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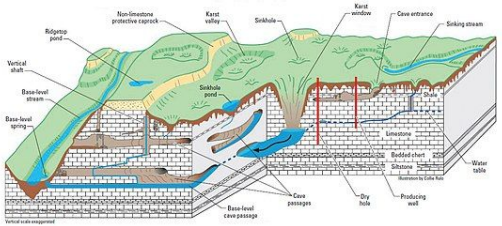
Geography

KARST Processes

The Karst Landscape

Definition

- Refers to **limestone** terrain lacking surface drainage, possessing a patchy and thin soil cover, containing many enclosed depressions, supporting subterranean features.
- Best developed on **LIMESTONE** (80% CaCo3).



1

Limestone

What is it?

Characteristics

The 4 Characteristics of Limestone

- A type of **sedimentary rock**.
- Geologic Structure consist of **strata** (horizontal beds of rock) → Very susceptible to weathering.
- Soluble.
- **Permeable**, not porous.

2

Processes

The **2** main weathering processes.

Weathering Processes

2 main weathering processes

1. **Carbonation**
   - Water + Carbon Dioxide = Carbonic Acid → Reacts with Calcium Carbonate to form Calcium Bicarbonate → Weaker compound → Rock weathered and weak.
2. **Solution**
   - Solution Calcium Bicarbonate is dissolved in water → Running water removes soluble minerals from limestone and weakens rock structure.

[Both carbonation-solution takes place in unison]

3

Conditions

What is needed to produce a karst landscape?

Conditions

4 conditions required for karst development

1. Presence of a soluble rock (limestone), with abundance of **joints**.
2. Moderate amounts of **rainfall**.
3. **Vegetation** (*increases acidity of water by adding CO2 and organic acids).*
4. Undulated **topography**, high elevations **exposing limestone**.

Factors (*for exam*)

Internal Factors

- Rock/Geologic Structure (joins and bedding planes)
- Rock Chemical Composition ($CaCO_3$)

External Factors

- Climate
- Collapse (sudden Mass Movement)
- Vegetation Cover

Exam Requirements

- Understand the different factors/conditions which may result in the formation of a karst landscape (namely internal and external factors). You must be able to **explain** them.
- Understand the **main processes** (weathering processes) which karst landscapes undergo.
- Main focus for this topic is on the karst **landforms** (**Next Part/Video**)

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GEOGRAPHY

KARST Landforms

Karst Landforms

Main Karst Landforms

- **Cone Karst, Tower Karst**
- **Isolated Karst**
- Caves

1

The Cockpit Karst

The Cone, Tower and Isolated Karst **family**

The Cockpit Karst

Egg-Carton-Type Topography

Cockpit Karst

- Star-shaped depression surrounded by cone-shaped hills, with an egg-carton-type topography.

Formation:

River channels develop inside cockpits/enlarged fissures caused by erosion and weathering

→ Forms underground caves

→ As the caves grow and collapse

→ Forms huge valleys

→ Egg-carton-type topography

Cone Karst

- Low hills with gentle sides, an expansion of cockpits from various sides.

Formation:

Weathering and river erosion wear down the limestone to form *alluvial plains*

→ Remaining limestone in between continues to experience erosion and weathering

→ Enlarged cockpits on the sides are known as **Cone Karsts**.

Tower Karst

- Steeper variety of cone karsts, a bigger height-diameter ratio.

Formation:

Repeated cycles of *Solution* and precipitation of calcium bicarbonate

→ Water which runs down the eastern slopes and prevalent trade winds drying the same side results in **case-hardening** of limestone

→ Results in the precipitation of calcite deposits on the slopes which are harder to dissolve.

Tower Karst

→ The **case-hardened** layers are called **resistant caprock**

→ They protect the underlying layers of limestone from being weathered

→ Hence becoming vertical columns of limestone which build up

→ Thus the landform of **tower karsts**

Tower Karst

Isolated Karst

- Tower karsts which have separated from the cockpit karst due to heavy erosion and weathering via a river channel/water body. .

Formation:

When repeated erosion in major fissures/alluvial plains has resulted in the formation of a meandering river

→ Erosion will continue to take place and push the tower karst "outwards"

→ As a result, the tower karst would stand alone hence an **isolated karst**.

Isolated Karst

2

Caves

An extra landform that you **should** know!

Caves

- A solutional opening underground, large enough for a human to enter.
- Characteristic of **Speleothems** (*Stalactites & Stalagmites*)

Phreatic Zone	**Vadose Zone**
Wet	Dry
Circular-shaped caves	**Rectangular-shaped** caves
A mix of both will result in **keyhole-shaped** caves [Circular at the top and block-like at the bottom]	

Caves

- Caves have entrances via dolines and vertical shafts.

Formation:

The underground passages are formed along lines of structural weaknesses

→ Enlargements of joints due to ***solution*** by circulating water and abrasion by sediment that arrives in high flow from surface

→ Chemically precipitated carbonated deposits, otherwise known as **speleothems**.

Caves

→ Water in the cave may evaporate causing precipitation of $CaCO_3$ → Forms vertical bodies of limestone stretching from the roof → **Stalactites**

→ Lime-rich water may evaporate from the floor leading to the precipitation of $CaCO_3$ → Builds upwards to form incipient pillars → **Stalagmites**

Stalagmites and Stalactites may meet to form **pillars**.

Caves

3

Factors

An exam requirement

Factors affecting Karst

- All the factors affecting a karst landform have already been buried within their formation processes.

Most important factors:

- **Climate** (Rainfall and Temperature) → Tends to impact on a large scale, to the whole area and will definitely affect both surface and subsurface landforms.
- **Chemical Composition** of rocks → Requires limestone to even be called a 'Karst' landscape.
- **Fissures/Joints** → Required for water to infiltrate/cockpit karst to form.

Exam Requirements

- Understand the different factors/conditions which may result in the formation of a karst landform. You must be able to **explain** them.
- Be able to assess which factor plays the most important role in the formation of a karst landform.
- Be able to discuss both **surface** and **subsurface** landforms.

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Geography

The Aeolian Landscape & Factors

1

The Aeolian Landscape

The Aeolian Landscape

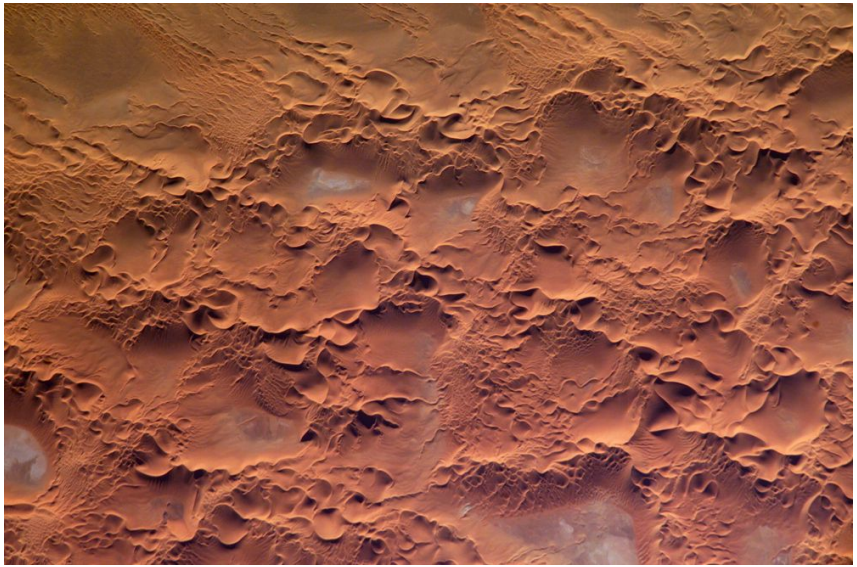
Definition

- An area which **lacks available moisture**, with a **high rate of evapotranspiration** and **high diurnal temperature** ranges, tending to be the *Tropical Deserts* [BWh].
- There are **5** types of arid landscapes
  1. Hamada [Barren rocky highlands]
  2. Reg [Vast stony plains]
  3. Erg [Sand seas]
  4. Mountainous areas
  5. Intermontane Basins [Inter drainage basins with salt lakes]

The Aeolian Landscape

Hamada

Erg



The Aeolian Landscape

Reg

Intermontane Basins

The Aeolian Landscape

To Note:

In **Rocky** areas → Main weathering agent is **WATER**.

In **Sandy** areas → Main weathering agent is **WIND**.

2

Factors

What affects the processes that shape arid landforms?

Factors **(covered in depth in Aeolian Series Part 3/4)**

Internal Factors

- Rock/Geologic Structure (joints and bedding planes)

External Factors

- Climate
- Vegetation Cover

Physical and Chemical Weathering (*less dominant*) [ALL]

Exam Requirements

- Understand the different factors/conditions which may result in the formation of a karst landscape (namely internal and external factors). You must be able to **explain** them.
- Next part will go through the Aeolian **PROCESSES** such as **erosion**, **transportation** and **deposition** which takes place.

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Geography

Aeolian Processes

1

Overview of Wind Processes

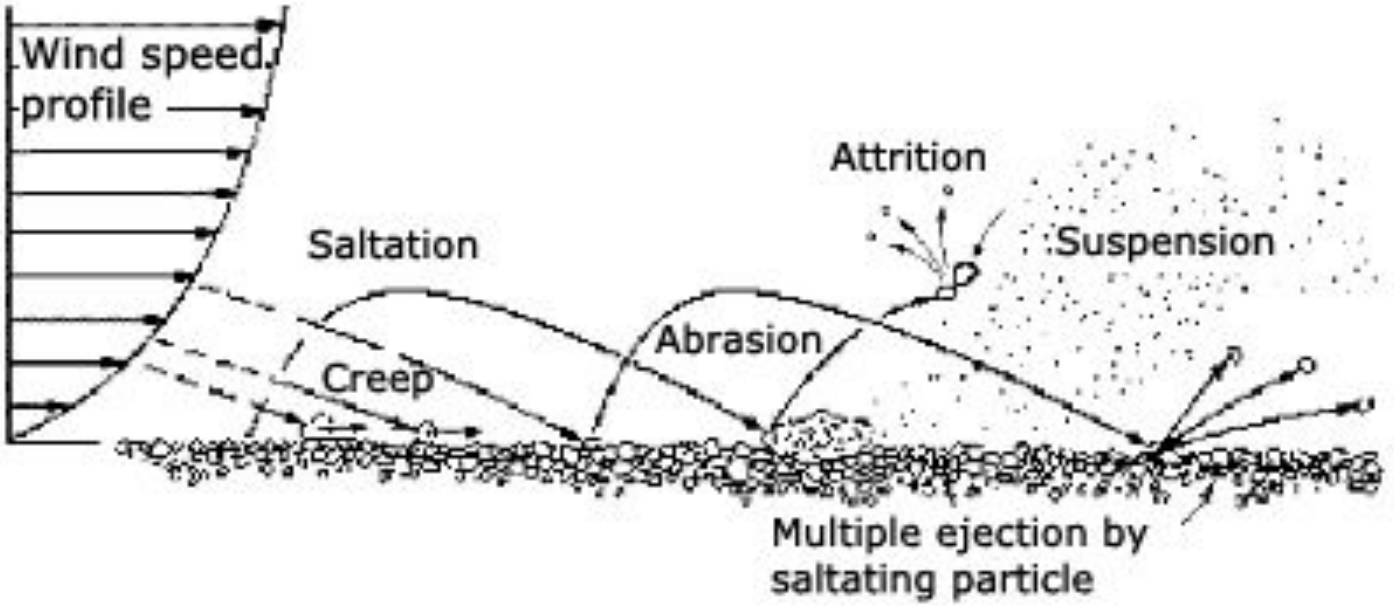
Aeolian **Erosion**, **Transportation**, **Deposition**

Aeolian Processes

Wind/Aeolian Processes

1. **Erosion**
   - Deflation, Abrasion, Attrition
2. **Transportation**
   - Saltation, Reptation, Suspension, Creep
3. **Deposition**
   - Sedimentation, Accretion, Encroachment

Aeolian Processes



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Wind EROSION

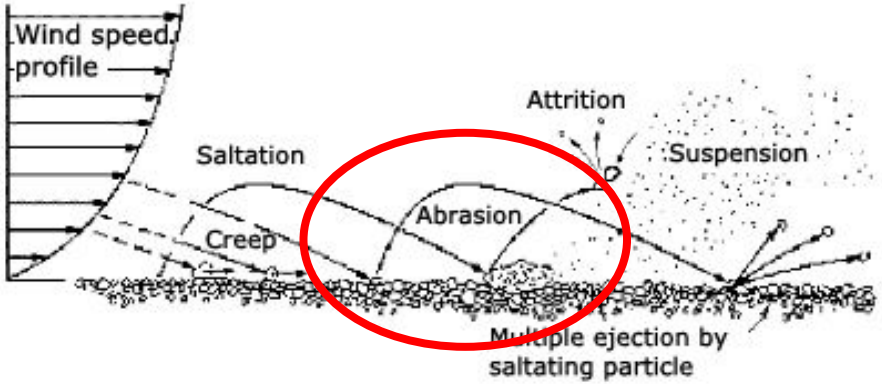
Deflation, Abrasion, Attrition

Deflation

- The **picking up** of dust, sand and loose rock fragments.
- The **entrainment** of loosened materials by wind, overtime, **lowers** ground.
- Operates on a **LOCALISED** scale.
- Fine materials (silt, clay) are often pre-weathered by salt weathering before going through deflation.
- Aids in the formation of ***yardangs***.

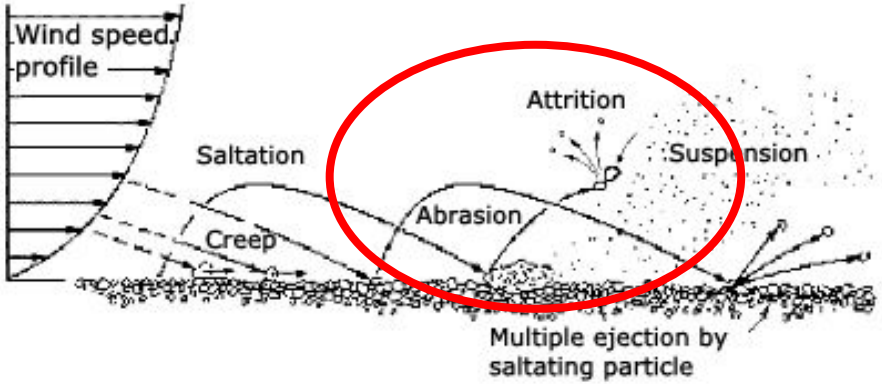
Abrasion

- Abrasion refers to the **mechanical wear** of rock or sediments by the **impact** of particles in ***saltation***.
- Bouncing particles commonly **dislodge** other grains when they strike the surface.
- Number of particles diminishes with height.



Attrition

- Attrition occurs when wind-borne material is in **constant motion** and consequent attrition of the material occurs → Particles become **rounder** and **smaller**.



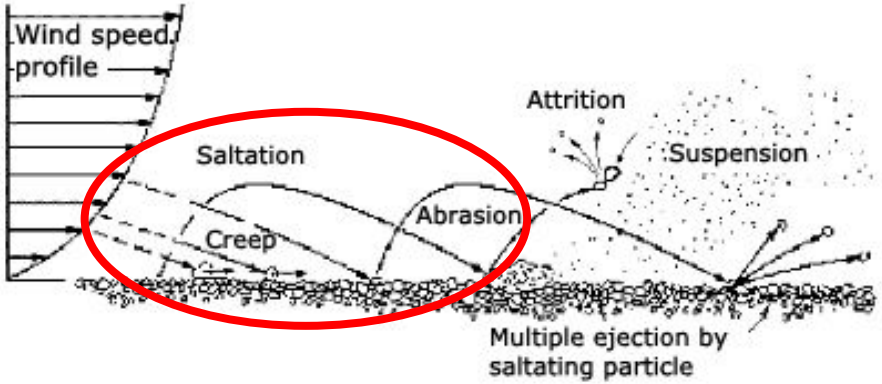
2

Wind TRANSPORTATION

Saltation, Reptation, Suspension, Creep

Saltation

- Saltation refers to when coarse materials such as sand grains **bound**, **land** and **rebound** (*Distances shorter than height of 2m*).
- The **key process** which powers *suspension*, *creep*, *reptation* as the size of sand **determines whether it will continue to bounce in saltation zone or enter suspension zone**.

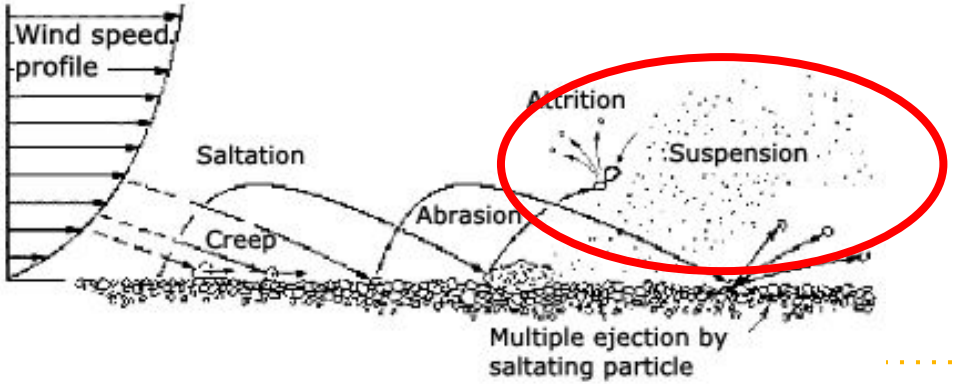


Reptation

- On hitting the surface, saltating grains release a small **splash-like shower of particles** that make small hops from the point of impact.

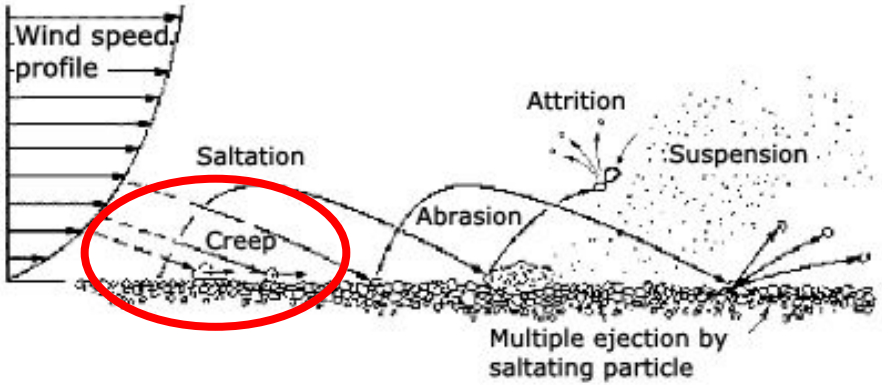
Suspension

- **Smaller sized particles** such as silt and clay are lifted into the atmosphere and become suspended, travelling over **great distances**.



Creep

- Coarse sand and small pebbles **inch forward** by **rolling and sliding** with the momentum gained from the impact of jumping sand particles.



The Bernoulli Effect

- The reason behind wind transportation (will go through in another video in event of popular demand).

2

Wind DEPOSITION

Sedimentation, Accretion, Encroachment

- Responsible for the formation of **sand dunes** and **loess**

Sedimentation

- Occurs when grains **fall out of the air** or **stop creeping** forward.
- Due to **insufficient force/weight**.

Accretion

- The depositional process which stops ***saltation***.
- When the grains hit the floor due to ***saltation*** with great force → Some grains continue to carry on moving forward as creep while **the majority come to rest** → **Accretion**.

Encroachment

- Deposition which occurs on a rough surface for **coarser** grains.
- Occurs on the front of a **sand dune** when grains roll down the surface and come to a rest.

Exam Requirements

- Wind Processes (*Erosion*, *Transportation*, *Deposition*) can come out as **12m** essay questions.
- Requires you to understand the different types of sub-processes and how they operate.
- Usually acts an **explanation** to the formation of aeolian landforms.

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Geography

Aeolian Landforms

Rills/Gullies and Sand Dunes

Aeolian Landforms

Main Aeolian Landforms

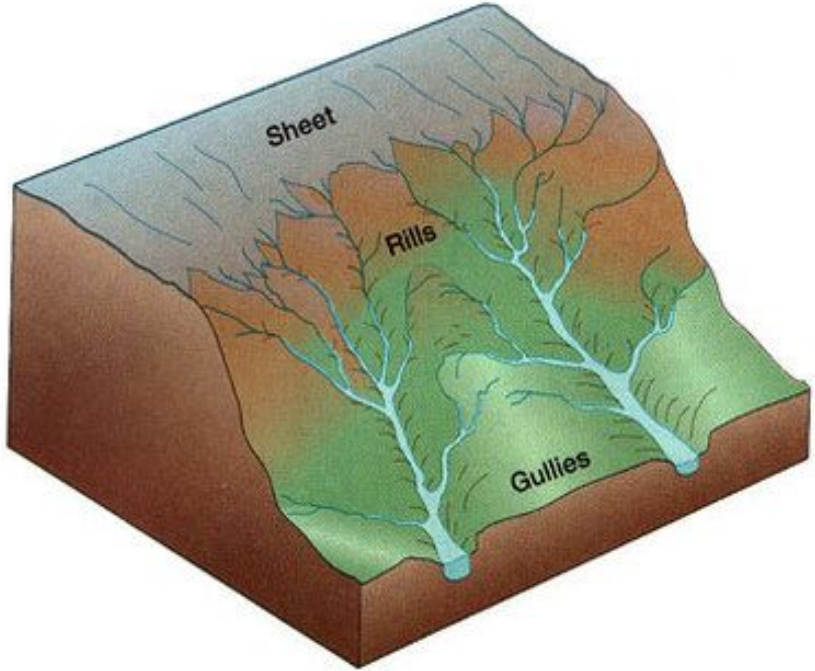
- Rills and Gullies [*Part 3*]
- Sand Dunes [*Part 3*]
- Yardangs [*Part 4*]
- Loess [*Part 4*]

1

Rills and Gullies

A **FLUVIAL** Erosional Landform

Rills and Gullies



Rills

- Tiny hillside channels that are cut by ephemeral streams.
- Inside rills → Running water is doing both **erosion and transportation** as particles are detached from the surface and transported to the base of the slope.

- During dry seasons: Forms **pediment slope** (rarer)

Gullies

- Rills which expands/combines hence growing in size will form gullies.

- During dry season: Results in the formation of **wadi** (carries ephemeral streams).

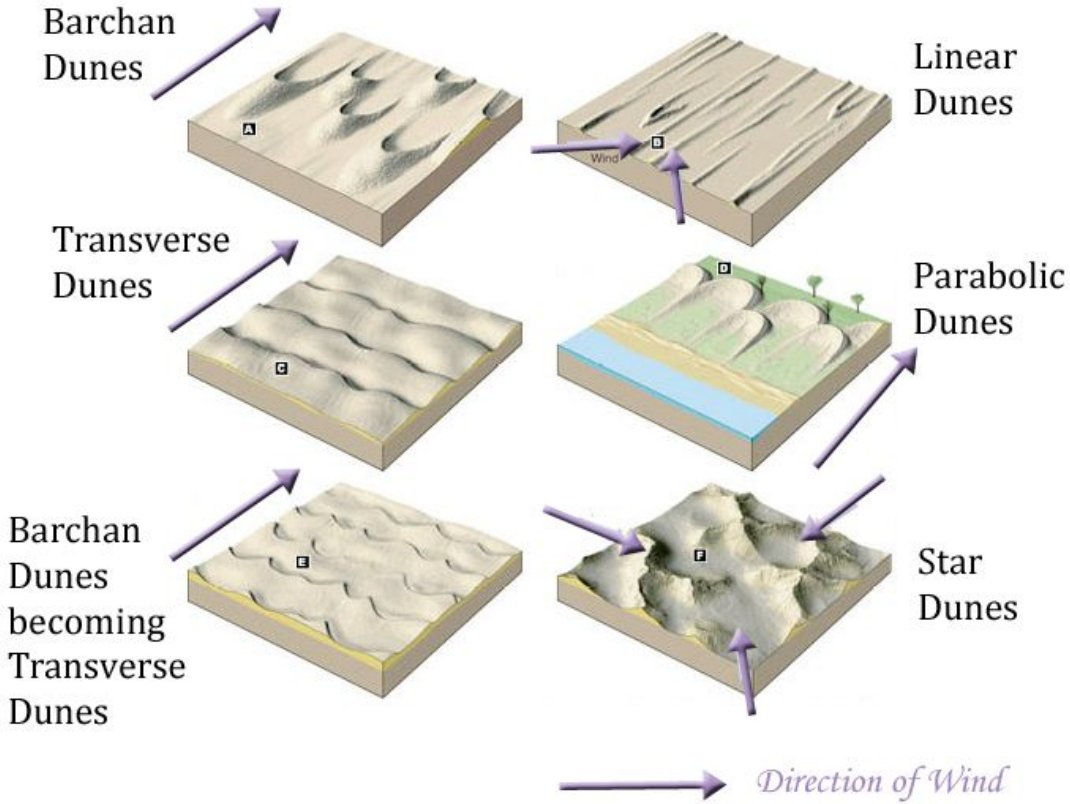
Gullies/Wadi

Wadi

2

Sand Dunes

A **LOT** of different types!



Sand Dunes

- Dynamic landforms that **migrate** and **changes in shape** with changes in conditions.
- Includes the **windward slope**, **crest** and **slip face** (leeward slope).
- **Erosion occurs at the windward side.**
- **Deposition occurs at the leeward side.**

Sand Dunes [*Factors*]

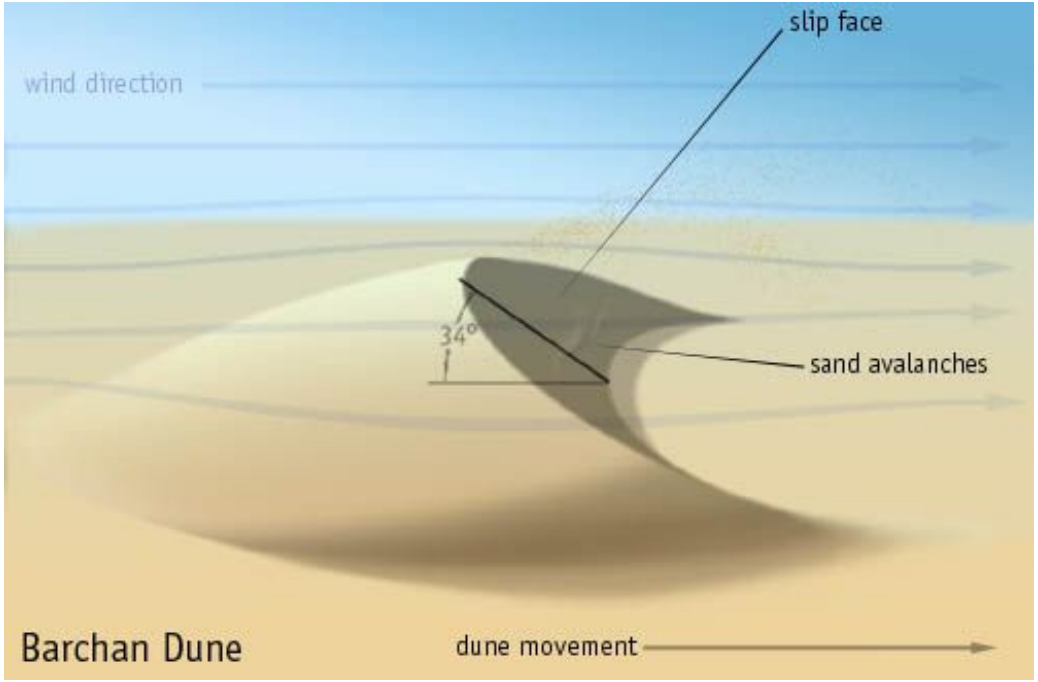
Factors affecting sand dune:

1. **Sediment Supply** [More sand = Larger sand dune]
2. **Amounts of Vegetation** [Deposition occurs downwind from vegetation and around its base, plant roots also stabilise sand and holds the dune in place].
3. **Wind Speed, Direction** [Strong wind will increase sediment transportation on windward slope and cause dune to grow in height while **weak winds result in more sand transportation at the crest and lowers height of the dune, depositing more on the leeward side**].

Barchans

- A U-shaped dune that has its 'horns' pointing **downwind**, away from the wind.
- **Gentle windward slope**, **steep flip face**.
- Requires **limited sand supply**, with **constant wind direction**.
- Formation begins as sand gets trapped in an obstruction such as a bush/shrub.
- Overtime → Downward migration of dune occurs → **Slowest at centre** of dune and more **rapid on both ends** → Forms **'horns'**.

Barchans



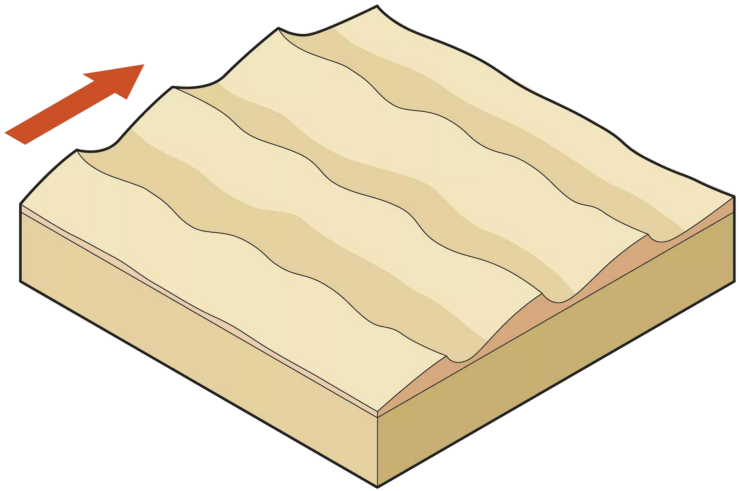
Star Dunes

- Star-shaped with **3 or more slip faces that radiate from a central**, pyramid-shaped peak.
- Requires **abundant sand supply**, and **multi-directional** winds.
- Star dunes grow upwards rather than laterally.

Star Dunes

Transverse Dunes

- Forms where sand supply is **abundant**, with the ridge forming **perpendicular** to the direction of wind.
- Steep slip face.

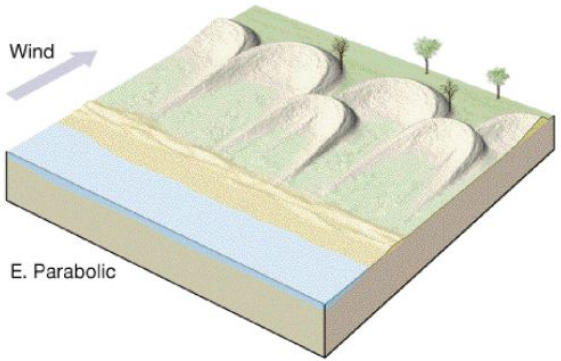


Longitudinal Dunes

- **2 or more** wind directions.
- Forms at the **convergence** of cross winds → Pushes sand into long lines and ridges (parallel to wind direction).

Parabolic Dunes

- U-Shaped, ‘horns’ point **into the wind** and deeply curved.
- **Windward side is concave**, **leeward side is convex**.



Exam Requirements

- Understand the landforms of Rills & Gullies, as well as the different type of sand dunes.
- Sand dunes will usually come out as a DRQ/case-study question, asking you to **identify** the dune then **explain its formation** and **factors** affecting it.
- If it comes out as an essay question, you need to use these landforms with those in **Part 4 [Yardangs & Loess]**.

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Aeolian Landforms

Yardangs and Loess

Aeolian Landforms

Main Aeolian Landforms

- Rills and Gullies [*Part 3*]
- Sand Dunes [*Part 3*]
- Yardangs [*Part 4*]
- Loess [*Part 4*]

3

Yardang

The **most important landform** you should know!

Yardang

Definition

- **Narrow, elongated** rock structures that are streamlined according to the wind direction.
- Presence of **ridges** and **troughs** due to wind erosion.

Windward Side	Leeward Side
Blunt, steep and high	Gentle, Declines in elevation

Yardang

Yardang [*Factors*]

1. **Shape** and **Size**
- **Varies** in size.
- Yardangs that cover a large area are known as **yardang field**.
- Shape as seen in previous slide.

2. **Conditions** required for yardang formation.
- **Aridity** [Less than 100mm per annum, needs a little bit of water as moving water has a role to play still].

Yardang [*Factors*]

- **Moving Water** [Rill wash, gullying and erosion enlarge joints before formation. After formation, helps steepen surface and sides]
- **Wind** [Need for one-direction wind, abrasion and deflation to take place]
- **Rock Type** [Need for hard and soft rocks of different resistance for erosion]
- **Geologic Structure** [Pre-existing lineament of weakness for the wind to exploit]
- **Mass Movement** [Rock fall may modify yardang slide]

Yardang [*Formation*]

Formation

Phase 1:

- Pre-existing rock structure with **alternating hard and soft rock beds** perpendicular to the surface with pre-existing **joints**.
- **Erosive winds** and water at constant velocity carrying abrasive sand enter the joints → **Abrasion** and **saltation** take place along the joints.

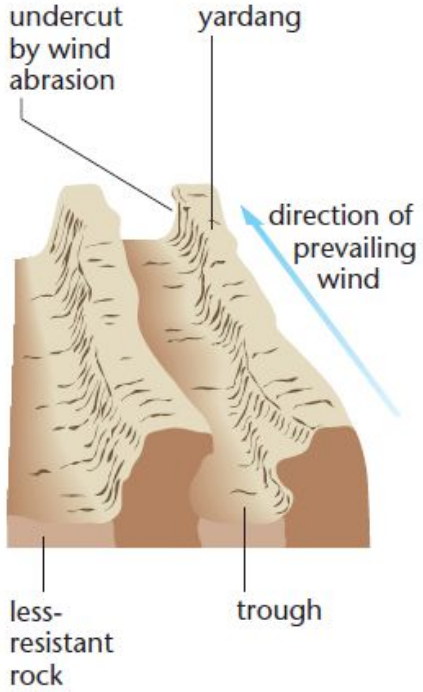
Yardang [*Formation*]

Formation

Phase 2:

- Sand particles will **abrade** the bottom and side of joints → **Enlarges** joints.
- Softer rock beds will be eroded first by abrasion → Forms **troughs**.
- Harder rock beds → **Parallel ridges** carved out (aligned to prevailing winds).
- **Progressive steepening** of yardang slopes and deepening of troughs.

Yardang [*Phase 2*]



Yardang [*Formation*]

Formation

Phase 3:

- Abrasion is ***accelerated*** in the course of blowing prevailing winds → **Enlarged joints** are now **eroded** into **narrow corridors**.
- Abrasion intensifies on windward side of yardang → **Ridges** becomes **smaller** and **shorter**.
- Band of **hard rocks increase in height** above soft bands.

Yardang [*Formation*]

Formation

Phase 4:

- Yardangs form in a large field (different shapes and sizes)
- In downwind direction → There is a decline in yardang size due to the **increased availability** of abrasive sand.

Yardang [*Factors*]

Main Factors (in order or importance):

1. **Climate** (Need for water and air so that erosion can take place in ***Phase 1, 2 and 3***).
2. **Wind/Water Erosion and Weathering Processes** (Need for abrasion and deflation to take place in ***Phase 1, 2 and 3***)
3. **Geology/Rock Structure** (Need for the **presence of joints** such that the wind can exploit for erosion in Phase 1, 2)
4. **Mass Movement** (Coincidental rock falls may enlarge joints)

4

Loess

A **depositional** landform.

Loess

Definition

- Loess deposits are **sheets of fine sand deposits**; composed largely of windblown silt particles and made of quartz over an extensive area.

Need for 3 conditions:

1. Source of silt (Abundant supply of fine-grained sediment)
2. Wind (To transport the silt)
3. Suitable site for deposition and accumulation (Rough surfaces will increase friction hence more landing particles)

Loess

Loess [*Formation*]

- Erosion by rivers, abrasion by wind → Produces **silt-sized** particles.
- **Finer silt and clay** may be borne further → Brought down by wet or dry deposition.
- To accumulate → Dust must be deposited on **rough** surfaces because deposits on dry and smooth surfaces are more susceptible to *re-suspension* of particles.

Exam Requirements

- Understand the landforms of yardangs [**MOST IMPORTANT**] as well as Loess Deposits.
- Yardangs and Loess can come out for case-study/DRQ or essay-based questions so be prepared to identify and explain them in all phases (for yardangs).
- If it comes out as an essay question, you need to use these landforms with those in **Part 3 [Sand Dunes & Rills & Gullies]**.

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Geography

Floods

Hydrographs

Definition

- A flood hydrograph is the **river discharge** plotted against **time**.
- **2** main types: **Storm** hydrograph and **Annual** hydrograph.

Storm Hydrograph

- Illustrates the short-term fluctuations in discharge of a river after a single episode of rainfall.
- **River floods**: Rivers overtop their banks and spill out onto surrounding land.
- **Flash floods**: Rapid rise of water which lasts a very short period of time (due to intense periods of rainfall in a short time).

Annual Hydrograph

- Long term seasonal changes in discharge of a river.
- Show variability in discharge of a river during the year.

Components of a Hydrograph

Rising Limb - Reflects the rate of increase of the river discharge from the peak rainfall intensity.

Lag Time - Time period between maximum rainfall and maximum discharge.

Crest - Shows maximum discharge.

Recession Limb - Rate of river discharge receding

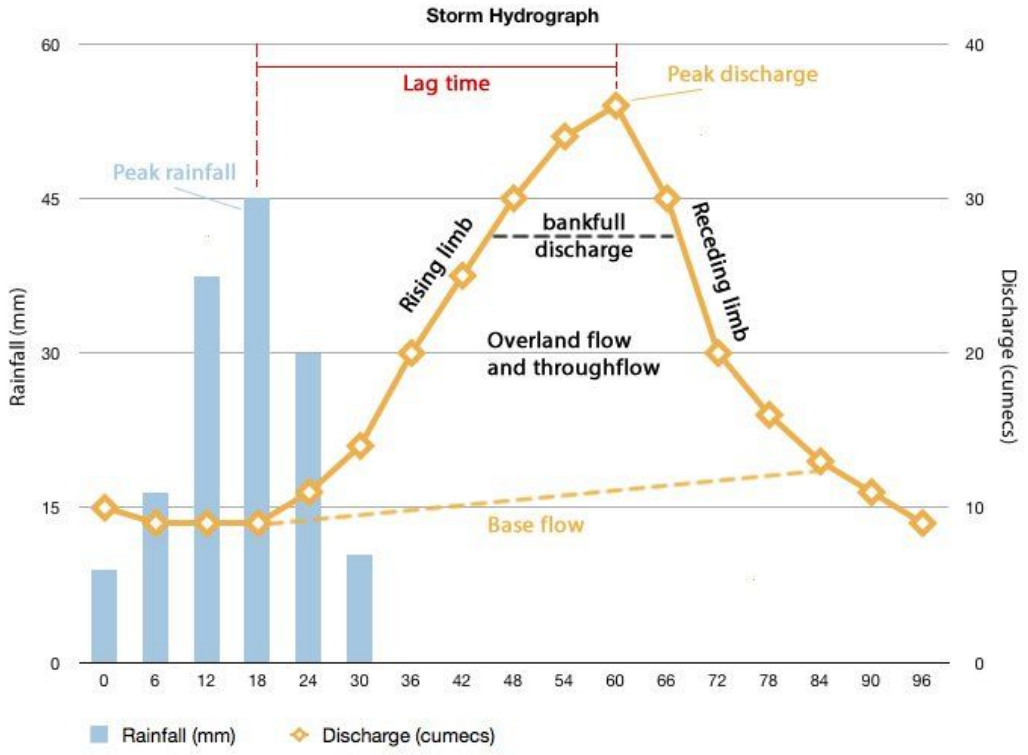
Components of a Hydrograph

Baseflow - Long-term, the amount of water in the river channel that is derived from groundwater sources.

Peak rainfall - Maximum amount of rainfall during time period.

Peak discharge - Maximum amount of discharge in the river during time period.

Bankfull discharge - The flow at which water just fills a channel without overtopping the banks



Factors affecting the storm hydrograph

Basin Size, Shape, Relief

Size: Small basin → Rainfall reaches main channel quicker → **Shorter lag time**.

Shape: Circular Basin → Flows of water are equidistant from main channel and tributaries reach river at the same time → **Shorter lag time**.

Relief: Steeper slope basin → More likely to have water reaching the river faster than gently sloping lowland rivers → **Higher peak, shorter lag time**.

Weather/Climate

Prolonged Rainfall (single episode): Flooding most frequently occurs when ground has become saturated → Saturation overland flow → Increase in river discharge.

Intense storms (multiple rainfall episodes): Heavy rains, rainfall intensity may be greater than infiltration capacity → Rapid increase in river discharge → Flash floods occur.

Vegetation Cover

Plant Roots: Reduce throughflow byu taking up water from soil → **Gentle rising limb** and **lower peak discharge**.

Layer of Hummus: Aids infiltration → Reduces surface runoff → **Gentle rising limb**.

Urbanisation

- Water cannot infiltrate surfaces made of tarmac and concrete → More surface runoff.
- Stormwater accumulates downstream more quickly than in natural rivers → **Higher peaks, shorter lag time and steeper rising limbs**.

Exam Requirements

- Be able to explain the various features of a flood hydrograph and draw one.
- Explain and discuss the various factors that play a role in affecting the various components of a flood hydrograph (*natural vs human factors*).

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Geography

Cyclones

Pattern, Conditions/Factors

Definition of Tropical Cyclones

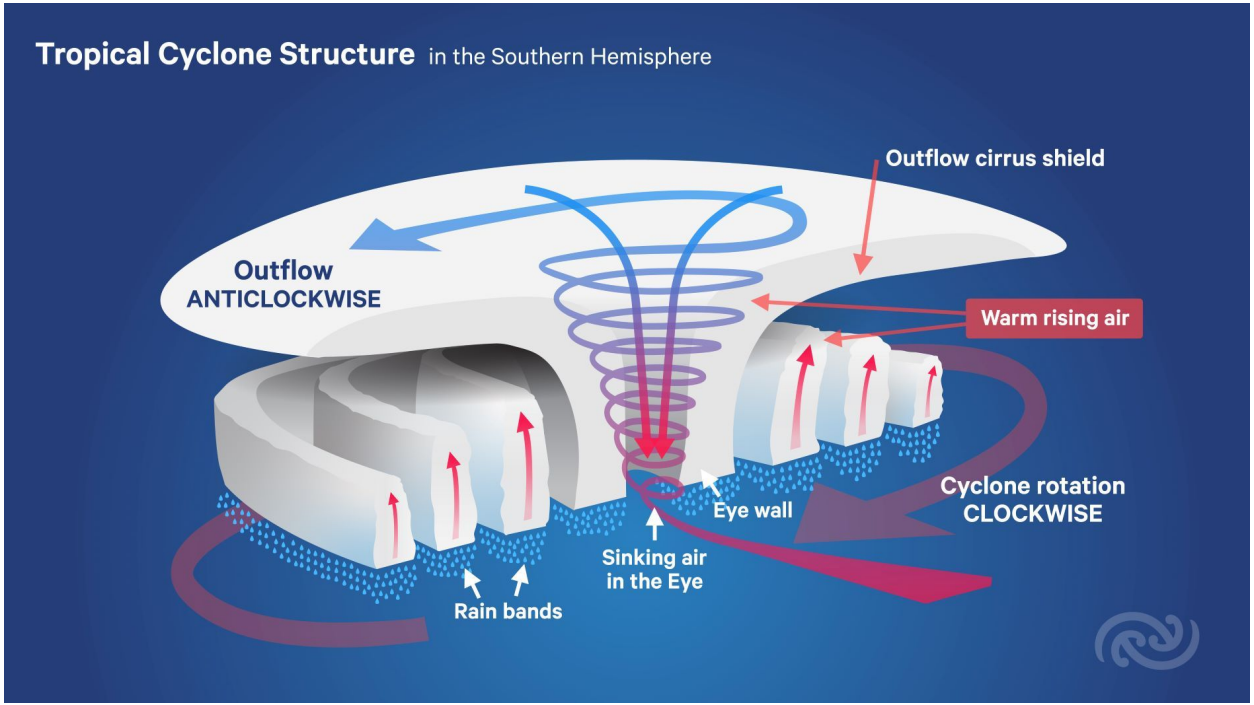
- Tropical cyclones are **large thunderstorm complexes** rotating around an area of **low pressure** that have formed over *warm tropical or subtropical ocean water*.
- Cyclones are the same as hurricanes and typhoons.

How does a cyclone evolve?

- Most tropical cyclones start but as small-scale disturbances.
- Due to intense convection activity → Cumulonimbus clouds form → Coriolis effect → Enlarge into rotating wind systems.

Tropical **Disturbance** → Tropical **Depression** → Tropical **Storm** → Tropical **Cyclone**

Tropical Cyclone Structure



Factors influencing the formation of tropical cyclones

Factors influencing formation

1. A location over the ocean with surface temperatures more than 27 d celcius.

- High temperature required for initial heat energy,
- High rate of evaporation → Condensation → Release latent into the atmosphere → Makes air lighter to cause surface low to strengthen → More moisture flow into the system.
- Intense convectional activity → To form cumulonimbus clouds.
- Friction-free surface → Continuous supply of warm moist air.

Factors influencing formation

2. Location between 5 to 20 degrees North and South of the equator

- Required for **coriolis force** to help wind spiral inwards towards the low pressure centre.

Factors influencing formation

3. Presence of an upper atmosphere air rotation (anticyclone circulation) in the upper troposphere.

- Stops rising air from advancing and allows air to draw outwards of the system at the top.
- A strong anticyclone would be able to **sustain the air circulation** within the low pressure area and continue to intensify and grow in size to become a cyclone.

Factors influencing formation

4. The absence of a vertical wind shear with altitude

- Small wind speed and direction changes with altitude is needed to **maintain maximum conventional activity** and cumulonimbus development over the region of low pressure.

Exam Requirements

- Be able to explain the factors that influence the formation of a tropical cyclone.
- Describe/Explain the pattern of occurrence/development of a tropical cyclone.

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Geography

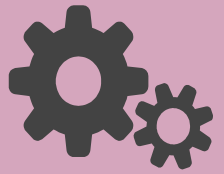
Floods

Causes

Characteristics/Mechanisms

1. **Flood Magnitude**
   - Impact/Strength of the flood
2. **Flood Frequency**
   - How often flooding takes place

→ Look at various **physical** and **human** factors that contribute to the flood magnitude and frequency.



Physical Factors

Excessive Precipitation

- Prolonged rainfall over several days means higher water content in rivers and on the surface.
- In the tropics → **Monsoon** rains, **Hurricanes/Cyclones** and **Convectional Rainfall** result in such excessive precipitation.
- Excessive precipitation → Can result in overland flow (hortonian) overtime when **rainfall intensity > infiltration capacity and rate**.
- Climate can **increase** both **flood frequency** and **magnitude**.

Basin Characteristics

Basin Size: Smaller basins respond more quickly than large.

Basin Shape: Basins that are equidimensional more likely to flood.

Relief: Steeper slopes = More surface runoff/overland flow.

No. of Tributaries: Dense stream network = more rapid to rainfall, shorter lag time.

Soil Antecedent Moisture Conditions

- When soil is saturated due to previous rainfall, subsequent rainfall cannot absorb/infiltrate soil → Soil reaches infiltration capacity faster → **Saturated Overland flow** → Likely to lead to greater **magnitude** of flood.

Coastal Storm Surges

- Storm surges are caused by low pressure systems (tropical cyclones) which increase water levels along the coast.
- Results in a sudden rise/**surge in water** along the coast which can overflow onto land.

Anthropogenic Factors

Urbanisation

Increase in magnitude and frequency of floods via:

- Creation of highly impermeable surfaces such as roads, roofs, pavements → **Increase in overland flow**.
- Construction of dense network of smooth. Drains, gutters and underground sewers → **Increase drainage density**.
- Modification of natural river channels → Fall in carrying **capacity**.

Deforestation

- Reduces infiltration capacity with lesser vegetation cover → Overland flow.
- Loosens soil binding capacity → Increase soil erosion → Increase in sediments that get washed to the river channel → Increase in clogging → **Greater flood magnitude**.

Exam Requirements

- Be able to explain and discuss the various factors that cause floods.
- Link the causes of floods to the flood frequency and magnitude for stronger evaluation.

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Floods

Effects

Effects of Floods

- **Socioeconomic** Effects of Floods
- **Environmental** Effects of Floods

Socioeconomic Effects

1. Death

- Flash floods have the highest potential to kill people.
- Tends to occur more **frequently in LDCs** due to lower level of preparedness and measures in place.
- Can result in long-term detrimental **mental impacts** on third parties (family members).

2. Health Hazards

- During a flood, sewage pipes are often broken → results in leakages into the flood water → Contaminates water → Leads to **water-borne diseases**.
- Such water can **infiltrate into peoples' homes** → Difficult to clean and rid off.
- Some may **consume** the contaminated water as well.
- E.g. Outbreak of diarrhea in the 2004 Bangladesh floods.

3. Damage to Property and Infrastructure

- One of the **biggest** economic effects of a flood.
- Water can cause a lot of damage to **property**, collecting large chunks of debris along the way such as cars, parts of buildings.
- Affects **local businesses**.
- Replacement/Repair of damaged infrastructure (power lines, water pipes) can be **very costly**.
- Less Developed Countries will suffer more economically.

4. Unemployment

- To fully recover from a flood, much time is needed.
- Businesses that are unable to fully recover from floods would leave more jobless, and possibly require laying off of workers to cut losses.
- Results in increased unemployment and lower living standards amongst households.

Environmental Effects

1. Erosion of Land

- As flood waters recede, there will be massive erosion of land due to fluvial processes and as a result of materials (debris) being dislocated and transported over ground.
- Increased soil erosion.
- Results in a changed physical landscape.

2. Destruction of Ecosystem

- Floodwaters will destroy large acres of natural vegetation → Home to many species of flora and fauna.
- When river floods onto farmland → Water may be polluted by **pesticides** → Brought to the river channels → Pollute and kill wildlife in the river.
- Higher levels of flooding may also kill animals on low-lying ground.

Evaluation

- This chapter is still part of your Physical Geography syllabus, hence, place more focus on the **physical effects** of floods (environmental effects).
- **Effects** of floods (both socioeconomic and environmental effects) are bound to occur, but the extent to which/severity can be **mitigated with the proper strategies** in place (next video).

Exam Requirements

- Be able to explain and discuss the various socioeconomic and environmental effects of floods.
- Use evaluation techniques where required to assess the significance of such impacts that floods have on society.

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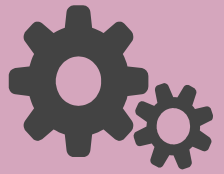
Floods

Strategies

Hard vs Soft Engineering

- **Hard engineering** involves strategies that are **tangible**, such as through the use of artificial structures.
- **Soft engineering** involves strategies that are **intangible**, and are more sustainable.



Hard Engineering Strategies

1. Levees/Embankments

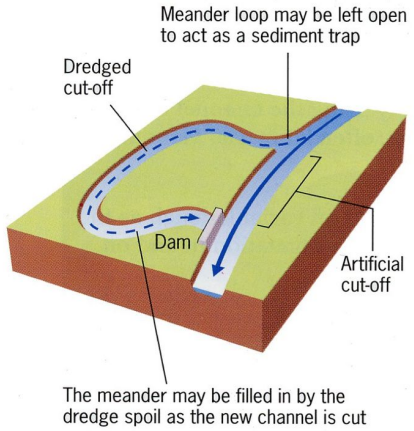
- Levees raised on river banks → Increase the height of the river banks → Prevents river from **exceeding bankfull discharge**.
- **Low-cost** strategy (through the use of sandbags).
- Requires **constant maintenance** and **strengthening** to ensure full effectiveness.

2. Dams and Reservoirs

- To store excess rainwater → Reduce impact of floods in immediate region.
- May not provide full flood control as all dams have life spns and are **limited by the durability** of construction materials.

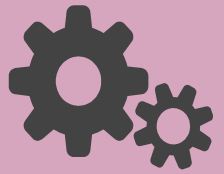
3. Channel Realignment

- To modify the channel by realigning → Helps to increase the **velocity** of the water and **direct floodwaters away** from important areas/**low-lying** areas.



4. Channel Dredging

- Keeps the channel **free from sediments**, **increases channel depth** and **channel capacity** to hold channel flow → Allows for **more water** to pass through.
- Reduces sedimentation of channel (process of sand and silt filling up the channel).



Soft Engineering Strategies

1. Land-use Zoning

- Involves **dividing the floodplain** into areas which experience **different degrees of flood risk**.
- Regulates land-use to take into account flood hazards.
  - **Higher-risk** areas will have **lesser developments**, increased flood-proofing and flood insurance in place.

Benefits: Can be highly effective in managing floods (addresses root cause).

Limitations: May not be realistic for existing urban areas as relocation comes at a high cost.

2. Evacuation

- Involves the people and property being removed from flood hazard area (through the creation of evacuation plans and backups).
- Requires adequate flood warning systems for effectiveness.
- Effectiveness of evacuation improves with increased warning time.

3. Loss Sharing (Insurance & Flood Aid)

- Disaster aid refers to any **aid and equipment, staff, and technical assistance** that is given to a community after a disaster.
- In DCs → Insurance is an important loss-sharing strategy, though **not all households have insurance**.
- In LDCs → Tends to **lack insurance** and flood aid, may require more regional/international assistance post-flood.

Limitations: May encourage people to continue living on floodplain rather than developing land elsewhere → Results in dire consequences when another flood hits.

Evaluation

- Soft-engineering strategies should definitely be the **preferred choice** over hard-engineering strategies.
  - Proper soft-engineering strategies can greatly **minimise the impacts** of floods.
- Hard-engineering strategies act more as a 'second-line of defence'.
- Nonetheless, a need for a **two-pronged approach** with the incorporation of both soft and hard strategies to ensure all potential failures are well-targeted.

Exam Requirements

- Be able to explain and discuss the various hard and soft engineering strategies in managing floods.
- Use evaluation techniques where required to assess the effectiveness of such strategies.

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Geography

Deforestation

Causes

Anthropogenic Factors

1. Excessive Logging

Commercial Logging:

- Hardwoods like teak take hundreds of years to grow and are still **high in demand** for **furniture**, construction materials → Chopping down of trees.
- Extraction of such trees also require **logging roads** into the forest → Leads to further clearing of forest.
- One of the biggest cause of deforestation → Companies tend to be the driving player behind this.

1. Excessive Logging

Subsistence Logging:

- For the purpose of cooking, heating, fulfilling of basic needs.
- Tends to be a **smaller-cause** of deforestation, but is an immediate problem at the **local scale** (when the less fortunate do not have direct access/require immediate resources).

2. Agriculture

Commercial Agriculture:

- Primary products are seen as an **income source** for less-developed countries → Avenue for them to boost growth.
- There is also an increasing **search** for **palm oil** (with the depletion in fossil fuels) → Requires extraction through deforestation.

2. Agriculture

Subsistence Agriculture:

- For the purpose of **immediate harvesting** by **small-scale farmers** for profit.
- Widespread due to the large number of poor people living in tropical areas.
- Deforestation conducted via **'slash-and-burn'** technique (e.g. Indonesia).

3. Mining Industries

- Increase in demand for world's **natural resources (oil, coal, rare elements)** → Countries and companies are looking at increasingly isolated locations such as rainforests to set up extraction sites.
- Oil and coal mining requires **huge areas of land and roads** to be constructed for **transportation** of materials → Further clearing of forests.
- A factor that is on the rise due to scarcity and hunger for profits (by TNCs).

Natural Factors

1. Forest Fires

- Forest fires may occur in areas with **extreme warm summers** and **milder winters**.
- Forest fires that are **uncontrollable** can destroy thousands of acres of forest.
- E.g. California, Bushfires in Australia (New South Wales, etc.)

Other Factors (Stakeholders)

1. Debt - DCs vs LDCs

- Many developed countries which face a **lack of natural resources** may tap on resources of **financially poorer** countries which are resource-rich.
- In order to **waive some debts**, many less-developed countries **have to allow TNCs** in developed countries to set up factories/operations that require deforestation for land.
- A power struggle between DCs and LDCs.

Evaluation

- The ultimate drivers of deforestation would be **population growth** and **industrialization** → Adds pressure on the forests due to greater need for materials to create value-added goods.
- A need for **strong governance** to **govern forest-usage** and ensure deforestation is kept to a minimum.

Exam Requirements

- Be able to explain and discuss the various causes of deforestation (Human factors, Natural factors and Other factors).
- Use evaluation techniques where required to weigh and determine the underlying root causes of deforestation.

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Deforestation

Effects

Local Scale

1. Increase in Soil Erosion & Sedimentation

- **Soil erosion accelerates** with deforestation → Absence of vegetation which acted as a natural barrier and binds soil to slow water as it runs off land.
- **Increase in sediments** washed into river → **Sedimentation** or **silting** of ivers.
- Affects **quality of water** in the river and **impacts ecosystems**.

2. Increase in flood frequency and magnitude

- **More overland flow** due to **lesser infiltration** and interception.
- Results in **higher occurrence of flash floods** due to higher overland flow.
- Soil erosion creates higher amounts of sediments in the river → Results in **silting** and hence greater flood potential.

3. Displacement of indigenous communities

- When forests are cleared/deforested to open up areas for mainland-people, **access to forest resources by indigenous people are ignored**.
- Results in the destruction of traditional lifestyles, customs, homes, infrastructure for development such as roads, commercial buildings from the mainland → **Social injustice**.

National Scale

1. Loss of natural resource

- Rampant deforestation in a country can **deplete its only source of natural resource** (wood/trees in this case → finite resource).
- *Indirect effects*: Radiation absorbed by ground increases → Increase in surface temperature

2. Regional Climate Change

- Deforestation can impact regional climate change, including feedback effects.
- Rainforest soil loses fertility very quickly after deforestation → Leads to **desertification** and **degradation of soil quality**.

Global Scale

1. Contribution to global warming

- Lesser forests equates to increase in atmospheric concentrations of greenhouse gases → Results in a net increase in global mean temperature.
- Trees that are deforested also **releases stored carbon**, and there is a **reduction in photosynthesis**.

Exam Requirements

- Be able to explain and discuss effects of deforestation.

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Deforestation

Strategies

1. Selective Logging

- Selective logging refers to passing a law that trees of a **certain size/age** are allowed to be cut down.
- By doing so, younger trees are prevented from being cleared away, thereby ensuring safer management of the forest.
- Selective logging can be done via the tagging of trees for identification purposes.

2. Reforestation

- Referostation efforts refer to the **planting of new trees** to replace those that have been deforested.
- A **long and tedious process** that requires a lot of manpower, as well as **long waiting time** for the trees to grow in order to see its positive effects.

3. Protection and Conservation

- Protection and conservation efforts involve the implementation of **environmental laws** that prevents the logging of trees, as well as banning of acts such as illegal logging → Protects the forest by preventing deforestation directly.
- Alternative conservation efforts such as the construction of **national parks and nature reserves** will allow for the conservation of the forests as it **prevents logging activites from taking place in cordoned off areas** → May require further maintenance and regulations.

4. International Policies

- International efforts such as world-wide programmes and frameworks can be implemented to deter deforestation.
  - **REDD (Reducing Emissions from deforestation and degradation) programme**: Introduced by the United Nations, offered monetary incentives to encourage LDCs to curb deforestation.

4. International Policies

- **Sustainable Development Goals**: SDG 15 is titled 'Life on Land' → A framework that encourages all countries to adopt national and international efforts to protect and restore forests.

- International policies are important as they steer all governments into the correct direction when implementing polcieis to fight deforestation, but may be **hard to track** if countries are progressing or not.

Exam Requirements

- Be able to explain and discuss the various strategies used to combat and curb deforestation.

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