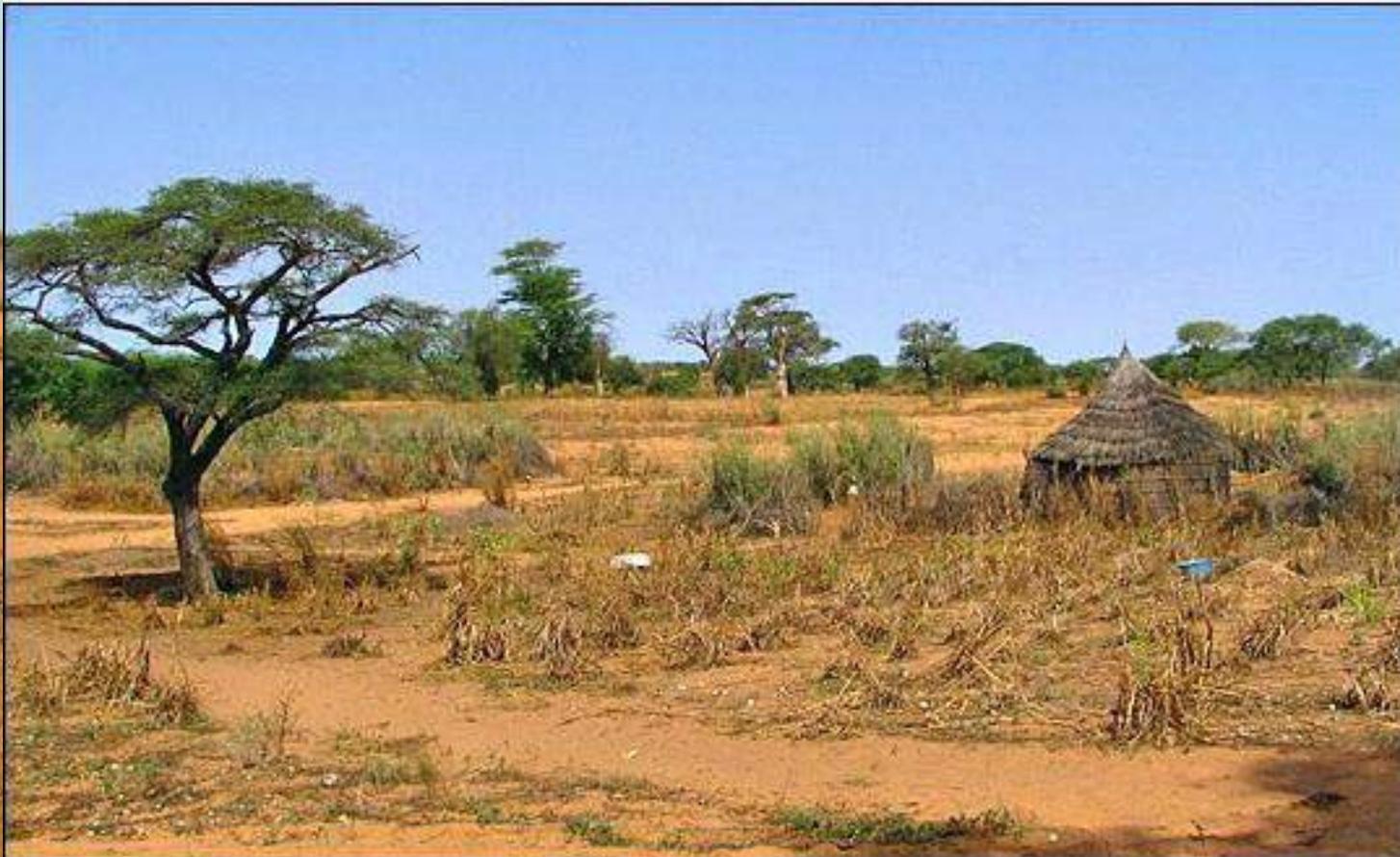


# RURAL GEOGRAPHY

## Case Study: The Sahel



# What are the outcomes?

## **1. Use a range of research skills and techniques in human environment contexts by:**

- 1.1 Identifying suitable sources of geographical information
- 1.2 Collecting geographical information using at least two gathering techniques, including fieldwork where possible
- 1.3 Processing geographical information using a range of techniques
- 1.4 Analysing geographical information

## **2. Draw on and apply knowledge and understanding of the processes and interactions at work within human environments by:**

- 2.2 Giving detailed descriptions and detailed explanations of a process/interaction at work within rural environments in a developed and a developing country
- 2.3 Giving detailed descriptions and detailed explanations of a complex issue relating to human environments in a developed and a developing country

# What you need to know:

- What RLD is
- What the human and physical causes of RLD are
- What the consequences of RLD are
- What solutions there are to RLD and how effective they are

<https://www.youtube.com/watch?v=403sT9CGRI0>

# Rural Land Degradation in Context

- Across the world the human population continues to increase at a rapid pace – [Population clock](#)
- This puts enormous pressure on the food supply chain, which in turn puts pressure on the land
- Grasslands, forests and soils are being degraded to grow food for the world's growing population
- Some ecosystems have been damaged to a point beyond recovery
- Estimates vary for annual soil loss between 500 million and 75 billion tonnes per year
- Expanding world population has cut the grain land per person in half, from 0.23 hectares in 1950 to 0.10 hectares in 2007.

# What is Rural Land Degradation?

- Rural land degradation basically means soil deterioration.
- Soil is said to be deteriorated if it cannot support the vegetation cover it previously supported.
- Degradation occurs when the soil is exposed to erosion (wearing away). If this happens faster than soil formation the soil will begin to degrade.
- Soil erosion results from both physical conditions and human activities
- In the Sahel rural land degradation takes the form of desertification: when soil degrades the land turns to desert



Task: Explain what rural land degradation is in your own words.

# Soil erosion processes

- Rainsplash
- Sheet erosion
- Gully erosion

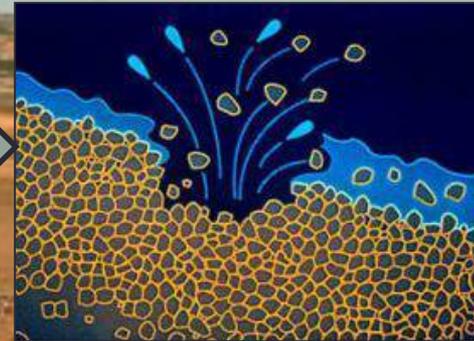


# Rainsplash erosion

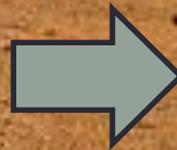


Draw a series of diagrams to describe the process of rainsplash erosion

- 3 step process
- Detachment  $\longrightarrow$  Transportation  $\longrightarrow$  Deposition
- Rain breaks up soil into individual particles by direct impact (**rainsplash**) lifting the particles and dropping them in new positions. On sloping ground rainsplash shifts the particles down hill.



Raindrop lands on a wet soil surface. The larger the raindrop, the faster it falls and the harder it hits the soil.



A miniature crater is produced and grains of clay and silt are thrown into the air. These may be blasted up to 2 meters horizontally.

# Tasks



Write the heading “Rainsplash erosion” and answer the questions below in detail:

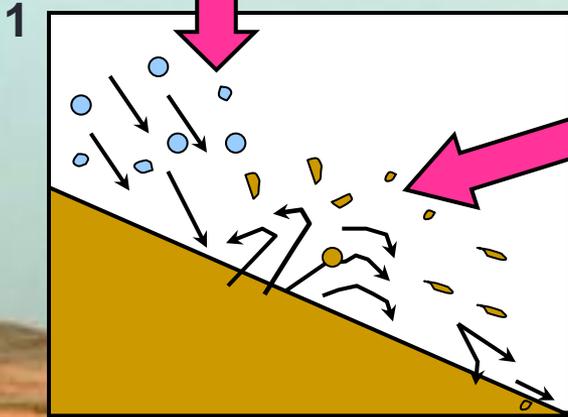
1. What are the main causes of rainsplash erosion?
2. How does the size of the rain drop affect its impact on the soil?
3. What feature forms on the soil surface as a result of rainsplash erosion?
4. How does the gradient/slope of the land influence rainsplash erosion?

# Sheet Erosion



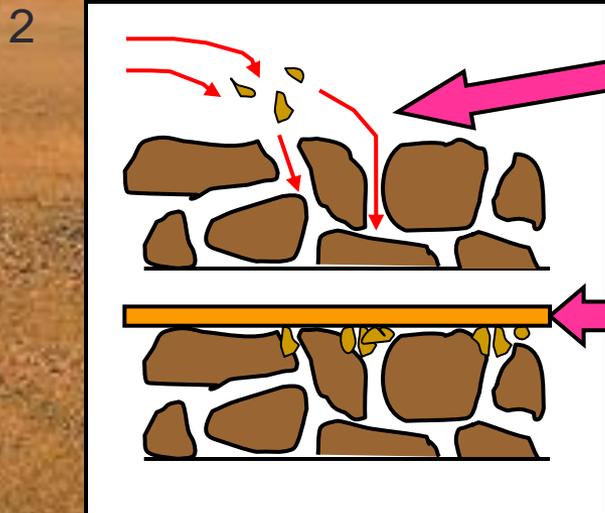
Collect a set of diagrams and stick them into your notes. Add on the labels to explain the process of sheet erosion

Raindrops blast the soil surface



Crumbs of soil are broken into smaller pieces

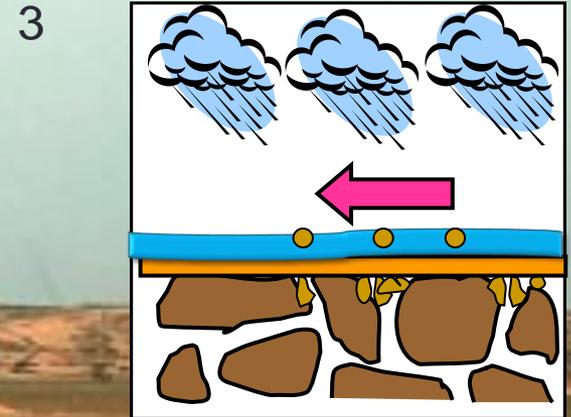
These particles are scattered by the impact



Soil crumbs have spaces or "pores" between them

The small particles are blasted into these pores

The end result is the formation of a crust across the soil



The newly formed crust reduces the infiltration capacity of the soil

This results in less absorption and increased surface run-off which picks up the displaced soil particles and transports them down slope

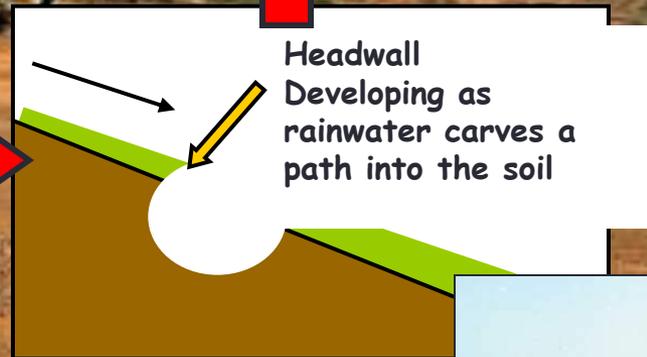
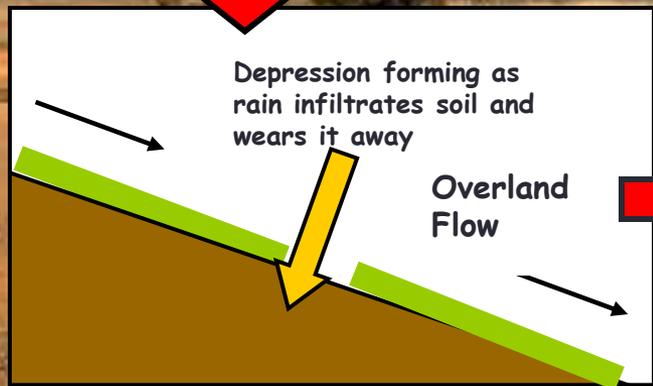
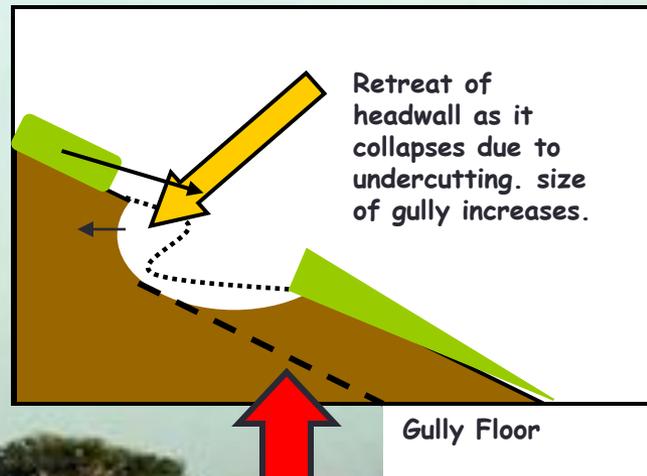
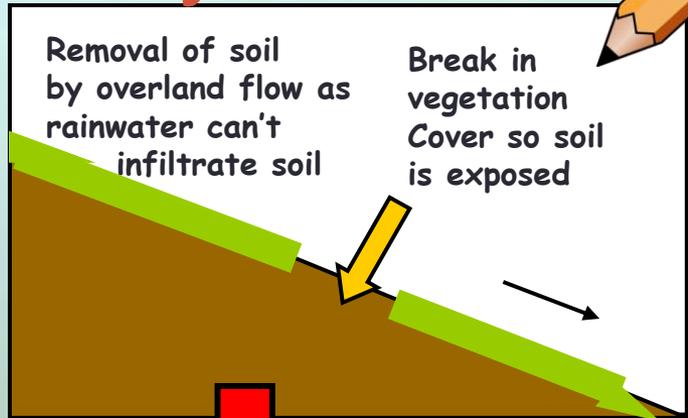
# Sheet Erosion (Sheet wash)

Write the heading “sheet erosion (sheet wash)”

Answer the questions below in detail:

1. Describe the 2 main initial impacts that raindrops have on the soil surface.
2. How do the soil pores contribute to the erosion process?
3. What does the newly formed soil crust consist of?
4. Explain in detail how this crust contributes to the processes of soil erosion and degradation.

# Gully erosion



# Rill and Gully Erosion



- Describe and explain the main differences between rill erosion and gully erosion.

Rill erosion affects only the topsoil (approx. 30 cm on mature arable soils) while gully erosion bisects the entire soil profile. Gullies in tropical climates can progress rapidly beyond the stage where they can be filled in.

Rills are shallow drainage lines less than 30cm deep. They develop when surface water concentrates in depressions or low points through paddocks and erodes the soil.

Rill erosion is common in bare agricultural land, particularly overgrazed land, and in freshly cultivated soil where the soil structure has been loosened. Rill erosion is often described as the intermediate stage between sheet erosion and gully erosion.

Gullies occur when smaller water flows concentrate and cut a channel through the soil. Most gullies extend upslope as a result of the head of the gully being continually undercut and collapsing. However, collapse and slumping of sidewalls usually contribute a greater proportion of soil loss.

# Wind erosion: nature and processes

Read the information sheet provided on wind erosion and answer the questions below:



1. Outline the 3 steps involved in the process of soil erosion by wind.
2. For each of the factors that influence the process of wind erosion try to explain the effect.
3. Describe and explain the processes of suspension, saltation and surface creep.
4. Explain the relationship between the size of soil particle and the process of wind erosion that takes place.



Below are several stages in the process of desertification. Arrange them into a flow diagram to show the sequence of events.

Land Degradation

Misuse of topsoil by monoculture, overgrazing.  
Soil compaction by animals/machinery

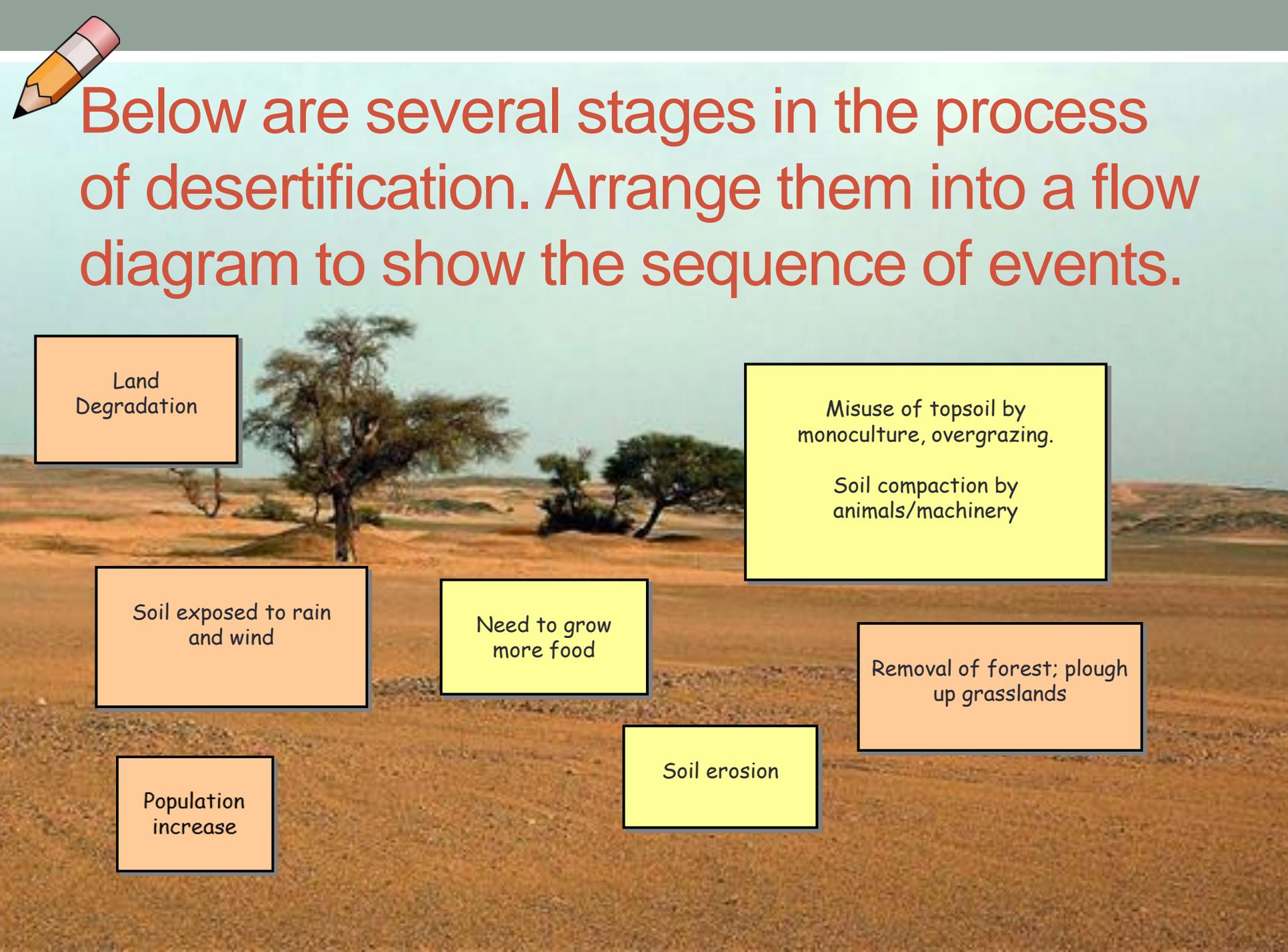
Soil exposed to rain and wind

Need to grow more food

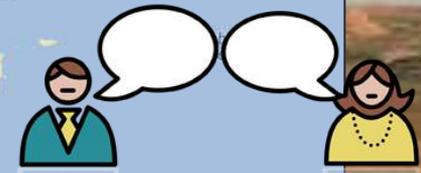
Removal of forest; plough up grasslands

Population increase

Soil erosion

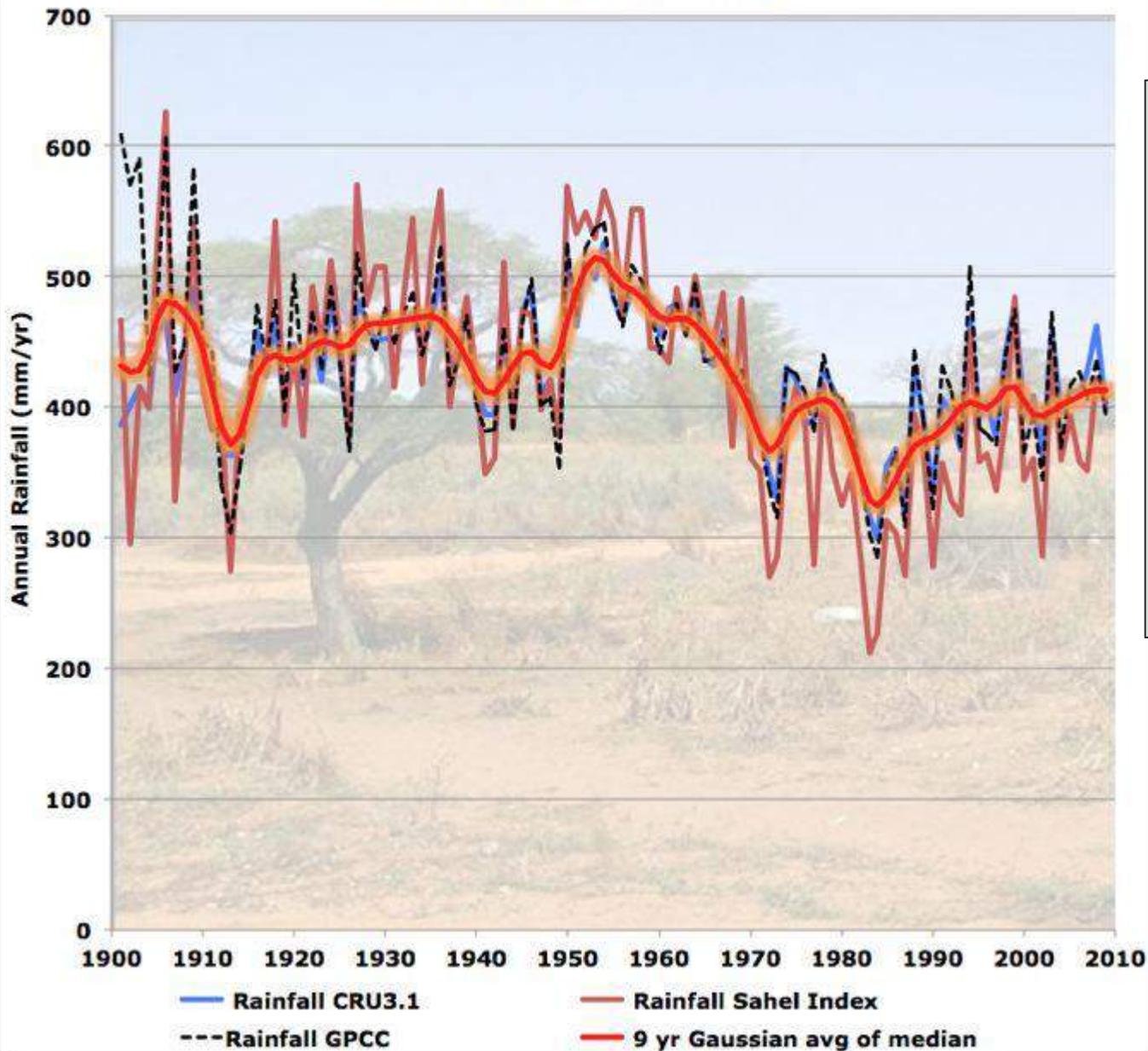


# Where is the Sahel?



**Paired discussion:**  
What climate would you expect to find given the Sahel's location?  
What problems might this cause?

## Sahel Rainfall, 1901 – 2009



Answer the following questions:

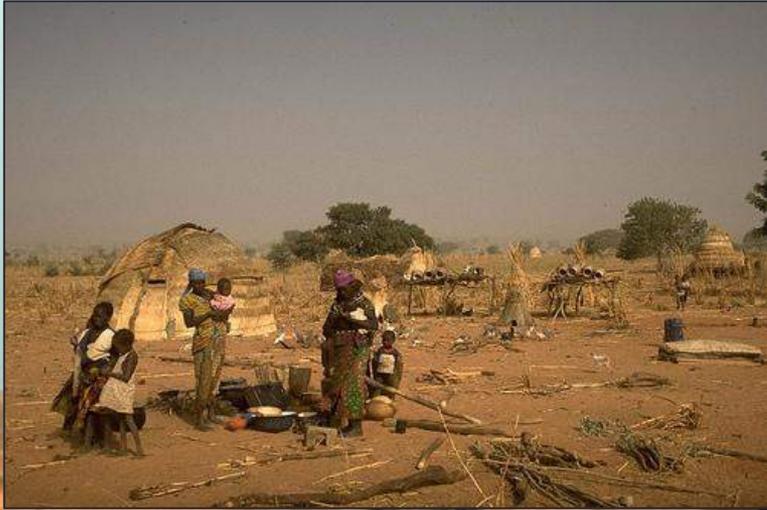
- What has happened to the rainfall in the Sahel since 1950?
- What impact will this have on the soil? EXPLAIN in detail.



Copy the table below and use the information on the next few slides to complete it.

Physical Causes of RLD	Human Causes of RLD

# Human causes of land degradation:

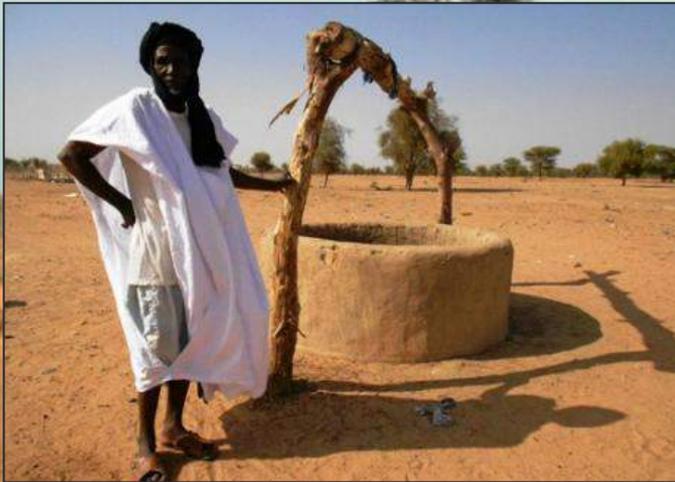


## Population growth leads to:

- **over-cultivation** and often involves farming on more marginal and more fragile land and decreases the fallow period so land cannot recover
- a larger demand for firewood collection which causes **deforestation**
- 90% of the population of the Sahel rely on wood for fuel, so trees, particularly around towns and villages, are felled on a daily basis.
- **over-grazing** destroys vegetation cover

# Human causes

**Water shortages** lead to the demand to dig more wells which further lowers the water table



**Poor irrigation** leads to evaporation of stagnant water leaving a salty and infertile crust.

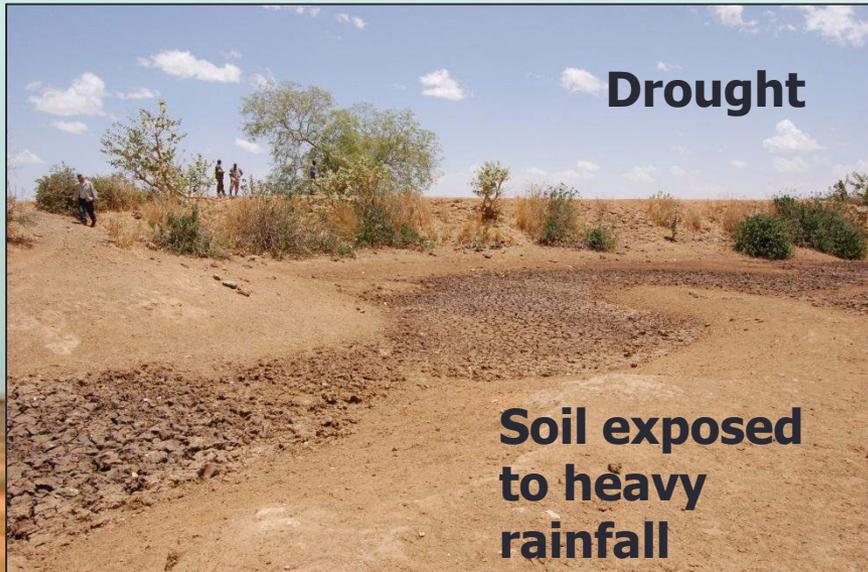
In some cases, large scale irrigation projects such as the Tiga Dam and Kano River Project have forced people from the best farmland onto marginal areas which they have over cultivated and overgrazed, so desertification has taken place.



Use of **inappropriate farming techniques** further degrades fragile soil – the best land is used to grow cash crops which forces food production onto more marginal land. Many farmers have been forced to grow cash crops such as cotton and rice. This results in them practising monoculture (growing only one crop year after year). As a result the soil is rendered infertile and its nutrients depleted. The infertile, nutrient-less soil is easily eroded and desertified.



# Physical causes of land degradation:



- A fall in the water table caused by **drought** and wells means roots can no-longer reach water and plants die.
- Lack of vegetation **exposes soil** to rainfall and wind.
- **Droughts** also dry out the soil and leave it more vulnerable to **wind erosion**.

# Physical causes

**Droughts** are occurring in the Sahel with greater frequency than previous years. In Burkina Faso for example, the water table dropped by 20 metres between 1920 and 1995.

The movement of the Inter-tropical Convergence zone (**ITCZ**) heavily influences the climate and the likelihood of desertification.

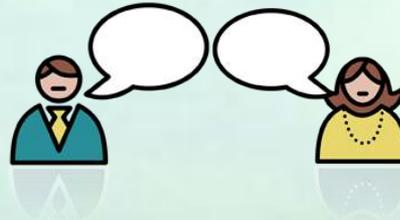
Winter brings the cool dry season as Tropical Continental air and the Harmattan wind dominate the Sahel bringing long months of drought.

In Summer, as the ITCZ moves north, warm wet Tropical Maritime air should move into the Sahel bringing much needed rain, but this has failed to happen recently and so the Sahel is influenced by Tropical Continental air and therefore dry all year round. The dry, unvegetated soil is easily eroded.



Namibia, the driest country in sub-Saharan Africa, is currently facing its worst drought in 30 years. September 2013

# Paired discussion



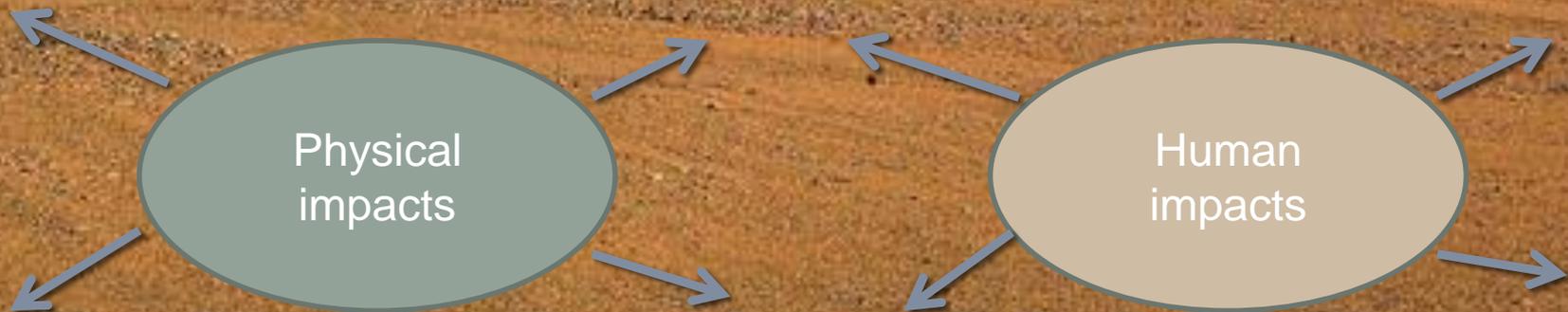
- Human factors are more to blame for rural land degradation in the Sahel than physical factors.
- Do you agree with this statement?
- Discuss as a pair and be ready to feedback your answer with reasons.

# The impact of land degradation in the Sahel



With a partner discuss the impact of land degradation in the Sahel that you would expect to find based upon what you have in your notes about the causes.

Create two mind maps as shown below and add on as many ideas as you can



# Physical impact – check your answers

Desertification has become so severe that it has led to the southward expansion of the Sahara desert into the Sahel. In the last 50 years, 65 million hectares of the Sahel have turned into desert.

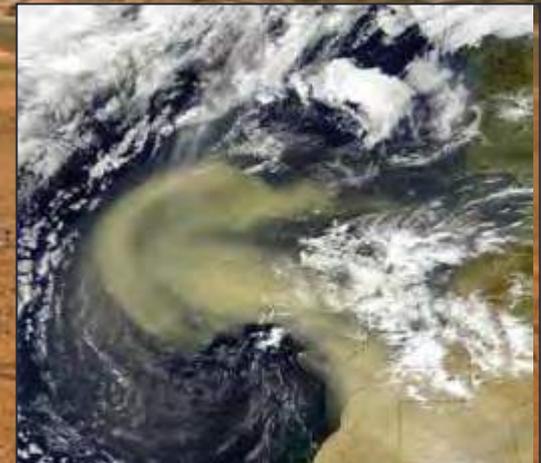
The misuse of fragile soils through over cultivation, overgrazing and deforestation, coupled with the frequency of drought periods has left the Sahel soil bare and exposed to the elements

Physical impact

Intense tropical downpours have cut rills and gullies in the landscape.

In Mali, Burkina Faso and western Niger rainfall has almost doubled since the droughts of the 1980s.

Loose topsoil is easily blown away by the strong Harmattan wind



This map shows a huge dust storm over West Africa on the 26th of August 2000, caused by strong Harmattan winds.

# Human impacts – check your answers

Malnutrition has been exacerbated by the reduction in variety of crops grown in order to concentrate on cash crops.

The failure of crops year after year has led to widespread starvation and famine in the Sahel. From 2010-2012 East Africa was hit by the worst drought in 60 years. Somalia, Djibouti, Ethiopia and Kenya were badly hit. In Somalia alone an estimated 260 000 died.

Migration has also led to the loss of traditional ways of life and farming techniques and in some cases has caused a demographic imbalance in rural populations. In Niger for example younger men leave in search of an alternative income, leaving the women, children and elderly at home.

Human impacts

Economically, farmers have lost their income as a result of poor crop yields and repetitive crop failures. They can no longer afford to pay for their basic needs, such as food, schooling and healthcare for their families

Conditions in relief camps are often poor, with overcrowding, disease and a lack of food and water. Conditions like cholera and TB increase the already high death tolls.

The degradation of farmland has forced many people to migrate away from their Sahel lands in search of new land to farm. Many have been forced to trek long distances in search of a better future for themselves and their families. Many migrants end up in relief camps, relying on aid from agencies like Oxfam.

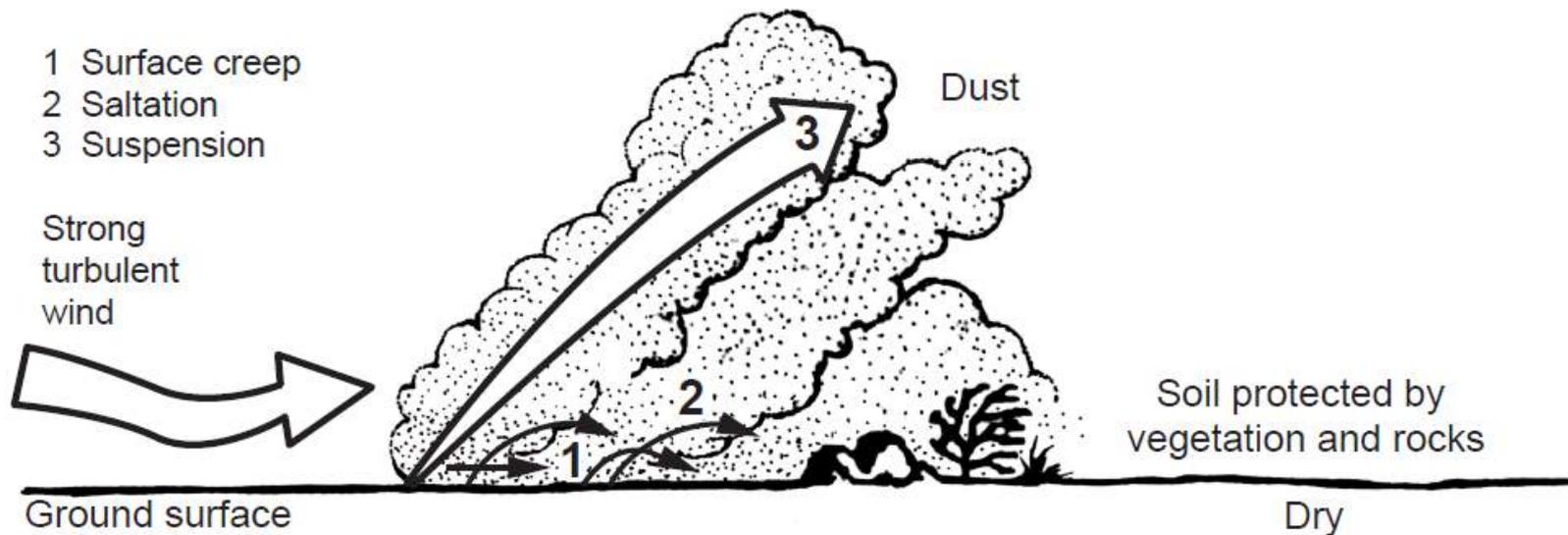
# Exam practice



explain the processes of soil erosion by wind.

6

Diagram Q2: Selected processes of wind erosion



Explain how **human activities**, including inappropriate farming techniques, have caused land degradation in Sub Saharan Africa.

7

# Mark Scheme

The three main processes can be described from the reference diagram:

- Surface Creep – the slow movement of the larger particles across the land surface.
- Saltation – the ‘bouncing’ along of lighter particles.
- Suspension – the lightest particles (dust) being blown in the air.
- The explanation should focus on the principle that the wind can move smaller (lighter) particles more easily than larger (heavier) particles – hence the difference in process.
- The largest (and heaviest) particles (stones and boulders) will not be moved by the wind.

-

# continued

- Answers should include explanations in the four areas of human activity (Africa north of the Equator):
- Deforestation for firewood and farmland left soil exposed to erosion, removed root systems which would hold soil together, and removed shelter belts and wind breaks.
- Overgrazing exposed soil to winds by loss of vegetation cover, hooves break up soil making it susceptible to wind and water erosion, and in some cases compact the soil, especially near water holes.
- Overcropping means soil structure breaks up, with monoculture depleting nutrients, reduced fallow times meaning soil cannot rest or recover, marginal land eg slopes being used and becoming susceptible to wind and water erosion.
- Inappropriate farming techniques including monoculture, inappropriate ploughing eg deep ploughing of fragile soils, irrigation leading to salinisation, lack of organic fertilisers used.

# Exam practice



1. Referring to named locations in Africa north of the Equator **explain** the impact of land degradation on the people, economy and the environment.



# Mark Scheme

For **Africa, north of the equator** descriptions may include:

- Desertification has become so severe that it has led to the southward expansion of the Sahara desert into the Sahel.
- Intense tropical downpours have cut rills and gullies in the landscape.
- Sahel soil bare and exposed to the elements. Loose topsoil is easily blown away by the strong Harmattan wind
- Crop failures and the resulting malnutrition leading to famine eg Sudan, Ethiopia and much of the Sahel.
- Economically, farmers have lost their income as a result of poor crop yields and repetitive crop failures. They can no longer afford to pay for their basic needs, such as food, schooling and healthcare for their families
- Southward migration on a large scale – usually into shanties on the edge of the major cities.
- The collapse of the nomadic way of life due to the lack of grazing and water.
- Many nomads forced to settle in villages – with a consequent increase in pressure on the surrounding land.
- The breakdown of the settled farmer/nomad relationship in places like Northern Burkina Faso.
- Disease and illness can become endemic.
- Conflict within countries as people move and re-settle.
- Countries increasingly rely on international aid.

# Solutions

- Collect a worksheet “Solutions to rural land degradation in the Sahel”
- In pairs discuss the solutions 
- For each solution aim to identify one advantage and one disadvantage – add this to your table 
- Now make a decision – you are working for the FAO and have been allocated a team of ten UN workers, \$1 million and 2 years to tackle rural land degradation in Namibia
- How do you spend your time/money?
- Give reasons to justify your answer. 

# Case study 1 – The Eden Foundation in Nigeria

The project worked to educate farmers about growing perennial plants to protect the soil against heavy rain.

Where farmers intercrop annuals with perennials, their land will produce more food both from the perennials and from increased yields from annuals lessening the pressure to move into the natural green belt.

It is both more difficult and costly to repair the damage already done to the agricultural land and the natural green belt than to maintain them in good condition.

Plant coverage prevents rainsplash from dislodging fine particles and binds the loose soil.



Eden's solution leaves farmers to revegetate by their own initiative. They then retain their dignity as Westerners are not revegetating their land for them but at the same time Eden supports their work by researching species that they will use.

The Director of the National Department of the Environment in Niger said that 250,000 hectares are being lost each year in Niger through desertification.

The soil does then not have to be ploughed so the soil structure remains intact. The organic matter holds the soil particles together.

For more details click on this link

<http://www.fao.org/partnerships/great-green-wall/in-action/activities/en/>

Make notes



# Case Study 2 – The Great Green Wall

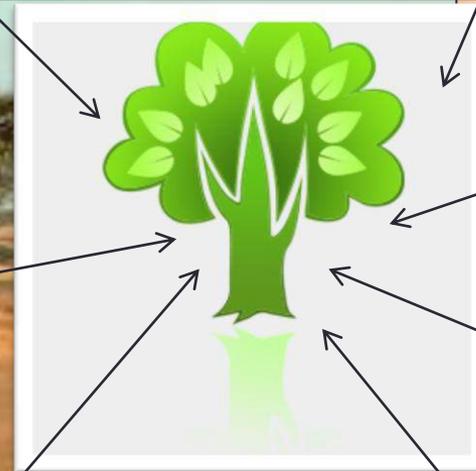
In 2007 Africa's Heads of State and Government endorsed the Great Green Wall for the Sahara and Sahel initiative

Main aim: to tackle detrimental social, economic and environmental impacts of land degradation and desertification in the region.



Bench terraces have been constructed to initially reduce run-off.

Countries involved: Algeria, Burkina Faso, Chad, Djibouti, Egypt, Ethiopia, the Gambia, Mali, Mauritania, Niger, Nigeria, Senegal and the Sudan.



In one year more than 100 hectares of land has been won back

Uses forests, rangelands and other natural resources to improve soil quality in drylands e.g. strips of vegetation such as Makarikari grass which can then be used as fodder. Grass binds soil, reducing erosion potential

Initial idea was to create a line of trees from the East of Africa to the West. This has now evolved into a mosaic of interventions focusing on sustainable land management strategies.



# Exam practice



1. For named areas in Africa north of the Equator:
  - a) **explain** soil conservation strategies that have reduced land degradation;
  - b) **comment** on the effectiveness of these strategies.



# Mark scheme

For **Africa, north of the Equator**, answers may include:

- Diguettes or 'magic stones'
- Dams built in gullies
- Animal fences
- Dune stabilisation

Possible answers might include:

**Eden Foundation in Nigeria:**

- Educated farmers to grow perennial plants to protect the soil against heavy rain. (1 mark)
- They prevent rainsplash from dislodging fine particles and bind the loose soil. (1 mark)
- Farmers produced twice as much millet (drought-tolerant crop) as those who did not use this technique. (1 mark)
- Undisturbed by ploughing, the soil structure will remain intact. (1 mark)  
Organic matter holds the soil particles together.
- Stone lines are commonly used in Burkina Faso and Niger, to trap soil and water, and slow run-off. (1 mark)
- Instead, water will sink into the soil through the cracks and pours, preventing erosion. (1 mark)
- Strips of vegetation can also be used in a similar way, and can provide fodder for animals (eg Makarikari grass) or a cash crop of pumpkins could be grown. (1 mark)
- Build wells to allow effective irrigation. (1 mark)
- Contour ridges slow run-off and catch sediment before it is washed away. (1 mark)

**Afforestation**

- To prevent soil erosion as roots will bind the soil and hold it in place. (1 mark)
- Fanya juu terraces (popular in Makanya in north-eastern Tanzania) can be made by digging a drainage channel and throwing soil uphill to make a ridge. In drier areas, trees can be planted in the ditch, and in wetter areas on the ridge. (1 mark)
- In Makanya, maize is grown between the trenches. Maize crops have increased from 1.5 tonnes per hectare to 2.4 tonnes per hectare. (1 mark)

Put in your own examples from your case studies

Notice how you can evaluate as you go! You can add some disadvantages too

# Evaluation continued

Some example points from old Higher mark scheme:

For **Animal fences** – movable fencing allows farmers to restrict grazing animals to specific areas of land and allows remaining land to recover. This allows farmers to move animals between fenced areas, reducing the dangers of overgrazing and trampling of soil and allowing the soil and land to recover between grazing sessions.

For “**Magic Stones**” – This is a simple but very effective method of conserving soil. Diguettes are lines of stones laid along contours of gently sloping farmland to catch rain water and reduce soil erosion. Diguettes allow the water to seep into the soil rather than run off the land. This prevents soil being washed away and can double the yield of crops such as groundnuts.