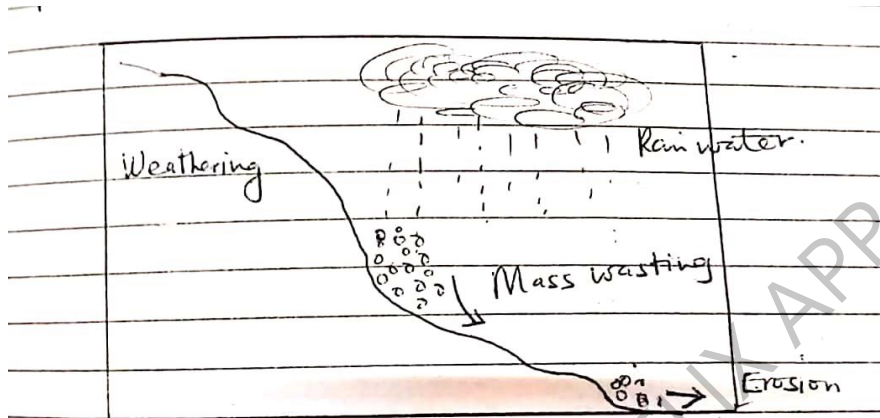


MASS WASTING IN EAST AFRICA

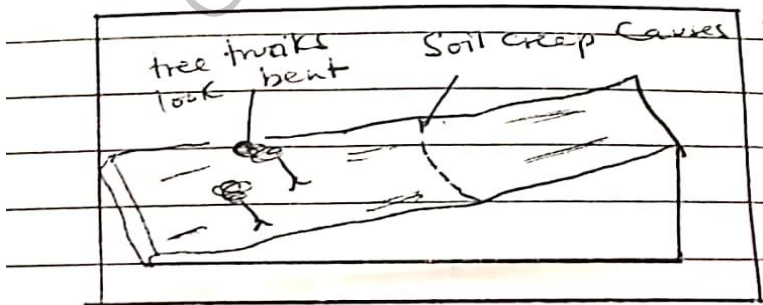
Mass wasting or slope movement or mass movement is the movement of the layers of loose rock particles downhill-slope under the influence of gravity. Mass wasting is an important part of the erosional processes as it moves material from higher elevation to lower elevations where transporting agents like streams and glaciers pick up the material and move it to lower elevations.



TYPES OF MASS WASTING

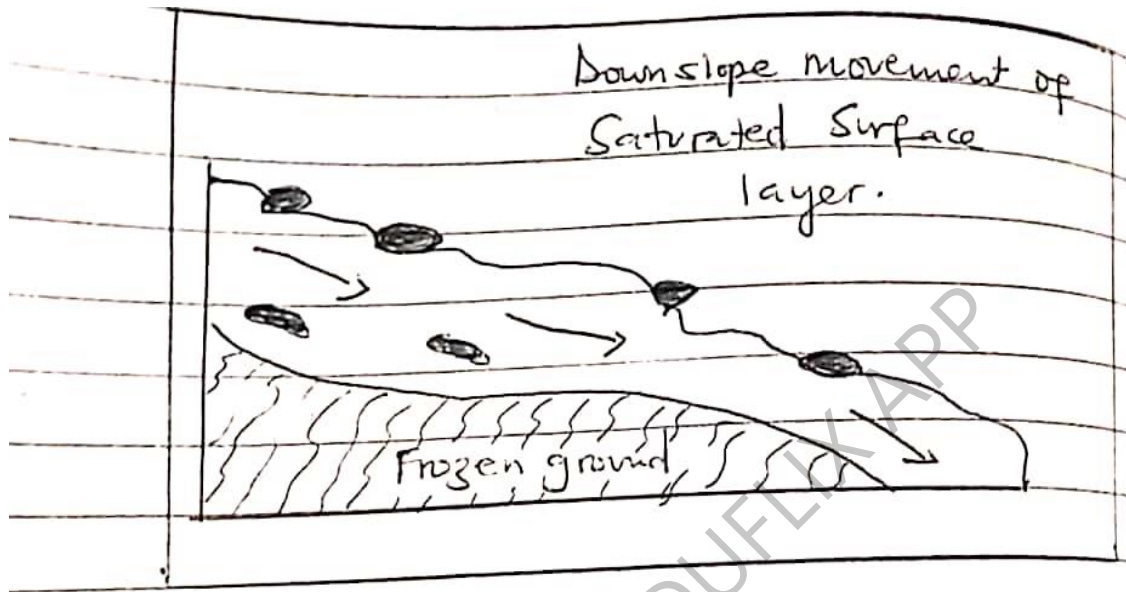
1. Soil Creep.

This is the lowest types of mass movement usually a continuous movement of soil and rock particles down slope. It occurs on almost all slopes. It occurs when rain water lubricates soil particles and enables them to slide over each other. Boulders and stone in the soil are carried down slope by the soil. Soil creep is a slow movement but can be seen by fences and trees that lean down the slope and by bulging walls. Fences to bulge.



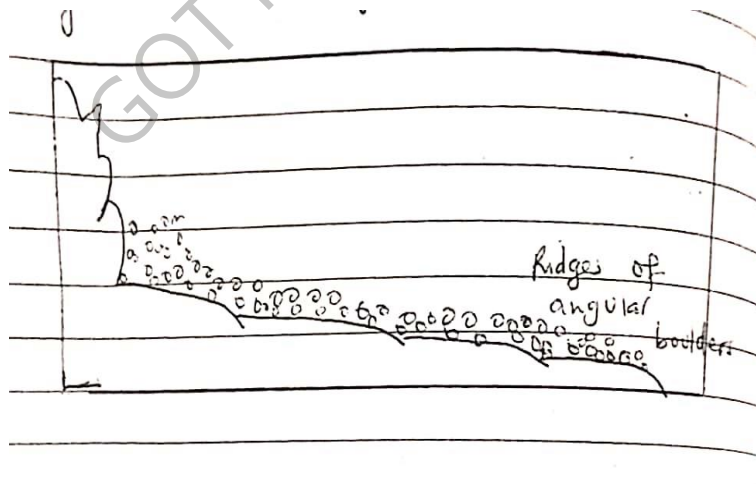
2. Solifluction

This type of mass wasting takes place when weathered rock pieces slide down the slope over impermeable rocks or materials due to lubrication by water. It occurs where freezing causes a saturated surface layer to creep as a mass over underlying frozen ground.



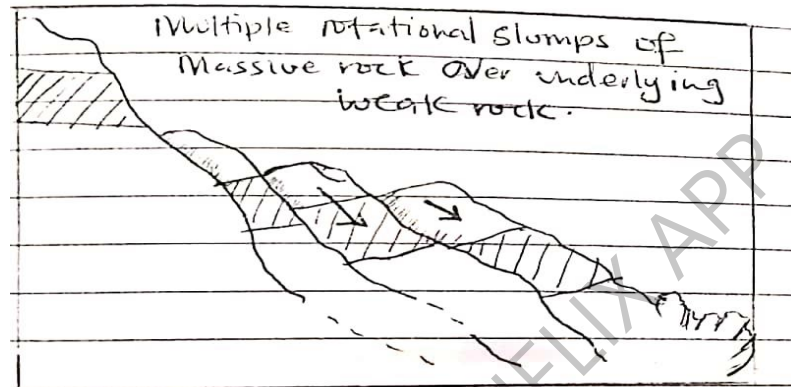
3. Talus Creep

These results when rocks or debris slide down a pre-existing surface such as a bedding plane on rock joints. Piles of talus or scree are common at the base of a rockslide/debris is no rotation of the sliding rock mass along a curved surface.

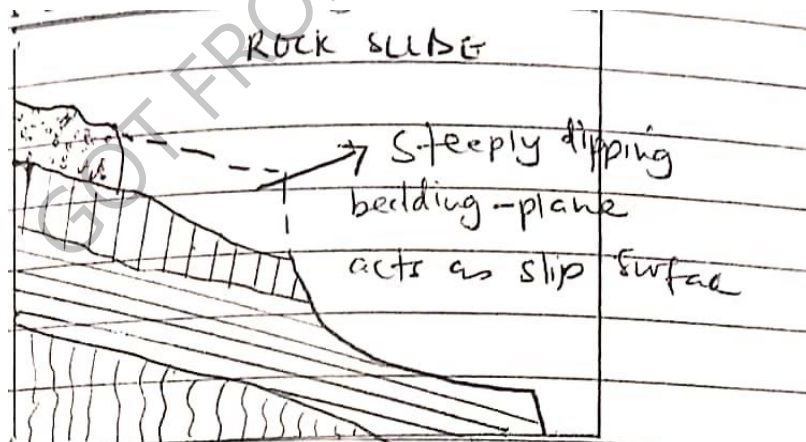


4. Land slides

- **Mud flows.** These are moderate and fluid types of downhill wasting. They are highly fluid and occur in areas with abundant unconsolidated sediments that can be picked up by streams. After heavy rains, streams can turn into mud flows as they pick up more and more loose sediments.
- **Slumping.** This involves fast/rapid movement of large masses of rocks & debris along a steepened slopes under the influence of gravity.



- **Rock Fall.** It is the fastest form of landslides. It involves a free fall of boulders along very steep and vertical slopes at a very fast speed under the influence of gravity. It occurs on Mt. Elgon and Rwenzori.



- **Rock slide:** This involves detachment of large quantities of rocks and environment. Rocks slide down under the influence of gravity and common in Kigezi and Kenya highlands.

FACTORS INFLUENCING /CAUSES OF MASS WASTING

1. **Relief.** Gentle slopes lead to occurrence of slow movement e.g. solifluction, soil creep along the foot hills of mountains where as steep slopes/gradient lead to faster movements like rock fall.
2. **Climate.** Heavy rainfall makes the rocks soft and weight and increases and friction between the rock particles reduces leading to movements inform of slumping, mud flow, rock fall etc. e.g. Bududa landslides along mountain Elgon.
3. **Nature of the rock.** Soft rock easily absorbs water and their cohesive force reduces hence easily moved down slopes under the influence of gravity where as hard rocks will not easily absorb water. Massive permeable rock overlying impermeable ones will lead to slumping, rock slides etc. e.g. along Mt. Elgon.
4. **Vegetation Cover.** Absence of trees/forests vegetation increase rock movements since roots of plants hold soil particles together hence reducing chances of movement. Absence of thick vegetation enhances soil creep, and mud flows over gentle slopes and rock slides and slump over steel slope.
5. **Occurrence of Earth Quakes.** Earth quakes set up vibration which loosen the rocks and cause them to move downslope under the influence of gravity e.g. in Bundibugyo.
6. **Human Activities.** Human activities like quarrying, mining, deforestation, agriculture etc. loosen the rocks which finally set them into motion by gravity e.g. deforestation along Mt. Elgon together with heavy rainfall lead to landslides.

EFFECTS OF MASS WASTING

Negative

- Destruction of communication like roads, railways as they roll down slope e.g. Kabale – Katuna road.
- Landslides result into destruction of lives and property where massive movement of rocks uproots houses. Bududa.
- It has resulted into mass destruction of agricultural land as the fertile hills slope soils are removed making the slopes less production.
- Landslides contribute to destruction of forests through uprooting trees e.g. along Mt. Elgon in Bufumba in 1990.
- Materials deposited in low lying areas displace water and block the water channels resulting into flooding e.g. Mt. Elgon Slopes.

- Materials deposited in low-lying areas (debris) pollutes the sources causes diseases to the local people.

Positive

- The rocks carried by mass wasting many settle in the valley and block streams leading to formation of lakes.
- It leads to creation of new features e.g. terraces from soil creep e.g. in Sheema district.
- It leaves to formation of feature like spurs along Mountain slopes which are tourist attractions.
- Mass wasting exposes minerals to the surfaces thus making mining activities easy.
- Areas of Mass wasting are used for research and study purposes e.g. by Geography students.

MEASURES TAKEN TO CONTROL MASS WASTING

- i) Afforestation and re-afforestation along the steep slopes to keep the rock particles intact so as to stop them from moving.
- ii) Establishment of forest reserves mountain areas where people aren't allowed to encroach.
- iii) The depressions with hanging slopes left after mining should be filled with waste materials (debris).
- iv) Mass education to people on how to properly utilize the environment.
- v) Soil erosion control measures e.g. terracing, strip cropping and contour ploughing.
- vi) Settling up to resettlement schemes to reduce on the proper living in areas affected by landslides.
- vii) Constitution of gabions on slopes created by cliffs rivers backs and road cutting to keep the slopes stable.

GLACIATION IN EAST AFRICA

Glaciation refers to the process through which moving ice (glaciers) modifies the landscape through erosion, transportation and deposition to form landform features.

A glacier is a mass of ice flowing out of a snow field under the influence of gravity i.e. a glacier is ice in motion.

In East Africa, glaciation is confined in three major mountains. These include;

- i) Mountain Rwenzori
- ii) Mountain Kilimanjaro
- iii) Mountain Kenya

TYPES OF GLACIERS

- a) **Valley glacier:** This is found on Mountain slopes and they occupy valley sides. It is sometimes called highland glacier.
- b) **Continental glacier:** These are masses of ice flowing out of a snow field which cover large areas of continents in the temperate regions.

FACTORS/CONDITIONS INFLUENCING FORMATION OF GLACIERS IN EAST AFRICA

- i) **Altitude:** Areas of high altitude of over 4700m above sea level experience temperature of above 0°C and below hence favouring freezing of water into ice.
- ii) **Precipitation/Rain fall.** Glaciers form from rain water in form of snow. Rain water freezes into ice under low temperatures. The greater the precipitation, the greater the amount of glaciers formed.
- iii) **Nature of relief.** Ice accumulation occurs in steep slopes with rugged terrain which can facilitate rapid accumulation of ice i.e. trapping ice in depressions.
- iv) **Periodic climatic changes.** These changes associated with warm and cool conditions result into reduction in or increase in glaciers.

WORK OF GLACIERS

Glaciers erode the valley beds and sides in the following processes;

- i) **Plucking:** This is the tearing away of blocks of rock which have become frozen on the sides and bottom of the valley. This is most effective on jointed rocks.

ii) **Abrasion.** It is the wearing away of rocks underneath the glaciers by the scouring action of the rocks embedded in a glacier. Its work is to deepen the valley floor.

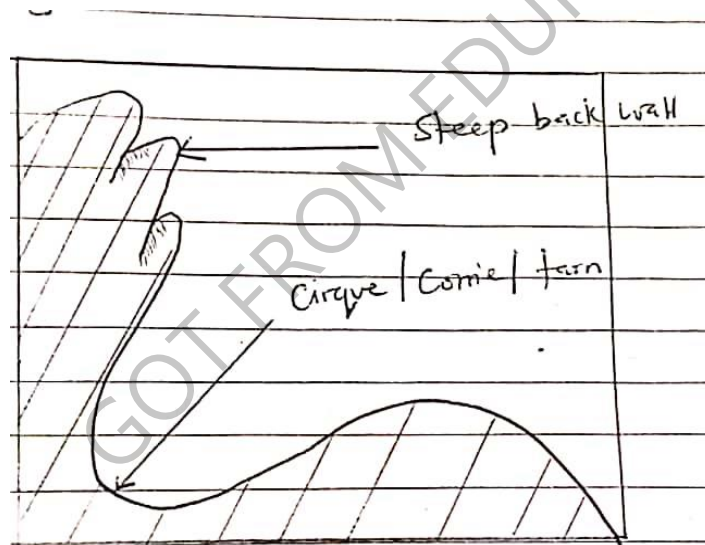
iii) **Basal Sapping:** This is erosion which glaciers slip and slide over the underlying rocks, polishing and scrubbing them. It is common in rocks with cracks.

This can also be called frost shattering or freezing where water enters on a warm day at night. It freezes into ice due to cold temperatures. Ice occupies more space hence widening the cracks and with time the rocks become detached.

LANDFORMS DUE TO GLACIAL EROSION

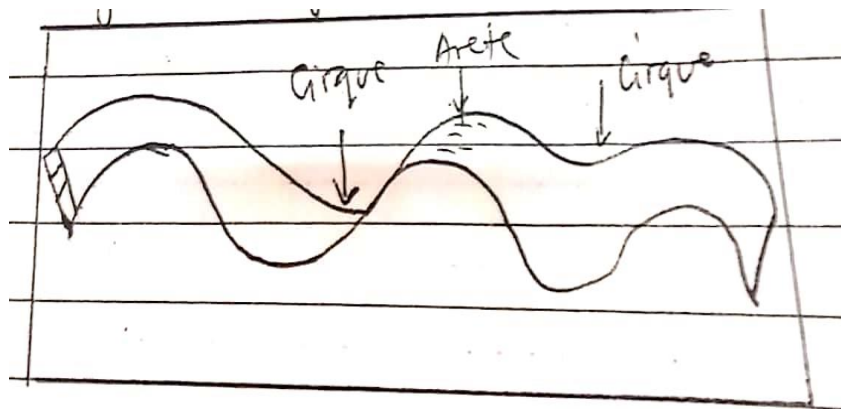
a) **Cirques /Corrie/Tarn.**

This is a semi-circular steep sided rock basin/arm chair. Shaped steep sided rock depression cutting. When moving ice enters in a crack along a mountain side. It compresses the crack, walls causing breakdown of rocks to form a semi-circular rock basin called a basin. When water collected into a cirque, it forms a lake known as a Tarn; examples Teleki on Mt. Kenya & Nanyuki. Lacaris, Lado Catherine on Mt. Rwenzori.



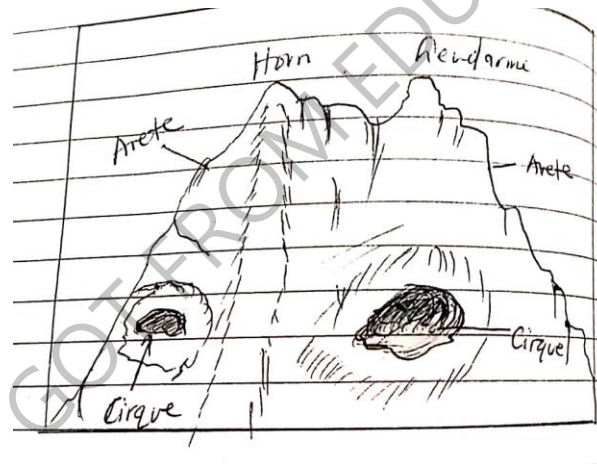
b) **Aretes:**

It is a narrow steep-sided ridge developing between two cirques. It results from glacial erosion process of plucking and basal sapping. The back wall recession of two adjacent cirques lead to formation of sharp – knife – like adged ridge which is called an arête separating two cirques. Examples are Bujuku valley, Nelion and Butain on Mt. Kenya.



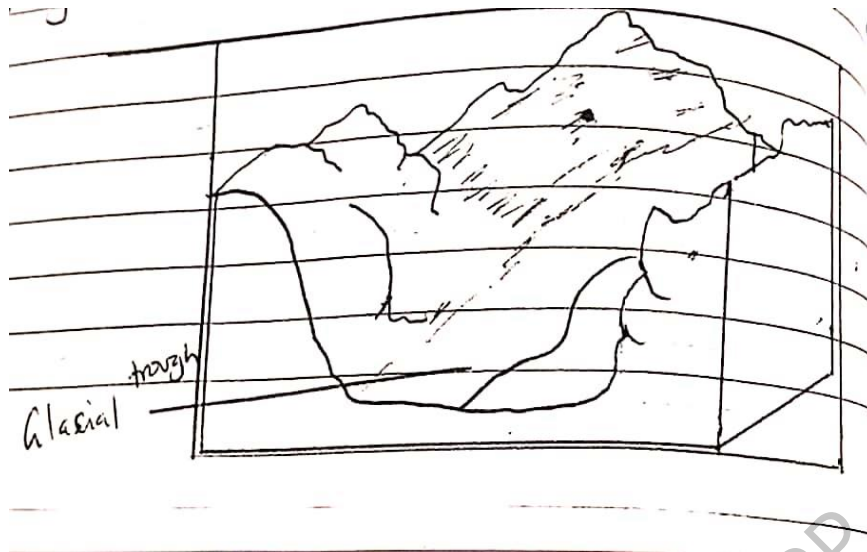
c) Pyramidal peak (Horn)

This is rugged peak found on glaciated mountains. It is a sharp rock which is steep sided surrounded by a system of radiating arêtes. It is formed when three or more cirques being eroded backwards towards the central peaking forming a horn pyramidal peak e.g. Margherita peak (5190m) on Mt. Rwenzori, Stanley, Speke then Pidget, Nelson and Batian on Mt. Kenya.



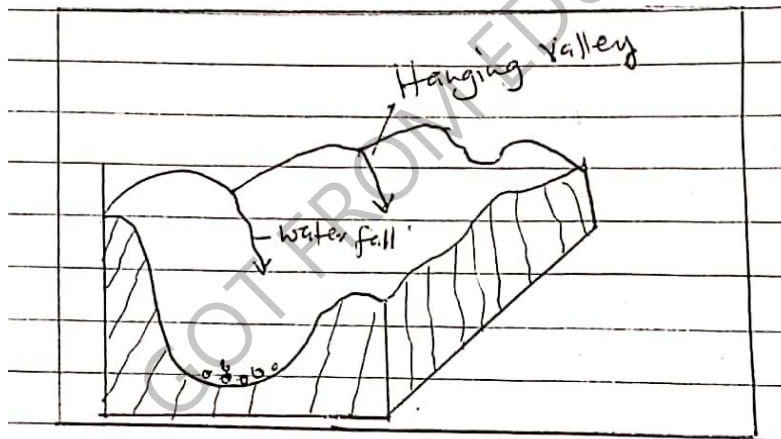
d) Glacial troughs (U-shaped valleys)

This is a broad steep sided U-shaped valley which is flat bottomed. It is formed when ice occupies a V-shaped river valley and as a result of plucking, the valley is widely by lateral erosion examples include Bujuku and Mobuku valley on Rwenzori, Teleki Valley on Mt. Kenya.



e) Hanging Valleys

Hanging valleys are tributary valleys of glacial troughs but appear at a higher level. It is formed as a result of differences in size and volume of ice in the main and tributary valley. More erosion in the main valley and minimal in the tributary which makes it hanging.



LAND FORMS DUE TO GLACIAL DEPOSITION

When a glacier reaches 3000m where temperatures are relatively warm, ice begins to melt and gives off water. Here materials are transported. When a glacier retreats it will leave behind materials hence glacial deposition leading to formation of the following features.

a) Moraines

These refer to materials carried and later deposited by a glacier as it stagnates and retreats in low lands. Moraines exist in the following types.

- i) **Terminal Moraines.** This is a ridge-like feature formed by accumulation of unsorted fragments of all sizes extending across the valley developing from a glacier that remains stagnant e.g. Kamusoso Valley on Mt. Rwenzori.
- ii) **Lateral Moraines.** This is an elongated ridge of mountains formed along the valley sides e.g. Losilube valley on Mt. Rwenzori.
- iii) **Medial Moraines.** When two glaciers meet, the lateral moraine of inner side of both glaciers join at the center of the valley to form medial Moraines.
- iv) **Ground Moraines.** This is formed when materials are deposited at the base of a glacier.

Other glacial deposition features include

- b) Erratics
- c) Drumlins
- d) Kame and Kame terrace
- e) Out wash plains
- f) Eskers
- g) Kettle lake

REASONS WHY GLACIATION IS LIMITED IN EAST AFRICA

1. East Africa lies astride the Equator where temperature is constantly hot hence melting down the glaciers.
2. Most of the highlands in East Africa are below 4200m above the sea level yet it is the snowline which makes only Rwenzori, Kenya and Kilimanjaro with glaciers.
3. The rain shadow effect some highlands have lee ward sides that are low and melt down the glaciers very fast.
4. Global warming. East Africa is experiencing global warming which is responsible for melting down the glaciers on Rwenzori Mountain.
5. Absence of large water bodies in some areas of East Africa that would increase on the amount of precipitation of the atmosphere to form snow.
6. Rivers that originate from the summits of mountains carry out erosion which leads to disappearance of glaciers.

ADVANTAGES OF GLACIATION TO PEOPLE OF EAST AFRICA

1. Glaciers melt down and form rivers which provide water for both domestic and industrial purposes e.g. Mobuku from Rwenzori which serves Kasese town.
2. The U-shaped valleys provide a good site for generation of hydro-electric power.
3. Rivers from melting ice also support fishing activities e.g. on River Tana.

4. Glacial features such as Arete, pyramidal peaks etc attract tourists who earn foreign exchange to East Africa.
5. Moraines provide fertile soils that are good for agriculture e.g. crops like Irish potatoes in low lands of Mt. Rwenzori.
6. Glaciers lower temperature of the adjacent areas this discouraging the breeding of pests like mosquitoes

DISADVANTAGES OF GLACIAL FEATURES

1. The melting glaciers increase the volume of water in the river valleys leading to flooding in the low lands e.g. Kasere town.
2. Glaciers are agents of soil erosion thus reducing soil fertility hence low crop production.
3. Glaciers are very cold hence discouraging human settlement.
4. Glaciers carry rock boulders in form of landslides to low-lying areas that destroy life and property.

DRAINAGE IN EAST AFRICA

THE RIVER SYSTEM AND DRAINAGE PATTERNS

RIVER SYSTEM

A river is a body of water that flows in definite channels. A river performs three major functions.

- i) Erosion
- ii) Transportation
- iii) Deposition

RIVER EROSION

Erosion occurs when a stream has excess energy. The river erodes its banks and the bed through different processes which include the following;

- i) **Attrition.** This is the process by which the load itself is broken down. The eroded material like boulders and rocks hit and collide hence reducing to smaller particles.
- ii) **Corrasion.** This refers to wearing away of the sides and beds of the river channel by the load
- iii) **Solution.** This is the solvent action of the water flowing over calcareous rocks like limestone.
- iv) **Hydraulic action.** This refers to the force of moving water which is able to remove loose material such as gravel, sand, silt etc.

TYPES OF EROSION

- i) **Head ward erosion.** This is when the river increases its length. It is achieved by a river cutting back at its source.
- ii) **Vertical erosion.** This is when a river deepens its channel.
- iii) **Lateral erosion.** This is wearing away of the sides of the channel.

OTHER TERMS USED

- 1. River banks. Those are the sides of the river channel
- 2. River Confluence. This is a point where two rivers join.
- 3. River discharge. This is the quantity of water (volume in a stream)
- 4. River regime. (This is the seasonal variation of water volume in a stream.)
- 5. River capture/River piracy. This is the diversion of a part of a river course into the system of an adjacent powerful river.
- 6. Elbow of a capture. This is a feature found at the point of diversion and is normally marked by a bend.
- 7. Wind gap (Dry gap). It is the part of the captured river where there is no water.

RIVER TRANSPORT

All materials that a river transports are known as load. A river transports its load in four ways. These include;

- 1. Traction. This is the dragging of large pieces of materials such as boulders along the river bed.
- 2. Saltation. This is the bouncing of smaller pieces of rocks over the river bed.
- 3. Suspension. This is the movement of light materials such as silt and mud in water.
- 4. Solution. This is the movement of certain minerals after dissolve in water e.g. limestone.

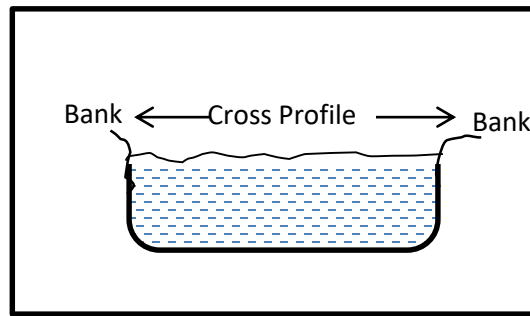
RIVER DEPOSITION

Deposition of the load (eroded material) occurs when the river has insufficient energy to transport its load; materials deposited are called alluvium and a number of landforms occurs when deposition takes place.

RIVER PROFILE

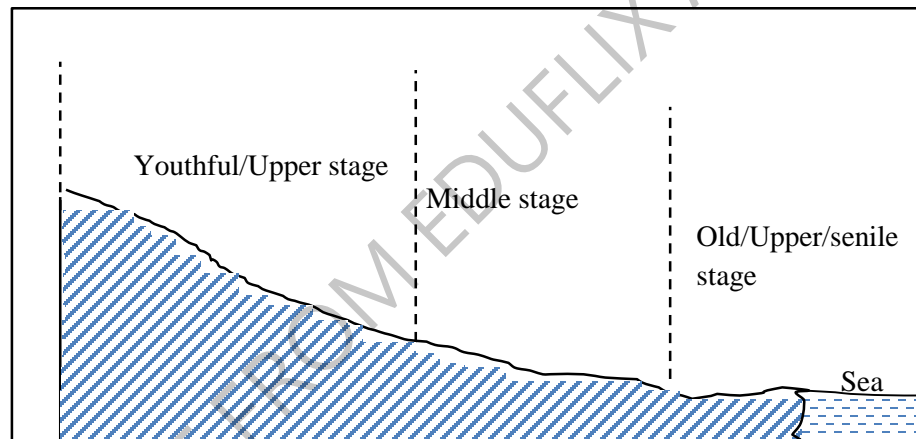
A river profile is a distance covered by the river. A river profile exists in two categories. These include;

- a) **Cross profile.** This is the distance covered by a river from side to side of bank to bank.



b) Longitudinal /Long Profile. This refers to the distance covered by a river from its source to the mouth. It is divided into three stages namely;

- i) The youthful stage /torrential /upper
- ii) Middle/mature stage
- iii) Old/lower /senite stage



i) Youthful stage

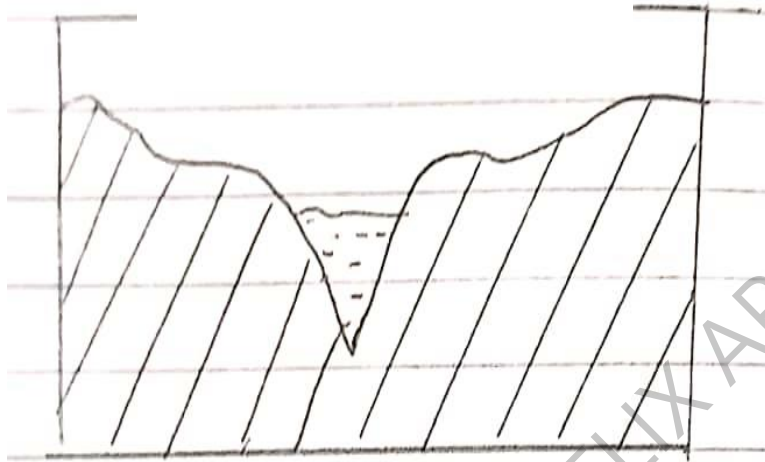
This stage is found in a region where the river originates from and there are hills, highlands or mountains.

Characteristics.

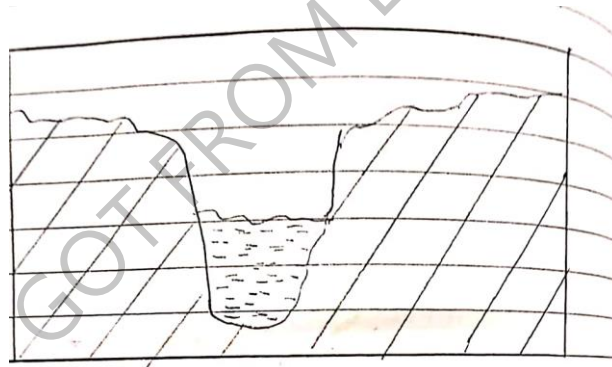
1. There is a lot of vertical erosion (eroding the bed)
2. Water flow at very high speed.
3. The river flows along a steep gradient.
4. There is formation of water falls and rapids.
5. The road carried by the river is inform of large particles
6. Formation of pot holes, V-shaped valley, interlocking.

LAND FORMS IN THE YOUTHFUL STAGES

- i) **V-shaped valley.** This is formed mainly due to vertical erosion which exceeds lateral erosion in the upper stage. The water volume is small where by it can't spread over the under area rather it must create a channel by cutting vertically.

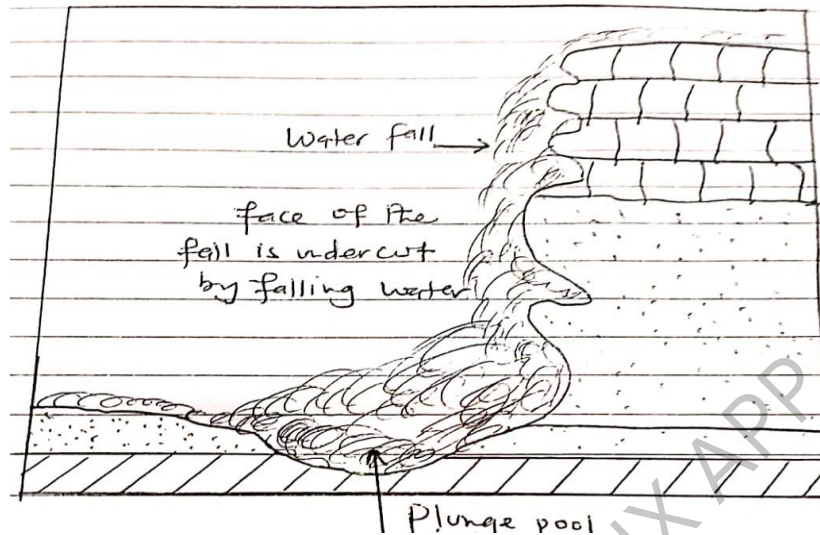


- ii) A Gorge



- iii) **Pot holes.** These are circular depression that are cut on the river's bed. They are formed where the forces of water removes soft rock through the process of erosion hence forming small circular depression know as potholes e.g. R. Arthur.
- iv) **Water Falls.** A waterfall is a sharp brake with the river's channel where water falls very fast. A water fall is formed in the following ways
It is formed due to difference in the rock resistance to erosion.

A river may be flowing on soft rocks which are easily eroded and finally enters into a region of hard rocks, where water begins to fall off over the hard resistance rocks thus forming a water fall.

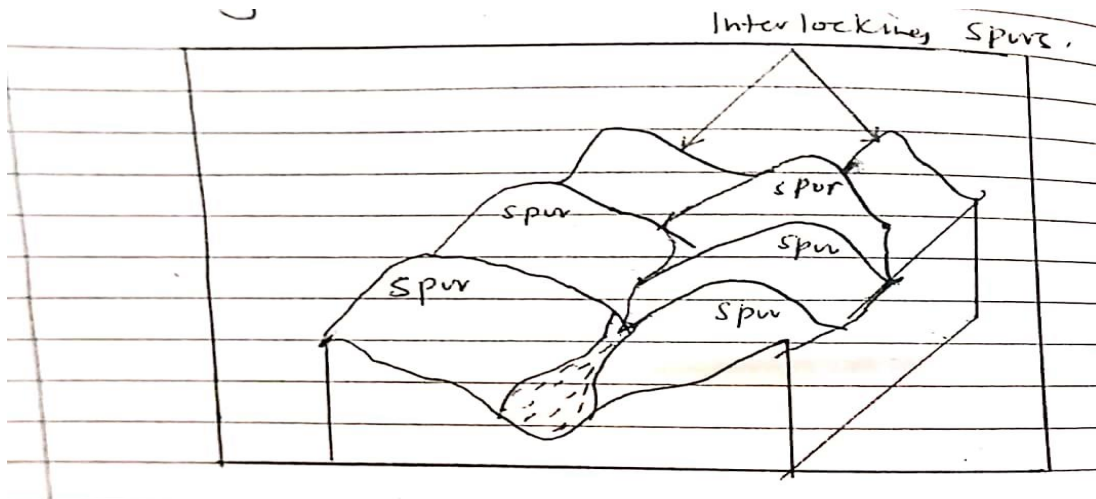


Examples are Sezibwa on river Sezibwa, a Thika falls on R. Thika.

- c) **A water fall.** Is also formed by faulting, it is formed where a line of weakness (fault line) cuts across the river's course. The flowing water will eventually follow the line of weakness thus forming a waterfall. e.g. Karuma and Murchison falls on river Nile.
- d) **Plunge Pool.** A plunge pool is a depression that is formed at the base of the water fall. The force of water removes the soft rock at the base of the water fall thorough the processes of erosion (abrasion & hydraulic action) leading to formation of a depression known as a plunge pool.
- vi) **Rapids.** Rapids refer to areas or points of the river where the river moves very fast. They are formed where a river flows over a gently dipping band of rocks. This is seen at Bujagali in Jinja.

vii) Interlocking spurs

These form in areas where they are alternating hard and soft rocks. They tend to form in highland areas where a river tends to follow the winding courses as it tries to dodge the obstacles, examples are seen on R. Kagera, Nile, Tochi, Aworanga etc.



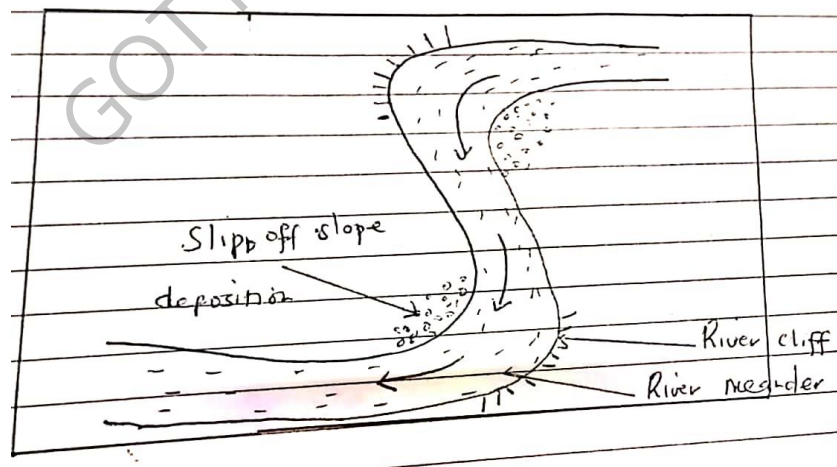
MATURE /MIDDLE STAGE

This is the second stages of the river development and it is characterized by the following features.

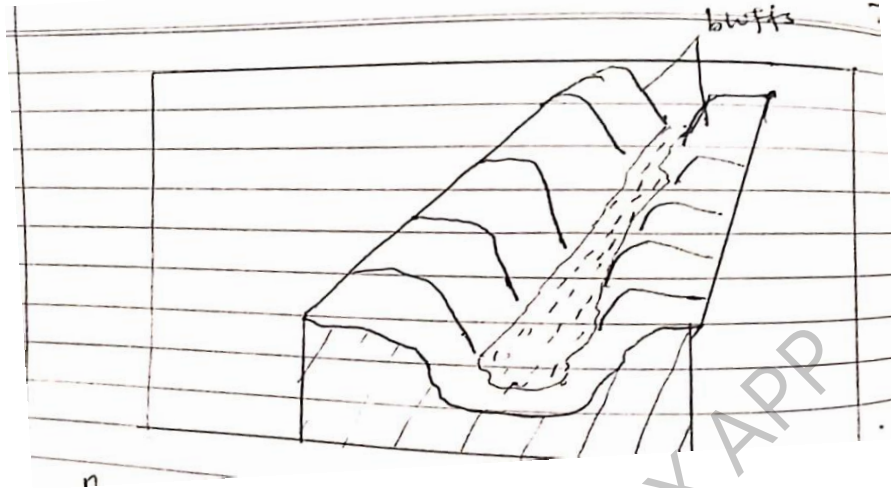
i) River Meanders

These are curved bends of the river channel. They develop as a result of lateral erosion and the low gradient that forces a river to wind or swing so as to avoid hard work rock within its channel thus developing in meanders.

- River Semliki
- River Nzoia in Kenya
- Tana
- Kilombero in Tanzania



- ii) **Bluffs.** These are formed when the interlocking spurs are eroded away by lateral erosion. In the mature stage of the river, river meanders migrate down the stream and the ends of the interlocking spurs are cut by lateral erosion to create bluffs.

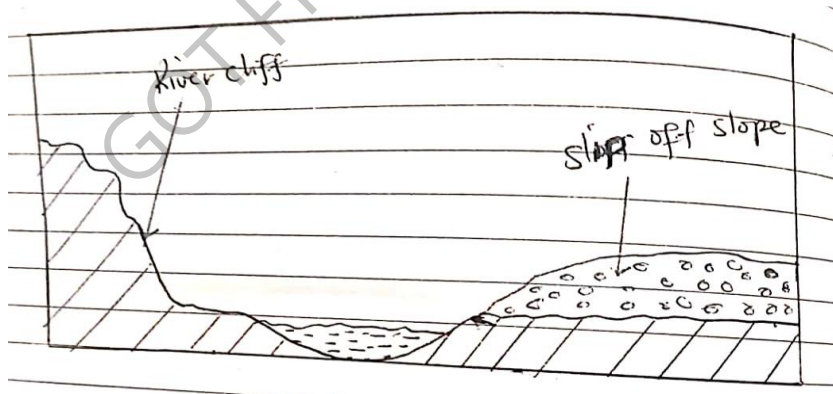


iii) River Cliff

This is a steep rock face which is either standing or vertical along the river. Cliffs are formed due to lateral erosion and vertical erosion especially on the concave banks of the river meanders.

iv) Slip off slope

This is a gentle slope forms on the convex bank of a river meander. It's formed as a result of deposition that take place on the convex bank. e.g. River Ruvuma and Galana in Kenya.

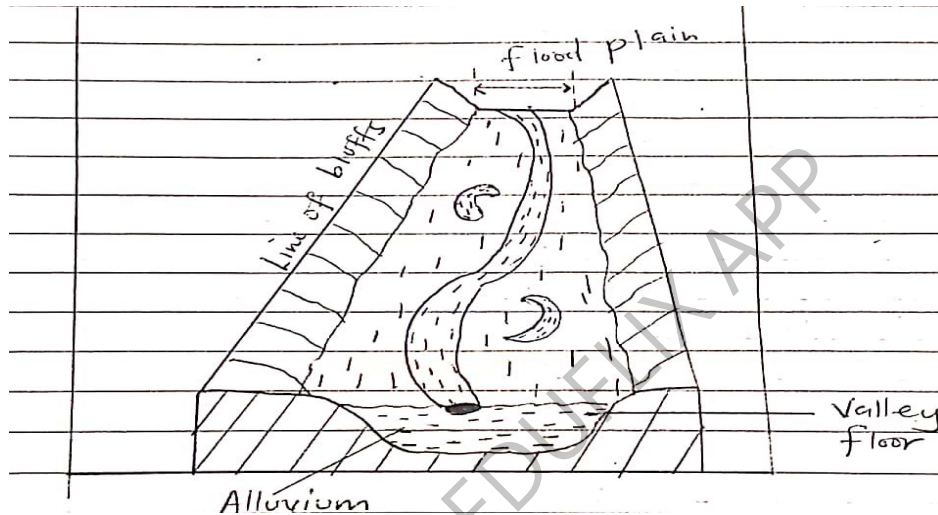


THE OLD /SENILE/LOWER STAGE

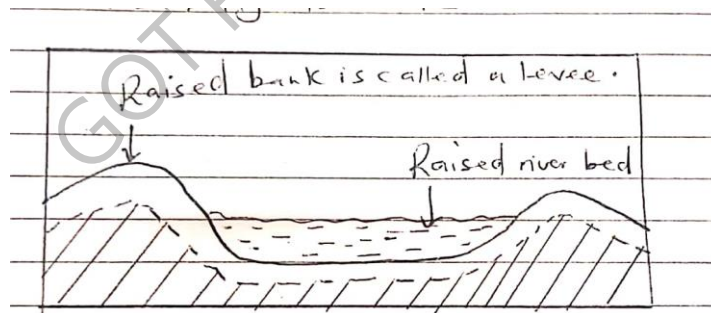
i) Flood plains

This is a gently sloping plain of alluvium covering a valley floor in which a river tends to flow in a meandering channel.

The flood plain is formed as a result of successive deposition with the river's channel and this is shown below;

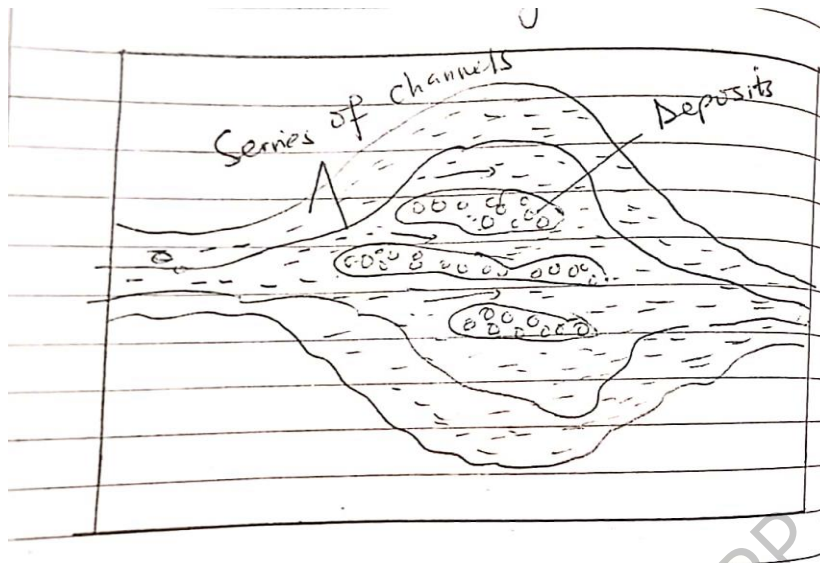


- ii) **Levees.** These are ridge-like features (embankment of sand) built by the flooded rivers and deposition takes place on the river (river banks) thus forming features known as levees e.g. River Malaba, Nyando etc.



iii) Braided Channels

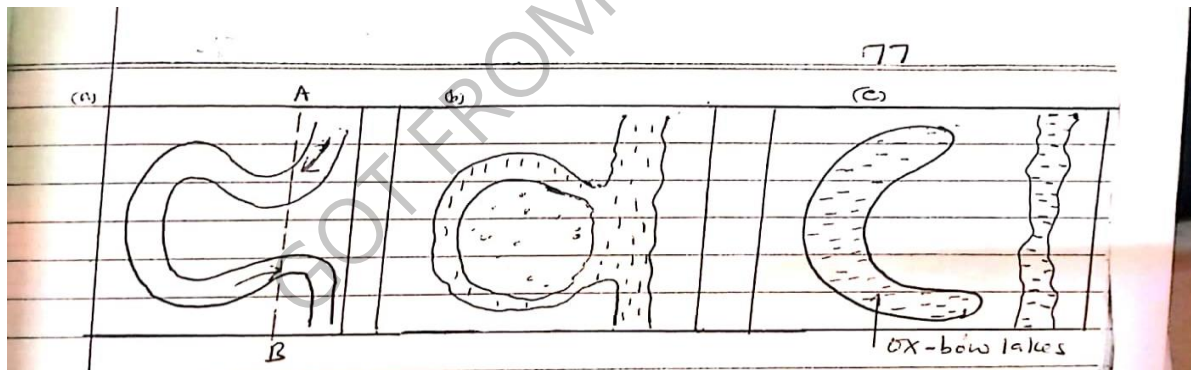
These are sub-divisions of the river's channel into series of minor channels. They are formed as a result of deposition of sediments within the main channel leading to subdivision. E.g. Kilombero and Rufiji in Tanzania, Tana and Athi in Kenya.



iv) Ox-bow lakes

An ox-bow lake is horse-shoe shaped section of once a pronounced meander that has been cut off from the main river. It is formed when the ends of the meander almost meet. The lateral erosion causes the sealing off the meander from the meander thus forming an ox-bow lake. Examples are seen on R.Ngaila, in Kenya, R. Nyando, R. Rwizi, R. Semliki, R. Tana, R.Nzoic etc.

NB. When an ox-bow lake dries out it leads to the formation of the meander scar.



v) Deltas

A delta is a low-lying swampy plain which gradually becomes colonized by various types of plants. The delta is usually composed of fine sediments in form of sand silt and clay.

Deltas form where rivers enter the sea or lakes. Example of the rivers with deltas include;

- Rufiji
- Tana
- Semliki
- Omo

- vi) Presence of weak current on wave which allows the settlement of deposited materials for deltas to be formed.

CONDITIONS NECESSARY FOR FORMATION OF DELTAS

- i) Presence of low gradient that encourages the accumulation of sediments.
- ii) The river should be carrying much load to allow massive deposition to occur.
- iii) There should be flooding of the river in the lowlands resulting into much deposition.
- iv) The presence of fine particles such as sand, clay, and silt.
- v) The river must be entering the sea at a very low speed to allow large sediments to occur thus forming a delta.
- vi) Presence of weak current or wave which allow the settlement of deposited materials for deltas to be formed.

TYPES OF DELTAS

i) Accurate Delta

This is inform of a triangle shape composing of large and fine sediments e.g. gravel e.g. Rufiji and Semliki delta.



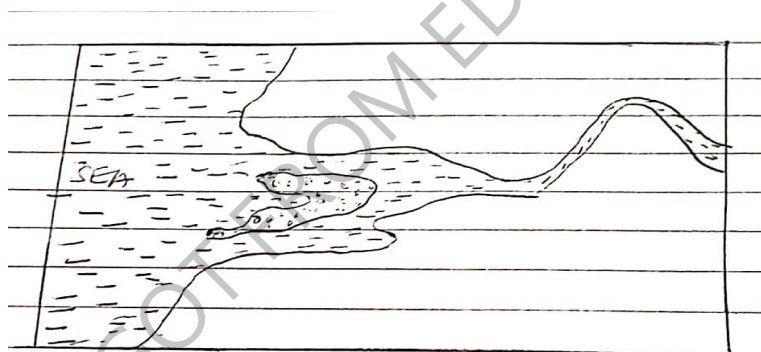
ii) Bird's foot delta

This composes of fine materials known as silt. The river sub-divides into few distributaries which are clearly defined e.g. on River Omo and Nyando./



iii) Estuarine Delta

This is formed on the drowned river's mouth. It is therefore found within a drowned river's mouth and it is caused by an increase in the water level in the sea examples can be seen at Wari and River. Tana.



ECONOMIC IMPORTANCE OF RIVERS TO MAN

1. Rivers are sources of water for both domestic and industrial use e.g. R. Nile.
2. Rivers form attractive features like water falls, rapids that attract tourists hence foreign exchange earnings.
3. They facilitate social and political boundaries e.g. River Nile separates Buganda from Busoga.
4. Rivers contain minerals which are valuable e.g. River Athi in Kenya has scattered gold.
5. Rivers tend to encourage fertile alluvial soils that have encouraged crop growth e.g. Sugar cane along R. Kilombero.
6. They provide building materials e.g. sand thus promoting building and construction industry.

7. They contain waterfalls and rapids which provide ideal sites for dam construction hence H.E.P generation.

PROBLEMS FACED BY PEOPLE USING RIVERS

1. Flooding along the river banks which destroys people's property and infrastructure.
2. Waterfalls and rapids especially along River Nile hinder navigation.
3. Swamps along the rivers harbor dangerous animals like hippos and crocodile which threaten river users.
4. The water logging conditions act as breeding grounds for vectors like mosquitoes which spread Malaria.
5. Most rivers in East Africa have rough beds with sharp rocks and narrow valleys which hinder navigation.
6. Swamp vegetation like papyrus hinders activities like fishing and navigation.

DRAINAGE PATTERNS IN EAST AFRICA

This is the arrangement of the rivers and their tributaries on the earth's surface or

It is a layout of the river and its tributaries. Drainage patterns in East Africa are attributed to three major factors; these include;

i) Climate

Heavy rainfall increases the discharge (water) due to large amount of water thus encouraging river development and its tributaries.

ii) Relief

The raised landscape is the origin of the river (source) thus making the river and its tributaries developed.

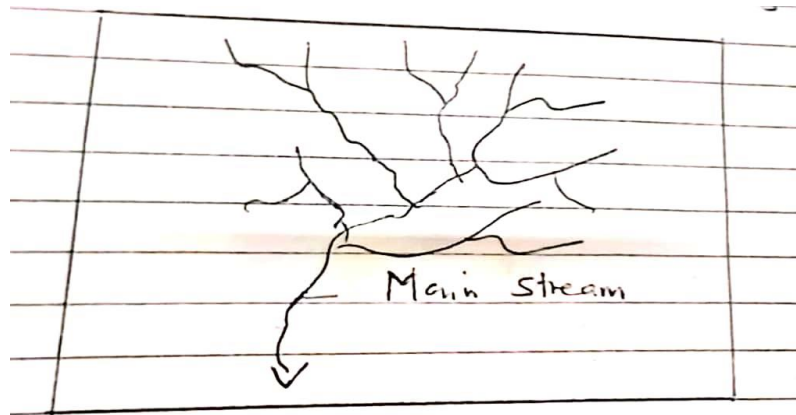
iii) Difference in rock resistance

Rivers and their tributaries develop quickly in area of soft rocks than in areas of hard rocks.

TYPES OF DRAINAGE PATTERNS IN EAST AFRICA

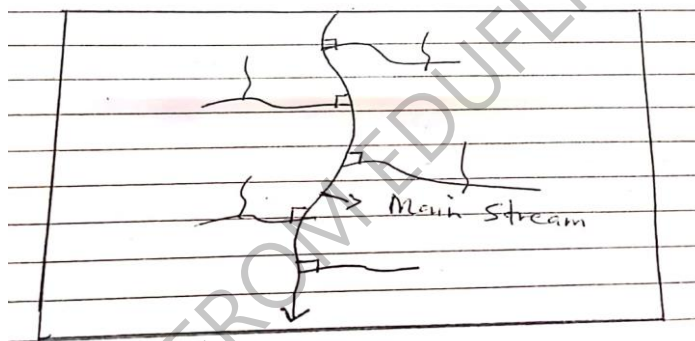
i) Dendritic drainage pattern.

It is a type of drainage pattern whose structure resembles the tree and its branches. It is arranged in such a way that tributaries join the main river at acute angles e.g. R.Athi, Rufiji, Kilombero, Nzoia etc.



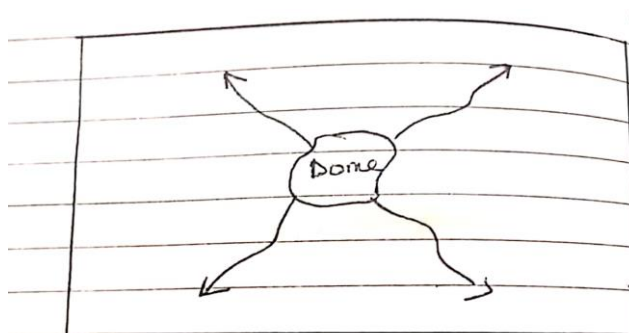
ii) Trellis/ Rectangular drainage pattern

This is a type of drainage pattern where tributaries join the main river at almost right angles. This develops in region of alternating hard and soft rocks. It is seen on rivers like Aworanga, Tochi, Tana, Mara etc.



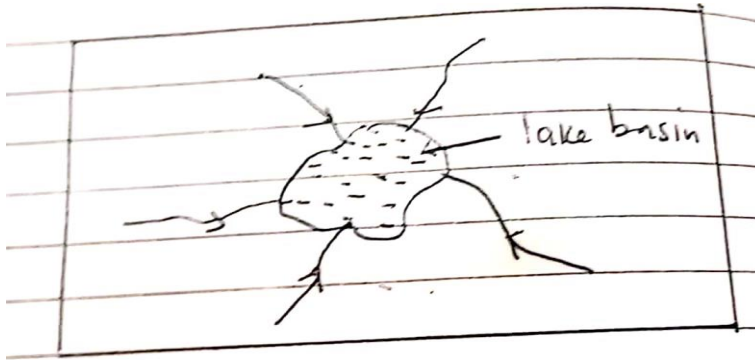
iii) Radial drainage pattern

It is a drainage pattern where rivers originate from a mountain top and spread in different directions e.g. R. Mobuku, Nyamwamba from Rwenzori. Sironko Ssipi, Malaba, Manafwa from Elgon.



iv) Centripetal drainage pattern

This is a pattern where rivers originate from various areas and able to flow towards the same centre which is always a lake and ocean or low land e.g. Rivers Katonga, Kagera, Mara and Nzoia drain into victoria basin.



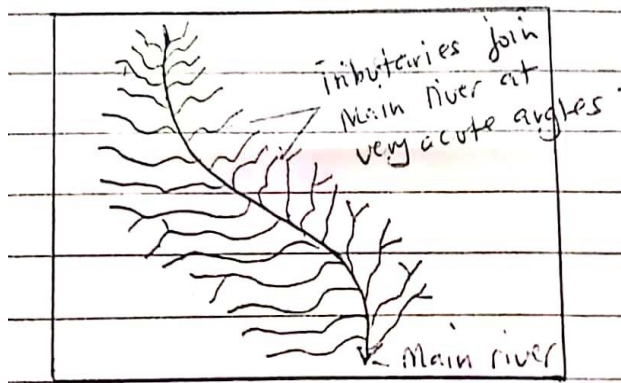
v) Parallel drainage pattern

This is where rivers flow parallel to each other, moving in the same direction but with limited chances of meeting. This is due to alternating hard/ soft rocks e.g. R. Nkusi and Hoima.



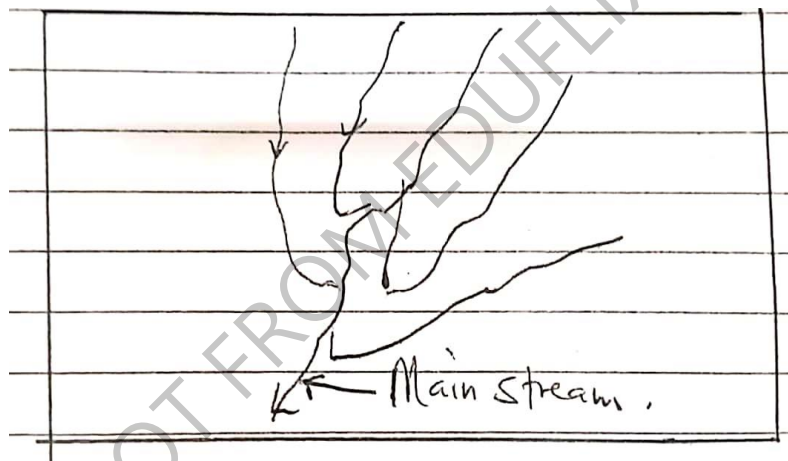
vi) Pinnate Drainage Pattern

It is a type of tributaries join the main river at extreme acute angles. The resemble the bird's feather.



An example is seen in Kerio valley Western Kenya.

- vii) It is a type where tributaries make sharp turns before joining the main river to form hooks. Tributaries flow in opposite direction before joining the main river. This is seen at Katonga, Kafu and R. Kagera.

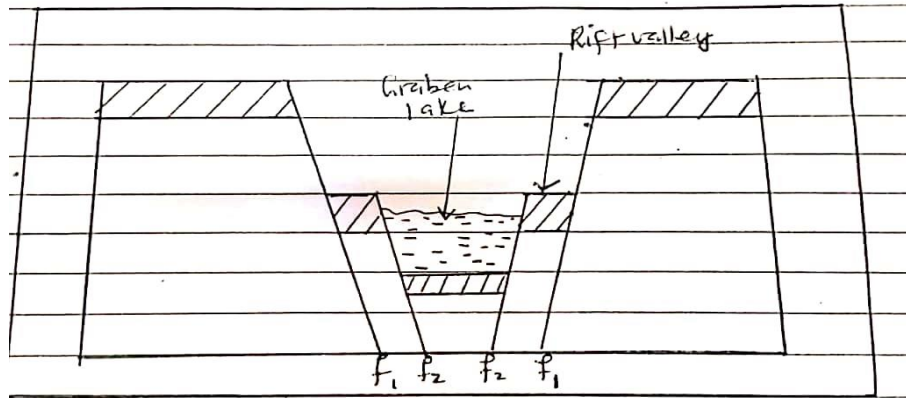


[illegible]

A lake is a larger water body that is contained in a depression or basin on the earth's surface. Lakes vary in size and depth. Some lakes are permanent while others are temporary.

1. Rift valley /Graben/Fault lakes

This creates a graben that fills with water from streams and precipitation to form a lake.



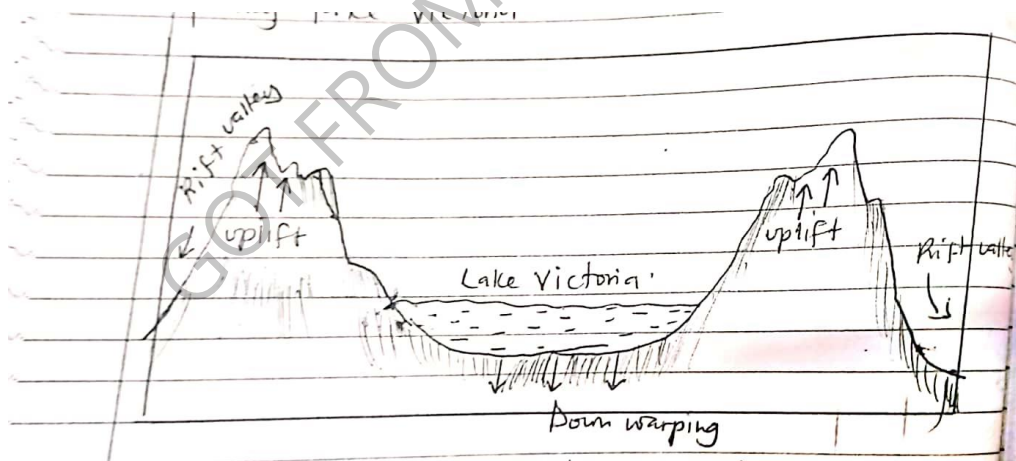
$F1$ – Initial faulting for the formation of a rift valley

$F2$ – Secondary faulting

2. Lakes formed by down warping (down warped lakes)

These are formed as a result of down warping. Down warping is a process which is responsible for the sinking of the earth's crust or sagging of the earth's crust.

There was uplift of land in the western part of Uganda and central Kenya. This forced the central region to sink thus forming Victoria basin. The uplift led to reversal of rivers like Katonga, Kagera, Nzoia, Mara etc. to fill Victoria basin hence forming lake Victoria.



NB. River reversal also led to formation of lakes where rivers changed their directions and filled their former valleys and tributaries. This process known as back pondage which led to formation of lakes like;

- Mburo
- Kyoga
- Kijinabarora

3. Volcanic lakes

These are lakes formed as a result of volcanic activity. They include; Caldera lakes, crater lakes and lava dammed lakes.

i) Caldera Lakes

These occupy calderas which form as a result of violent eruptions that blow off the tops volcanoes to form, depression that fill with water to form caldera lakes e.g. Ngorongoro, Napak, Meru, Suswa, Ngozi etc.

ii) Explosion crater lakes

These are formed as a result of explosive eruptions of molten rocks which blow off the rocks examples are Lake Katwe, Nyamunuka, Munyanyange, Nyungu, Kyamwiga etc.

iii) Lava Dammed lakes

These are formed when the flowing lava from a volcanic mountain blocks the river valley and as result water is trapped behind to a volcanic Mountain to form a lava dammed lake. Examples include;

- L. Mutanda
 - L. Ndagala
 - L. Mulehe
 - L. Bunyonyi
 - L. Kafi
 - L. Kayombu
- } All in Kabale

4. Glacial Lakes

These are formed after the melting of glaciers during erosion that forms a tarn that fills with water to form a lake e.g. L. Teleki on Mt. Kenya and also glacial lakes formed due to deposition i.e. kettle lakes, Moraine dammed etc.

5. Depositional lakes

These are formed when a material is deposited either by the moraine, Oases or by wave action leading to formation of lakes like Nabugabo which was cut off from R. Victoria due to wave deposition (lagoon) Ox-bow lakes, Delta lakes, Oases etc.

6. Man-made lakes

These are lakes formed due to man's activities such as mining, irrigation, farming e.g. Kibimba, Kindaruma.

7. Man-made lakes

These are common in areas with limestone rocks. The rocks are easily dissolved by water resulting into development of depression which fill with water to form solution lakes. (Karst lakes) examples include Nyakasura Lake in Fort Portal, Lake Kambe, Wajrm Elwark etc.

ECONOMIC IMPORTANCE OF LAKES IN EAST AFRICA

1. Areas around lakes have fertile alluvial soils which support crop growing e.g. bananas around Lake Victoria.
2. They act as natural boundaries between countries of East Africa e.g. Victoria lake separates Uganda, Kenya and Tanzania.
3. Some lakes have animals like hippos, snakes, crocks which attract tourists who earn East Africa foreign exchange.
4. They also promote mining e.g. salt from lake Katwe, soda ash from Lake Magadi etc.
5. Lakes also act as fishing grounds thus providing fish which improves people's diet.
6. Lakes such as Victoria and Kyoga have got papyrus vegetation which promotes art and craft making.
7. Lakes help in the modification of climate through formation of convectional rainfall that encourages growing.
8. Lake also provide4 water which is used for both domestic and industrial purposes e.g. Uganda Breweries gets its water from Lake Victoria.
9. They ease nagivation/water transport across country boundaries e.g. Uganda – Congo on Lake Albert, Uganda – Kenya – Tanzania on Lake Victoria hence promoting trade.

NEGATIVE IMPORTANCE ON LAKES IN EAST AFRICA

1. Lakes act as breeding grounds for diseases carrying vectors like Mosquitoes which spread malaria to people.
2. They harbor dangerous animals like snakes, hippos and crocodiles which threaten people who use lakes.
3. Lakes also tend to cause flooding during the rainy seasons thus destruction of property.
4. Lakes tend to occupy large areas which could have been used for farming and other activities.
5. Some lakes are covered by water hyacinth (water weeds) which are a hindrance to navigation and fishing e.g. on Lake Kyoga.

A SKETCH MAP OF EAST AFRICA SHOWING THE MAJOR LAKES

GOT FROM EDUFLIX APP

COASTAL LANDFORMS IN EAST AFRICA

CORAL REEFS

A coral reef is a hard limestone rock formed from the accumulation of skeleton of dead coral polyps (Tiny marine animals) when they die. These animals have hard skeletons made up of Calcium Carbonate. When they die, their skeletons accumulate on the continental shelf where they gradually get compressed and cemented until they are transformed into a hard rock.

CONDITIONS FAVOURING THE DEVELOPMENT OF CORAL REEFS IN EAST AFRICA

1. Presence of warm sea temperature of about 21°C which enables the growth of planktons on which the coral polyps feed.
2. Existence of salty/saline water which provides calcium that enables cementation of skeletons of polyps to form coral reefs.
3. Existence of oxygenated water which enables the polyps to grow and survive before they die.
4. Existence of sediment free environment in water because muddy water prevents the growth of coral reefs.
5. Presence of abundant sunlight which enables the growth of planktons on which the polyps feed.
6. There should be variations in water levels to allow death of coral polyps and accumulation of coral shells along the continental shelf.
7. Existence of plentiful supply of food (planktons) for coral polyps to feed for survival.

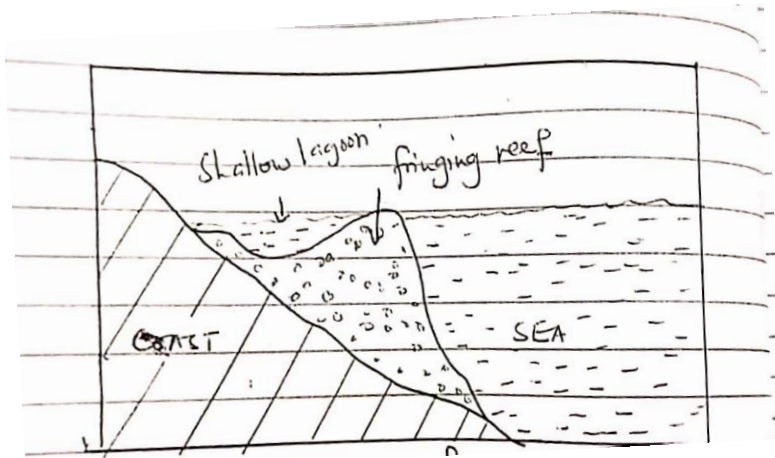
TYPES OF CORAL REEFS

These are three major types of Coral reefs i.e.

- i) Fringing reefs
- ii) Barrier reefs
- iii) Atoll reefs

FRINGING REEF

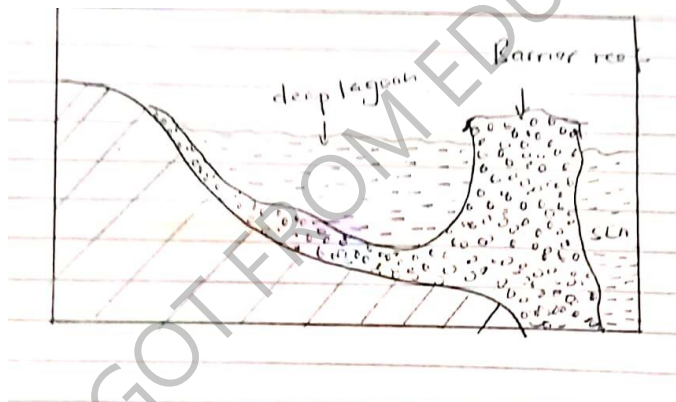
This is a coral reef formed very close to coast. The platform surface is usually flat or slightly concave and it is separated by a narrow and shallow lagoon from the coast.



Examples are seen at Bamburi north of Mombasa, Tanga and Kilifi.

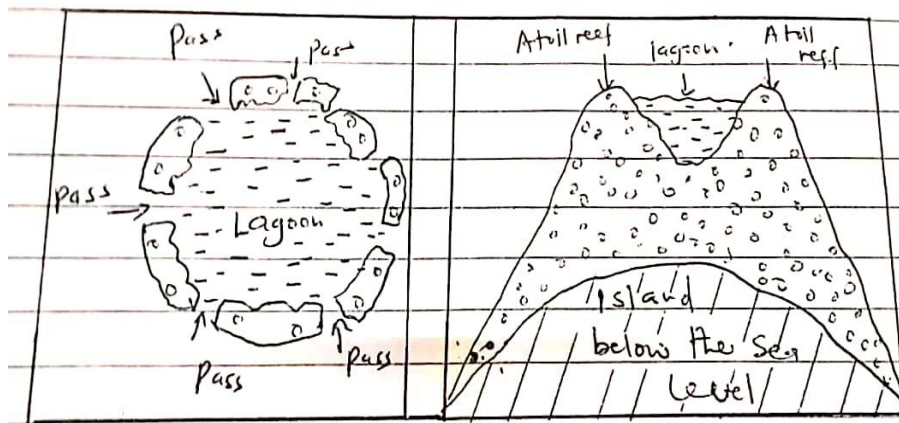
BARRIER REEF

This is a coral reef separated from the coast by a wide and deep lagoon. It is normally formed several kilometers from the shore. An example is seen around Mayotte an Island between Malagasy and Mozambique.



A TOLL REEF

This is a coral reef circular in shape and enclosed a lagoon that is fairly shallow whose floor is nearly flat shaped. Tolls are sometimes broken by narrow channel called passes. An example is Aldabara A toll off the Indian Ocean.



IMPORTANCE OF CORAL REEF TO PEOPLE OF EAST AFRICA

1. Fringing coral reefs at Mombasa and Dar-es-salaam have led to the formation of well sheltered ports and harbours.
2. Coral reefs are used as raw materials in the manufacture of cement hence industrialization e.g. Bamburi cement factory.
3. Coral reefs are impressive features and therefore important tourist attractions hence earning foreign exchange to Kenya and Tanzania.
4. They offer strong foundation for the construction of port facilities and buildings.
5. On exposures to weathering, they give rise to lime soils which favour the growth of cloves and coconuts.
6. They are quarried to provide coral rocks which are used in the construction of houses.
7. They can be broken down and used as souvenirs because of the attractive colours they have.
8. The lagoons for coral reefs are breeding grounds for fish and are used for fish activities.
9. They encourage petroleum exploration and research since their presence is a good indicator of the presence of oil wells.

PROBLEMS /DISADVANTAGES OF CORAL REEFS

1. Coral reefs on the East Africa coast interfere with the fishing by tearing the nets.
2. They weather down to form coral sands which are infertile soils and don't favour the growth of many food crops.
3. The lagoons enclosed with coral reefs are breeding sites for mosquitoes that spread diseases to people in the neighbouring communities.
4. The mining and processing of coral reefs produces dust which pollutes the atmosphere.
5. They occupy large pieces of land that would be used for development of natural harbor and other development activities.
6. They are obstacles to navigation since they break ship and boats for navigation.

WAVE ACTION ALONG THE COAST

Waves are oscillation /ripples on the surface of water. There are two major types of waves, namely;

1. Destructive waves
2. Constructive waves

Constructive Waves

These are waves with a powerful swash and are responsible for formation of depositional features along the coast.

Destructive Waves

These are with a more powerful back wash than S.wash and they erode the coast to form wavy erosional features.

WAVE EROSION

Waves erode the coast through four major processes namely;

- i) **Abrasion** .This is a process where waves use materials they are carrying such as pebbles/boulders to erode the coast.
- ii) **Hydraulic action**. This is a process where waves use the shear force water against the jointed areas along the coastal rocks.
- iii) **Attrition**. This is the breaking of boulder and rocks as hit against each other by breaking waves.
- iv) **Solution**. This is the ability of the wave to dissolve some of the rock minerals such as limestone.

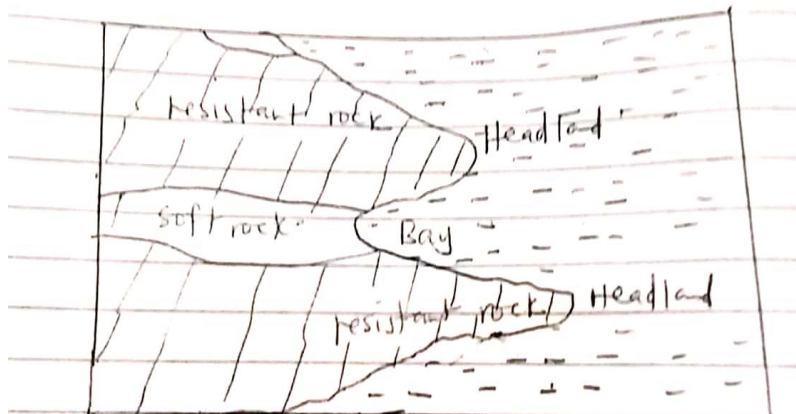
Coastal Landforms by Wave Erosion

- a) Headlands and bays
- b) A cliff
- c) Wave cut platform
- d) A blow hole
- e) An arch
- f) A geo
- g) A stack and stump.

a) Bay and Headlands

A head land is a projection of land into the sea or lake while a bay is an extension of ashoreline water into coastal land.

A bay is formed when soft rocks are removed by the wave and headland forms where harder rock exists due to their resistance to erosion.



Examples are seen at Kasenyi on Lake Victoria and Watia at the coast of Kenya.

b) Cliff

This is a steep rock face along the sea coast. They are formed when waves create a notch at the coast. This notch further widens by wave action causing the collapse of the coast rock hence formation of steep rock face known as a cliff e.g. Kasenyi and Katosi on L. Victoria.

c) A wave cut platform

This is a gently sloping surface left behind at the base of the cliff after wave erosion. It is sometimes an area where waves deposit sand and other materials.

d) A cave

This is a cylindrical tunnel or a hole drilled into the face of a cliff. It is formed when waves continuously erode a line of weakness or crack along a cliff face which is further widened to form a cave. These are seen along Lake Victoria shores at Kasenyi.

e) A blowhole

This is a hole drilled in the roof of a sea cave. It is formed when a rock joint extending vertically from the roof of the cave to the top surface of a cliff is enlarged by hydraulic action through alternative compression and expansion of air in the rock joint. This forms a narrow hole through which water may gush out to the surface. It is found near Mombasa port.

f) A geo

It is formed when the roof of a cave collapses due to prolonged erosion by solution. When this roof collapses a narrow gorge like feature called a geo is formed.

g) Sea Arch

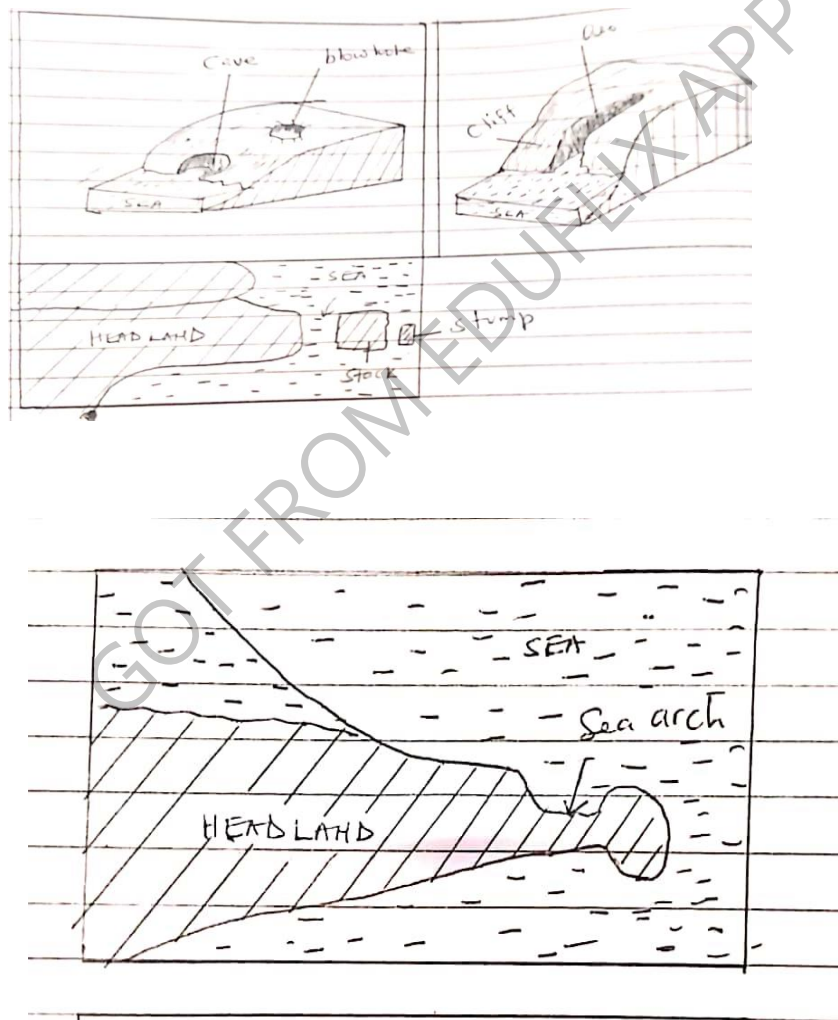
This is formed when two caves are joined together due to wave erosion from opposite sides of a headland with prolonged wave abrasion; the piece of land separating the two opposite caves is eroded away forming a tunnel – like feature called an arch.

h) Sea stack

This is formed when the roof of the sea arch collapses after prolonged wave erosion leaving a piece of rock standing above the water level like an Island, separated from the mainland e.g. Mafia, Pemba and Zanzibar Islands.

i) Stump

This is formed when the stack is eroded to the sea level. It is believed that some Ssese Islands were stacks that formed stumps.



WAVE DEPOSITIONAL LAND FORMS

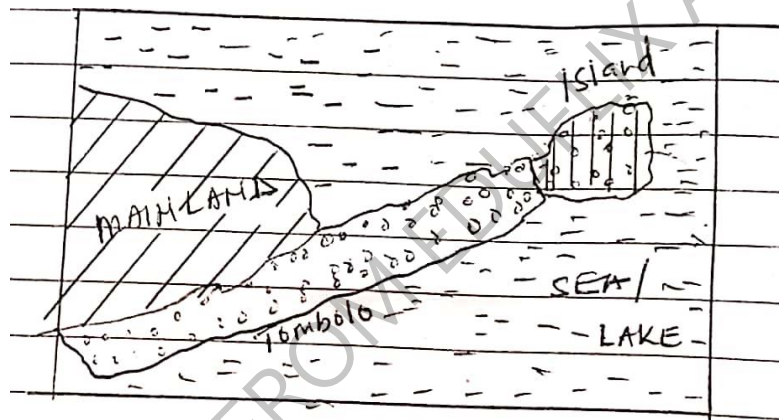
Wave deposition is responsible for the formation of features such as;

Wave deposition is responsible for the formation of features such as ;

- Tombolo
- Beaches
- Spits
- Bars
- Lagoons

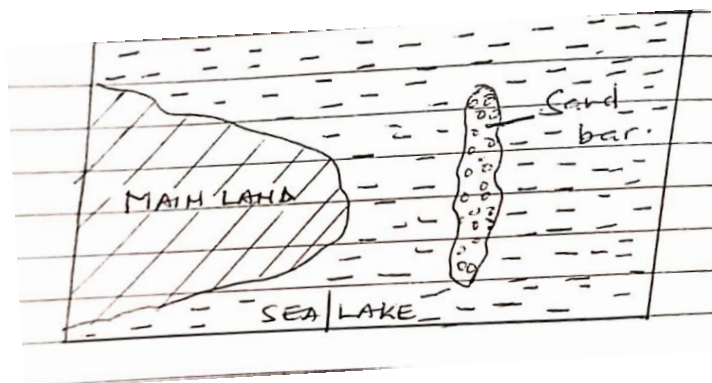
i) TOMBOLO

This is a wave depositional feature that joins an Island to the mainland. It is formed when constructive waves gradually deposit materials at the tip of a head land which extends outwards and towards an Island. e.g. A tombolo which joins Lambu Island to Bukakata main land in Masaka.



ii) A sand Bar

When constructive waves deposit materials like sand across the water body in an area parallel to the mainland, a sand bar is formed.



iii) A beach

This refers to an accumulation of sand/deposition along the shoreline. When constructive waves deposit materials such as sand, shells and gravel along a gentle sloping surface on a shoreline a beach is formed. e.g. Nyali beach at Mombasa, Gaba on Lake Victoria.

iv) A spit

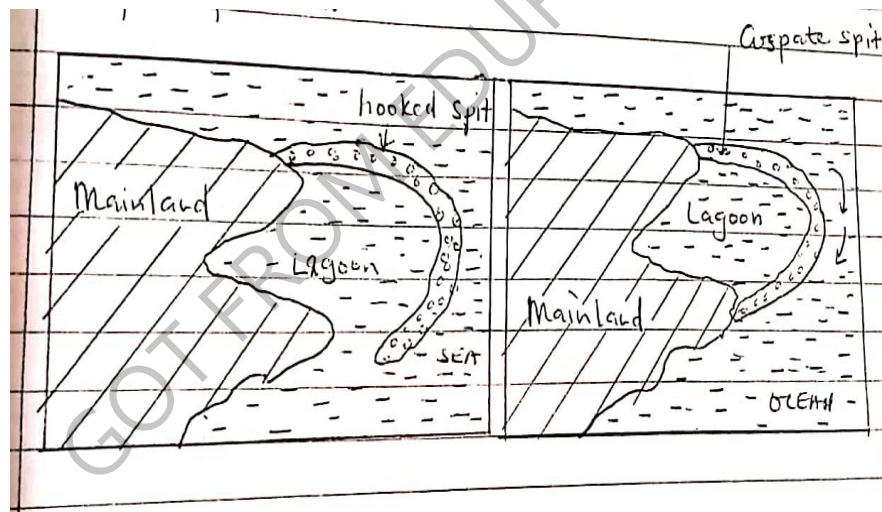
This is a long narrow ridge of materials usually made up of sand single and pebbles one end attached to the a sea or lake, spits exist in two types namely;

v) A hooked spit

This is formed when strong waves deposit materials at the end of the main land in curved format towards the water body examples are found at Tonya on the Eastern shores of Lake Albert.

vi) A cusplate spit

This is formed when curved spits joins into the head land. The curved spits many grow towards the land and eventually forms the land forming a cusplate spit which encloses a lagoon with deposits called a cusplate foreland.



NB.

When the sea level rises, it is positive. Eustatism and its results into submerging of the coastal feature like Rias, fords etc.

Aria is a submerge and drowned river valley. It is found at the coast i.e. Mombasa.

There are also features that result from a fall in sea level changes. They include;

- Raised cliffs
- Raised beaches
- Raised terraces

SOIL FORMATION IN EAST AFRICA

Soil is a thin layer of loose unconsolidated material found on the earth's surface where plant roots grow. Soils are made up of many components including organic matter, inorganic matter which is mainly the parent rock. Soil also composes of water, soil air and minerals.

Organic matter on the other hand is humus which is the main of decomposed dead plants and animal. Soil is also made of living organisms which help in the decomposing of those dead living organisms.

FACTORS AFFECTING SOIL FORMATION IN EAST AFRICA

i) Climate

Areas that receive heavy rainfall amounts i.e. 1000 – 1500 well distributed throughout the year encourage deep chemical weathering thus formation of deep mature fertile soils. However areas which receive little rainfall below 500mm with very hot temperature over 30°C encourage physical weathering leading to formation of shallow, sandy and infertile soil e.g. Karamoja.

ii) Relief /Topography

This is general appearance of land therefore on steep slope there is fast soil erosion leading to the formation of thin and skeleton soils.

On gentle slopes, there is deep chemical weathering of rocks resulting into deep mature soils while in the lowlands due to much deposition there is formation of clay soils.

iii) Parent Rock

This refers to the parent material from which soil is made, the parent rock may be volcanic (Igneous) sedimentary or metamorphic. In East Africa deep fertile soils are found in areas with sedimentary rocks.

iv) Living organisms

They include man, plants, animals and birds, man's activities like mulching, additions of fertilizers like phosphates which improve on the fertility of soil whereas deforestation, overgrazing, bush burning open up the land and expose it to agents of soil erosion thus leading to infertility.

Plants also influence soil formation in the way that areas with thick forests such as Mabira, Budongo encourage decomposition of organic matter to form humus hence formation of deep mature soils.

v) Time

This refers to the period of interaction between the parent rock and the soil forming processes. The longer the time of interaction between the parent rock and the soil forming processes, the deeper and mature soil is while the shorter the time of interaction the shallower soil will be.

PROCESSES OF SOIL FORMATION

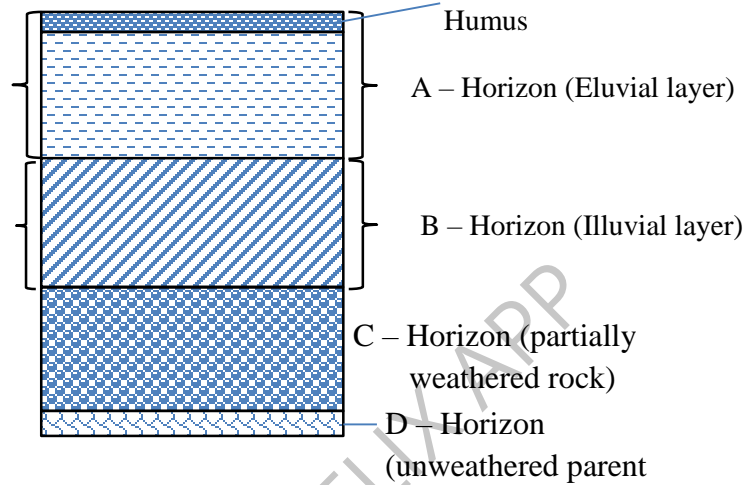
These are mainly various processes which work hand in hand to produce soil and these include the following.

- i) **Weathering.** This is the disintegration and decay of rocks on or near the earth's surface weathering break rocks into simple particles known as soil.
- ii) **Leaching.** It is the removal in solution by water of minerals from a horizon of the soil profile to the B-Horizon where plant rock cannot reach. It is responsible for the formation of reddish brown soils known as laterites especially on Buganda hills.
- iii) **Eluviation.** It involves the movement of soil materials in solution or suspension form either vertically or horizontally.
- iv) **Illuviation.** This is a process that involves the accumulation and deposition of leached and eluviated material. The process takes place in the B-Horizon of the soil profile and it forms soils which are rich in nutrients.
- v) **Humification.** This is a process through which the organic matter decomposes to form humus. The process is common in warm and hot tropical areas where rainfall is heavy accompanied by hot temperatures hence growth of forests to form humus.
- vi) **Mineralisation.**
This is the process of soil formation where organic matter is broken down into mineral substance e.g. Carbon dioxide, Carbonates, Oxygen. It takes place in the top layers of the soil profile.
- vii) **Calcification.** This process is common in areas which are dry e.g. Karamajo and Turkana. This is where there is Upwards movements of water by Capillary action. When water reaches the surface. It evaporates due to the dry conditions thus leaving behind salty soil known as pedocals.
- viii) **Laterization.** This involves the concentration of iron and alluvium in the A horizon of the soil profile after the removal of Silica by leaching process is very common in tropical and sub-tropical areas where rainfall is heavy. It leads to formation of hard pan that forms laterites common on the hill tops in Buganda.
- ix) **Gleization.** This is a soil forming process which occurs in areas which are water logged and is responsible for the formation of clay soils common in swamp areas of East Africa e.g. Kajjansi swamps, along rivers like Kagera and Katonga.
- x) **Podzolization.** It is a complex process that involves a combination of process such as leaching, eluviation and humification. The process for the formation of yellowish soils known as Pedozols.

SOIL PROFILE AND CATENA

Soil Profile; It is a vertical section /arrangement of soil layers from the surface of the earth downwards to the bed rock.

A soil profile shows the arrangement of soil layers or horizons in a specific area. The major factor influencing soil profile in East Africa is Climate.



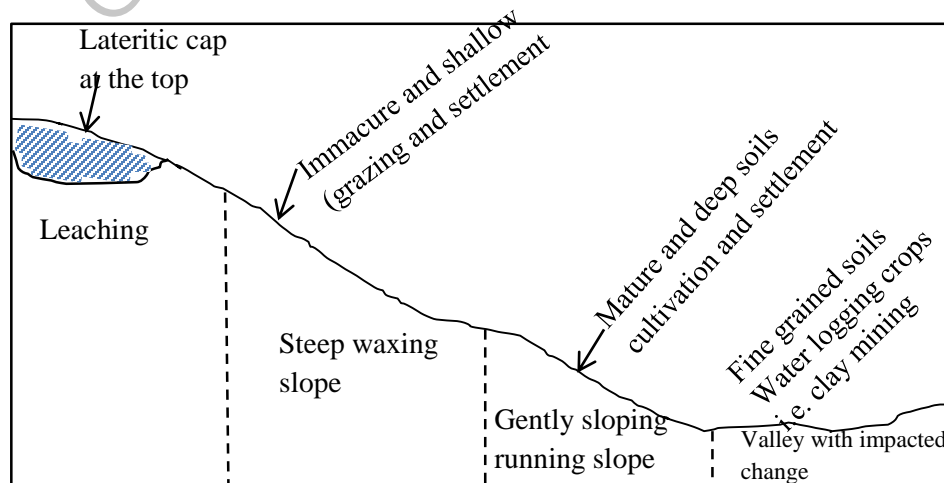
SOIL CATENA

This is the sequence of soil along the slope. It is the horizontal arrangement of soils from hill top to the valley bottom. Soil catena shows different characteristics of soil in terms of colour. Texture, depth and the water content.

Along the hill top these are reddish brown soils known as laterites. These are formed as a result of leaching.

On the steep slope, there are stony creep soils due to fast/rapid erosion.

On the gentle slope, there are deep loam soils due to deep chemical weathering of rocks. In the valley slope, there are clay soils due to much deposition.



MAJOR SOIL TYPES IN EAST AFRICA

1. Laterite Soils (Latosols)

This is a type of soil that is formed as a result of leaching refers to the washing away of the minerals or organic matter from the upper layers of the soil to the underlying layers (B).

These soils are also found on flat topped hills of Uganda particularly in Buganda.

Importance of Laterites

- i) They provide major raw materials for brick making.
- ii) They are also used as raw-materials for Art and Craft especially moulding.
- iii) They also provide murram which is used in road construction.
- iv) They tend to support the growth of short grass and bush used for the grazing of animals.

2. Clay soil

This is found in broad river valleys or low-lying areas which are water logged. The soil is grey in colour and contains a considerable amount of water hence being used for growing crops like rice, yams, sugar cane etc.

3. Alluvial Soils

These are soils that are deposited by rivers and they are found along the river banks or shores of lakes. These are common on the shores of Lake Victoria and along rivers like Kagera and Katonga. They are very fertile and tend to support crop growing.

SOIL EROSION IN EAST AFRICA

Soil erosion is defined as the removal of top soil by agents such as running water and moving ice from one place to another.

Areas affected by soil erosion in East Africa.

- a) In Uganda they include; Ankole – Masaka dry corridor, Karamoja, Kigezi highland, Rwenzori slopes in Kasese, Steep slopes of Mt. Elgon, Bundibugyo, Teso etc.
- b) Kenya include; Nyanza province, Kenya Highlands, Machaakozi, Masai, Areas around Turkana, Wajir, Lodwar, Elwark etc.
- c) Tanzania include; Umatengo region (Southern Tanzania), Kondoia region, Central Tanzania, Masai, Sukuma land, slopes of Mt. Kilimanjaro areas around Katema.

TYPES OF SOIL EROSION

These are also known as processes of soil erosion they include;

a) Sheet Erosion

This refers to the uniform removal of top soil from one place to another by surface run off. This can't easily be noticed since the rate of removal is balanced by rate of soil formation. It commonly occurs along gentle slopes.

b) Rill Erosion

This involves the removal of soil through small channels known as rills. It is sheet erosion that upgrades into rill erosion and this is common along the steep slopes with scattered vegetation.

c) Gully Erosion

These are deep channels that have developed on the earth's surface as a result of emerging of the rills. It is caused by heavy rainfall on steep slopes that deepens and widens the channels to upgrade into gullies. These are common along Kisoro – Kabale road, Mt. Elgon slopes, Kigezi highlands.

d) Splash Erosion

It is a process of soil erosion that is caused by large drops of rain hitting the soil. Depression are left behind as a result, soils tend to spread and eventually carried away.

NB.

Wind erosion /deflation is a process of soil erosion that is caused by wind action. It commonly occurs in dry areas such as Turkana and Karamoja where wind blows large quantities of soil from one place to another.

Causes of Soil Erosion in East Africa

The causes of soil erosion include both physical, and human as shown below;

(a) Physical Cause

1. Presence of steep slopes which increase the speed of water thus developing gullies where soil is washed e.g. Kigezi highlands and Elgon slopes.
2. Presence of heavy rainfall which encourages surface runoff which carried away the top soil hence causing soil erosion. It is common in Nyanza Province, Kenya, Umatengo of Tanzania, Mbale etc.
3. Presence of strong winds which blow large quantities of soil due to lack of natural vegetation cover e.g. Turkana land Karamoja region.

(b) Human Causes

4. **Deforestation.** This involves the cutting down of trees without replacement. This destroys the plant cover which exposes the soil to agents of soil erosion such as running water. This has been seen along the slopes of Mt. Elgon.

5. Bush burning which is basically carried out by the nomadic pastoralists hence destroying the plant cover and thus exposing the soil to agents of erosion.
6. **Over grazing.** This involves grazing of animals in large number that the capacity of land and available pasture. The animals eat away all the grasses and destroy the soils thus making it easily carried away by mostly wind hence erosion.
7. **Monoculture.** This involves the growing of one crop on the same piece of land season after season. This leads to soil erosion that weakens the soil thus easily carried away by erosion agents like running water. e.g. Masaka where Coffee and bananas are grown under monoculture.

Other causes include;

- Road construction resulting into deep gulleys
- Land fragmentation resulting into the formation of rills and gulleys where soil is lost and its common in Kigezi highlands.

EFFECTS OF SOIL EROSION

Negative

1. It leads to the washing away of top soil thus resulting into the formation of infertile soils which cannot support crop growth.
2. It leads to formation of gulleys which may destroy transport and communication routes thus some areas are inaccessible e.g. along Kabale – Kisoro road.
3. It also leads to high spread of diseases such as flu and cough and skin rashes e.g. wind erosion.
4. It tends to cause invisibility due to air dust along roads hence causing accidents.

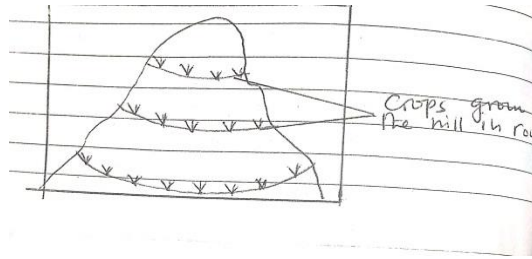
Positive

1. It leads to formation of deep fertile alluvial soils growth in the low lands areas thus encouraging crop growth in form of sugar cane and rice.
2. It exposes relief features like Inselbergs, volcanic plugs hence attracting tourists that fetch foreign exchange.
3. Soil erosion leads to the formation of soil especially the parent rock is exposed on the surface.

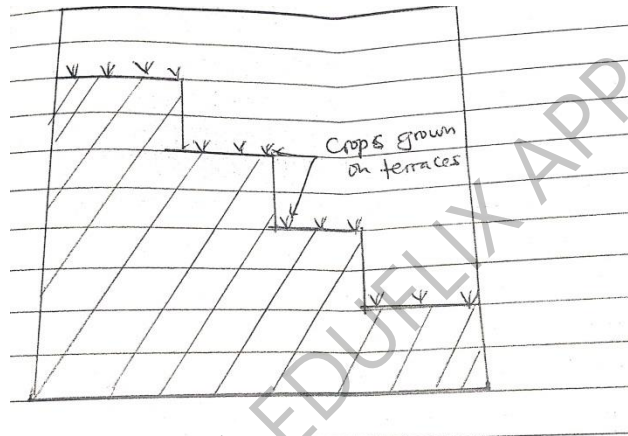
SOIL CONSERVATION MEASURES

Soil conservation is a practice of the management that involves to protect the natural fertility of soil through the use of various skills and techniques. The measures to control soil erosion include the following;

- i) **Contour ploughing.** This is cultivation of crops along the hill. it involves ploughing around the hill in rows where crops are grown at fixed intervals. This measure solves the effects brought about by up and down cultivation. It is common in Kenya highlands and Bundibugyo.



- ii) Terracing. This involves construction of flat surfaces (terraces) along the slope. The measure aims at reducing the speed of running water hence controlling soil erosion. It is common in Kigezi region.



- iii) Afforestation. This involves the planting of trees (vegetation cover) where they have never existed before. This is practiced in many dry areas in East Africa. e.g. Machakosi in Kenya.
- iv) Reforestation. This refers to the growing of trees after cutting the existing one. It is the planting of trees where they ever existed. It aims at providing plant cover the soil this solving soil erosion agents like running water, e.g. along the slopes of Mt. Elgon.
- v) Mulching. It involves the use of plant remains to cover the soils. Plants remain such as banana leaves. Sorghum stem and millet, coffee husks have all been used to cover the soil from agents like running water e.g. Masaka, Wakiso, Parts of Mbarara.
- vi) Application of fertilizers. These include phosphates sulphate so as to improve on soil fertility which makes the soil resistance to soil erosion agents.
- vii) Rotational grazing. This involves changing of animals from one paddock to another so as to reduce on the problem of over grazing and stocking. It is practiced in Ankole western Uganda.

A SKETCH MAP OF SHOWING AREAS AFFECTED MY SOIL EROSION.

GOT FROM EDUFLIX APP

- viii) Mass education or sensitization of people through newspapers, radios, community seminars about the causes of erosions and the possible measures such as afforestation and re-afforestation.
- ix) There is use of gabions (combination of stones and wires to hold the slopes from being taken away especially by running water e.g. in Kabale and Bundibugyo