



UNIT 3 GEOGRAPHY

SUMMARY NOTES FOR THE VCAA EXAMS



**WRITTEN BY A STUDENT WHO OBTAINED A
NEAR PERFECT STUDY SCORE**

UNIT 3

MELTING GLACIERS AND ICE SHEETS

Key terms – understand and be able to distinguish between

- **Glaciers:** A mass of land ice flowing downhill and usually contained in an alpine valley. Glaciers are usually found at high elevations in alpine regions.
- **ice sheets:** A mass of land ice covering an enormous area, that are not confined to valleys and bury large tracts of land beneath them. They form in high latitude regions and are characteristically very cold.
- **cumulative mass balance:** The process in which ice is accumulated and lost on a glacier. The zone of accumulation starts at the peak of the glacier where new snow is added. Moving in a downward direction, the snow undergoes a secondary stage of ablation where materials are lost through melting and evaporation, to form a final terminus part of the glacier.
- **Deforestation:** The long term reduction of tree canopy cover to below 10-30% (depending on the type of forest) of its original cover.
- **Afforestation:** The establishment of a forest in a region that has not previously been forested.
- **forest degradation:** Is when forests become subjected to substantial modification through human activities such as selective logging, replanting and fuelwood collection, with forest loss of up to 30%.
- **land cover:** The physical material covering the surface of the earth. It is often disturbed by human activity and their land uses are influenced by the availability of particular soils, climate, minerals, vegetation and wildlife that form exploitable natural resources from the land cover.
- **land use:** The arrangements, activities and inputs people undertake in a certain land cover type to produce, change or maintain it.

IMPACTS: GREENLAND; MELTING GLACIERS AND ICE SHEETS

ENVIRONMENTAL:

One negative environmental impact of melting glaciers in Greenland is:

- global rising sea levels
- More CO₂ generated from anthropogenic activities = more CO₂ trapped in the atmosphere
- Generating heat and increasing atmospheric temperatures.
- Meltwater recedes into the ocean.
- sea levels to rise globally by 0.5mm per year over the past 30 years.
- If Greenland's entire ice sheet melted, global sea levels would rise by 7m.
- the melting of Greenland ice is responsible for 25% of global sea level rise.
- Greenland's Jakobshavn glacier has receded over 40km since 1851.

SOCIAL:

One negative social impact of melting glaciers in Greenland is:

- that traditional ways of life are being challenged.
- Hunters are giving up dog teams to hunt reindeer as there are decreased opportunities to hunt on sea ice.
- In 2018, sea ice was forming 2 months later and melting 1 month earlier.
- the hunters are changing to fishing as fish species not seen before are migrating north as the water warms.
- in 2015 approximately 25620 people were employed into fishing businesses per month.
- in 2016, approximately 80,000 tonnes of fish was caught in comparison to 12,935 land mammals; reindeers and oxes
- decreasing from 2010, where 15000 land mammals were hunted.

ECONOMIC:

One positive impact of melting glaciers in Greenland is:

- increases in fishing rates.
- As more ice melts, it exposes more areas of oceans which absorb CO₂ and sunlight and become warmer.
- fish species not seen before are migrating north as the water warms.
- Mackerel, herring, cod and tuna are being caught in increasing quantities.
- 90% of Greenland's export income is derived from fishing
- but the move from hunting to fishing is very expensive as equipment needs to be purchased, infrastructure built and people trained in new jobs.
- In 2012, 23000 tonnes of halibut was caught generating 44 million EUROS

IMPACTS: BORNEO (DEFORESTATION)

ENVIRONMENTAL:

One negative, long term impact on the environment from deforestation in Borneo is:

- orangutan loss.
- Deforestation is the clearing of a wide area of trees which results in the loss of habitat for orangutans
- who rely on forests as a source of shelter and food.
- 50 orangutans have been killed each week in the past 10 years
- 100 years ago there were 230,000 orangutans and today there are only 112,000.
- Another report suggests that Borneo lost nearly 150,000 orangutans between 1999 and 2015.
- The study warns that 45,000 orangutans are doomed by 2050, due to the clearing of forests for logging, palm oil, mining and pulpwood leases

SOCIAL:

One negative, long term social impact from deforestation in Borneo is:

- the disturbance of the native people.
- Native people in Borneo have been brought up to live and connect with the environment. Therefore, the reduction of 31% of forest in Borneo over the last 40 years as had a detrimental effect on the native people of Borneo
- canopy's are sources of food, water and shelter.
- less forest means more infrastructure which ultimately means more employment, resulting in the movement of 1 million people to Borneo, seeking work opportunities.
- native people have to redevelop their lifestyle.

ECONOMIC:

One positive, long term impact of deforestation in Borneo is:

- the increase in wealth from illegal logging.
- Illegal logging is the harvest, transportation and sale of timber in violation of laws, often conducted by corrupt groups of people who access forests as a source of wealth.
- Borneo benefits economically from illegal logging and the expansion of palm oil and pulpwood plantations, as \$2.3 billion is generated from practice.
- This therefore not only immediately improves Borneo's economy but it strengthens its exportation relationships with neighbouring countries for future gain.

CAUSES: MELTING GLACIERS

ENVIRONMENTAL:

One natural process/environmental reason causing melting glaciers in Greenland is:

- naturally caused global warming; the steady and constant warming of the earth's climate.
- The changes in the earth's orbit and variations in solar energy input means that the sun's energy output is variable, including sunspots, increasing solar energy received by the earth.
- There has been an increase in global temperatures of approximately 0.2 degrees Celsius.
- Also, the earth has increased in temperature by 0.85 degrees since 1980, subsequently due to the warming of the earth over a gradual 12,000 year period from sediments like cryconite which absorbs the heat.
- According to NASA, 2014 was the hottest year on record, and the 10 hottest years have occurred since 1997

SOCIAL:

One human activity/social reason causing melting glaciers in Greenland is:

- human caused increases in solar radiation absorption.
- A change in albedo, and changes in the absorption of solar energy, changes moisture levels and wind, thus warming the planet.
- The increase in cryconite; a dark sediment on ice, which comes about from coal power stations, are carried by wind and cover ice
- decreasing reflectivity and increases global warming.
- Such an activity is the 2nd greatest cause of melting glaciers in Greenland, making up ¼ of human induced global glacial loss from 1851 to 2010,
- leading to about 64% of glacial melting in Greenland from 1991 to 2010.

ECONOMIC:

One economic reason causing melting glaciers in Greenland is:

- the increase in tourism of Greenland.
- Increases in tourism means more accommodation and infrastructure is required, leading to the building of roads and accommodation to hold tourists
- leading to more emissions of greenhouse gases which get trapped into the atmosphere heat the atmosphere and melt the glaciers.
- For example, from 2010 to 2017, yearly tourist numbers in Greenland increase by 22,000.
- This means that approximately in 2017, 118,000 tourists were accommodated in Greenland, which can further lead to more CO₂ and greenhouse gas emissions through more vehicles.

CAUSES: DEFORESTATION

ECONOMIC:

The most important reasons that cause deforestation are economic reasons:

- including the want to maintain the economy through anthropogenic activities that generate efficient revenue, including palm oil plantations, especially in Borneo.
- Palm oil plantations clear the previously forested area in order to produce palm oil products not only in Borneo but worldwide
- increasing employment in the region which subsequently increases the Borneo economy.
- Between 1980 and 2000 Borneo harvested more timber than Africa and the Amazon combined.
- Moreover, palm oil plantations are considered to be the main cause of deforestation in Borneo, as 87% of these plantations are located on deforested land.
- In 2010, 65,000km² was planted with palm oil.
- Employment has also increased as 44% of palm oil plantations are owned by small farmers.
- Also, land clearing and plantations generate \$40 billion to Indonesian and Malaysia, illustrating how palm oil plantations have a world wide effect.

SOCIAL:

A negative social reason causing deforestation is:

- land right issues and conflict.
- This is often due to unclear land tenure conditions in many developing countries of the world, leading to the manipulation of vulnerable native forest communities who thrive on forests as a source of livelihood.
- For example, the civil disruption in Rwanda led to the mass migration of more than 750,000 refugees to a camp near Virunga National Park in the neighbouring DRC, where large areas of gorilla habitat were deforested.

ENVIRONMENTAL:

Environmental reasons are the least important reason causing deforestation in Borneo.

- environmental causes like pest insects and wildfires can cause deforestation, but at a much smaller scale.
- Insects and pest diseases affect less than 2% of forests worldwide, yet can still have an impact in temperate and boreal zones.
- Also, wildfires only affect 1% of all forests worldwide, proving that economic and social causes are responsible for the majority of deforestation as forested areas are not often subject to environmental disasters.
- Although, they are still a main cause because fires do have the potential to cause damage during El Nino related drought, as seen in 1997-98- where 1 million acres in Borneo/Sumatra were lost.

RESPONSES:

Local: Greenland (Ilulissat Hydropower)

- The criterion used to evaluate the Ilulissat Hydropower Project in Greenland is sustainability.
- Sustainability is the capacity of the environment and social systems to support people and other living things now and into the long term future.
- Sustainability is an appropriate criterion for this local response because the aims of the response attempts to achieve environmental and social sustainability in the long term by replacing its diesel driven power plants with cheaper and resource efficient hydropower plants at a sustainable and manageable level to prevent large scale negative impacts.
- The response to Greenland's melting glaciers and ice sheets is the Ilulissat Hydropower Project which is being conducted at a local scale.
- This project was constructed between 2009 and 2014 with an ongoing timeframe to constantly supply glacial meltwater.
- This project cost approximately \$170 million AUD
- was contributed to by organisations including the Greenland government, Greenland communities, ABB; who provide a complete power and automation solution for Greenland, and the Icelandic based engineering and construction contractor Istak, in addition to the Danish government who often regulate Greenland's finances.
- The aim of this project was to provide a complete power and automation solution for a new hydropower plant in Greenland to provide the country's third largest community; Ilulissat, with emission free energy and to reduce the nation's dependence on costly imports of fossil fuel.
- According to the criterion of sustainability this local response has had a relatively strong and positive effectiveness as the aims of the project in improving the efficiency of natural resources has been met, improving environmental and economic sustainability.
- As a result, 70% of Greenland's electricity is now generated by emission-free hydropower.
- Movement of electricity across a 50km power line in Ilulissat has upheld social sustainability as sufficient power is generated for over 16,000 households

- Coincidentally, compared with fossil fuel generation, the plant saves 25,000 tonnes of CO₂, which is equivalent to annual emissions of 9,200 European cars.
- However, one negative associated with this local response is that reduced melting equals reduced power production. This is ironic as trying to improve global warming and reducing green house gas emissions into the atmosphere is beneficial in stabilising rising sea levels, but it reduces power production in the Ilulissat region.

RESPONSES

GLOBAL: BORNEO (REDD)

- The criterion used to evaluate the Reducing Emissions from deforestation and forest degradation (REDD) is sustainability.
- Sustainability is the capacity of the environment and social systems to support people and other living things now and into the long term future.
- Sustainability is an appropriate criterion for this global response because the aims of the response attempts to achieve environmental and social sustainability in the long term by cutting carbon emissions by 50% by 2030 from deforestation at a sustainable and manageable level to prevent large scale negative impacts.
- The response to Borneo's deforestation is REDD, which is being conducted at a global scale.
- The program was initiated in 2005 when the governments of Costa Rica and Papua New Guinea on behalf of the Coalition for Rainforest Nations
- With help from organisations like FAO and UN development programs and the UN environment program, UN-REDD and was formed to help implement REDD+ strategies worldwide, hoping to halve deforestation by 2030.
- However, the REDD+ project is expected to cost \$38 billion per year.
- The REDD+ project aims to utilise funding from industrialised counties to assist developing countries to improve the management of their forests or implement afforestation projects as a means of arresting greenhouse gas emissions.
- Therefore, making forests more valuable standing by acknowledging the \$4-5 trillion of ecosystem services inside intact forests, like carbon storage.
- In regards to Borneo specifically, REDD+ has still proven to be ineffective, having far more negatives that outweigh any positives.
- Firstly, REDD has failed economical and environmental sustainability in Borneo because it has only outcompeted oil-palm plantation projects in 55% of the unprotected forests, also requiring US \$27 million to secure these areas for 25 years.
- For regions in Borneo that store more carbon REDD would still only capture between 69%-74% of the unprotected forest, requiring US \$380–416 million in carbon financing.
- Moreover, social sustainability has failed to been addressed as approximately 20% of the population in Sabah and Sarawak, still live in poverty.
- The only positive coming out of REDD is that it is continuously providing opportunities in Borneo.

- This is evident as the project is still “on track to achieve its aims halving deforestation emissions especially in Borneo by 2030”.
- This hints at the projects environmental sustainability into the future, however, until then, REDD is posing too many economic and social threat which are too large to overlook.

SPATIAL TECHNOLOGY

GLOBAL FOREST WATCH (GIS) AT BORNEO

- A GIS is a framework for gathering, managing, and analysing data.
- Global Forest Watch is a type of GIS used by Borneo to manage and assess its region.
- GFW is an online platform that provides data and tools for monitoring forests.
- GFW is used to identify where trees are growing and where trees are disappearing.
- They also harness cutting edge technology, allowing anyone to access near real time information about where and how forests are changing the world.
- Technology and science are used to provide prompt and precise information about the status of forests in Borneo, to ensure management practices can be put in place.
- This includes alerts showing suspected locations of recent tree cover loss. Custom maps can be made and analysed, and data can be downloaded for Borneo.
- Changes can be assessed and the local government can step in to fine illegal loggers.
- For example, from 2001 – 2014, Global Forest Watch was able to assess the Net Forest Loss in West Kalimantan, Borneo. During this period, the Net Forest Loss for this region was approximately 17,600 kilometres squared.

GOOGLE MAPS AT GREENLAND

- A GIS is a framework for gathering, managing, and analysing data.
- Google maps is a type of GIS used by Greenland to manage and assess its region. Google Maps is an online platform that provides detailed information about geographical regions and sites around the world, also offering aerial and satellite views of ice sheet and glacial cover in Greenland.
- Google Maps is used to identify the sparseness of ice sheet cover and the extent to which Greenland’s land cover is that of ice.
- Satellite imagery is used to provide prompt and precise information about the status of glaciers in Greenland, to ensure management practices can be put in place.
- Custom maps can be made and analysed, and data can be downloaded for Greenland.
- Changes can be assessed and the local government can step in to address any issues on a social and economic level.
- For example, custom maps can observe an increase of 60% in summer melt in Greenland in the past 30 years.
- Google maps is able to do this because it can monitor 100% of Greenland’s land cover and provide satellite imagery on year to years basis’ which can be later compared to assess changes in ice sheets which can be managed in the future.

1. NATURAL PROCESSES AND HUMAN ACTIVITY CAUSING DESERTIFICATION

U.N Convention to Combat desertification: “land degradation in arid, semi-arid and dry subhumid areas resulting from various factors, including climatic variations and human activities.

CAUSES OF DESERTIFICATION:

ENVIRONMENTAL:

- The combination of **drought** and desertification is responsible for changing 12 million hectares of land into desert like environments each year.
- Precipitation can often be in the form of short heavy rainfalls which are not readily absorbed by the soil – 90% of the rain is evaporated.
- The predominant feature of drylands is water scarcity, with low, irregular and unpredictable precipitation- seasonally, annually and spatially
- This same area has the potential to produce 20 million tonnes of grains per year.
- Prolonged droughts increase vulnerability to poverty
- **Loss of vegetation cover**; as wood is the main energy source for food, heat and construction.
- Between 50 and 90% of energy used in Africa is derived from wood clearing.
- Drylands support 44% of the world’s food production systems and 50% of the world’s livestock.
- Drylands are home to 2 billion people, 90% of whom live in developing nations.
- **Overgrazing** also results in the loss of vegetation cover.
- Trees are often considered by farmers to outcompete with crops for soil nutrients, water and space.
- **Deforestation** exposes soil to wind and water erosion.
- The 2014 drought in Sahel Africa affected the livelihoods of 20.2 million people across the countries of Western Sahel.
- Deforestation and soil erosion occur at a faster rate than soil recovery.
- **Climate change**: increased temperatures = greater stress on vegetation while changing patterns in the amount and distribution of rainfall.
- More severe storms can cause erosion of fragile soils.
- No vegetation cover = lower humidity = fewer clouds = more sun = higher temperatures + less precipitation.
- Excessive water added to soils can cause water logging or rising water tables which create the movement of toxic salts towards the root zone of plants.
- Dryland areas are generally very windy as there is less dense vegetation to reduce windspeeds.
- Strong winds produce dust storms; soil fertility is poor with low organic matter and soil moisture.
- 5-10 times longer for the natural regeneration of vegetation and soils in drylands compared to other places that receive greater and more reliable rainfall.

SOCIAL:

- 2.5 billion people in nearly 100 countries live in drylands.
- **Rapid population growth** = greater need for drylands for food, water and wood.
- The Sahel region population increased by 30% from 2000 to 2016.
It is predicted to triple to 300 million by 2050 when the United Nations Food and Agriculture Organisation (FAO) predicts demand for food will increase by 60%.
- 120 million more hectares of land will be needed- more than vic and nsw areas.
- Food insecurity
- **Overgrazing**
- Drylands support 44% of the world's food production systems and 50% of the world's livestock.

ECONOMIC:

Overgrazing:

- Becomes unsustainable when there is insufficient time for plants to recover, exposing the soil to trampling compaction and erosion.
- Mongolia – 80% loss of vegetation due to overgrazing of cashmere goats.
- Overgrazing has occurred because:
Animals are a form of wealth and status among many groups of people.
As populations increase, there is a need for more animals – milk, meat, skins.
Improvements in veterinary care, vaccinations and breeding programs have improved the health and life span of animals.
Animals can be reared for export, thus improving both the local and national economies.
Often, farmers, might keep larger herds to hedge against the risk of falling prices.
- Population increase forces fallow fields into production. Croplands increase.
- Cities grow due to rural-urban migration.

Over cultivation:

- Occurs when the same land is used repeatedly without the benefit of soil rest + recovery.
- Soil fertility declines.
- Vegetation fails.
- Land becomes barren and vulnerable to degradation.
- Increasing pressures to produce more food.
- Expansion of cropping into marginal lands suitable for farming.
- Frequency of droughts.
- Between 50 and 90% of energy used in Africa is derived from wood clearing.
- Drylands support 44% of the world's food production systems

Political:

- Places like Niger + Mali, **governments are often under pressure** to provide the basic human needs.
- Environmental concerns get little financial attention.
- Insufficient laws regarding land + resource ownership.
- Nomadic farming is a traditional method of grazing animals in drylands, allows herders to move in response to rain and availability of animal pasture.
- 65% of drylands are rangelands- more suitable to grazing than cropping.
- Higher government policies restrict the movement of nomadic herders.
- Mongolia – Chinese government introduced new methods of managing grasslands by constructing fences.
- **Conflict** can create a movement of refugees and IDP – pressure on land resources.
- In Nigeria, 415 grazing reserves that were established for herders in the northern regions have since been lost due to lack of formal protection law and the division of the region into 19 new states, each with their own growing population and needs for land.
- Movement of nomadic herders in search for pasture has created violent conflicts with sedentary farmers to the south.
- Ongoing conflict has displaced more than 62,000 people and destroyed crops and livestock.

2. CASE STUDY- LOESS PLATEAU: FACTORS CONTRIBUTING TO DESERTIFICATION: (SEE ABOVE IN CAUSES AND RELATE BACK USING STATS)

CAUSES:

- **Overgrazing:** 28.3% of total desertified land.
- Population pressures on marginal land. Home to over 90 million people. The problem is somewhat analogous to what happens in areas that have been deforested.
- Once an area is degraded, people move into a new area and degrade that while the old area takes decades to recover or never does. Dr Sing Yuquin of Beijing University told the NY Times, "Once the process gets started it tends to expand exponentially. And the people are pushed into a poverty trap in which it's hard to escape."
- Mao's plan is a plan to raise grain in areas where grain didn't grow well, such as inner Mongolia. This deprived land of grass which prevented soil being blown away by the fierce winds that ravage this region. (HISTORICAL)
- Social population pressure = demand on resources = overcultivation + overplanting + overgrazing + overplowing + raising crops in dry regions.
- Infertile crops – herding was the livelihood.
- Animals remove vegetation

- Animals exceed carrying capacity
- Wind blows away topsoil
- Raise livestock numbers to increase GDP

From 2 million in 1977, the number of animals grazing the Xilingol Steppe reached 18 million by 2000, exceeding the Hushandake desert = desertification

- **Overcultivation:** 25.4%
- **Fuel wood cutting:** 31.8%
- **Misuse of water and vegetation removal due to construction:** 9%
- **Sand dune encroachment:** 5.5%
- **Climate change:** higher temperatures, lower rainfall and stronger winds since the 1950s.
- Persistent **drought** robs the soil of moisture and makes it easier for the soil to be picked up and carried away by wind
- Infrequent storms
- Low rainfall
- Powdery soil
- Persistent drought
- Large range of temperature due to continental location
- High temp.
- Strong wind
- Average temperature increased by 2.1 degrees in the last 50 years
- Rainfall has dropped 5.7mm every decade since the 1960s.

3. LOESS PLATEAU: IMPACTS ON SOCIAL CONDITIONS, ENVIRONMENT, ECONOMIC ACTIVITY

IMPACTS

ENVIRONMENTAL:

- Damages ecological balance.
- Loss of useable land resources
- Biodiversity and habitat loss contribute to the insecurity and impoverishment of some of the most fragile communities.
- Approximately 160000 square km of cropland is damaged by drought each year.
- Storms deposited an average of 35 tonnes of sand per km.
- China's deserts make up 2.7% of land mass, increasing by 10000km² per year
- Desertification covers 27.4% of China affecting 400 million people
- From 2000 to 2015 there has been approximate drop of 50km² of farmland in the Loess Plateau

On the **Loess Plateau** the average erosion model records between 5 000 to 8 000 t/km²/yr with 20 000 t/km²/yr as maximum. The annual quantity of silt flowing into the Yellow River now totals 1.6 billion tons (t) which raises the river bed in the lower reaches by ten centimetres (cm) each year.

ECONOMIC:

- In China, over 400 million are affected by soil erosion, causing annual economic loss of US\$10 billion
- When rural land becomes unable to support local population the result is mass migrations to urban areas. Thus, local villages are mainly the old and very young, thus, local economy drops.
- Direct economic costs reduces the income obtained by land users as a result of the lower productivity of land resulting from desertification. These 'on site' costs are experienced by either the land user who degrades the land, or by another user who uses the site subsequently.

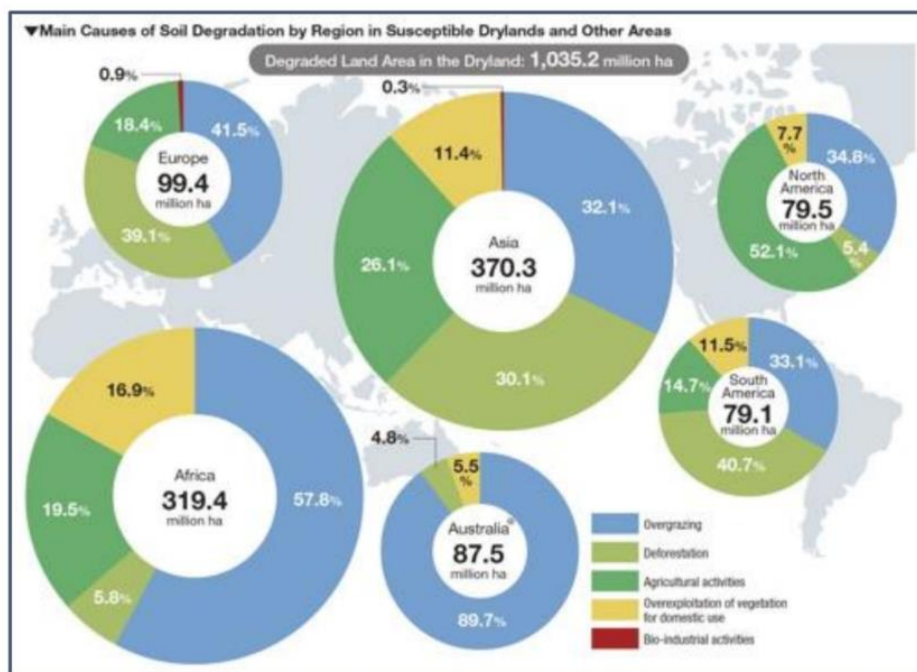
SOCIAL:

- Decreased china's living space
- Threatened communities safety and normal operations: traffic, water conservancy projects.
- Health risks: dust storms
- Ecological refugees
- Threatens peoples livelihood
- Increases poverty
- Sand storms reduce visibility, close airports, create breathing difficulties
- Billions of \$ worth of damage is done to power lines and built features
- Severe land degradation increases distribution of drylands.

It is predicted to triple to 300 million by 2050 when the United Nations Food and Agriculture Organisation (FAO) predicts demand for food will increase by 60%.

- 120 million more hectares of land will be needed- more than vic and nsw areas.
- Food insecurity

RELATIVE IMPORTANCE AND RANKING OF CAUSES



1. **Overgrazing** (Economic + Social)
2. **Agricultural activities** (Environmental + Social)
3. **Deforestation** (Economic + Environmental + Social)
4. **Overexploitation of vegetation for domestic use.** (Social+ Economic)
5. **Bio- industrial activities.** (Economic + Political)

4. RESPONSE TO DESERTIFICATION; + 8. EFFECTIVENESS OF RESPONSE

WATERSHED REHABILITATION PROJECT:

Time Frame: May 26, 1994 – December 31, 2005

Organisations: The Chinese Government

Total Amount (\$): \$500 million (including World Bank and non World Bank services)

Scale: National

Aim: The primary aim of the Loess Plateau Watershed Rehabilitation Project was to increase agricultural production and incomes on 15,600km² of land in the Loess Plateau watershed of the Yellow River.

RESPONSE:

- Home to more than 50 million people, the Loess Plateau in China's Northwest takes its name from the dry powdery wind-blown soil. Centuries of overuse and overgrazing led to one of the highest erosion rates in the world and widespread poverty.
- Guiding the locals of Loess Plateau to use sustainable ways of living and farming replanting trees, grass and shrubs for land stabilisation and to combat soil erosion; and substantially reducing sediment runoff through the construction of sediment retention dams.
- **No conservation** = sloping cropland and high run off and high recharge
- **Structural conservation** = Check dam: low run off and high recharge + cultivated terrace : low runoff + high recharge
- **Ecological conservation** = Mature plantation: low run off and low recharge + natural forest: low runoff and low recharge.
- Check dams have been constructed for soil erosion control and agricultural production; key for soil and water conservation in Loess Plateau
- River basin management.
- Remote google earth imagery is used to derive the spatial distribution of the check dams in the Huangfuchuan catchment.
- Mechanically built terraces are robust + drought resistant
- Fruit trees planted diversify incomes.
- To conserve land, control sediment, and enhance farm incomes through terracing, afforestation, and orchards, grassgrowing, construction of sediment control dams; the second is capacity building such as training, scientific research and technique promotion.
- **Ban tree cutting** – a law was instituted banning indiscriminate tree cutting throughout China following the devastating floods of 1998.
- **Ban planting on steep slopes** – this reversed centuries of unsustainable agricultural practice among poor farmers trying to plant crops on the sides of hills and gullies.
- **Ban free-range grazing of livestock** – this policy ended the practice of allowing great numbers of goats and sheep to range freely to strip away the natural vegetation.

- **Land tenure** – clear policies on land tenure were established to portray the rights and responsibilities of farmers for each terraced field and each tree planting area in the project.
- **Differentiate and designate ecological and economic land**, restricting production to suitable land and releasing marginal land to return natural vegetative cover.
- **Integrated watershed management practices** which created water-harvesting structures, ensured continuous vegetative cover by release of marginal lands to nature and including large-scale reforestation and grasslands regeneration and the use of agro-forestry methods.
- **People participation** was a central part of the project as each division of land was maintained by locals who all had land use contract and who understood that they were the beneficiaries of the new agricultural practices.
- **Build dams** that would capture the rainfall during the rainy season. Without it more topsoil would have been removed through flooding.

EFFECTIVENESS

BENEFITS:

- These projects have curbed soil erosion, reduced sedimentation of waterways and increased agricultural yields and the incomes of Loess Plateau residents.
- Projects also implemented across china- 20 million people have benefited.
- Soil erosion curbed on 900 000 ha, and soil losses reduced by 60-100 mt (metric tonnes – 1000kg) per year.
- More than 2.5 million people lifted out of poverty.
- Through the introduction of sustainable farming practices, farmers’ incomes doubled, employment diversified and the degraded environment was revitalized.
- The project has turned out to be the largest and most successful water and soil conservancy project in the world.
- It has convinced planners and farmers that land conservation is compatible with sustainable and productive agriculture.
- It has brought significant benefits to over 1.2 million farmers in the project area.
- Thanks to the implementation of the Loess Plateau Watershed Rehabilitation Project and the governments poverty alleviation policies, the population living under the poverty line in the project area has dropped from 59 percent in 1993 to 27 percent in 2001.
- **Incomes doubled:** Incomes in project households grew from about US\$70 per year per person to about US\$200 through agricultural productivity enhancement and diversification.
- **Natural resources were protected:** Uncontrolled grazing, subsistence farming, fuel wood gathering and cultivation of crops on slopes were previously the main causes of desertification throughout the Loess Plateau. The project encouraged natural regeneration of grasslands, tree and shrub cover on previously cultivated slope-lands. Replanting and bans on grazing allowed the perennial vegetation cover to increase from 17 to 34 percent.
- **Sedimentation of waterways was dramatically reduced:** The flow of sediment from the Plateau into the Yellow River has been reduced by more than 100 million tons each year. Better sediment control has reduced the risks of flooding with a network of small dams helping store water for towns and for agriculture when rainfall is low.

- **Employment rates increased:** More efficient crop production on terraces and the diversification of agriculture and livestock production have brought about new on-farm and off-farm employment. During the second project period, the employment rate increased from 70 percent to 87 percent. Opportunities for women to work have increased significantly.
- **Food supplies were secured:** Before the project, frequent droughts caused the failure of crop cultivation, sometimes requiring the government to provide emergency food aid. Terracing not only increased average yields, but also significantly lowered their variability. Agricultural production has changed from generating a narrow range of food and low-value grain commodities to high-value products. During the second project period, per capita grain output increased from 365 kg to 591 kg per year.

DOWNFALLS:

- **Time:** The length of the project would have made it an inconvenience for the locals especially those who lived in areas where roads were developed for the access of vehicles and farm equipment required for labor.
- **Cost:** \$500 million was provided by the Chinese Government for the construction of this project, meaning that high amounts of money were taken out of plans for other development issues that may have been deemed more significant by the locals; i.e. urban development.
- **Public Inconvenience:** This project may have inconvenienced the lives of many locals as increased vehicles, heightened pollution levels, but also, the project also required high levels of manual labor which was tiring financially poor.
- The policy of replanting trees even in the good areas was a difficult proposition for the locals to understand, as they believed that the next generation wouldn't benefit from crop production as the plants were so young.

SHANGHAI ROOTS AND SHOOTS

Time Frame: 2007- present

Organisations: Shanghai Roots and Shoots Program and regional inner Mongolia government.

Total Amount (\$): -

Scale: Regional/Local

Location: Inner Mongolia

Aim: Aims to improve both ecological and humanitarian conditions by planting specific trees that do not require as much water and also sequester carbon dioxide. The project gives individuals and organisations an opportunity to fight desertification by planting oxygen producing trees and maintaining their development in regional areas like inner- Mongolia.

RESPONSE:

- Since 2007, volunteers from the megacity of Shanghai have come to desolate inner Mongolia to plant trees with local farmers.
- The organisation asks farmers to monitor and maintain those trees, engages local students for environmental education, and employs a full time forestry manager to evaluate and ensure tree growth.
- More than 1.2 million trees have been planted – target is 2 million.
- Reforest the area in order to revitalise land and block the effect of sandstorms that destroy homes.

EFFECTIVENESS

BENEFITS

- Increase biodiversity of plants in the region to reduce the chances of pest disasters killing off plant species.
- Ensures farmers are given the opportunity to improve their own land, giving them some sort of economic prosperity.
- Allows the younger generation to be involved in fighting against climate change, increasing education.
- Blocks desertification impacts like sandstorms which destroy homes.
- Improves the economy as new fruit producing trees ensure that fruit can be sold, also retaining food security.

NEGATIVES:

- **Time:** The length of the project would have made it an inconvenience for the locals especially when regional farmers were involved in the manual labor and were not payed for their work.
- **Cost:** High amounts of money were taken out of plans for other development issues that may have been deemed more significant by the locals; i.e. urban development.
- **Public Inconvenience:** This project may have inconvenienced the lives of many locals as increased vehicles, greatened pollution levels, but also, the project also required high levels of manual labor which was tiring and financially poor.
- The policy of replanting trees even in the good areas was a difficult proposition for the locals to understand, as they believed that the next generation wouldn't benefit from crop production as the plants were so young.
- Replanting trees in infertile areas may see immediate development but may lead to the reduction in tree development resulting in the whole cycle of desertification again.

SPATIAL TECHNOLOGY

Google Maps at Loess Plateau:

- A GIS is a framework for gathering, managing, and analysing data.
- Google maps is a type of GIS used by the Loess Plateau to manage and assess its region.
- Google Maps is an online platform that provides detailed information about geographical regions and sites around the world, also offering aerial and satellite views of the plateau itself and the surrounding Wei River valley and the southern half of the Ordos Loop of the Yellow River.
- Google Maps is used to identify the distribution of terraces across the Loess Plateau as well as the losses of vegetation and erosion in the region .
- Satellite imagery is used to provide prompt and precise information about the status of the valleys in the Loess Plateau, to ensure management practices can be put in place, especially in regards to preventing further soil and vegetative erosion.
- Custom maps can be made and analysed, and data can be downloaded for the Loess Plateau.
- Changes can be assessed and the local government can step in to address any issues on a social and economic level, including revegetation practices.
- Google maps is able to do this because it can monitor 100% of the Loess Plateau land cover and provide satellite imagery on year to years basis' which can be later compared to assess improvements in the Loess Plateaus valleys and vegetation cover which can be continue to be managed in the future
- Can observe the changes in perennial vegetation from 17% to 34%.

NATIONAL SCALE RESPONSE 2: THE GREAT GREEN WALL OF CHINA

- A 2800 mile network of forest belts covering all the major deserts and sandy land in north west china, over 40% of the country's entire territory
- Serves as a windbreak to stop sandstorms, halt the expansion of desertification, to restore land to a productive and sustainable state.
- The project has replanted and protected about 10 000 square miles of forest.
- Achieving more than 2/3 of its goal of 14500 miles by 2050
- Winter storms can destroy vulnerable new trees.
- Greater areas returning farmland to forest and grassland
- Increases in grass cover
- Halts the expansion of china's desert regions
- Between 1978 and 2017, over 60 billion trees have been planted
- Forest shelter belts will be planted for 4500km along the edge of china's northern, north-western and north-eastern desert regions
- 98% of land affected by desertification
- Aerial seeding, farmers and volunteers replant trees
- Increasing forest cover in the region from 5 to 15%, and across china to 42% by 2050.
- Shelter belts act as wind breakers, reducing the loss of topsoil.
- Vegetation will help stabilise sand dunes and compensate for the 3600 square kilometres of grasslands lost due to the spreading of the gobi desert
- Reduce the frequency and severity of sandstorms
- Reducing desertification and restoring land improves food production, incomes and livelihood.

GLOBAL RESPONSE: UNCCD (UNITED NATIONS TO COMBAT DESERTIFICATION)

- Approximately 2.6 million square kilometres of china is affected by desertification
- Still increasing by 2460km ² annually
- Develop forestry
- Improve environment
- Combat desertification

UNCCD have:

- Helped to raise public awareness about desertification prevention and control
- Promoting sectoral cooperation in china's desertification control activities
- Promoting adoption of advanced applied technologies, improving dissemination of forestry and desertification control related knowledge and intensifying technology popularisation
- Strengthening desertification monitoring and early warning activities
- Encouraging improvements in china's legal system and the establishment of an effective legal system for desertification prevention and control
- Encouraging the chines government to adopt penitent policies and support mechanisms which have attracted more investment in forestry and desertification control.
- Promoting international cooperation in combating desertification
- China has been a signatory since 1994
- Countries globally suffering from dryland degradation has increased from 110 in the 1990s to 168 in 2013
- Thus, UNCCD, hasn't been successful, creating long term targets of 2030.
- UNCCD relies heavily on donations of developed countries, many whom have done little to help the problem and provide insufficient funding
- Making many programs unaffordable for UNCCD

OTHER GENERAL FACTS:

- 50 million people may be displaced in the next 10 years due to water shortages and low agricultural outputs
- Directly impacts the lives of approximately 1.5 billion people.
- In Sub Saharan Africa, 60 million people are expected to move to northern Africa and Europe by 2020 – increasing out to 2045.
- Africa 2003: 19 million tonnes of cereal had to be purchased + \$3.8 billion of overseas aid to replenish food stocks
- 850 million people are malnourished or starving
- Amount of malnourished people in sub Saharan Africa doubled from 88 million in 1970 to 200 million in 2001.
- Malnutrition contributes to 8 million infant deaths each year.