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OCR Geography A-level

# Dryland Landscapes

PMT Education

Written by Jeevan Singh



# Hot Desert Systems and Landscapes

## Deserts as Natural Systems

- Deserts form because of air currents and circulation. Cold ocean currents cool the air above, making it dry. When this air reaches the land, it causes more evaporation than precipitation, due to the lack of moisture, which results in the formation of a desert.
- Other geological settings that cause desert formations are: extreme distance from oceans and cold ocean currents.
- A desert is thus a landscape which receives very little precipitation. These regions receive an average annual precipitation of less than 250mm.
- Hot deserts exist in rich and poor countries around the world. The largest hot desert in the world is the Sahara desert in northern Africa which covers over 9 million square kilometres.
- Hot deserts in rich areas, such as the Mojave Desert in America, are usually used for human activities such as commercial farming, tourism and mining. Hot deserts in poorer areas are usually used for hunting, gathering and farming.



## Systems and Processes

- Sources of energy in hot desert environments involve isolation, winds and runoff.
- Geomorphological processes include weathering, mass movement, erosion, transportation and deposition.
- Weathering processes include salt weathering, where rocks form fractures due to high efflorescent salt contents, exfoliation and chemical weathering, which is limited by the lack of water, the amount of capillary action and the alkaline nature of chemicals taken into rocks.
- Wind has an important role in erosion, transportation and deposition of sediment. Wind erosion includes:
  - **Abrasion:** Small particles are hurled by the wind against rock surfaces, smoothing the rocks.
  - **Deflation:** Wind blows away rock waste and lowers the desert.
  - **Attrition:** Rock particles rub against each other and wear away.
- The three main types of river and water sources found in desert areas are:
  - **Exogenous Rivers:** Sources outside the desert.
  - **Endoreic Rivers:** Near the desert.
  - **Ephemeral Rivers:** These flow for only part of the year.
- Desert lakes are generally ephemeral and are called playas, which vary in size and are very salty.
- The episodic role of water includes sheet flooding and channel flash flooding.



## Arid Landscapes

- Aridity is caused by atmospheric processes relating to pressure, winds, relief and cold ocean currents.
- Desert landforms include:
  - **Rock Pedestals:** These are created by abrasion processes where the base of rock structures are cut away.

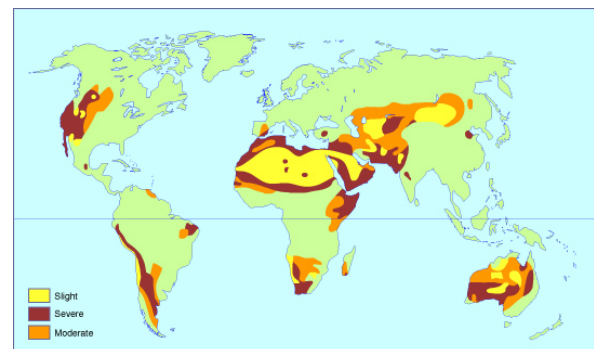
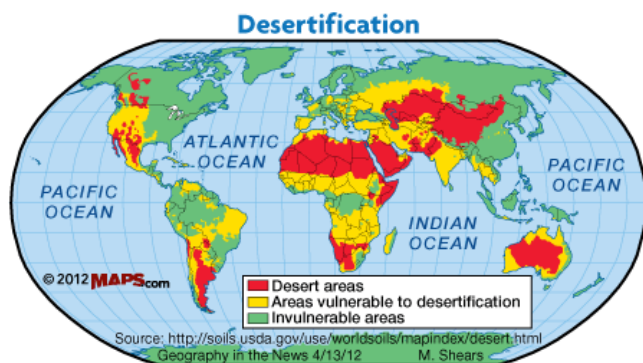


- Deflation Hollows: Depressions are formed by sand settling after it has been carried over long distances by wind. These depressions, called deflation hollows, collect rainwater.
- Yardangs: These result from sand grains pushed by persistent winds to form low ridges of sand carved in soft rock.



## Desertification

- (Adeel, 2005): 'Desertification is potentially the most threatening ecosystem change impacting livelihoods of the poor... The basic materials for a good life for most dryland people have their origin in biological productivity'.
- People in drylands solely depend on the ecosystem for their basic needs, using it to produce crops, livestock, fuelwood and construction materials → all these rely upon the plant productivity which is often restrained by water availability.
- (UN, 1994): Desertification affects one quarter of the world's total land surface and is defined as (UNCCD, 1994) 'land degradation in arid, semi-arid and sub-humid areas'.
- (UNCCD, 1994): Desertification is caused by 'complex interactions amongst physical, biological, political, social, cultural and economic factors.'
- Common causes of desertification involve:
  - Climatic variations → prolonged high temperatures with infrequent and below average rainfall prevents the growth of vegetation.
  - Human activities → Countries relying on agriculture can damage soils by excess usage or reducing fallow periods (ploughing without sowing so fertility is restored). This forces soils to reduce organic matter, limiting plant growth and increasing erosion vulnerability.
- 2.6 billion depend on agriculture but 52% of land is degraded. This effects 74% of the poor globally.
- 12 million hectares (where 20 million tonnes of grain could be grown) are lost to desertification every year.



- Desertification is particularly acute in Africa, where in the future, areas suffering from 'slight' desertification may become severe. (IDN, 2010): Asia holds 33% of the world's arid zones.
- If the north/south divide exists, there is a correlation between richer northern countries being invulnerable whilst poorer southern countries are highly vulnerable to further desertification.

## What are the impacts of desertification? (Different scales: local, regional, global)

- At a local scale, there is reduced land productivity and socio-economic problems, which then cause regional impacts such as a reduction of food availability, leading to insecurity, migration and limited development options.

- There is also large ecosystem damage whilst drylands remain vulnerable to climate change. On a global scale, the cost of land degradation is ever increasing, currently at US\$42 billion per year, excluding hidden costs of more fertilizer use and loss of biodiversity/landscapes.
- (Cigar, 2015): "Rural dryland communities in the developing world have suffered a history of neglect, sustainable development"
- (The Facts of Desertification and United Nations Convention to Combat Desertification, 2000): Additionally, soils become less stable and are either washed or blown away which removes nutrients. Vegetation is then damaged as roots become exposed, killing many plant species.
- Famine can result as entitlements are lost through desertification. This can then endorse food loss as soils cannot grow food. Other effects involve poor water quality, pollution, flooding and stand storms.



### **What are dryland ecosystems?**

- (Excellent Development, undated): Drylands support 74% of the world's poor, most of them living in rural areas.
- (IUCN, 2008): Drylands are arid/semi-arid regions which encounter low annual rainfall and are often confined to short seasons. They mainly occur in tropical or sub-tropical climates where extreme temperatures are present.
- Most soils in drylands have low fertility and limited soil retention. Not ideal for large scale food production.
- The world's drylands (not including deserts) are home to more than 32 percent of the world's population, which includes many 'million cities', and cover more than 34 percent of the world's land surface.
- (UNCCD: A visual synthesis): They add the following factor to their definition:
  - Low, infrequent, irregular and unpredictable precipitation;
  - Large variations between day and night-time temperatures;
  - Soil containing little organic matter, and a lack of water; and
  - Plants and animals adapted to climatic variables (drought-resistant)



### **Why are dryland ecosystems so vulnerable to over-exploitation and inappropriate land use?**

- (UNDP, 2014): Infrastructural conditions in dryland areas, particularly in rural communities limit access to markets, even if goods can be produced at high value. Thus, private sector investment is minimal because they are perceived to have low returns on investments.
- They are also plagued with recurrent droughts, insufficient infrastructure, limited investment, little renewable water supply and the large scale population growth.
- (UNDP, undated): Poverty poses the greatest challenge in the drylands. There is evidence of a positive correlation between poverty levels and dryness, and yet most investments in development have been made in what is considered high potential areas.
- The drylands face other major challenges that include: Climatic and ecological challenges (water deficit, land degradation), policy and institutional challenges (lack of development policies). Physical challenges include poor infrastructure, limited access to information and communication technologies.



## Desertification and Food Insecurity Case Studies

1. **Australia:** This continent has strong global power but is strained due to the aridity of land. Although food insecurity is currently a hidden battle, this may be brought to the forefront as climatic variability becomes more prominent in the future.

- In the Murray- Darling basin, human activity and drought conditions are causing a reduction in basin size. The Murray-Darling River holds freshwater and is primarily the source for agriculture.
- Australia is the world's driest continent (excluding Antarctica) where very few soils are naturally suited for agriculture, having high salt stores, low nutrients or being shallow. Only 6% of land is arable without irrigation.
- Livestock is the most extensive use of agricultural land but desertification is reducing the life expectancy of animals due to strained water resources, and increase in annoying insects and inability to adapt to changing climatic conditions.
- The Salvation Army's [2015 economic social impact survey](#) found 10% of Australians said they could not afford to buy enough food, with this proportion on the rise.
- Governments have implemented security protocols, creating policies which encourage self-reliant approaches to manage climatic variability and protect agriculture. For instance, in Queensland, they have introduced satellite monitoring of rangeland condition which will hopefully be extending throughout the continent so land can be regulated. Heimbuch (2009) claims Australia 'takes the lead on combating desertification.



2. **Sahel:** Desertification is perhaps the greatest cause of food insecurity in Sahel as crop failures have engendering entitlement losses which governments fail to correct.

- Causes of desertification involved over cultivation, overgrazing, deforestation and climate change.
- Crop failure, due to soil erosion, has caused widespread famine with people unable to work due to poor health. Often death rates are highest amongst the elderly and infants who are unable to fund for themselves.
- In Niger 2004, a plague of locusts consumed remaining crops, worsening the situation as food then had to be supplied through aid from the international community. This is unsustainable as the root cause of food insecurity is not addressed by players. Instead, local community farming practices should be improved to ensure security when factors such as climate change come into play.



3. **Gobi Desert:** As food cannot be grown in many parts of the region, it is causing localised food insecurity for those who cannot cope otherwise. However, for the parts of the desert within China, there is limited food insecurity as the government provide assistance with crop growth and conservation.

- Population of 57, 200 people (Sansar, 2009). Social changes involve increased out migration and changes in employment structure, decreasing the number of farmers and thus food availability.
- Because of continentality, the region experiences very low annual rainfall with cold winters (40C). Climate change is expected to worsen these conditions but the reintroduction of traditional herding will help cope with food insecurity.
- Government is the key player in the Chinese region of the desert (Gobi intersects the north of China) as they control markets and introduce the settled farming of specific crops.

- In the Mongolian region of the Gobi desert (southern part of the country), there is no government encouragement towards rain-fed intensive farming, compared with China.
- Herders are moving away from traditional role, causing a large flow of out-migration, as more women go to university whilst men work in the mines (Mongolia is rich in gold, copper and tin).
- Out-migration has weakening community networks which have usually been a fundamental safety-nets in managing disasters such as desertification. Herders are therefore forced to migrate into the city where they rely on cheap (Chinese) imported food; unsustainable for the future.
- (Aljazeera, 2012): The Gobi desert is expanding because of desertification in southern China, overtaking 3600 km<sup>2</sup> of grassland per year. Dust storms additionally cause further damage to the agricultural economy.
- Expansion occurs because of deforestation, overgrazing and depletion of water resources. China has created some solutions, such as the 'Green Wall of China', creating a ring of newly planted forests to stabilise soil, retain moisture and prevent desertification. Thus, although the physical environment is vulnerable to environmental changes, superpowers such as China are not vulnerable to food insecurity as have strong governmental players.



**4. China:** Drylands will have a greater impact on food insecurity in the future as more and more land is overtaken by desertification. However this may be countered depending on China's development which may produce global networks and safety nets, allowing for disaster management in the case of food insecurity.

- Growing economies are causing rapidly changing societies, inviting food insecurity in the future. There has been a loss of traditional nomadic farming techniques.
- There was a winter drought in eastern China during 2011 but was managed by imports of wheat from the world market. Elsewhere in the world, food prices rose, marginalising those with a lower capacity to cope.
- (Aljazeera, 2012): Desertification has affected 400 million people in recent decades where ¼ of land is degraded because of a naturally dry climate, over-cultivation or excessive soil erosion (The Guardian, 2011).



**5. Afghanistan:** Within this nation, the changes to the physical environment has been masked by implications of war and political unrest, having worsened desertification and food insecurity throughout Afghanistan. Being one of the poorest countries in the world, they are forced to rely on aid.

- (WFP, 2013): This nation is still facing recovery after three decades of war, civil unrest and reoccurring natural disasters. Half the population live below the poverty line within deteriorating infrastructure and environmental damage.
- Additionally, 1/3 are food insecure as desertification is further exacerbated the ability to reach safe and nutritious food for an active and healthy lifestyle.
- Environmental damage is the cause of war, uncontrolled grazing, pastureland encroachment, illegal logging and the loss of forest and grass cover, all having worsened drought and agricultural productivity.
- As a solution, the WFP have assisted 3.5 million in 2013, specifically in remote areas, Their 'School Meals' system helps governments rebuild the education system by using the incentive of food. 740, 000 children were given micronutrient-enriched biscuits, prolonging livelihoods.

