CLASSIFICATION OF SOIL

Soil types in E.Africa fall under three major groups (types) namely;

i) Zonal soils
ii) Intra-zonal soils
iii) Azonal soils

1. Zonal soils:

- These are mature soils which have well developed soil profiles
- Their formation is dominantly influenced by climate and vegetation (organic matter) upon the parent rock over a long period of time.
- They are said to have had sufficiently long periods of exposure to the soil forming processes and therefore have well developed profiles with distinct horizons.
- They are formed on gently sloping and well drained areas in E.Africa such as around the Lake Victoria basin and along the foot hills of the highlands
- They are sub divided into **two groups** i.e.
  - **Pedocals** which are rich in calcium carbonate formed in areas of low rainfall (semi areas)
  - **Pedalfers** which are rich in aluminium and iron. They develop in areas of high rainfall (humid areas). They include lateritic soils, tropical red earths and tropical black earths among others.

- The following are the **Types of Zonal soils in East Africa**:

i. **Lateritic soils (Latosols):** These are soils formed in humid tropical regions where heavy leaching takes place all the year. They consist of mainly hydrated iron and aluminum oxides and have stony particles due to the loss of mineral nutrients by removal of bases and silica from top soil to the underlying horizon.
It is formed by the lateralization process and mainly used for grading roads.
ii. **Tropical red earths:** These are formed in tropical regions with definite wet seasons during which heavy leaching takes place. They are characterized by a loamy mixture of clay and quartz
iii. **Tropical black earths:** These are soils formed in humid tropical regions where there are basalt rocks for example parts of Kenya. It is black in colour due to high content of titanium salts in the basalt bed rock or parent rock.
iv. **Red desert soils:** These are soils that are reddish in colour. They are formed in hot and dry regions. They are sandy and contain a lot of salts.

2. Intrazonal soils:

- This category of soils occurs where special conditions of the parent rock or drainage exert a stronger influence on the resultant soil type than other factors. This could be in form of presence of much water, large amounts of salts etc
- They exist in different parts of the world rather than in specific zones.
- Intrazonal soils are intermediate between the zonal soils and the azonal soils.
- They show profiles which are distinct, an indication that there has been a dominant control factor in their formation i.e. parent rock material or drainage other than climate.

Examples of Intrazonal soils include:

i. **Saline soils:** These are the soils which have high levels of soluble salts. They are grey because of the salt content and they occur in regions or areas where evaporation is very high. They are so common in semi desert areas. They include solonchaks and solonetz soils. They are also known as **Halomorphic soils**

ii. **Peat soils:** These are soils which occur in water logged (marshy) areas with almost no air space to allow easy water percolation or infiltration. The decomposing plant remains accumulate on top of this impervious soil to form peat or bog soil for example in swamps and valleys as well as the coastal areas of E.Africa such as meadow soils and gley soils. They are also called **Hydromorphic soils**

Relatedly, meadow soils (silt and mud) occur in river flood plains

iii. **Calcareous soils:** These are soils which are formed from limestone rocks. They include Rendzina soils which are dark-coloured, loamy soils containing chalk or limestone fragments formed under humid conditions and Terrarossa soils which are reddish residual soils that normally accumulate in limestone depressions usually under semi-arid conditions. They are also known as **Calcimorphic soils**

3. Azonal Soils:

- They are immature or young soils which show characteristics of their original parent rock.
- Their development is incomplete, that is why they don't have well marked horizons i.e they have no clear soil profile.
- They are soils which have not been exposed to soil forming processes for a long time to develop mature characteristics hence they are immature soils.
- They are skeletal soils with shallow profiles so they reflect (show) similar characteristics of the original parent rock hence, they resist change
- Azonal soils can be described as transported soils which are deposited by the agents of erosion because they are derived from un consolidated materials such as alluvium, sand, volcanic ash among others

- Azonal soils are divided into two (2) categories i.e **Lithosols** and **Regosols**

Examples of azonal soils include:

i. **Mountain soils/Scree soils:** These are soils which are stony consisting of large rock fragments that weather down by frost action. They are coarse grained (textured) and heavily leached. They are found on mountain slopes formed from the accumulation of weathered rock fragments
ii. **Alluvial soils:** These are deposited soils consisting of a mixture of sand, silt, mud and clay (river borne materials). They are fine textured and suitable for agriculture.
iii. **Marine soils:** They are common in coastal areas associated with water bodies for example lakes, seas and oceans formed as a result of wave action such as mud and clay.
iv. **Volcanic soils:** They are the soils produced by weathering of volcanic rocks. They are highly acidic and fertile for example recent lava and ash soils.
v. **Glacial soils:** They are soils formed as glacial deposited materials for example till soils, fluvial glacial soils, gravels and clay as well as outwash sands deposited in glacial lakes by glaciers and rivers flowing from glaciated highlands.
vi. **Wind-blown soils (Aeolin):** especially sand sheets, dry sandy soils, sand dunes and loess. They are blown and deposited by wind in arid areas e.g Kotido and Moroto in Karamoja region, the rift valley region in Western Uganda and Chalbi desert in Kenya.

FACTORS/CONDITIONS/PROCESSES RESPONSIBLE FOR THE FORMATION OF AZONAL SOILS IN E.AFRICA:

(a) Denudation processes (Erosion, transportation and deposition)

- Wave deposition results into the formation of marine deposits and the resultant soils include mud-flat soils/marine clay soils e.g along the East African coast at Mombasa.
- Glacial deposition results into the formation of fluvio-glacial soils e.g tills, outwash sands, gravel and clay deposited in glacial lakes e.g Lac du Speke on Mt. Rwenzori.
- River deposition results into the formation of alluvial soils particularly silt and mud e.g along the banks of river Pangani and river Rufigi in Tanzania.

(b) Climate

- Heavy amounts of rainfall cause floods and sea level changes forming alluvial soils in lower courses of rivers e.g along River Rufigi and River Pangani as well as marine soils in coastal areas.
- Heavy rainfall also causes severe erosion along the steep slopes of highlands e.g Rwenzori and deposition in lowlands forming soils such as silt, mud like in some parts of Kasese.
- Temperature changes in mountains / highlands like Rwenzori and Mt. Kenya cause frost action to take place consequently forming scree soils or mountain soils.
- Differences in pressure within desert / semi desert areas cause strong winds to blow resulting into wind erosion that forms loess soils

(c) Relief

- The steep slopes of highlands promote weathering, erosion and mass wasting to take place hence forming scree soils
- Valleys / lowlands encourage deposition of eroded materials to form soils like silt and mud

(d) Volcanic activity produces volcanic soils such as lava, ash/cinders etc

(e) Nature of the parent rock (Rock structure)

- Dark coloured rocks are easily weathered to form scree soils
- Well jointed rocks in highland areas are easily weathered to form scree soils
- Soft rocks are easily eroded by rivers and glaciers to form alluvial soils, till soils among others
- Loose/light rock particles are easily blown, transported and deposited to form wind-blown soils such as loess and sand dunes

(f) Biotic factors i.e man and the effect of burrowing animals

- Human activities like agriculture, quarrying and mining lead to break up of the parent rock into small particles thereby producing loose or un consolidated materials which form scree soils.
- Man also dumps waste materials that may result into weathering of the rock hence forming azonal soils.
- Deforestation, bush burning, over stocking and over grazing expose the parent rock to weathering processes that lead to formation of young soils.

(g) Time

Azonal soils are young (immature) soils implying that they are exposed to the soil forming processes for a short period of time during their course of formation.

Qn a) Distinguish between azonal soils and intrazonal soils

b) Account for the formation of azonal soils in East Africa

OR

Qn. Examine the conditions/factors/processes responsible for the formation of azonal soils in East Africa.

SOIL EROSION IN EAST AFRICA:

Soil erosion is the process of washing away or removal of the top thin layer of soil by agents like running water, wind, ice (glaciers) and man from one place to another. The eroded soils are transported and deposited to another area.

There are **two (2)** types of soil erosion namely **geological** and **accelerated** soil erosion.

Geological soil erosion is regarded as normal erosion which takes place whenever there is a flow of energy on the surface of the earth. It is a slow process in which the removal of the surface soil may be matched by the formation of new soil. It is therefore not dangerous to the soil and occurs in areas with vegetation cover.

Accelerated soil erosion occurs when geological soil erosion is speeded up by man's activities. In this case the rate of soil loss is greater than the rate of soil formation. This type of soil erosion takes place in all environments which have been disturbed by man.

Areas affected by soil erosion include: Slopes of Mt. Elgon, Kigezi highlands in Kabale and Kisoro, Kotido and Moroto in North Eastern Uganda and Ankole Masaka corridor.

In Kenya, it occurs in Machakos (Masai land), Nyanza province, Turkana land, Chalbi desert and the Kenya highlands.

In Tanzania, it is experienced in the Kondoa region, Miombo woodlands, Mt Kilimanjaro slopes and around the Southern highlands among others

Generally, soil erosion occurs in the highland and dry areas of E.Africa

TYPES/FORMS/PROCESSES OF SOIL EROSION IN EAST AFRICA:

1. Wind erosion/Deflation

This is the removal of light soil particles from one place to another by the action of wind. The soil particles are blown away by wind and later deposited to form sand dunes. It's very common in generally flat and dry (semi arid) areas with no or less vegetation cover e.g Chalbi desert of Kenya, Kotido and Moroto (Karamoja region)

2. Sheet erosion

It is the uniform removal of a thin layer of soil over a large area by running water and wind. This mainly occurs when rain falls on a gentle slope which is bare without any vegetation e.g in Nakasongola, Mbarara and Bushenyi

3. Rill erosion

This is the uneven removal of surface soil by running water in which numerous small channels (furrows or rills) of a few centimeters in depth are formed. This occurs on gentle slopes where vegetation has been cleared. It is more frequent in areas that receive frequent rainfall e.g around Lake Victoria in Mukono, Kampala, Wakiso and Mt. Elgon slopes in Mbale.

4. Gulley erosion

It is where deep and wide channels/grooves are created by running water on the earth's surface. It is common in steep slopes which receive heavy rainfall especially where vegetation has been destroyed e.g Kabale, Kisoro and Kabarole in Uganda.

5. Splash erosion

It is caused by the impact of rain drops which dislodge soil particles and scatter them in different directions. The splashed particles are later pulled down by gravity. Therefore rain drops do not only detach loose soil particles but also affect the horizontal movement of the those particles

CAUSES OF SOIL EROSION IN EAST AFRICA:

Soil erosion is influenced by both **Physical** and **human** factors. They include:

a) Physical factors:

- **Climate**
  - Prolonged and heavy rainfall especially in highland areas creates excessive surface runoff that increases the erosive energy of the running water resulting into rill and gulley erosion
  - Prolonged but gentle/moderate rainfall leads to minimal rates of erosion
  - Strong winds especially in semi arid/arid areas with very little rainfall cause deflation (wind erosion)

- **Vegetation**
  - Areas with limited (thin) vegetation cover experience high rates of erosion. Scanty vegetation encourages excessive surface runoff hence causing wind deflation, rill and gulley erosion
  - Areas with thick vegetation cover are associated with minimum rates of erosion such as around Mabira

- **Topography/relief**
  - Steep slopes in highland areas accelerate high rates of erosion especially gulley erosion. In other words, the longer and steeper the slope, the greater the velocity (speed) and erosive power of the surface runoff hence leading to gulley erosion.
  - Gentle slopes encourage sheet erosion

- **Nature of the soils**

  Porous and un consolidated soils especially young volcanic soils and sandy soils offer less resistance to the erosional agents like wind and running water hence causing high rates of erosion. Such soils are very light in nature that's why they are highly susceptible to erosion especially at Kotido and Moroto. Young volcanic soils are found at Bududa hence promoting gulley erosion

- **Biotic factors**
  - The presence of harvester ants and wild animals in pastoral and semi arid areas leads to rapid loss of vegetation cover especially grasses leaving such areas bare and less resistant to erosion. This is responsible for wind deflation and splash erosion in areas like Machakos, Ankole-Masaka corridor, Nakasongola and Karamoja areas

- **Prolonged drought**
  - This limits the growth of natural vegetation cover hence leaving the land bare and exposed to agents of soil erosion like strong winds and heavy rain drops. This is very serious in Karamoja region, Turkana land, Masailand and Miombo woodlands

b) Human factors:

- **Deforestation**
  - The excessive cutting down or clearing away of trees by man reduces the protective cover of soil and encourages runoff subsequently resulting into soil erosion in form of sheet and gulley erosion

- **Shifting cultivation**
  - This is an agricultural practice which involves cutting down trees, planting crops on the land and thereafter abandoning it when it loses its fertility. The soil is easily eroded once the bare land is abandoned by the farmers who shift to other virgin lands which are still productive

- **Overstocking/over grazing**
  - Large numbers of animals lead to the emergence of bare patches of land leaving the land highly prone to erosion especially wind deflation. This is so common in nomadic pastoral areas

- **Over cropping**
  - It refers to continued cultivation of crops on the same piece of land for a long time without giving it rest. It causes severe soil exhaustion. The soils ultimately become loose and are easily washed away by the erosional agents

- **Up and down slope cultivation**
  - If there's persistent ploughing of highland slopes without using proper methods of cultivation, it encourages surface run off thereby resulting into rill and gulley erosion

- **Mining and quarrying**
  - Open cast mining involves the removal of large quantities of surface vegetation and this leaves such areas bare and prone to soil erosion by wind and running water

- **Construction works**
  - The establishment of roads, motorable trucks and rail way involves removal of vegetation and exposes the soil to the harmful effects of raindrops, running water and wind. In addition, running water easily takes advantage of transport routes to create gullies hence soil erosion

- **Swamp reclamation**
  - This involves the draining of swamps for agricultural purposes. Floods especially in rainy seasons occur which carry away the soil e.g in Busoga, Tororo, and parts of Buganda

- **Bush burning**
    - This is mainly done by the pastoralists like the Bahima in Uganda, Masai in Kenya as well as Tanzania and cultivators leading to the destruction of natural vegetation cover. This exposes the top soil to agents like running water and winds leading to wind deflation, rill erosion, sheet erosion and splash erosion

- **Monoculture**
    - This is the persistent growing of a single type of crop on a piece of land for a long period of time. This makes the soil loose and easily carried away by the agents of erosion e.g Kikuyu land in Kenya, Mukono and Lugazi in Uganda

- **Growing of poor cover crops**
    - Some crops such as cotton and tobacco leave bare land in between the rows and this incidentally encourages erosion of the soil by running water.

EFFECTS OF SOIL EROSION:

Negative effects:

i. Soil erosion results into washing away of the finest and most fertile soils which are rich in organic matter. This results into infertile (unproductive) soils which cause low crop yields hence leading to famine.
ii. Soil erosion physically destroys the soil surface by creating gulleys and therefore causing waste Lands leading to loss of farm land. Equally, the waste land / bad lands with gullies hinder transport and communication as well as mechanization
iii. Soil erosion can result into landslides especially where gulleys are formed. These gulleys weaken the stability of a slope thereby leading to landslides.
iv. Soil erosion results into pollution of water bodies e.g. springs, wells and rivers through deposition of silt and sand into the water bodies. It adds other impurities into the water which may be harmful to human health. Relatedly, wind erosion causes air pollution due to excessive dust
v. Areas with rampant soil erosion are infertile. They are therefore associated with limited vegetation cover since heavily eroded soils are unable to support plant growth. This results into reduced evapotranspiration, low rainfall and scarcity of pasture for the animals
vi. Soil erosion also causes flooding in broad river valleys and lowlands due to siltation of rivers and other water sources. This ultimately results into loss of human life and destruction of property

vii. It costs a lot of money and efforts to individuals and governments to control. Farmers also lose their crop fields because of soil erosion
viii. It may also lead to silting of lakes and irrigation canals. This in turn affects fishing and agriculture
ix. The dust particles carried by wind are deposited around social infrastructure like roads, buildings among others leading to increased costs of maintenance

Positive effects:

x. Soil erosion leads to removal of top soil thus exposing the fresh parent rocks to the agents of weathering leading to formation of new soils hence it facilitates soil formation.
xi. It leads to transportation, deposition and accumulation of fertile alluvial soils in the low land areas which are utilized for agriculture/crop farming e.g. River Manafwa at Doho irrigation scheme.
xii. It leads to exposure of physical landforms such as inselbergs which attract tourists thus promoting the development of the tourism industry e.g. in Mubende and Nakasongola.
xiii. Soil erosion exposes minerals nearer to the earth's surface and this makes them easy to extract e.g. limestone rocks in Tororo. When they are exported, revenue is earned

Steps taken to control soil erosion in East Africa:

i. **Afforestation and re-afforestation programs** are being encouraged and people are planting trees in fresh areas and in areas where forests were cleared. This makes soil particles on highland slopes to be held tightly together by the tree roots.
ii. **Terracing method** of farming on steep slopes is being used where by bench like steps are cut along a highland slope and these become gardens. These steps break the speed of the water and its energy to wash away the soil.
iii. **Contour ploughing** is used where by cultivation on slopes follows the heights of the slope so that areas of the same contours/height are cultivated together across a slope. This reduces the surface runoff as the raised ridges break the flow of the running water for example in the Kenya highlands.
iv. **Crop rotation system of farming** is being applied. This involves successive cultivation of different crops in the same field following changes in the season. This helps to maintain the soil structure and soil fertility.
v. **Strip cultivation** is being practiced on steep slopes where the gardens are separated by strips of uncultivated grass. This breaks soil erosion because as water begins to run, its speed is broken by entering into a grass strip.
vi. **Use of cover crops** especially those crops which spread as they grow and cover the soil such as beans, sweet potatoes, pumpkins and other legumes. These break down the speed of the running water and its energy to erode and wash away the soil.
vii. **Mixed or intercropping system of farming** where different types of crops are grown in the same field at the same time for example crops like maize, beans,

ground nuts and Irish potatoes are inter-planted and this assists to bind the soil particles

viii. **Restricted or controlled grazing** which involves controlling the number of animals grazing in a particular area so as to make the soil remain with some grass to hold it and protect it from erosion for example zero grazing.

ix. **Bush fallowing system of rotational farming** where some pieces of land are left under fallow or rest, in order to regain fertility naturally. This improves the soil structure which makes it hard for the soil to be eroded away.

x. **Addition of organic manure and other artificial fertilizers** to improve on the soil fertility and structure. The soil particles become cohesive and too hard for running water to wash them away.

Qn. Discuss the causes and effects of soil erosion in East Africa.