiopia
- This can also result in increased movement to refugee camps, e.g. Syria to Jordan

Economic impacts

- As the land becomes unproductive, farm income falls
- This leads to widespread poverty and an increased reliance on overseas aid
- Desertification also reduces vegetative productivity, leading to long-term declines in agricultural yields, livestock yields, plant standing biomass, and plant biodiversity
- Reduced agricultural exports, increased dependency on government grants
- People and communities suffer the loss of income, further reducing the ability to produce food, which affects the economy of the country

Climate change and desertification

- By 2050, temperatures in the world's drylands could rise by 2 to 5°C, accelerating and increasing desertification impacts

- Precipitation rates will decrease; moving semi-arid areas into arid regions
- Extreme weather events are likely to become more frequent
- Increased migration to already overcrowded cities
- Less productive soils will lead to rural areas becoming less viable, forcing more people to migrate further afield, This adds pressure on other countries to provide food, water and shelter when they themselves may be struggling
- Some may stay and adapt by using soil conservation strategies or changing agricultural practices


Your notes

Management of Desertification


Your notes

- Desertification is a very difficult process to reverse while rainfall remains low
- Halting and reversing desertification means tackling the causes
- There are a variety of possible methods that can be used

Water management

- Contour stones or bunds can be used to increase infiltration
- Earth dams can be used in the wet season to store water
- Drip irrigation can be used to water crops more efficiently

Education

- Education including:
  - Sustainable farming methods, including agroforestry and crop rotation, which help to keep the soil healthy
  - Family planning to reduce population growth

Agroforestry

- This combines agriculture with forestry, which means some trees remain, which:
  - Decreases deforestation
  - Provides shade as well as increasing infiltration and interception, which reduces soil erosion
  - Provides organic matter from the trees and adds nutrients to the soil

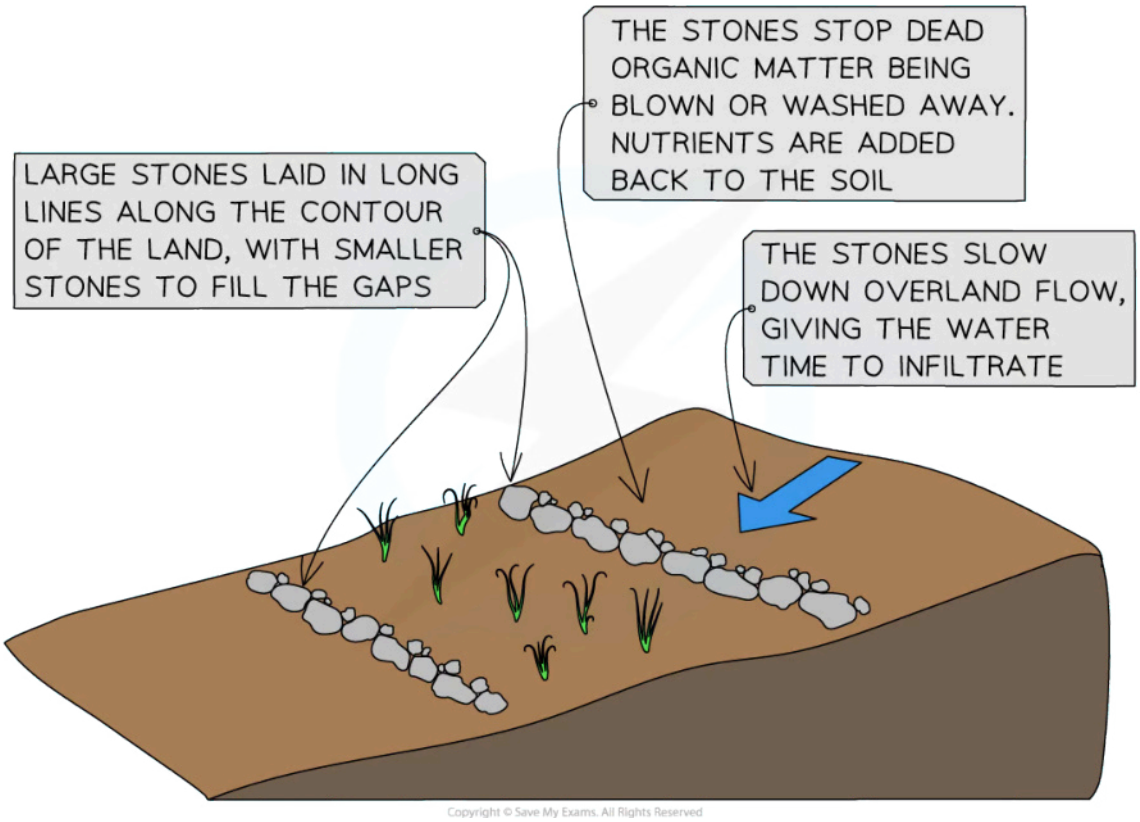
Afforestation

- Tree planting, such as the **Great Green Wall** across the **Sahel**, helps to reverse desertification in several ways:
  - The roots help to bind the soil together, reducing soil erosion
  - The canopy offers shade, helping to prevent the soil from drying out and also reducing soil erosion from rainfall landing directly on the soil
  - Falling leaves and branches replace nutrients in the soil
  - The trees increase animal and insect activity, which helps improve soil quality

Contour stones or bunds

- These help to reduce soil erosion by:
  - Preventing the soil from being blown or washed away
  - Reduce overland flow
  - Ensuring that dead organic matter stays in one place and can decompose, adding nutrients to the soil
- Additionally, they increase infiltration of water into the soil

Your notes



Stone contouring on a slope to reduce soil run-off after rainfall

Alternatives futures

- The future for those living in areas of desertification depends on the action taken to mitigate and ameliorate land degradation
- No one plan or action can solve the issue of desertification and this means there are two possible outcomes:
  - Desertification continues (business as usual)
  - Human intervention stops or reverses desertification

Table Showing Possible Futures

Desertification Continues	Intervention
If no action is taken or strategies are not appropriate or insufficient, then the rate of desertification may increase, leading to larger areas of degraded land	Appropriate and sufficient action taken may reduce or reverse desertification and areas could return to previous conditions

Reduction in agricultural output increases malnutrition and famine and this lack of food security hinders the development	Improved farming techniques and education reduce the impact of wind erosion, improve soil fertility and reduce the effect of land degradation
Migration can lead to overcrowding in receiving areas, which can lead to sanitation and health issues, along with increased pressure to find housing, jobs and food can lead to conflict within and between countries	Global responses to climate change could have a major impact, but requires commitment on a global scale and not every country agrees with cutting emissions of greenhouse gases


Your notes

6.4.2 Case Study: Desertification

Your notes

Desertification in the Sahel

Position

- The Sahel is the transition zone between the Sahara Desert to the north and the wetter, more grassland savannas to the south
- It stretches from the Atlantic Ocean to the Red Sea, a distance of 5 400 kilometres from west to east
- The total area is roughly 3 million square kilometres and is home to around 260 million people

Population

- Growing at a rate of 3% per year, the population doubles every 20 years
- The rate of population growth is higher than the rate of food output
- The majority of the population relies on agriculture to meet food demands
- Meeting those demands is difficult in a region with a high population and a warming climate

Climate

- It receives approximately 200 to 600 mm of annual rainfall, which fluctuates annually
- There are periods of intense rainfall in the Sahel, but they bring little benefit due to poor infiltration
- Recurring droughts have caused famines in the region
- Between 1970 and 2010, the region was notorious for hunger and malnutrition
- Satellite imagery from the 1980s showed the Sahara expanding southward into the Sahel, but 10 years later, further images showed that the desert had retreated back to the north
- Studies suggest that the Sahara fluctuates between expanding and retreating every few years
- Despite no long-term trend in the Sahara Desert expanding, farmers are still under pressure to overgraze small areas of marginal land, thereby speeding up the process of desertification

Awaiting

Map showing extent of the Sahel region and reafforestation project

Causes of desertification in the Sahel

- The causes of desertification in the Sahel can be divided into direct and indirect causes and are driven by:
  - Changing climate (direct)
  - Overgrazing (direct)
  - Deforestation (direct)
  - Poor agricultural practices (direct)
  - Population pressures (indirect)
- Despite the 3% growth in population each year, the Sahel region produces just 2% a year
- This leads to intensive farming methods or farming on unstable land
- People are becoming less active because of economic reasons or changes in the weather
- Sedentary lifestyles are more degrading on the land due to increased water, food and resource consumption

- This leads to over-cultivation, overgrazing, deforestation and overexploitation of water
- Also, slash-and-burn farming has become more popular, which makes wind erosion worse by leaving behind dry, empty land


Your notes

Solutions to desertification

- **Dams, irrigation canals and wells** were built during the 1980s and 1990s
  - However, these wells were too small to combat drought, plus they provided a breeding ground for insects such as mosquitoes, which can carry disease
- **Countries** in the Sahel region **joined forces** to form an alliance to combat severe drought and invested in high-yielding and drought-resistant crops
  - This helped to stop soil degradation, desert encroachment whilst also providing jobs and promoting ecotourism
- In **Burkina Faso**, Oxfam worked with farmers to improve the traditional stone wall, aiming to increase food production by using bund lines of stones across a slope to stop water and soil from running away
  - This method preserves the topsoil and has improved farming and food production in the village
  - They managed to increase millet, the staple crop in Burkina Faso, production by 50% on average
- On a larger scale, the **Great Green Wall** is a plan to grow an 8 000–kilometre band of trees across 11 Sahel countries
  - It is hoped that by 2030, 100 million hectares of degraded land will have been restored, which will help to decrease the impact of drought in the region
  - Ethiopia has restored 15 million hectares

6.4.3 Competition for Access to Resources

Your notes

Role of Indigenous Groups

Resource competition

- A **resource** is anything that is **useful** to people
- They are limited and competition arises because of their usefulness
- As demand rises, the pressure to extract them from extreme environments increases

Resources in extreme environments are:

- **Cultivable land** in cold and arid regions is limited
  - Mineral extraction and development damages these lands, leaving people import-dependent
- **Water** resources are limited in both cold- and hot-arid regions
  - People in arid areas struggle to find water
  - In cold environments, frozen or poorly draining soil reduces accessibility to water
  - Development needs significant amounts of water, leaving little for local communities
- **Mineral** resources in extreme environments offer opportunities for huge **economic gains**
  - However, extraction has been costly and difficult in the past
  - Improved technology and rising demand now make these regions a viable proposition
- The competition for land, water and economic resources bring various stakeholders into conflict

Indigenous groups and their lands

> ”
>
> Doctrine of Discovery was a 15th century justification that newly arrived Europeans immediately and automatically gained legal property rights over Indigenous lands and also gained governmental, political and commercial rights over the inhabitants without the knowledge or consent of Indigenous peoples. Source: Adapted from Miller, R. et al. (2010[4]), Discovering Indigenous Lands

- For Indigenous peoples, **land** has a **spiritual** and **cultural value** rather than an economic one
- **Conflict** between Indigenous groups, or between Indigenous groups, businesses and authorities, is **long-standing and biased against Indigenous peoples**
- Particularly where Indigenous law, including land rights, is separate from the country's mainstream legal structure
- In some instances, the government **forcibly relocates** Indigenous groups to areas away from their traditional lands and their opportunities to benefit from the wealth beneath their land
- Usually, they are relocated to **land** in **worse** locations and of **poor quality**, away from main populations
- In cold and arid areas, the forced relocation of disempowered Indigenous communities is common
  - In Australia, many Aboriginal communities that occupied productive lands that could be used for animal raising were either killed or forcibly relocated away from their traditional land to make way for the European settlers

- Greenland, where the Uummannaq Inuit community was forcibly relocated to make way for a strategic US military base
- In northern Siberia, the Yamal Peninsula is a remote, windblown tundra region
  - It has one of the world's largest natural gas reserve, at an estimated 55 trillion cubic metres
  - The Indigenous Nenets are nomadic reindeer herders that have used the Yamal Peninsula for over 1 000 years.
  - They graze reindeer in the north during the summer and migrate south for the winter
  - Due to climate change and oil and gas exploration, the Nenets are under threat
  - Russia intends to exploit the region, putting the future of nomadic herding at considerable risk
  - Reindeer are unable to cross the roads and pipelines, affecting their migration routes and many have been shot
  - Oil spills damage the quality of the pasture and freshwater
  - The River Ob has seen a decline of fish yields as spawning grounds have been polluted
  - Nearly 30 fisheries on the tributaries of the Ob are gone


Your notes

Role of Civil Society Groups


Your notes

- **Civil society groups**, also known as **civil society organisations (CSOs)**, are a wide range of organised groups, including NGOs, trade unions, social movements, grassroots organisations, networks and communities
- CSOs have created **positive social change** in numerous places throughout the world
- They can start conversations that bring people together to take action as a group and get people to speak out about problems at the local, national, regional, and foreign levels
- Push for new laws, plans, policies, or strategies, and make sure that governments keep their promises
- CSOs can also offer services such as education and healthcare

CSO and the Himba tribe

- Semi-nomadic pastoralists, The Himba, live in the deserts of northern Namibia and southern Angola
- They raise cattle, sheep and goats and move with the availability of water
- Any threat to water access will endanger the tribe
- The Kunene River flows through the middle of the Himba lands and forms a natural border between Angola and Namibia
- The Himba depend on these waters to provide drinking water for their animals and grow food
- In the mid-1990s, plans were made for a large hydropower dam on the river, but these were shelved
- In 2012, both governments announced that work would begin
- At least 5 000 people will be displaced because the dam will flood 290 square kilometres of land
- The dam lake will cover the ancestral burial grounds, which is a concern in a society that values honouring the dead and asking their advice before making any big decisions
- Direct protests by Himba leaders and followers have sparked efforts to stop the dam's construction, along with civil society groups such as:
  - Earth Peoples
  - International Rivers Network
  - Habitat International Coalition
- Despite the continued support, opposition to the dam has been ineffective
- The Himba don't have a political party and don't know how to officially or formally take part in the decision-making process of the government
- A number of international civil society groups have written on their websites about Himba's resistance to the dam and its environmental effects
- However, this hasn't changed the plans of the Angolan or Namibian governments

Role of TNCs

- In places such as Sudan, Egypt, Mali, and Uzbekistan, there are **financial pressures** because **big companies** are willing to **pay large sums** of money to **buy land** to grow cotton to sell abroad
- Traditional farmers who grow food cannot compete with the financial pressures of transnational corporations (TNCs) that only care about making money
- As a result, land that **used** to **grow food** is **now** used to **grow industrial raw materials** like cotton
- This leads to reduced biodiversity because mixed crops are replaced by monoculture (plantings of only one plant type), such as coffee or palm oil

Role of Militia Groups


Your notes

- In some arid and semi-arid environments, such as the Sahel and the Sahara, **political militia groups** have made it harder for people to get land and other resources by forcing local communities to live with them
  - Boko Haram, also called the 'Islamic State in West Africa,' is a terrorist group in the Sahel area of northeast Nigeria
  - They have killed over 20 000 people and forced about 2.5 million to flee to Chad, Cameroon, Niger, and other parts of Nigeria
- Other militias working in the Sahel region are:
  - GSPS (Salafist Group for Preaching and Combat) in southern Algeria
  - AQIM (al-Qaeda in the Islamic Maghreb), which is linked to Tuareg fighters in northern Mali
  - MUJAO (Movement for Unity and Jihad) in West Africa
- The Sahel region is less stable now because of these groups
- They have **changed the way land is owned**, as well as how farms and businesses are run
- They have also **stopped** many foreign **companies** from **investing** money into mining, oil, and gas projects
- As a result, many **resources** are **undeveloped** or **not exploited**

6.4.4 Extreme Environments & Sustainable Development

Your notes

New Technology & Sustainable Development in Cold Environments

- The ecosystems of cold environments are **naturally fragile** and provide one of the **last wilderness spaces** on Earth
- Economic growth risks pushing these ecosystems into a decline that is impossible to recover from
- With careful management, it is possible to find a balance between economic growth and saving the cold environments
- Strategies include:
  - **Use of technology** to monitor wilderness areas
  - Using **appropriate technology** to increase sustainability in areas at risk of damage

Sweden

- Sweden is a heavy consumer of energy due to its development and cold climate
- However, it has some of the lowest carbon emissions of any developed country
- Sweden has invested money into renewable energy sources like solar and wind power
- Sweden gets more than half of its energy from clean sources such as wind, sun, and water
- 95% of these green energy sources come from hydroelectricity, but solar and wind power are becoming more important

Solar panels in Stockholm

Your notes

Photo by Nazrin Babashova on Unsplash

Nepal

- The population of Nepal is mainly rural, with only 16% of the population living in towns and cities
- Nepal has no coal, oil or gas reserves, so these have to be imported
- The landscape is mountainous and includes much of the Himalayas, which are an obstacle to providing modern energy
- Only 10% of the mountain villages have access to electricity, with the remaining villages relying on fuelwood
- Nepal does have a good supply of water, enabling the use of small-scale hydroelectric projects
- **Micro-hydro** harnesses the power of water to produce electricity
- Cheaper, faster and less damaging than large hydroelectric dams, these micro-hydro projects have improved the standard of living in the communities
- The reliance on kerosene and fuelwood has reduced and emissions have fallen

Method of cooking using a pressurised kerosene stove

Photo by Aalok Atreya on Unsplash

Your notes

New Technology & Sustainable Development in Arid Environments

Your notes

- The use of sustainable and suitable technology in arid regions involves major investments in projects that some countries would find difficult to fund
- Deserts are good for **solar energy** since they receive high levels of sun
- **Solar panels** are expensive to build and buy, so they are only affordable in wealthier nations or where governments or charities can fund them
- Instead of technology, traditional desert communities use passive cooling and convection currents to make their homes cooler
- HICs use solar energy more

New Mexico earthship homes

- **Earthship homes** in New Mexico's deserts are an example of sustainable housing
- Earthship houses are passive solar homes made from natural and recyclable materials that are designed to be 'off-the-grid' and consume no fossil fuels or energy
- Earthship homes are **thermal-mass constructed**, which is when they are naturally insulated
- To achieve this, walls made of thick mud bricks or old car tyres rammed with earth that are half-buried
- The design promotes **natural convection and cross-ventilation**, allowing air to enter the house through windows or louvres and leave through skylights, providing a nice breeze
- The homes are **oddly shaped to maximise solar energy**
- In winter, sun-facing windows provide heat, while in summer they are shaded
- Earthship homes use **water sustainably** by collecting water from their surroundings
- Water is **collected** from occasional **rain, winter snow, and condensation**
- Water collects on house roofs and travels through a tiny gap into storage cisterns inside
- **Wind energy** supplements solar power, and each home has one or more wind turbines that produce electricity to store in batteries

Earthship house

Your notes

Photo by Natalia Blauth on Unsplash

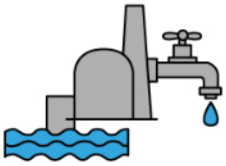
Desalination

- Involves the **removal** of **salt** from seawater to make it drinkable
- It is a costly method of increasing fresh water supplies
- Seawater, overland flow, and groundwater can be used for desalination
- The two main methods are:
  - **Distillation**
    - The **traditional** way
    - Seawater is **heated** and **boiled**
    - The steam produced is **condensed**
    - The salt is left behind in the boiler
  - **Reverse osmosis**
    - Seawater is filtered at high pressure
    - Small tubes syphon off drinkable water
    - The saline solution left behind is pumped back to sea
- Both methods are still used but **reverse osmosis** is more **modern** and **efficient**
- Desalination plants are expensive to build and maintain, so they mainly operate in HICs in water-stressed regions
- **Saudi Arabia**: water desalination has doubled over the past decade to reach 2.2 billion ≣ in 2021, up from 1.1 billion in 2010

- **Oman**, **UAE, Australia and USA** are the other big users of desalination

Your notes

Pros and cons of desalination



PROS

INCREASED WATER SUPPLY:
DESALINATION PROVIDES A RELIABLE SOURCE OF FRESHWATER IN REGIONS WITH LIMITED ACCESS TO CLEAN WATER, ADDRESSING WATER SCARCITY AND ENSURING A STEADY WATER SUPPLY

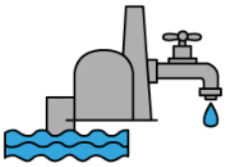
INDEPENDENCE FROM FRESHWATER SOURCES:
DESALINATION ALLOWS COUNTRIES TO REDUCE THEIR RELIANCE ON FRESHWATER BODIES, SUCH AS RIVERS AND LAKES, WHICH MAY BE SUSCEPTIBLE TO DROUGHTS OR CONTAMINATION

QUALITY CONTROL:
DESALINATED WATER UNDEGOES RIGOROUS TREATMENT PROCESSES, RESULTING IN HIGH-QUALITY DRINKING WATER FREE FROM MANY CONTAMINANTS, INCLUDING BACTERIA, VIRUSES AND SALTS

ECONOMIC BENEFITS:
THE DESALINATION INDUSTRY CAN CREATE JOB OPPORTUNITIES, STIMULATE LOCAL ECONOMIES, AND ENCOURAGE TECHNOLOGICAL ADVANCEMENTS IN WATER TREATEMENT TECHNOLOGIES

ENVIRONMENTAL SUSTAINABILITY:
DESALINATION CAN REDUCE THE STRAIN ON NATURAL WATER RESOURCES, PRESERVING FRESHWATER ECOSYSTEMS AND PROTECTING NATURAL HABITATS

Your notes



CONS

HIGH ENERGY CONSUMPTION:
DESALINATION REQUIRES SUBSTANTIAL AMOUNTS OF ENERGY, USUALLY FROM FOSSIL FUEL SOURCES, LEADING TO INCREASED GREENHOUSE GAS EMISSIONS AND CONTRIBUTING TO CLIMATE CHANGE

COSTLY INFRASTRUCTURE:
BUILDING AND MAINTAINING DESALINISATION PLANTS INVOLVE SIGNIFICANT CAPITAL INVESTMENT AND OPERATIONAL EXPENSES, MAKING IT A RELATIVELY EXPENSIVE WATER SUPPLY OPTION COMPARED TO OTHER SOURCES

ENVIRONMENTAL IMPACT:
THE BRINE AND CHEMICALS DISCHARGED AS BY PRODUCTS OF DESALINATION CAN HARM MARINE ECOSYSTEMS IF NOT PROPERLY MANAGED, LEADING TO THE POTENTIAL FOR SALINITY IMBALANCES AND DAMAGE TO COASTAL ECOSYSTEMS

DEPENDENCE ON EXTERNAL FACTORS:
DESALINISATION RELIES ON THE AVALIABILITY OF SEAWATER AND ITS PROXIMITY TO THE TREATMENT PLANTS, WHICH MAY LIMIT ITS FEASIBILITY IN LANDLOCKED REGIONS OR AREAS FAR FROM THE COAST

SOCIAL EQUITY CONCERNS:
DESALINISATION PROJECTS MAY DISPROPORTIONATELY BENEFIT WEALTHIER COMMUNITIES DUE TO THEIR HIGH COSTS, POTENTIALLY EXACERBATING SOCIOECONOMIC INEQUALITIES IN ACCESSING CLEAN WATER

Hydroponics

- Hydroponics is a type of agriculture that grows plants **without soil**
- Plants can be grown **indoors** in **carefully-controlled conditions**
- Their roots are suspended into **an aqueous solution** that contains all the **nutrients** that they need to grow

- The solution flows around the greenhouse in channels so all the **plants are well supplied** with nutrients
- **Lighting** can be supplied via solar panels
- Conditions can be monitored carefully and yields can be improved
  - Yields are **not dependent** on good weather
  - **Tomatoes**, **strawberries**, **cucumbers**, **lettuces** and **peppers** are examples of hydroponically-grown crops
- This uses 90% less water than traditional farming methods
- **Disadvantages of hydroponics**
  - High setup costs
  - There is a high running cost for fertilisers, artificial light and perhaps heat
  - Disease can spread quickly around a hydroponic greenhouse and damage a lot of crop in a short space of time


Your notes

6.4.5 Impacts & Management of Global Climate Change in Extreme Environments

Your notes

Impacts & Management of Global Climate Change in Cold Environments

- Rises in global warming have led to unprecedented levels of melting in cold environments
- Approximately 40% of permafrost areas are at risk of degradation, melting and the development of thermokarst subsidence (see periglacial processes here)
- Very cold areas will remain well below freezing even if they experience a rise in temperature, such as in central Antarctica
- The average air temperature in the Arctic has risen by over 2 °C since 1960, nearly twice as fast as the average global temperature increase
- The extent and thickness of the sea ice have declined, threatening the traditional hunter-gatherer existence of the Inuit
- Changes in seasonal melt have placed ice-dependent animals at risk
  - The far northern Canadian polar bears are expected to face starvation and reproductive failure by 2100

Present and Future Impacts of Climate Change

Present Impacts	Future Impacts
Rates of global glacial retreat has increased	Positive feedback of methane release from the permafrost into the atmosphere, raising greenhouse gas levels
Sea level rise due to melting glaciers and ice sheets of Greenland and Antarctica	Flooding of cold, low-lying coastal areas due to further sea level rise as warming temperatures accelerate glacial melting
Permafrost melting is accelerating, causing buildings and roads to collapse	Winter sports regions are seeing reduced snowfall, which has economic impacts for the locals. By 2050, only resorts above 1500 m would be able to offer snow for 100 days or more
Ice roads, which are essential supply routes, are open for less time each year	Ingress of warmer-loving flora and fauna into cold regions as temperatures increase, outcompeting native species
Migratory patterns of birds and animals are changing inline with seasonal changes	Existing flora and fauna become extinct as they are unable to adapt to warmer climate quickly enough
Increasing UV radiation has caused alterations to phytoplankton communities, impacting the food chain	Flooding and landslides increase, as inland glaciers retreat

- There may be some advantages of global climate change in cold environments, such as:
  - Rising temperatures increases agricultural output as the length of the growing season increases
    - The extent of cultivable land increases as permafrost levels decrease
  - Forestry, particularly coniferous forestry, may be possible as the treeline extents poleward
  - Tourism may increase in certain areas as they become more accessible
- However, most of these benefits are only short-term and eventually, these environments will become too extreme for people, settlements and economic activities to continue


Your notes

Examiner Tip

Being synoptic in your exam is an important skill the examiner is looking for. Therefore, remember to draw on knowledge of climate change from other parts of the course, such as permafrost acting as a carbon sink and the impact it has on the carbon cycle, etc.

Impacts & Management of Global Climate Change in Arid Environments


Your notes

- By 2050, temperatures in the world's arid regions could rise by 2 to 5 °C, accelerating and increasing desertification impacts
- Precipitation rates will decrease, moving semi-arid areas into arid regions
- Extreme weather events are likely to become more frequent such as drought
- There will be an increasing pressure on scarce water resources, reduced agricultural production, lower crop yields and increased food insecurity
- Daily tasks will become more difficult to complete due to rising temperatures
- Increased migration to already overcrowded cities
- Less productive soils will lead to rural areas becoming less viable, forcing more people to migrate further afield
- This adds pressure on other countries to provide food, water and shelter when they themselves may be struggling
- Some may stay and adapt by using soil conservation strategies or changing agricultural practices

- The future for those living in extreme environments depends on the action taken to mitigate and ameliorate climate change
- No one plan or action can solve the issue, and this means there are two possible outcomes:
  - Business as usual
  - Human intervention stops, halts or reverses change
- Strategies in arid regions could include:
  - Improving soil fertility through the careful use of fertilisers
  - Using indigenous plant species that are better suited to extreme conditions
  - Improving irrigation systems and pest control
  - Adopting water and soil conservation techniques

Enabling mitigation

- Communicating and accessing weather and hazard information
- Creating transport systems that work amid extreme events
- Using banking credit and insurance to spread the risk before, during, and after extreme events
- Diversifying business and personal economic prospects
- Providing basic language and skills to understand risks and change livelihoods
- Providing the freedom to organise, access and voice issues through varied public, private, and civil society organisations
- Combining social and scientific knowledge into planning and learning from experiences. proactively identify hazards, assess risk, and create local responses