DESERT SYSTEMS AND LANDSCAPES: DESERT SYSTEMS AND PROCESSES

INPUTS

Precipitation: Minimal and irregular – often arriving in sudden, intense downpours that trigger flash floods.
Solar radiation: Constant input due to minimal cloud cover and atmospheric moisture.
Descending air: At the Intertropical Convergence Zone (ITCZ) - air sinks rather than rises, leading to dry, high-pressure conditions that inhibit cloud formation and precipitation.
Other inputs:

- Geological factors such as rock type and structure
- Human activities such as overgrazing or deforestation

OUTPUTS

Surface runoff: Occurs when sudden rains exceed the infiltration capacity of the dry, compact soils, leading to rapid overland flow and erosion.
Re-radiation of longwave radiation: As the Earth's surface rapidly emits heat absorbed during the intense daytime sun, contributing to significant diurnal temperature changes.
High rates of evaporation: Driven by intense solar heating and dry atmospheric conditions.
These outputs contribute to the overall aridity and energy loss characteristic of desert environments.

STORES

Playas (salt lakes): Temporary water stores that form after rainfall events but often quickly evaporate, leaving behind crusty salt flats.
Sand dunes: Particles transported by wind accumulate into large-scale landforms.
Other stores include sparse vegetation and limited soil moisture (influenced by climatic and geological inputs)

TRANSFERS

Wind-blown sand: Dominant transfer process, where particles are picked up, transported, and redeposited by strong desert winds.
Surface runoff: During rain events also transports sediments and minerals across the desert floor.
Salinisation: Occurs when water evaporates and leaves behind concentrated salts in the soil, altering its composition.

FEEDBACK LOOPS

Desert systems exhibit feedback mechanisms that either amplify or dampen environmental changes.
Positive feedback: Occurs when vegetation loss (due to overgrazing, deforestation, or climate change) reduces the amount of moisture released into the atmosphere through evapotranspiration. This reduction in atmospheric humidity leads to even lower rainfall, causing further vegetation loss, accelerating desertification.
Negative feedback: Stabilises the environment, e.g. intense weathering of slopes can cause scree (loose rock debris) to accumulate at the base of mountains. Over time, this build-up acts as a protective layer, shielding the underlying rock from further weathering and slowing down the rate of landscape change.

DYNAMIC EQUILIBRIUM

Dynamic equilibrium demonstrates the ability of desert systems to adjust to external changes while maintaining internal stability…

- Seasonal cycles, such as variations in wind patterns, can cause short-term shifts in landforms like sand dunes
- But long term, these changes are balanced out, and the overall shape and structure of features like dunes remain broadly constant

DESERT SYSTEMS AND LANDSCAPES: HOT DESERT CHARACTERISTICS

CLIMATE

Temperature: Very high average temperatures during the summer months (+ 40°C), while winter nights can be very cold, sometimes dropping below freezing.

Diurnal range: Variations of up to 30°C between day and night…

- Day – the lack of cloud cover allows intense solar heating of the surface
- Night – the same absence of clouds allows rapid re-radiation of heat into the atmosphere, causing temperatures to plummet

Precipitation: Rainfall is extremely low, typically less than 250mm per year, and when it does occur, it often arrives as short, intense storms that cause flash flooding.

Coastal deserts: E.g. Atacama – may experience fog and drizzle from nearby ocean currents, but measurable precipitation remains minimal.

Strong winds and sandstorms: These are common in deserts, especially where large temperature gradients exist, and occasional thunderstorms can result from intense convective activity.

DESERT SOILS

Soils in hot deserts are typically poorly developed and reflect the arid climatic conditions.

Organic matter: The lack of vegetation means that organic matter is extremely limited, so desert soils tend to be thin, sandy, not very fertile.

Decomposition: When vegetation does die, the low levels of moisture inhibit the decomposition process, preventing the formation of rich humus layers that are common in more temperate soils – so desert soils often appear dry, light, and dusty, with a high content of mineral particles.

Oxidation: Weathering process where oxygen reacts with iron compounds in rocks, often gives desert soils a characteristic reddish or orange coloration.

Movement of water: Desert soils are also typically highly porous and permeable so water to pass through rapidly – limiting moisture retention.

Leaching: Due to minimal rainfall this is limited – and salts can accumulate at or near the surface, sometimes leading to salinisation.

Despite these harsh conditions, with appropriate irrigation and management, desert soils can support agriculture, as seen in many irrigated desert farming projects.

DESERT VEGETATION AND ADAPTATIONS

Vegetation in hot deserts faces extreme survival challenges due to high temperatures, intense sunlight, limited water, and poor soils.
Xerophytic plants: Adapted to survive in deserts, possessing features that help them conserve water and withstand limited water availability…

Quick life cycles: Flowering straight after rain events before dying back during dry periods (and being dormant during droughts).

Long taproots: That penetrate deep underground to reach groundwater.

Shedding leaves: Some plants reduce water loss by shedding their leaves during dry seasons.

Succulents: Store water in fleshy stems, leaves, or roots.

Shallow widespread root systems: To quickly absorb water from rare rainfalls.

Small, waxy leaves or spines: To minimise transpiration and deter herbivores.

Oasis: This may form in places where underground water comes close to the surface allowing for pockets of much denser vegetation.

DESERT SYSTEMS AND LANDSCAPES: CAUSES OF ARIDITY

ATMOSPHERIC CIRCULATION – HADLEY CELL

Key to the global distribution of hot deserts.
Location of deserts: located between 20° and 30° north and south of the Equator.
Hadley cell:

1. At the Equator, intense solar heating causes air to rise, creating a zone of low pressure known as the Intertropical Convergence Zone (ITCZ).
2. As the air rises, it cools, loses its moisture through heavy rainfall, and then diverges poleward.
3. Around 30° latitude, this dry air begins to descend, creating areas of high pressure where air sinks, compresses, and warms up.
4. This descending air inhibits cloud formation and results in extremely dry, clear skies – perfect conditions for desert climates.

Deserts like the Sahara, the Kalahari, and the Arabian deserts owe their existence to this global atmospheric circulation system – it results in a persistent environment of dryness, high temperatures, and minimal rainfall.

RELIEF

Relief also influences the distribution of deserts through the creation of rain shadows…

- When moist air masses are forced to rise over mountain ranges, they cool and lose their moisture as precipitation on the windward side
- By the time the air descends on the leeward side, it is dry and warm, creating an arid, desert-like environment

This process explains the presence of deserts such as the Atacama Desert, which lies in the rain shadow of the Andes Mountains.

CONTINENTALITY

This is climatic effect of being situated deep within a landmass, far from the moderating influence of the oceans.
Interior of continents: The distance from moisture-bearing oceanic winds leads to a significant reduction in rainfall, contributing to arid conditions.

Example: Hot deserts located in continental interiors, such as the central parts of the Sahara in Africa and the Simpson Desert in Australia, are affected by continentality..

- The absence of maritime air masses means that precipitation is rare and sporadic, making these deserts even drier than those closer to coastal areas
- The lack of nearby large water bodies leads to greater temperature extremes, with baking hot days and much colder nights - enhanced by the desert's low humidity

Continentality reinforces both the aridity and extreme temperature ranges that are characteristic of hot desert climates.

COLD CURRENTS

Cold currents, like the Humboldt Current off the coast of South America, cool the air above them, reducing its capacity to hold moisture and suppressing the formation of rain clouds.
Even though fog and drizzle may occasionally occur, they provide very little actual rainfall, resulting in the formation of extremely dry coastal deserts.
Example: The Atacama Desert, again is one of the driest places on Earth, despite being close to the ocean, because of the combined effects of relief and cold ocean currents.

DESERT SYSTEMS AND LANDSCAPES: WATER CYCLE AND ENERGY IN DESERTS

LOW PRECIPITATION AND HIGH POTENTIAL EVAPOTRANSPIRATION (PET)

Hydrological imbalance: Caused by extremely low levels of precipitation and very high potential evapotranspiration. Rainfall in deserts is rare, unpredictable, and often occurs in short, intense bursts, leading to overland flow and flash flooding rather than steady infiltration into the soil.

Annual precipitation: Usually falls below 250mm, and in some hyper-arid deserts, it can be significantly lower, sometimes less than 50mm.

PET: The amount of water that could be evaporated and transpired if sufficient moisture were available – this is extremely high due to the intense solar radiation, high temperatures, low humidity, and strong winds.

Water deficit: Because PET far exceeds actual rainfall, deserts are in a near-constant state of water deficit. Even when rain falls, it is often quickly lost through evaporation or runoff, leaving little water available for ecosystems or soil moisture storage.

This harsh imbalance shapes desert ecosystems, landforms, and human activity in these regions.

WATER BALANCE FORMULA

This is the relationship between precipitation, evaporation, soil water storage, and runoff within a system.

It can be expressed by the simple equation:

Precipitation = Evaporation ± Soil Water Storage + Runoff.

Negative water balance: In most desert environments, potential evapotranspiration consistently exceeds precipitation, resulting in a negative water balance. There is typically no surplus of water to contribute to surface water features or groundwater recharge.

Evaporation: Instead, any moisture that does arrive is either rapidly evaporated or flows away quickly as runoff. This is why rivers are rare in deserts.

Agriculture: Farming in these regions depends heavily on imported water sources or irrigation from ancient underground aquifers, which may themselves be non-renewable (fossil water), e.g. farming in the USA in arid states like Nevada and Arizona

SOURCES OF ENERGY: INSOLATION, WATER, AND WIND

Desert environments are driven by several key energy sources that shape their physical processes and landforms….

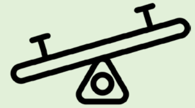
Insolation: The most dominant energy input is or solar radiation. Deserts receive some of the highest levels of insolation on Earth due to their clear skies and low atmospheric moisture. This intense solar energy drives high daytime temperatures and also causes thermal weathering processes such as exfoliation, where rock surfaces expand and contract dramatically between day and night.

Water:
Although water is scarce, when it does appear (often during short-lived but powerful storm events) it becomes a high-energy agent of erosion. Desert storms can generate intense runoff, creating features like wadis and alluvial fans through the rapid transport and deposition of sediments. Flash floods are particularly effective at reshaping desert landscapes despite their brief occurrence.

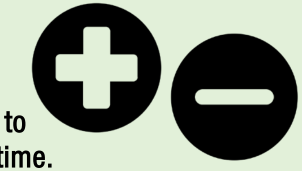
Wind: A crucial source of energy in deserts. Due to the absence of vegetation and loose, fine sediment on the surface, winds can mobilise particles through processes such as saltation, surface creep, and suspension. Wind energy shapes distinctive aeolian landforms such as dunes, ventifacts, yardangs, and desert pavements. Although wind typically acts more slowly than water in terms of shaping landforms, its constant action plays a major role in the long-term evolution of desert landscapes.

DESERT SYSTEMS AND LANDSCAPES: DESERT SEDIMENT SYSTEMS

DESERT SEDIMENT BUDGETS



Sediment budget: Measures the balance between the amounts of sediment entering (inputs) and leaving (outputs) a particular desert system. It evaluates whether a landscape is gaining, losing, or maintaining its sediment stock over time.



Positive sediment budget: When deposition exceeds erosion e.g. when sand accumulates to form large dune fields.

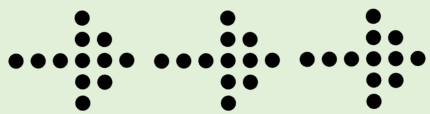
Negative sediment budget: When erosion outpaces deposition, leading to features like deflation hollows where the land surface is lowered over time.

Erosion processes: E.g. slopewash, sheetwash, and wind deflation are powerful forces that can remove sediment rapidly, especially after intense rainfall events or during high winds.

Only a small proportion (around 22%) of the total eroded material is actually deposited locally within desert systems – the majority is either transported further across the desert or lost to external systems.

Importance: Understanding sediment budgets is crucial for predicting the evolution of desert landscapes and assessing the impacts of climate change and human activities, such as land clearance and overgrazing, on desert sediment dynamics.

SEDIMENT CELLS IN DESERT SYSTEMS



Sediment cell: Closed system in which sediment is ‘ sourced, transported, and eventually deposited.

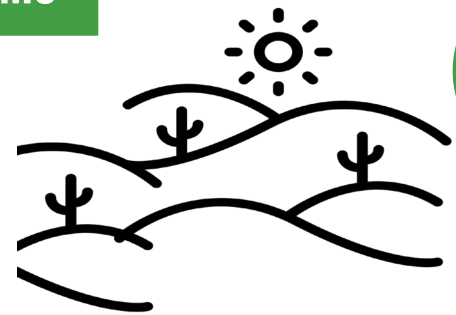
Inputs: Include material generated by weathering or imported by rivers and winds.

Transfers: Occur when sediment is moved across the desert surface by processes such as surface runoff, sheet flooding, or wind transportation mechanisms like saltation, surface creep, and suspension.

Deposition: Sediment is then deposited into sinks such as sand dunes, playas (dry salt lakes), or alluvial fans.

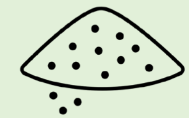
Outputs: Occasionally, strong winds or water flows can act as outputs, removing sediment from the desert entirely and transporting it beyond the cell's boundaries.

Sediment cells provide a useful model for understanding the dynamic movement and redistribution of material within the desert landscape.

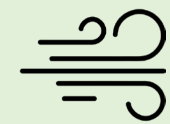


SEDIMENT SOURCES IN HOT DESERTS

Sediment in desert environments originates from a variety of internal and external sources.

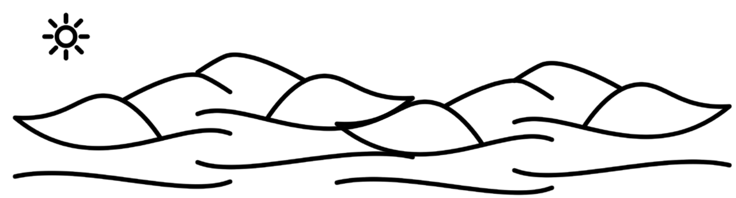


Internal sources: Include local weathering processes, such as thermal fracture from high diurnal temperature changes and salt crystallisation where evaporating water leaves salt crystals that break down rock. These processes continually generate loose material like sand, dust, and small rock fragments within the desert itself.



External sources: Rivers that flow from wetter regions into deserts (known as exogenous rivers) bring with them large quantities of sediment from outside the desert system. Winds can also transport fine material over long distances from other environments, adding external sediments to the desert.

Deserts receive sediment from both local mechanical and chemical weathering as well as external inputs from distant fluvial and aeolian (wind) processes.



DESERT SYSTEMS AND LANDSCAPES: WEATHERING PROCESSES

MECHANICAL: THERMAL FRACTURE

The most important type of mechanical weathering – the result of intense temperature fluctuations causing expansion and contraction, promoted by the presence of moisture.

Colour, rock type and geology all determine the process of disintegration.

Exfoliation: Repeated heating of the outer surface of a rock leads to the outer skin peeling away (also known as 'onion skin' weathering).

Shattering: Rocks that are not granular or jointed tend to shatter into angular fragments.

Granular disintegration: Coloured minerals in rock heat up at different rates, helping break-up.

Block separation: Breaking up of rock along joints and bedding planes.

MECHANICAL: SALT CRYSTALLISATION

In arid conditions, groundwater or rainwater can evaporate quickly, leaving behind salts such as sodium chloride or gypsum within the cracks and pores of rocks…

- As these salts crystallise, they exert pressure on the surrounding rock material
- Over time, the growing salt crystals force the rock to fracture and break apart

This process is particularly effective in desert environments where evaporation rates are extremely high, concentrating salts in the soil and rock surfaces.

Salt crystallisation often contributes to the formation of granular disintegration, where the surface of rocks becomes crumbly and loose.

MECHANICAL: FROST SHATTERING

Water (often dew) freezes and expands in cracks and pores within rocks.

Repeated freezing/thawing shatters rocks.

Also known as 'freeze-thaw' weathering.

CHEMICAL WEATHERING

Although mechanical weathering dominates, chemical weathering still plays a significant role in shaping desert landscapes, but at a slower rate compared to more humid environments.

Oxidation: Occurs when oxygen from the atmosphere reacts with iron-rich minerals in rocks, leading to the formation of iron oxides. This reaction often gives desert rocks and soils their characteristic red or orange coloration.

Hydration: Where minerals absorb water and expand, can also weaken rock structures, although the lack of consistent moisture limits its overall impact.

Solution: The process where minerals dissolve in water, is important in deserts particularly following rare but intense rainfall events. Rainwater, even when scarce, can slightly dissolve minerals like salts, carbonates, and gypsum from rocks.

Timescale: Long-term, these chemical reactions contribute to the weakening and disintegration of desert surfaces. However, because moisture availability is so limited, chemical weathering is much slower and less visually dramatic in deserts than in tropical or temperate regions, but still contributes to the overall long-term evolution of desert landscapes.

BIOLOGICAL WEATHERING

Microorganisms like lichens, cyanobacteria, fungi, and bacteria, as well as green algae, contribute to the breakdown of rocks in desert environments. These organisms form biofilms, or biological rock crusts (BRCs), which modify the rock's surface and contribute to its deterioration.

Also animal burrowing and plant roots.

DESERT SYSTEMS AND LANDSCAPES: AEOLIAN PROCESSES AND LANDFORMS

KEY TERMS

Aeolian processes: Wind-driven – erosion, transportation, and deposition of sediment. Common in areas with sparse vegetation and abundant loose sediment, e.g. deserts. Responsible for the formation of sand dunes and the movement of dust.

PROCESS: DEFLATION

The removal of fine, loose particles (e.g. silt, sand, and clay) from the desert surface by the wind…

- Over time, deflation can significantly lower the land surface, especially in areas where vegetation is sparse or absent
- The material lifted by deflation can be carried away over long distances, contributing to the formation of features like sand dunes elsewhere
- Deflation hollows, or blowouts, are landforms resulting from this process
- These are depressions or basins where wind has scoured away loose material, sometimes down to the water table, creating shallow lakes or playas after rain

Example: Qattara Depression in Egypt, which has been shaped largely by deflation over thousands of years.

PROCESS: ABRASION

Wind-driven sand and smaller particles are hurled against rock surfaces, gradually wearing them down (like natural sandblasting)…

- Most effective close to the ground where sand particles are in greater concentration
- Over time, abrasion can smooth, polish, and shape exposed rock surfaces, creating distinct erosional features
- Rocks subjected to persistent sandblasting may develop pitted or grooved surfaces

However, because deserts often lack large volumes of sand for long periods, and strong winds are needed to keep particles moving, the rate of abrasion can vary greatly from place to place.

LANDFORM: DUNES

Formed when sand carried by wind is deposited – due to a drop in wind speed or an obstacle (causes a loss of energy) – leads to gradual build up of dunes.

Dunes vary greatly in size and shape, depending on wind strength, wind direction, and sand supply, and are constantly shifting and evolving – highly dynamic.

Barchan dunes: Crescent-shaped with their tips (or 'horns') pointing downwind, formed under unidirectional wind conditions with limited sand supply.

Seif dunes: Long, linear ridges aligned parallel to the prevailing wind, often formed where wind direction varies slightly over time.

LANDFORM: YARDANGS

Streamlined, elongated ridges carved out of bedrock or consolidated sediments by the combined action of wind abrasion and deflation…

- Aligned parallel to the prevailing wind direction
- Form where there are alternating bands of hard and soft material – the softer material is eroded away more quickly, leaving the harder material standing as narrow ridges
- Can range from a few metres to several kilometres in length

LANDFORM: ZEUGENS

Tabular masses of resistant rock, often with a flat top…

- Formed where layers of hard rock (e.g. limestone or sandstone) cap softer rock (e.g. clay or shale)
- Initially, horizontal layers protect the softer material below
- However, once cracks or joints develop in the hard rock, wind and water exploit these weaknesses, eroding the underlying softer material faster
- Over time, this leads to the creation of tabular or mushroom-shaped rock features, with a hard, resistant caprock sitting atop narrower, eroded bases

LANDFORM: VENTIFACTS

Individual rocks that have been abraded, polished, and shaped by wind-driven sand particles...

- These rocks often exhibit smooth, faceted surfaces, with sharp edges and flat faces resulting from sustained sandblasting on their windward sides
- In some cases, ventifacts may develop multiple faces if wind direction varies over time
- Small-scale pitting and fluting may also occur in softer rock types
- Ventifacts are often found scattered across stony desert surfaces or within deflation zones

DESERT SYSTEMS AND LANDSCAPES: FLUVIAL PROCESSES AND LANDFORMS

WADIS

Dry riverbeds or valleys that only carry water during rare intense rainfall, after sudden storms…

- For most of the year, wadis remain dry due to the extremely low precipitation
- When rainfall does occur, it is usually too heavy for the soil to absorb quickly, resulting in rapid surface runoff that rushes through wadis in powerful, short-lived flash floods
- These flows can be highly erosive, scouring the wadi floor and walls and transporting large quantities of sediment downstream
- Over time, wadis can become wide and deep due to repeated erosion events
- Their floors often contain coarse debris such as boulders, gravels, and sand, deposited during these flood events
- Wadis help to channel scarce water across desert landscapes, and often serve as routes for transport and settlement where groundwater may be accessible beneath the surface

ALLUVIAL FANS

Form where ephemeral desert rivers, flowing out of mountainous regions, lose energy rapidly as they reach flatter ground…

- As the river slows down, it deposits its sediment load, which spreads out in a fan-shaped deposit
- The size and slope of an alluvial fan depend on sediment load, slope gradient, and the volume of water flowing during flood events
- Larger fans can coalesce over time, forming broad features called bajadas
- Alluvial fans are composed of a range of sediments, from large boulders near the source to finer silts and sands further downslope
- Important economically as they often create fertile soils suitable for agriculture when irrigated and can trap underground aquifers

CANYONS

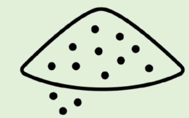
Steep-sided, deep valleys formed through the action of fluvial erosion, where water cuts down through bedrock over long periods...

When rain does occur, it can cause intense flash flooding that has immense erosive power
Over millions of years, this episodic but powerful water flow can carve dramatic landforms like canyons.
Example: The Colorado River (USA) has sculpted vast, steep-walled canyons in the Grand Canyon
Smaller canyons, often linked to wadis, are common, created by rare but violent flood events that deepen and widen valleys over time.

PLAYAS

Shallow, flat-floored desert basins that periodically flood following rare rainstorms but usually remain dry for extended periods...

- When water collects in a playa, it quickly evaporates due to high temperatures and low humidity, leaving behind layers of salt, clay, and other minerals (salt flats)
- Form in closed basins where there is no outlet for water to drain away, so water is removed by evaporation
- Over time, repeated flooding and evaporation cycles can lead to significant salt crust development



Example: Bonneville Salt Flats in Utah and Chott el Djerid in Tunisia. These environments are extremely harsh, but they can also be important habitats for migratory birds after temporary floods.

PEDIMENTS

Pediments are gently sloping, rock-cut platforms found at the base of mountains or steep escarpments in desert environments…

- Formed by a combination of weathering, sheetwash (thin flows of water across a surface), and erosion
- Initially, mechanical weathering processes like thermal fracture weaken the bedrock, while sheetwash during occasional rains removes loose material
- Over time, the rock surface becomes smoothed and bevelled into a low-angled slope
- Often merge into surrounding desert plains or can form part of a wider erosional landscape along with inselbergs (isolated hills or mountains rising abruptly from a plain)

DESERT SYSTEMS AND LANDSCAPES: DESERTIFICATION

KEY TERM

Desertification: The process where fertile land becomes increasingly arid and desert-like, losing biological productivity – results from a combination of natural and human factors, working together to accelerate land degradation.

NATURAL CAUSES OF DESERTIFICATION

Prolonged periods of drought: Where rainfall levels are significantly below normal. In desert margins, even small decreases in precipitation can disrupt fragile ecosystems, leading to vegetation loss, soil exposure, and increased vulnerability to erosion.

Climate change: Intensifies drought patterns by altering rainfall distributions and increasing temperatures, which raise evapotranspiration rates and dry out soils further.

HUMAN CAUSES OF DESERTIFICATION

Overgrazing: Occurs when too many livestock feed on vegetation, stripping land of protective plant cover and exposing soil to wind and water erosion.

Overcultivation: Happens when land is farmed intensively without adequate periods of fallow, depleting soil nutrients and reducing its structure and fertility.

Deforestation: For fuelwood and agricultural expansion removes vital trees and shrubs that bind the soil together, further accelerating erosion.

Overirrigation: Can lead to salinisation – water evaporates quickly due to the heat, leaving harmful salt deposits that poison the soil and make it unsuitable for crops.

Other: Poor land management, population pressures, and unsustainable farming techniques all intensify desertification, particularly in marginal areas like the Sahel region in Africa.

IMPACTS OF DESERTIFICATION ON PEOPLE

Reduced food security: Particularly for subsistence farming communities who rely directly on the land for their livelihoods. Can lead to famine and malnutrition.

Environmental migration: People are forced to migrate in search of better living conditions.

Water resources become scarcer: Increasing the burden on women and children who often spend hours collecting water from distant sources.

Conflict over dwindling resources: E.g. grazing land and water – can exacerbate political and social instability.

In many regions, desertification traps people in a cycle of poverty and environmental degradation, making sustainable development extremely difficult.

IMPACTS OF DESERTIFICATION ON ECOSYSTEMS

Loss of biodiversity: As plants and animals adapted to semi-arid conditions struggle to survive in increasingly barren landscapes – may become dominated by hardy invasive plants, further declines in native biodiversity.

Reduction in vegetation cover: Eliminates habitats but also disrupts food chains, making entire ecosystems more fragile.

Soil erosion: Removes the nutrient-rich topsoil necessary for plant growth, leading to the collapse of previously stable ecosystems.

Reduces cardon sequestration: Indirectly contributing to global climate change. Areas that once supported a rich variety of species

IMPACTS OF DESERTIFICATION ON LANDSCAPES

Soil erosion: Creates gullies, sand dunes, and dust storms. Large-scale dust storms can spread across entire continents, impacting air quality and disrupting weather patterns.

Land degradation: Fertile areas turn into barren, cracked surfaces which can't support agriculture or natural vegetation recovery, reducing resilience which makes it harder to recover from droughts and floods.

DESERT SYSTEMS AND LANDSCAPES: CASE STUDIES

MOJAVE DESERT – LOCATION

The Mojave Desert is in the south-western USA across California, Nevada, Utah, and Arizona – known for its extreme temperatures, unique ecosystems, and striking landforms.

MOJAVE DESERT – LANDFORMS

Alluvial fans: Prominent at the foot of mountain ranges, formed where intermittent streams deposit sediments as they slow down upon reaching the flat desert floor.

Playas: Flat, dry lake beds like those found in Death Valley are also common, highlighting the region's history of occasional, now-evaporated, water bodies.

Sand dunes: Such as the Kelso Dunes, are shaped by prevailing winds moving vast amounts of sand.

Rockier landscapes: Include rugged mountain ranges, deep canyons, and isolated inselbergs (rocky outcrops).

MOJAVE DESERT – MANAGEMENT

Human pressures: Including urban expansion (notably around Las Vegas), tourism, mining, and military training.

Mojave National Preserve: 1.6 million-acre reserve managed by the National Park Service to balance conservation with human use and protect a large area of the desert.

Management strategies to reduce environmental impact:

- Controlling access to sensitive areas
- Restoring damaged ecosystems
- Promoting sustainable tourism
- Wildlife conservation – efforts are made to protect endangered species, such as the desert tortoise, whose habitats are threatened by development

BUT, challenges remain, e.g. climate change increases the frequency of droughts and wildfires, putting even more pressure on fragile desert ecosystems.

BADIA REGION – LOCATION

Also known as the Syrian Desert – primarily in Jordan, Syria, and northern Saudi Arabia, but also extends into parts of western Iraq. The Badia is a vast steppe desert.

BADIA REGION – DESERTIFICATION

The Badia is a vast arid and semi-arid region that historically supported nomadic pastoralism, but it has suffered severe land degradation over recent decades.

1991 Gulf War: Resulted in the collapse of traditional land management practices when large numbers of livestock, particularly sheep and goats, were moved into Jordan from neighbouring countries.

Overgrazing: Caused by the sudden influx, as the fragile desert vegetation could not recover between grazing periods. Combined with drought conditions, this pressure resulted in widespread desertification, soil erosion, and a sharp decline in vegetation cover.

RANGELAND REHABILITATION PROJECT

This project was launched to reduce the effects of desertification, supported by international organisations like the United Nations…

- The project aimed to restore degraded lands by reintroducing traditional systems of land management, including seasonal grazing to allow vegetation to recover
- It also involved planting drought-resistant shrubs, building micro-catchments to capture scarce rainfall
- And it encouraged community participation to ensure sustainable outcomes

Success: The project demonstrated that with careful management and local engagement, even severely degraded desert environments could begin to recover – vegetation cover increased in targeted area, soil erosion was reduced, and resilience of pastoralist livelihoods was strengthened.

However, the project also highlighted the ongoing challenges of balancing economic pressures with environmental sustainability in vulnerable desert regions.