**SOIL IN EAST AFRICA**

**(a)What is soil?**

**(b)Examine the processes of soil formation in East Africa**

**Approach**

* Define soil
* Give and explain briefly components of good soil.
* Describe the processes that lead to formation of soil in their order.

**Components/ Constituents of Soil**

Soil is a thin layer of the earth crust composed of naturally weathered rocks, water, organic matter and living organisms capable of supporting plant life.

**Good soil consists of;**

**Tiny mineral particles** derived from weathering of parent rock. For example phosphorus, magnesium, potassium, calcium, sulphur, iron, copper and zinc

**Humus** derived from decaying Organic matter. Humus is broken down by micro-organisms to enrich the soil with nitrogen, phosphorus, calcium and potassium which plants absorb through roots. Humus increases soil fertility, soil texture and water retention for example in sandy soils.

**Living organisms such** asearth worms, termites and bacteria such as “rhizobium” (nitrogen fixing bacteria in legumes). Living organisms decompose organic matter physically and chemically to form humus. The number of living organisms in the soil depends on the aeration of soil.

**Air-** for example oxygen and nitrogen to support living organisms in soil. The amount of air present in the soil depends on drainage. Therefore waterlogged places have limited air and biological activity.

**Water** derived mainly from rainfall and varies from nil in deserts to logging in equatorial regions. Water moves down in the soil by infiltration and to sub-layers by percolation and upwards to the surface by capillarity.

Water dissolves minerals taken up by plant roots. It also acts as a medium for chemical weathering processes that take place within the soil for example leaching and eluviation.

**PROCESSES OF SOIL FORMATION**

Processes of soil formation refer to a ctivities that take place to produce soil from parent material, organic and inorganic matter. These processes include weathering, leaching, Eluviation, Illuviation, Humification, Mineralization, Calcification, Calcification, Laterisation, Gleization and Podzolisation; and have to be presented in order.

**Weathering-** refers to the physical disintegration and chemical decomposition of rocks in situ by natural agents on or near the earth surface.

Weathering of the parent rock produces tiny mineral particles or colloids which are worked on by other soil forming processes to produce mature soil.

High weathering rates for example in hot humid (equatorial regions) produce deep and mature soil while slow weathering rates for example in arid and semi arid regions produce shallow and immature soil.

**Leaching-** this is the process by which soluble minerals are washed out/ removed by water from the upper layer of the soil profile (A’ Horizon) to the underlying layer (B’ Horizon). Leaching washes out soluble minerals like silica, potassium, magnesium, sulphate, and calcium carbonates from top layer.

Leaching leaves the A’ horizon impoverished forming poor soil especially in humid regions where vegetation cover has been cleared.

**Eluviation-** is the removal of insoluble compounds or colloids such as iron and aluminum from the top soil to the sub-soil in solution or suspension from one place to another within the soil.

The movement may be vertical or horizontal depending on the movement of soil water. Eluviation leads to complete loss of soil nutrients from top soil and impoverishment of A ‘horizon of soil profile.

This process is mainly influenced by climate and the nature of the parent rock.

**Illuviation-** is the deposition and accumulation of both leached and eluviated materials in the B’horizon of the soil profile. It’s responsible for the development of the **b2** layer (dark colored zone) due to maximum accumulation of colloids.

**Humification** is the process by which organic matter is decomposed by bacteria and earth worms in soil to form humus. Humification is more rapid in equatorial regions than dry and cold areas because of hot and humid conditions, dense foliage on the ground e.t.c

Humification influences the development of A0 and A1 zones of the top soil and determines the soil fertility.

**Mineralization-** takes place when humus is broken down farther into basic parts such as carbon oxide, water and silica. Mineralization influences the development of A’ horizon due to presence of high organic matter.

**Calcification-** (named after calcium salts) involves the movement of calcium salts from the sub-soil (B’horizon) upwards to the surface by capillarity caused by hot high temperatures. Calcification is common in dry / arid areas where high daily temperatures encourage capillarity and evaporation of water containing dissolved calcium bicarbonates. As water evaporates, calcium is deposited on the surface where it accumulates to form a calcite layer and soils rich in calcium known as **pedocols;** with a shallow soil profile. This process is common in the karst regions of East Africa.

**Salinisation** (salt) - this is the process by which salts from the sub-soil accumulate to the surface. It is common in semi arid areas composed of salt rock. Hot temperatures pull salt solution to the surface by capillarity and as water evaporates, salt evaporites such as **sulphates, sodium and chlorides** are left on or near the surface.

Salinisation leads to formation of saline soil with a shallow soil profile, poor and toxic to plants hence unsuitable for agriculture. Saline soils are found around Lake Magadi in Kenya, Lake Katwe south western Uganda and other parts of rift valley.

**Laterization-** occurs in hot humid regions where heavy rainfall and humic acid form decaying organic matter remove silica and other soluble substances completely from the top layer and leave behind iron and aluminum; which are oxidized to form latosols and lateritic soils which are non nutritious hence unsuitable for agriculture.

**Gleization** (comes *from glej; a polish name for muddy soil***) -** occurs in cool and water logged environment such as swamps. In such places Permafrost and water logging conditions slow down chemical weathering; resulting into formation of semi decomposed soils called peat/ grey with poorly developed soil profile.

Peat/ grey soil is usually acidic and oxygen poor hence unsuitable for agriculture.

**Podzolization** *(comes from podzol; a Russian word for something like ash*) **-** takes place in temperate region particularly in areas experiencing cold temperatures and heavy rainfall through out the year (coniferous forest region) in mid and high latitudes.

Cold temperatures and heavy rainfall reduce the rate of chemical weathering; resulting into formation of semi decomposed soils called podzol.

Podzodic soils are ash like, light gley in color and shallow. They are also very acidic due to accumulation of decomposed and semi decomposed organic matter in ‘B’ horizon due to leaching and eluviation in the top soil brought about by the heavy rainfall hence unsuitable for agriculture.

**Factors That Influence Soil Formation**

**Account for soil formation in East Africa**

**Approach**

* Define soil
* Explain the factors and show the type of soil formed

**Answer guide**

Soil is a thin layer of the earth crust composed of naturally weathered rocks, water, organic matter and living organisms capable of supporting plant life.

The type and nature of soil formed depends on; climate, nature of the parent rock, relief, living organism and time.

Climate Facilitates soil formation through its elements of rainfall and temperature which determine the rate and type of weathering and vegetation type for formation of humus as explained below.

●Hot humid climates experience rapid and deep chemical weathering leading to formation of deep and fertile soil for example the northern shores of Lake Victoria.

●Hot dry climates (semi arid and desert regions) physical weathering dominates producing thin/ skeletal soils/ Azonal soils with poorly developed profiles.

**Influence of vegetation type present**

Thick and luxuriant vegetation cover decays; producing high humus added into ‘A’ horizon of the soil profile. In addition plant roots disintegrate rocks easily leading to soil formation. Forested areas therefore tend to have deep soils with well developed profiles while areas with thin vegetation cover such as scrub have thin skeletal soils.

**Nature of the parent rock**

This is the original rock weathered to produce mineral particles. The nature of the parent rock in terms of hardness, jointing, color and permeability facilitates soil formation in the following ways;

●Hard and resistant parent rock such as granite and gneiss take long to weather hence produce shallow soil such as sand while Soft rock like limestone and chalk weather down very fast to produce deep soil.

●rocks with joints and cracks such as granites and limestone weather easily under humid and hot conditions to form deep and mature soil compared to those with out for example gneiss and quartzite; take long to weather under similar conditions hence form coarse textured and shallow soils.

●Mineral composition of the parent rock. Rocks rich in calcium such as limestone and chalk and rocks rich in feldspar, mica and silicates for example basalt; weather easily under hot humid conditions leading formation of deep fertile soil while rocks rich in rich in quartz such as granites take long to weather leading to formation of poor and swallow soils.

**●Rock color**. Dark colored rocks such as basalt absorb a lot of heat hence weather easily to form deep and mature soil for example volcanic soils in Kigezi while brightly colored rocks such as granites reflect back much heat hence take long to weather leading to formation of shallow and poor soils such as sandy.

●Permeable/ porous rocks such as Loess, chalk and limestone weather easily by chemical processes to produce deep but dry soil while impermeable rocks such as Gneiss limit chemical weathering leading to swallow soil.

**Relief or topography** determines the rate soil formation through erosion and deposition of weathered materials and the rate of chemical weathering through percolation of water. Consequently:

●On steep slopes, soils form very fast because erosion exposes fresh rocks to physical weathering. However, high rate of soil erosion removes weathered materials producing shallow and poor soils for example scree soils on the steep slopes of Aberdare and Kipengere ranges, mountain Rwenzori and Kilimanjaro.

●Very steep slopes and cliffs discourage soil formation since rock debris break down physically without undergoing chemical change.

●Gentle slopes- percolation of water encourages chemical weathering and the rate of deposition of weathered materials from steep slopes exceeds erosion; leading to development of deep and mature soil.

●Valleys or lowlands - extensive deposition and percolation of water lead to deep chemical weathering hence formation of deep and mature soil.

However where water logging conditions exist for example swampy areas , poor and immature soils such as peat are formed because water logging conditions limit deep chemical weathering.

**Drainage**

Well drained areas allow percolation of water leading to deep chemical weathering and formation of deep and mature soil while poorly drained or waterlogged areas limit biological activities and chemical weathering hence formation of poor and swallow soils for example peat soil common in swampy areas.

**Influence of living organisms** for example termites, earth worms, bacteria and moles facilitate the rate of soil formation and the depth of the soil formed in the following ways;

●bacteria and roots of growing plants excrete nitric acid and ammonia which react with rock minerals hence decompose to form deep soil.

●Plants and animals produce organic matter or humus and other nutrients that increase soil fertility.

●Termites, earth worms, moles**, rodents** and other organisms in soil break down rocks into smaller particles, improve on drainage and aeration by creating underground tunnels hence facilitate chemical weathering leading to formation deep and mature soil. In addition they churn out materials and transport this material from one layer to another leading to formation of deep soil.

Therefore soil with numerous living organisms have deep and well developed soil profile than soil with few living organisms.

**Influence of man’s activities.** Human activities such as agriculture, mining and quarrying and construction lead to break down of rocks and formation of deep soils characterized by well developed profiles.

However human activities such as Overstocking, overgrazing, deforestation and uncontrolled construction expose soil to agents of erosion leading to development of swallow soil.

**Time**. Soil forming processes need ample time to interact with factors that influence soil formation to produce mature and deep soils called Zonal soils. Short interaction leads to formation of young soils called Azonal soils.

**To what extent has the nature of the parent rock influenced soil formation in East Africa?**

**Approach**

* Define soil,
* Give the 1St evaluation and explain the role of the parent rock. That is, (jointing, hardness, color, permeability and mineralogy)
* Give the 2r d evaluation and explain other factors that influence soil formation

**To what extent has climate influenced soil formation in East Africa?**

**Approach**

* Define soil,
* Give the 1St evaluation and explain the role of climate. That is, rainfall and temperature in different climatic regions.
* Give the 2r d evaluation and explain other factors that influence soil formation.

**To what extent has relief influenced the process of soil formation in East Africa?**

**Approach**

* Define soil,
* Give the 1St evaluation and explain how relief influences soil formation on different slopes,
* That is, steep slopes, Very steep slopes, Gentle slopes, Valleys or lowlands
* Give the 2r d evaluation and explain other factors that influence soil formation.

**General classification of soils**

Globally soils are classified into three major groups due to variation in climate, parent material, vegetation and impact of man’s activities. That is; Zonal soils, Intra-zonal soils and Azonal soils.

**Intrazonal soils**

These are intermediate soil types with distinct profiles largely influenced by relief / topography and the nature of parent rock, exerting strong contribution to the soil forming processes than climate and vegetation.

They are mainly common on flat lands and have poor drainage for example peat soils formed in swamps, terra rossa formed in semi- arid limestone areas and saline soils.

**(a)Distinguish between Zonal and Azonal soils.**

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

**Approach**

* Define each soil type , state its characteristics,
* factors that influence the formation each soil type,
* Example and where they occur.
* In part (b) explain the factors that limit the development of a complete or mature soil.

**Answer guide.**

**Zonal soils-**

▪These are soil types largely resulting from the climatic factors which contribute to the soil forming processes.

▪Zonal soils are mature soils with well developed soil profiles due to prolonged action of climate which influences weathering and vegetation cover present in a particular region.

▪Zonal soils develop under conditions of good drainage hence they are well drained soils and develop on gentle slope and flat landscapes.

▪Zonal soils are divided into two groups depending on the mineral content present. That is; pedocals and pedafers.

▪Pedocals contain high content of calcium carbonate and develop under condition of low rainfall which prevents leaching out of soluble minerals. Pedafers are rich in aluminum and iron hydroxide and develop under conditions heavy rainfall which leaches out soluble minerals to form acidic soils.

▪Zonal soils are found in different regions of the world depending on climate that influences the type of weathering in that particular region. That is;

▪In low latitudes (tropics), the hot humid conditions give rise latosols and tropical black earths/basisols (formed from deep physical and chemical weathering of basaltic rocks).

▪In mid latitude / temperate region, cool and humid conditions a give rise podzols and brown earth soils that are heavily leached and very acidic. They are associated with cool temperate forests.

▪In areas receiving seasonal rainfall, chernozem soils / black earth soils develop and are rich in humus. They are associated with grasslands of sub humid temperate climates for example the Canadian prairies, North Dakota in USA and parts of Argentina’s Pampas.

▪Semi arid and arid conditions give rise to chestnut colored soils.

▪High latitude climates, zonal soils occur in form tundra and artic brown soils because of low annual temperatures, permanently frozen sub- soil and limited weathering.

**While**

**AZONAL SOILS**

▪These are young soils without a clear soil profile. They are newly formed soils hence lack complete soil profile.

▪They are soils which have not been exposed to soil forming processes long enough to develop characteristics of mature soil.

▪They are skeletal soils. That is, soils which contain only mineral particles derived from weathered parent material without humus.

▪Azonal soils are divided into two groups. That is lithosols and regosols.

▪Azonal soils are derived from unconsolidated materials such as alluvium, sand and volcanic ash.

Examples of Azonal soils include;

▪Scree soils on mountain slopes,

▪Mud flat soils/ marine clays,

▪Fluvial- glacial soils such as tills, outwash sands and gravel, and resorted clays laid down in glacial lakes,

▪Wind blown soils especially sand dunes and loess soils,

▪Volcanic soils such as Lava/ ash soils cinder and pumice.

**(b)** Azonal soils have developed in East Africa because of the following factors.

**Hard and resistant parent** rock prevents deep chemical weathering and other soil forming processes which results into skeletal soils For example scree soil on the mountain slope of Rwenzori.

**Violent volcanic eruption** produces lava/ ash soils, cinder and pumice.

**Agents of erosion** such as running water, waves glaciers and wind transports and deposit materials else where to form different azonal soils as below;

▪Wave erosion and deposition produces marine deposits which form mudflat soils/ marine clay soils

▪Wind erosion and deposition produce wind-blown soils such loess, sand sheets and dunes.

▪Glacial action (fluvio-glacial erosion) produces fluvio-glacial soils such as tills, out wash sands and gravels, and resorted clays (deposited in glacial lakes)

▪River erosion and deposition produces alluvial soils common along river valleys, deltas and low lying plains.

**Climate** influences formation of azonal soils through its elements of rainfall and temperatures which accelerate weathering and erosion as shown below;

▪Heavy rain fall such as El-Nino causes river floods that increase river erosion and deposition of alluvium in the lower course.

▪In addition, heavy rainfall causes high rate of erosion on the steep slopes and deposition of materials in lowlands to form alluvial soils.

▪Temperature changes in glaciated highlands cause frost weathering to form scree soils on mountain slopes.

**The nature of relief** influences the formation of azonal soils by accelerating erosion of weathered screes on the mountain slopes and their subsequent deposition to form new soils.

**Influence of human activities** influence formation of azonal soils in the following ways;

▪Mining and quarrying lead to breaking of parent rock into tiny particles which form skeletal soils.

▪Deforestation, bush burning and over grazing expose the parent rock to physical weathering processes that lead to formation of young soils.

**Time lapse.** Azonal soils are newly formed soils which have not been exposed to soil forming processes for so long to produce characteristics of mature soil. Therefore require more time.

**Soil Profile**

**(a)What is a soil profile?**

**(b)Explain the factors or conditions that have influenced soil profile development of in various parts of East** Africa.

**Approach**

* Define soil profile
* Explain the components of a fully developed soil profile, characteristics and
* Draw a diagram of a fully developed soil profile.
* In part (b) explain the factors in details. That is, (climate relief, parent rock, living organisms and time)

**Answer guide**

Soil profile is a vertical section through the soil from the surface of the earth down to the bed rock.

Soil profile is composed of soil layers called horizons which are differentiated in terms of color, depth, texture and mineralogy.

Soil profiles differ from place to places however an idealized soil profile is composed of four horizons: A, B, C, D or A’ horizon (top soil), B’ horizon (sub soil), C’ horizon (weathered parent materials) and D’ horizon (unweathered parent rock/bed rock).

**A Diagram Showing an Idealized Soil Profile with Four Distinct Horizons**

**Description of the diagram**

**Horizon A** is the top most soil layer and is subdivided into, A00 –A3.

**A00** consists of undecomposed litter of dead leaves, leaves and vegetation and is followed by A0

**A0** is made of decomposing organic matter and is followed by A1 which has high humus content which gives it a dark color.

The quantity of humus present depends on the density of foliage and living organisms to decompose organic matter to humus.

**A1**is followed by **A2** which is poor in nutrients because of the effect of leaching and eluviation which wash out soluble mineral nutrients to the sub-soil; leaving it bleached, light colored and impoverished.

**A2** is followed by a transition zone called **A3**

**Horizon B** is the soil layer below horizon A and is some times called the sub-soil. It is the horizon where nutrients washed out from horizon A are deposited and accumulate by the process known as illuviation; making this horizon richer in nutrients and dark in color than A’ horizon above it. It’s some times characterized by a hard pan caused by the accumulation of large quantities of clay and other nutrients.

**N.B** Horizon A and B form what is regarded as mature soil.

**Horizon C** lies beneath the subsoil and located far from the surface hence experiences partial weathering to produce partially weathered materials which form immature soil.

**Horizon D** is the last layer of the soil profile and consists of solid parent rock. There is no soil formed because the parent rock is located deep in the crust and therefore not affected by weathering and other soil forming process.

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**Factors Influencing the Development of a Complete Soil Profile**

**Climate**

Climate Facilitates soil profile development through its elements of rainfall and temperature which determine the rate and type of weathering and vegetation type for humus formation as explained below.

●Hot humid climates experience rapid and deep chemical weathering leading to formation of well developed/mature soil profile for example the northern shores of Lake Victoria.

●Hot dry climates (semi arid and desert regions) physical weathering dominates producing thin/ skeletal soils/ Azonal soils with poorly developed profiles.

**Influence of vegetation type present**

Thick and luxuriant vegetation cover decays; producing high humus added into ‘A’ horizon of the soil profile. In addition plant roots disintegrate rocks easily leading to soil formation. Forested areas therefore tend to have deep/ well developed profiles while areas with thin vegetation cover such as scrub have thin skeletal soils and poorly developed profiles.

**Nature of the parent rock**

This is the original rock weathered to produce mineral particles. The nature of the parent rock in terms of hardness, jointing, color and permeability facilitates the development of soil profile in the following ways;

●Hard and resistant parent rock such as granite and gneiss take long to weather hence form poorly developed soil profiles while Soft rocks like limestone and chalk weather down very fast to produce deep soil profile.

●rocks with joints and cracks such as granites and limestone weather easily under humid and hot conditions to form deep and mature soil compared to those with out for example gneiss and quartzite; take long to weather under similar conditions hence form coarse textured and shallow soils.

●rocks with joints and cracks such as granites and limestone weather easily under humid and hot conditions to form deep and mature soil profile compared to those with out for example gneiss and quartzite under similar conditions.

●Mineral composition of the parent rock. Rocks rich in calcium such as limestone and chalk and rocks rich in feldspar, mica and silicates for example basalt; weather easily under hot humid conditions leading to well developed profile while rocks rich in rich in quartz such as granites take long to weather leading to poorly developed soil profiles.

●Rock color. Dark colored rocks such as basalt absorb a lot of heat and weather easily to form deep and mature soil profile while brightly colored rocks such as granites reflect back much heat hence take long to weather leading to poorly developed soil profiles.

●Permeable/ porous rocks such as Loess, chalk and limestone weather easily by chemical processes to produce deep soil profile while impermeable rocks such as Gneiss limit chemical weathering leading to swallow soil profile.

**Relief or topography** determines the rate soil profile development through erosion and deposition of weathered materials and the rate of chemical weathering through percolation of water. Consequently:

●steep slopes tend to have thin, stony and poorly developed soil profiles because excessive run off removes weathered materials as soon as they are formed hence limiting soil profile development for example on the steep slopes of Aberdare and Kipengere ranges.

●Gentle slopes- percolation of water encourages deep chemical weathering and the rate of deposition of weathered materials from steep slopes exceeds erosion; leading to development of mature soil profiles.

●Valleys or lowlands - extensive deposition and percolation of water lead to deep chemical weathering hence development of deep and mature soil profile.

However where water logging conditions exist for example swampy areas , poor and immature soil profiles develop because water logging conditions limit deep chemical weathering and complete decomposition of organic matter.

**Drainage**

Well drained areas allow percolation of water leading to deep chemical weathering and formation of deep and mature soil profile while poorly drained or waterlogged areas limit deep chemical weathering and complete decomposition of organic matter hence poorly developed soil profiles for example peat soil common in swampy areas.

**Influence of living organisms** for example termites, earth worms, bacteria and moles facilitate the development of a complete soil profile by;

▪**decomposing organic matter** physically and chemically to humus and other nutrients found in **A** horizon

▪facilitate weathering of rocks physically and chemically by creating underground tunnels where air and water pass and react with rock minerals, excrete acids like humic acid which weather the rock chemically

▪Plants and animals produce organic matter or humus and other nutrients that increase soil fertility.

▪Termites and earth worms in soil mix up humus and weathered particles from one horizon to another hence increase the depth of the soil profile.

Therefore soil with numerous living organisms have deep and well developed soil profile than soil with few living organisms.

**Influence of man’s activities.** Human activities such as agriculture, mining and quarrying and construction lead to break down of rocks and formation of deep soils characterized by well developed profiles.

However human activities such as Overstocking, overgrazing, deforestation and uncontrolled construction expose soil to agents of erosion leading to development of swallow soil.

**Time**. The development of complete soil profile requires ample time to develop. Therefore soils exposed to weathering and other soil forming processes for a very long time have deep and mature profile than newly formed soils (Azonal).

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**SOIL CATENA**

Soil catena is the horizontal sequencing or differentiation of soils along the slope from hill-top to the valley bottom

Soil catena displays the different soils along the slope formed under similar climatic conditions but the characteristics are different because of topography and drainage

Soil catena usually displays 4-5 different soil types in respect to texture, color and water retention as they succeed each other right from the hill top to the valley down the slope.

Soil catena is more pronounced in regions with relief composed of hills with steep slopes alternating with valleys. For example hills in the southern part of Buganda, Busoga region, shores of Lake Victoria and Kigezi in south western Uganda.

**Diagram showing a well develop ped soil catena in Buganda region**

The soil catena on Buganda’s hills is arranged in a way that;

**The top is composed of lateritic pan** or cap due to excessive leaching. This pan is weathered to form thin reddish lateritic soil; supporting poor scrub vegetation.

**Below** the lateritic pan is **a steep slope known as free face** composed of bare rock and very thin soil because of excessive soil erosion and mass wasting due to high gravity.

**Below** the free face is **a convex or waxing slope** of thin and skeletal coarse stony sandy soils used for grazing in Masaka and Ankole.

**The waning or concave slope** follows and fairly gentle, with deep and well drained fertile loam soil derived from materials deposited by erosion and wasting from upper slopes, best for cultivation of crops/ agriculture.

Lastly, valleys contain clay soil with grey color due to water logging conditions and very acidic, for example peat.

**Distinguish between soil profile and soil catena**

**Approach**

* Define soil profile, show the different layers/ horizon, and draw the diagram showing a well developed soil profile.
* Define soil catena, show its components from the top down the valley bottom, and draw a diagram showing a complete soil catena
* Then give the differences. That is;

Soil profile is a vertical section through the soil from the surface of the earth down to the bed rock, showing horizontal layers called horizons while soil catena is the horizontal sequencing or differentiation of soils along a slope from hill-top to the valley bottom.

The development of the soil profile is mainly influenced by climate which causes weathering, leaching, eluviation and illuviation while the development of soil catena is mainly influenced by drainage and relief which cause soil erosion and creep.

Soil profile focuses on vertical changes of soil in terms of color, texture and mineralogy but soil catena focuses on change in surface soil types in terms of texture, color and water retention as they succeed each other right from the top to the valley down the slope.

**Differentiate between soil profile and soil catena**

**Explain the causes of soil catena in East Africa.**

**Approach**

**Refer to question ….for part (a)**

**FACTORS INFLUENCING THE DEVELOPMENT OF SOIL CATENA IN EAST AFRICA**

**The type of weathering**, That is;

Hill tops and steep slopes experience physical weathering resulting into deep soil, which creeps down slope due to gravity, and washed down by soil erosion. This eventually produces thin soil, for example lateritic soil.

On gentle slopes, weathering, erosion and deposition take place in almost equal proportion leading to the formation of fairly deep soils.

In valleys, the dominance of chemical weathering due to water logging conditions, gives rise to clay and peat soil which is very acidic.

**Influence of Relief of the area.** That is;

Hill tops and steep slopes have thin/ skeletal soil because the rate of erosion exceeds deposition.

Gentle slopes have fairly deep soil because weathering, erosion and deposition take place in almost equal proportion.

Lower slopes have deep soil because chemical weathering and deposition exceed erosion.

Valleys have highly weathered clay and peat soil due to water logging conditions.

**Drainage.** That is;

Valleys encourage water logging conditions leading to deep clay soil. Hill tops and steep slopes have skeletal soil because of low water retention.

**Influence of vegetation cover**. That is;

Hill tops and steep slopes have poor scrub vegetation which gives rise to skeletal lateritic soil.

Gentle slopes and valleys have luxuriant vegetation which give rise well developed soils rich in humus content.

**Influence of human activities.** For example mining and quarrying, agriculture, settlement and grazing of animals on gentle slopes and valleys results into highly weathered laterites in the middle slopes and valleys compared to hill tops where there is limited or no human activities at all.

**Explain what is meant by the following terms;**

**(a) Soil structure**

**(b) Soil acidity**

**(c) Soil texture**

**(a) Soil structure**

Soil structure refers to how soil particles are aggregated or clustered into large pieces of various shapes and sizes. Each aggregate is separated from the adjoining aggregates by cracks that appear naturally on the surface of soil.

Soil particles are held together by tiny particles of organic and mineral substances in solution called colloids and by internal cohesion.

Aggregates pack together into large and fairly regular shaped units called peds.

Soil structure is described in terms of shape, size, and stability of peds within the soil. A soil without clusters is said to be structure less.

There are four main types of soil structure: platy, prismatic, blocky and Spheroidal.

Soil structure is greatly determined by climatic conditions, nature of the parent rock from which soil particles are obtained, and living organisms to break organic matter into humus and minerals.

Soil structure is important because: it determines soil resistance to erosion, degree of permeability, percolation and capillarity ,the ease of cultivation and a good balance between soil, water, air and nutrients.

The best soil structure is the one that has a high water retention and aeration.

**(b) Soil acidity**

Soil acidity refers to the degree of acidity and alkalinity of the soil is expressed in the pH value.

It is determined by concentration of hydrogen ions (H+) held by the soil colloids. If the concentration is high, the soil will be acidic and if it is low, soil is alkaline.

Hydrogen ions increase in soil due to poor aeration which retards the rate of decomposition of organic matter by microorganisms.

The degree of soil acidity is measured using the pH value scale, numbered from 1-14.

A pH value of 7 is considered neutral. If the pH is below 7, then the soil is said to be acidic. Acidic soils are common in hot humid regions, industrialized and irrigated areas.

If the pH value exceeds 8.0, then the soil has excess salts or is said to be very alkaline, common in desert areas due to absence of organic matter or humus.

The best soil for agriculture has neutral value. Soil pH is lowered by leaching, and use of fertilizers containing sulphur or nitrogen.

High acidity in soil can be reduced by adding lime (calcium hydroxide) to improve on its productivity.

Alkanity can be reduced by adding humus or gypsum to make the soil productive.

Soil pH value is important because it helps to determine the soil color, availability of nutrients, amount of ions present in soil, solubility of all materials in soil and the activities of micro bacteria in soil.

**(c) Soil texture**

Soil texture is concerned with different sizes of the smaller mineral particles, or grains that make up soil.

Particles are measured in terms of their diameter, ranging from 2 millimeters to less than 0.002 mm.

Soil particles are graded into three m ajor types: Sand, silt and clay.

Soils with large particles such as gravel and sand are said to be having a coarse texture while those with small particles like clay are said to have fine texture.

Gravel has soil particles measuring 2 .0+ millimeters in diameter.

Coarse sand has particles ranging between 2 .0 – 0.2 mm in diameter

Fine sand has particles ranging between 0.2 – 0.02 mm in diameter.

Silt has particles ranging between 0.02 – 0.002 mm in diameter

Clay has particles measuring below 0.002 mm in diameter.

Soil texture is important because it determines the degree of water retention, permeability, leaching and aeration.

Soils with a coarse texture such as sand and gravel are well aerated , very permeable, have a high rate of leaching of nutrients in the soil, have poor water retention, loose when dry and are easily washed away by agents of erosion.

Soil with a fine texture such as clay, have high water retention, impermeable, poor aeration, retards leaching of nutrients, sticky when wet and resilient to agents of erosion.

Silt grains are fine, sticky under wet conditions, have limited permeability and high capillarity during the dry season.

**LATERITIC SOILS IN EAST AFRICA**

**Account for the formation of lateritic soils in East Africa.**

**Approach**

* Define laterite soils
* Identify and describe the formation of lateritic soils
* state areas where lateritic soils are found
* Explain the process of formation and the factors that facilitate their formation.

**Answer guide**

Lateritic soils are red or black residual deposits, created from weathering of rocks bearing iron and aluminum under humid and hot tropical conditions in the low latitudes.

Laterite soils consist of either iron or aluminum oxides, and are found either as hard pans (duricrust) or soft clays (clay pan).

**Lateritic soils form through the processes;**

Heavy rain fall and high temperatures cause decay of vegetation and other organic materials, and deep chemical weathering of rocks.

Through the chemical process of leaching, silica and other soluble minerals are removed from rocks and A-horizon by water and transferred to B- horizon of the soil profile.

The insoluble material compounds of iron and aluminum are also moved to B- horizon of the soil profile through the eluviation and illuviation processes.

When temperatures exceed rain fall, iron and aluminum compounds are carried to the surface of the soil profile by evaporating water and fuse together.

Continuous fusion and accumulation of these compounds gradually harden to form a layer known as duricrust, or may remain under moist conditions at the surface to form soft clays known as Kaolin.

Weathering of the duricrust produces laterites or lateritic soils, with a greyish color derived from aluminum or reddish –brown color derived from iron compounds.

Laterites are sticky when saturated with rain water, hard, and drain quickly when dry.

In East Africa, laterites are found in various areas such as savannah and equatorial forests. For example central Uganda around mukono, lugazi, Mpigi and on hill tops, Nyanza province in western Kenya e.t.c

**Factors favoring formation of lateritic soils in East Africa**

**Relief.** Laterite soils form under conditions of low and gentle relief. This allows percolation of water, leaching in A- horizon and illuviation in B- horizon.

Chemical weathering by oxidation, solution change the color and transports the cementing silicate materials respectively.

**High temperature**. This is required for increasing the rate of chemical reactions.

**Vegetation cover**. This helps to hold the soils and allow weathering in situ.

**Nature of the parent rock**. The parent rock should not be extremely hard and should contain a lot of iron and aluminum compounds for oxidation to take place.

**Nature of the slope**. Very steep areas are prone to soil erosion which does not allow the formation of Laterite soils.

**Drainage.** Poorly drained soils don’t allow the formation of laterites. Lateritic soils form on well drained areas or soils.

**Human activities.** The formation of lateritic soil is interrupted by human activities such as agriculture, construction and mining.

**Geological time.** The formation of laterites requires long time to allow the formation and accumulation of oxides. For example many laterites in East Africa are relics of tertially weathering process.

**Examine the formation of laterites in East Africa and their effects on human activities**.

**Approach**

* Define laterite soil
* Identify and describe the formation of lateritic soils
* Give areas where lateritic soils are found
* Explain the process of formation and effects of laterites on human activities.

**Refer to the question …. Above for the introduction**

**EFFECTS OF LATERITE SOILS ON HUMAN ACTIVITIES**

Deeply weathered laterites form murrum, used in constructing roads.

Laterites also form firm foundation for construction of settlent structures such as storied buildings, schools, houses, water tanks e.t.c.

Erosion on lateritic duricrust produces beautiful dissected flat topped hills called mesa and butte for example in hill tops in Buganda region, used for settlement and forestry.

Laterites support mining of murrum, hence source of employment and income to different people for example on Mutundwe hill.

Laterites are unproductive in terms of agriculture because they are heavily leached and lack humus.

Lateritic soils support growth of poor scrub and grass vegetation used for grazing animals because they are palatable to cattle and sheep and goats.

Laterites hinder mechanization because the lateritic duricrust is hard and lead to break down of machines such as ploughs or wear down easily.

Kaolin clay is used as a raw material in making building materials such as bricks, tiles and maxi pans.

**SOIL EROSION IN EAST AFRICA**

**CAUSES AND EFFECTS**

**Examine the causes and effects of soil erosion in East Africa**

**Approach**

* Define the term soil erosion; identify the types /processes of soil erosion.
* State areas where soil-erosion is taking place in East Africa.
* Explain the causes of soil erosion
* Explain the positive and negative effects of soil erosion.

**Answer guide**

Soil erosion is the washing away/ removal of top soil by running water, wind, glaciers and animals.

The processes involved include splash, rill, sheet and gully.

**Splash / rain drop erosion**-is the removal of soil particles by the beating action of heavy rain drops usually on bare ground.

**Sheet erosion** -is the uniform removal of thin layers of soil by wind and running water over a wide area usually on gentle slopes.

**Rill erosion-** involves creation of small channels called rills normally in areas where the rate of rainfall exceeds the rate of infiltration. It’s common on slopes where the vegetation has been cleared.

**Gulley erosion-** occurs where erosion forms deep and wide channels /grooves through which soil is taken down slope by running water. It’s common in highland areas and on gentle slopes where the vegetation has been cleared.

**CAUSES OFkl SOIL EROSION IN EAST AFRICA**

Soil erosion in East Africa is caused by both physical and human factors as explained below;

**Heavy rainfall such as relief and El-Niño** leads to high surface run off that washes away the top soil. Heavy rainfall is responsible for soil erosion in highland areas such as Kigezi, Kenya high land, windward slopes of mountain Elgon, Kenya, Rwenzori, the northern shores of Lake Victoria basin and Kondoa .

**Nature of topography**. steep slopes /hilly areas where vegetation cover is cleared experience rapid soil erosion by because steep slopes increase the erosive power of running water than gentle slopes and low lying areas ,for example Kigezi, Kondoa, Kenyan high lands, slopes of mountain Elgon, Kenya, Rwenzori, Meru and Kilimanjaro.

**Occurrence of ferocious wind** especially in arid areas leads to washing away of top loose soil in suspense, for example Karamoja region, North Western Kenya, Northern and North Eastern Kenya and North Eastern Tanzania.

**Presence of weak and loose soils for example** Volcanic and sandy soils, soak easily and carried away by the destructive forces of wind and running water. For example in the volcanic highlands of Kigezi, Kipengere, Elgon e.t.c, and sandy soils in arid Areas like Karamoja and Northern Kenya and Machakos in Kenya e.t.c

**Presence of Biotic factors**, for example harvester ants, termites and locusts especially in arid areas. These insects eat all the grass leaving the surface bare and exposed to agents of erosion especially during the dry season/ spell. Wind and water get a clear sweep of bare land; carrying away soil for example Machakos, Ankole - Masaka ranching areas, Nakasongola and Karamoja, Turkana e.t.c.

**Deforestation on steep slopes** for more cultivable land, space for, settlements, road construction, wood fuel and lumbering e.t.c deprives soil of protective cover from splash and wind erosion. Deforestation also deprives soil of the binding effect of plant roots; making soil weak hence easily carried away, for example northern shores of Lake Victoria basin, Kigezi, Elgon, Kenya highlands, Karamoja and areas near urban centers.

**Over stocking and over grazing**. The keeping of large herds of livestock in as small areas of land leads to trample on land, breaking the loose particles weakens the soil and makes it susceptible to erosion. In addition large herds of cattle eat and uproot vegetation thus leaving the soil exposed. This practice is common in pastoral areas of East Africa such as Rakai, Nakasongola, Masaka –Ankole cattle corridor, Karamoja, Masai land, Turkana land and Kondoa district in Tanzania.

**Over cropping/over cultivation** -the repeated cultivation of crops on a fixed plot of land without rest or little rest weakens the soil thus making it vulnerable to erosion, for example Kigezi and Kenyan highlands, banan a plantations in Masaka e.t.c

**Monoculture-**the cultivation of one type of crop every season on the same plot of land leads to loss of soil nutrients; weakens soil structure and texture; making it vulnerable to agents of erosion, for example Irish and sweet potatoes ‘Ebitakuri’ in Kabale, sorghum and millet in Baringo- Kenya, banana and coffee in Buganda region.

**Mining and quarrying** for example, limestone and vermiculite in Mbale, wolfram in Kabale and Kigezi, cobalt recycling in kasese, diamond in shinyanga, sand, clay, murrum e.t.c weakens the soil and deprives the soil of protective cover thus exposing the soil to the agents of erosion.

**Repeated bush burning** especially in pastoral communities during the dry season so as to prepare for good pastures, kill pests and diseases e.t.c deprives soil of protective cover thus leaving the soil bare and vulnerable to wind and sheet erosion for example in Karamoja, Mbarara, Turkanaland, Masai, Nakasongola, Miombo in Tanzania and other pastoral communities.

**Planting of Poor cover crops** such as maize, sorghum, cotton, onions and finger millet leave the soil exposed to splash erosion and wind erosion, for example in Karamoja, Kigezi, Kondoa, Machakos, Baringo e.t.c.

**Land fragmentation** in highland regions involves creating boundaries which encourage high surface run off leading to rill and gully erosion for example in Kigezi and Kenyan highlands.

**Up and downward ploughing on hill slopes** encourage increased soil erosion as water finds it easy to flow down slope in cannels leading to rill and gully erosion during the wet season for example in Kigezi, Kondoa and Kenyan highlands.

**Construction works such as road networks, settlements** e.t.c reduce vegetation cover which protects the soil thus exposing it to agents of soil erosion.

**Herds of grazing animals in protected areas** such as National game parks for example, buffaloes, elephants e.t.c destroy the vegetation cover through over grazing, browsing and trampling especially near water sources creates bare patches leading to soil erosion. For example Kabalega, Queen Elizabeth, Masai Mara, Para and Serengeti National game parks e.t.c.

**High illiteracy rates especially in pastoral** areas such as Karamoja, Mbarara corridor, Kondoa e.t.c has led to persistent soil erosion because the local people tend to be ignorant about the effects of overstocking, overgrazing, bush burning and deforestation which expose the soil to agents of soil erosion.

**Rapid urbanization** has facilitated destruction of vegetation cover to create more space thus leaving the soil exposed to the agents of soil erosion for example Kampala, Mukono, Jinja, Nairobi, Dar-es-salaam e.t.c

**Increased use of heavy machinery** on farms and other surface compacts soil and sealing of pores which makes infiltration and percolation difficult thus high surface run-off which increase soil erosion

**Effects of soil erosion in East Africa**

(b) **Soil erosion has devastating effects than positive effects as shown below**;

**NEGATIVE EFFECTS**

Soil erosion leads to **Loss of top fertile soils** thus leaving poor and less productive soils which results into low crop yields for example in Kabale, Kondoa and Kenya highlands.

Wind and water erosion can carry away the entire soil cover **creating bare ground/ waste land** with low agricultural productivity. For example some parts of Karamoja, Nakasongola e.t.c

Low crop yields caused by loss of top fertile soil has resulted into persistent **famine** in some regions of East Africa for example Karamoja and Turkana land.

Soil erosion facilitates **aridity and desertification** because the poor vegetation cover cannot give-off adequate moisture into the atmosphere to facilitate formation of rain fall.

Soil erosion lowers **water table** due to limited infiltration. This leads to crop failure and low crop yields for example in Karamoja, Turkana land, Nakasongola e.t.c

Discharge of soil particles/ sediments leads to **pollution of water bodies** such as lakes, streams valley dams and wet land.

Discharge of soil particles/ sediments causes **silting of water bodies**. This reduces the storage capacity of these water sources and low hydro-power generation for example Lake Bunyonyi, Victoria, Mutanda, Murehe, Kyahifi and Masinga dam on river Masinga respectively .

Discharge of soil particles/ sediments leads **eutrophication** (a situation where water bodies become fertile and encourage growth of algae) which affects marine organisms especially fish. In addition, silting of culverts and other drainage systems **increases maintenance Costs** through dredging for example Lake Victoria, Turkana and Bunyonyi and Mutanda.

High surface run-off and silting leads **to flooding in low-lying areas/ valleys and destruction and property** such as gardens, houses, livestock, infrastructures and some times death of people for example in Bwaise, Natete, Kigezi, slopes of mountain Elgon, Teso and Turkana. The section of River Kagera from Mbarara to Tanzania experiences high rate of silting leading to floods during the wet season.

Rills and Gullies make **development of transport and communication net works difficult**; making such areas remote/ inaccessible for example Kitui, Machakos and Kondoa in Tanzania and some parts of Karamoja.

Wind erosion produces dusty storms which cause **poor visibility and accidents** especially in arid areas such as Karamoja

Water and air pollution facilitates the **spread of air and water borne diseases** such as Cholera, bilharzias, dysentery and flue.

Soil erosion facilitates physical weathering inform of pressure release thus exposing hard rocks underneath which **hinders agricultural mechanization** for example in Kigezi.

Soil erosion in highland areas weakens soil structure **leading to landslides** causing massive destruction of property and loss of lives for example in Kigezi, slopes of mountain Elgon, Rwenzori, Kilimanjaro and Kondoa.

Soil erosion produces azonal soils which are less productive because they lack humus and other vital soil ingredients.

**POSITIVE EFFECTS**

Soil Erosion facilitates pressure release thus exposing the fresh rocks to gents of weathering and formation of fresh or new soils.

Soil erosion produces alluvial fertile soils in low lands and valleys, support crop cultivation for example Irish and sweet potatoes, vegetables e.t.c in Kigezi, lower slopes of mountain Elgon, Kenya and Rwenzori.

Soil erosion exposes Inselbergs, volcanic plugs, batholiths, arenas e.t.c which create beautiful scenery for the tourism industry and earning of foreign exchange used for economic development, for example Karamoja

Soil Erosion exposes minerals like gold, diamond, limestone rocks hence reducing cost of mining. For example Diamond in Shinyanga, volcanic plugs in Tororo e.t.c.

**(a)Differentiate between sheet erosion and gulley erosion.**

**(b) Explain the causes of soil erosion in the highland areas of East Africa.**

**Approach**

* Define sheet and gulley erosion
* Give the characteristics of each type of soil erosion
* Identify the highland areas in East Africa affected by soil erosion descriptively or by use of a sketch map
* Explain the physical and human causes of soil erosion.

**Answer guide**

▪Sheet erosion is the uniform removal of thin layers of soil by wind and running water over wide area usually gentle slopes.

▪It involves slow movement of thin layers of soil and not easy to notice.

▪This movement covers a wide area / extensive areas especially on gentle slopes.

**WHILE**

▪**Gulley erosion** occurs where erosion forms deep and wide channels /grooves through which soil is carried down slope by running water.

▪It’s common in areas receiving heavy rain fall. **And**

▪on steep to gentle slopes where the vegetation has been cleared

▪Gulley erosion creates degraded /wasteland.

**(b)** Soil erosion is the removal or detachment of soil material from one place to another.

● highland areas of East Africa where soil erosion is rampant include Kigezi in south western Uganda, Uluguru, Kondoa, Usambara and Kipengere in Tanzania, Kenyan highlands, Slopes of mountain Elgon, Rwenzori, Kenya, Aberdare, Kilimanjaro, and Meru.

**CAUSES**

▪Heavy and torrential rain fall received leads to high surface run- off that carries away the top soil

▪Steep slopes in highland areas such as Kapchorwa, Bundyibugyo, Kenyan highlands encourage high surface run- off ▪presence of weak soils such as volcanic soak are weak, porous, unstable and easily washed away by running water and wind when vegetation cover is cleared.

▪Deforestation on slopes- the cutting of trees without replanting them due to need for agriculture, settlement e.t.c weakens the soil structure and exposes the soil to splash and wind erosion

▪Overstocking of livestock such as cattle, goats, pigs, sheep e.t.c leads to over grazing and depletion of vegetation cover; exposing the soil to agents of soil erosion

▪Over cropping/over cultivation -the continuous cultivation / planting of crops on a fixed plot of land with little or no rest, weakens the soil; making it vulnerable to erosion, for example Kigezi and Kenyan highlands.

▪Monoculture-the cultivation of a single crop year after year on the same plot of land leads to loss of soil fertility,

weakens soil structure and texture; making soil vulnerable to agents of erosion, for example Irish and sweet potatoes ‘Ebitakuri’ in Kabale, sorghum and millet in Baringo, Kenya e.t.c

▪Mining and quarrying for example, limestone and vermiculite in Mbale, wolfram in Kabale and Kigezi, cobalt recycling in kasese, diamond in shinyanga, sand e.t.c weakens the soil and reduces the vegetation that protects the soil; hence expose the soil to the agents of erosion.

▪Repeated bush burning in highland areas so as to prepare for good pastures, kill pests and diseases, create e.t.c leads to destruction of vegetation cover leaves the soil bare and vulnerable to wind and sheet erosion.

▪Planting of Poor cover crops like maize, sorghum, cotton, onions and finger millet leave the soil exposed to splash erosion and wind erosion, for example in Kigezi

▪Land fragmentation in highland regions involves creating boundaries which encourage high surface run off leading to rill and gully erosion for example in Kigezi and Kenyan highlands.

▪Up and downward ploughing on hill slopes encourages high surface run off leading to rill and gully erosion during the wet season for example in Kigezi, Kondoa and Kenyan highlands.

▪Construction works such as roads, motorable trucks, railways, settlements e.t.c reduce vegetation cover which protects the soil hence exposing the soil to agents of soil erosion.

▪Herds of grazing animals such as cattle, buffaloes, elephants e.t.c destroy the vegetation cover through over grazing, browsing and trampling especially near water sources hence create bare patches which expose the soil to agents of soil erosion, for example on the slopes of mountain Elgon, Kenya, Kilimanjaro e.t.c.

▪High illiteracy rates has led to persistent soil erosion because the local people tend to be ignorant about the effects of overstocking, overgrazing, bush burning and deforestation which expose the soil to agents of soil erosion.

▪Rapid population growth in highland regions such as Kabale, Mbale, Kapchorwa, Kenya highlands e.t.c has facilitated destruction of natural vegetation cover hence exposing the soil to the agents of soil erosion.

**To what extent is man been responsible for soil erosion in East Africa?**

**Approach**

* Define soil erosion and give the processes/ types of soil erosion in occurring in East Africa.
* State areas in East Africa experiencing soil erosion
* Give the 1St evaluation (larger extent) and explain the human activities that accelerate soil erosion on in the areas stated above.
* Give the 2r d evaluation (large extent) and explain the physical factors.

**Answer guide**

Man is largely responsible for soil erosion through his activities such as;

**Deforestation on steep slopes** for more cultivable land, space for, settlements, road construction, wood fuel and lumbering e.t.c deprives soil of protective cover from splash and wind erosion. Deforestation also deprives soil of the binding effect of plant roots; making soil weak hence easily carried away, for example northern shores of Lake Victoria basin, Kigezi, Elgon, Kenya highlands, Karamoja and areas near urban centers.

**Over stocking and over grazing**. The keeping of large herds of livestock in as small areas of land leads to trample on land, breaking the loose particles weakens the soil and makes it susceptible to erosion. In addition large herds of cattle eat and uproot vegetation thus leaving the soil exposed. This practice is common in pastoral areas of East Africa such as Rakai, Nakasongola, Masaka –Ankole cattle corridor, Karamoja, Masai land, Turkana land and Kondoa district in Tanzania.

**Over cropping/over cultivation** -the repeated cultivation of crops on a fixed plot of land without rest or little rest weakens the soil thus making it vulnerable to erosion, for example Kigezi and Kenyan highlands, banana plantations in Masaka e.t.c

**Monoculture-**the cultivation of one type of crop every season on the same plot of land leads to loss of soil nutrients; weakens soil structure and texture; making it vulnerable to agents of erosion, for example Irish and sweet potatoes ‘Ebitakuri’ in Kabale, sorghum and millet in Baringo- Kenya, banana and coffee in Buganda region.

**Mining and quarrying** for example, limestone and vermiculite in Mbale, wolfram in Kabale and Kigezi, cobalt recycling in kasese, diamond in shinyanga, sand, clay, murrum e.t.c weakens the soil and deprives the soil of protective cover thus exposing the soil to the agents of erosion.

**Repeated bush burning** especially in pastoral communities during the dry season so as to prepare for good pastures, kill pests and diseases e.t.c deprives soil of protective cover thus leaving the soil bare and vulnerable to wind and sheet erosion for example in Karamoja, Mbarara, Turkanaland, Masai, Nakasongola, Miombo in Tanzania and other pastoral communities.

**Planting of Poor cover crops** such as maize, sorghum, cotton, onions and finger millet leave the soil exposed to splash erosion and wind erosion, for example in Karamoja, Kigezi, Kondoa, Machakos, Baringo e.t.c.

**Land fragmentation** in highland regions involves creating boundaries which encourage high surface run off leading to rill and gully erosion for example in Kigezi and Kenyan highlands.

**Up and downward ploughing on hill slopes** encourage increased soil erosion as water finds it easy to flow down slope in cannels leading to rill and gully erosion during the wet season for example in Kigezi, Kondoa and Kenyan highlands.

**Construction works such as road networks, settlements** e.t.c reduce vegetation cover which protects the soil thus exposing it to agents of soil erosion.

**Herds of grazing animals in protected areas** such as National game parks for example, buffaloes, elephants e.t.c destroy the vegetation cover through over grazing, browsing and trampling especially near water sources creates bare patches leading to soil erosion. For example Kabalega, Queen Elizabeth, Masai Mara, Para and Serengeti National game parks e.t.c.

**High illiteracy rates especially in pastoral** areas such as Karamoja, Mbarara corridor, Kondoa e.t.c has led to persistent soil erosion because the local people tend to be ignorant about the effects of overstocking, overgrazing, bush burning and deforestation which expose the soil to agents of soil erosion.

**Rapid urbanization** has facilitated destruction of vegetation cover to create more space thus leaving the soil exposed to the agents of soil erosion for example Kampala, Mukono, Jinja, Nairobi, Dar-es-salaam e.t.c

**Increased use of heavy machinery** on farms and other surface compacts soil and sealing of pores which makes infiltration and percolation difficult thus high surface run-off which increase soil erosion

**On the** other hand, physical factors are responsible for soil erosion to a large extent through**;**

**Heavy rainfall such as relief and El-Niño** leads to high surface run off that washes away the top soil. Heavy rainfall is responsible for soil erosion in highland areas such as Kigezi, Kenya high land, windward slopes of mountain Elgon, Kenya, Rwenzori, the northern shores of Lake Victoria basin and Kondoa .

**Nature of topography**. steep slopes /hilly areas where vegetation cover is cleared experience rapid soil erosion by because steep slopes increase the erosive power of running water than gentle slopes and low lying areas ,for example Kigezi, Kondoa, Kenyan high lands, slopes of mountain Elgon, Kenya, Rwenzori, Meru and Kilimanjaro.

**Occurrence of ferocious wind** especially in arid areas leads to washing away of top loose soil in suspense, for example Karamoja region, North Western Kenya, Northern and North Eastern Kenya and North Eastern Tanzania.

**Presence of weak and loose soils for example** Volcanic and sandy soils, soak easily and carried away by the destructive forces of wind and running water. For example in the volcanic highlands of Kigezi, Kipengere, Elgon e.t.c, and sandy soils in arid Areas like Karamoja and Northern Kenya and Machakos in Kenya e.t.c

**Presence of Biotic factors**, for example harvester ants, termites and locusts especially in arid areas. These insects eat all the grass leaving the surface bare and exposed to agents of erosion especially during the dry season/ spell. Wind and water get a clear sweep of bare land; carrying away soil for example Machakos, Ankole - Masaka ranching areas, Nakasongola and Karamoja, Turkana e.t.c.

▪Presence of poor vegetation cover fore example scrubs, bushes, shrubs e.t.c offer less protection to soil leading to soil erosion, for example in Karamoja

**MEASURES / STEPS TAKEN TO CONTROL/ COMBAT SOIL EROSION**