SOILS / REGOLITH

- ✓ Soil is the loose top material on the surface of the earth / in which most of the plant roots grow or capable of sustaining plant growth. It is composed of both organic and inorganic matter. The organic matter consists decaying plants and animals.
- ✓ Soil is also composed of living organisms including bacteria, these organisms affect the composition of the soil particles which is filled with gases and, water.

Factors influencing soil formation.

1. **The parent rocks.** This is the rock material that breaks down to form soil particles. Parent rocks differ in terms of structure. E.g.
    - Some rocks are hard while others are soft.
    - Colour, some rocks are dark coloured while other rocks are shiny.
    - Some rocks are jointed, permeable, the above rocks respond to weathering processes at different rates. The composition of the parent rock directly determines the nature of soil nutrients e.g. a quartz rock is likely to lead to the formation of sandy soils.

    —Limestone will yield rocks rich in lime.

    —Laterite rock will yield skeletal laterite soils.
2. **Climate.** Influences soil formation through its elements of rainfall temperature and humidity. The hot temperature during the day and the cool temperature during the night lead to a high diurnal range which strains and stresses rocks thus breaking them into soil particles.

(In humid areas) there is abundant rainfall therefore adequate water which acts as a medium through which chemical reactions take place to decompose rocks into soil particles.

3. **Biotic life (living organisms)** Both plants and animals are responsible for the formation of soil. Man is the most important agent through activities like mining, cultivation, quarrying, road construction, over grazing etc. man can also develop soils by planting trees, use of artificial fertilizers, crop rotation etc.
   Bacterial organisms secrete solutions which progressively break down rocks which may look complex.
   Rodents and termites help to bind soil particles together thus protecting them from agents of soil erosion.
   Earth worms help to grind up mineral particles into smaller substances that are necessary for soil formation.
   Also plant leaves decay to form humus.
4. **Relief or topography of the area.** In steep areas, soil is exposed to agents of soil erosion and the soils in these regions tend to be thin or non-existent.
   On gentle slopes erosion tends to balance with deposition, soils are often deep and fertile.
   In flat areas deposition exceeds erosion and the soils are deeper and rich, however in swamps soils tend to be acidic due to water logging.
5. **Time / age.** The longer the soil forming process, the more complete and mature the soil will be.

Process of soil formation

These are activities that take place to produce soils, out of the dead organic matter or parent rock material.

a) **Weathering.** Physical weathering breaks bigger rocks into smaller ones while chemical weathering decomposes and decays parent rock into simpler substances.
b) **Leaching.** This is the removal by water of soluble constituents e.g. salts and carbonates from the upper layers of the soil profile to the underlying layers, leaching leads to an **impoverished** horizon A of the soil profile.
c) **Eluviation.** This is the movement soil material in solution (or in suspension) from one place to another within the soil profile or caterna. Eluviation may be lateral or vertical depending on the movement of soil water. Like leaching, eluviation leads to an impoverished horizon A since most of the nutrients are washed down to deeper levels
d) **Illuviation.** It is the precipitation and accumulation of leached and eluviated materials in an underlying layer. This process takes place in the horizon B of the soil profile.
e) **Humification.** This is the process through which organic matter decomposes to form humus. It is common in warm, wet and densely vegetated areas.
f) **Calcification.** This takes place in dry areas as result of upward movement of water (EXP because of excessive evaporation in dry areas, water containing dissolved calcium moves upward through the soil, i.e. by capillary action, and when it reaches the surface of the earth it evaporates). The dissolved calcium is then deposited on the earth's surface where it forms **calcite** layer which leads to the formation of soil rich in calcium known as **pedocals.**
g) **Mineralisation.** this occurs in extreme conditions where by decomposition of organic matter extends further than humification and organic matter is changed into mineral

substances e.g. carbon, silica this takes place in the horizon A though can take place anywhere provided organic matter is present.

h) **Laterization.** In this process silica is leached, and iron and aluminium are left concentrated in the top horizon which give the soil a reddish-brown colour. Laterization takes place in the humid tropical and subtropical regions where there is;

i) Abundant supply of decaying organic matter.

ii) deep and intense weathering of rocks due to heavy rainfall and hot temperatures.

iii) removal of silica and iron by leaching.

iv) accumulation of iron and silica in the horizon A.

j) **Gleization.** this is a characteristic of cold pre- glacial areas where permafrost (ground that continuously remain frozen) prevents drainage causing saturation of melted water. (holding much water or moisture as can be absorbed)

k) **Podzolization.** This process prevails in cool humid climates particularly in the coniferous regions, it is a complex process which combines leaching, eluviation, illuviation and humification. There is high acidity facilitated by accumulation of decomposed and partly decomposed organic matter which is a characteristic of many coniferous forest regions. The process leads to the formation of pedocals.

THE SOIL PROFILE

This is the vertical arrangement of soil types/layers from the surface of the earth down to the bed rock. The soil layers are called HORIZONS, exp. The layers don't have permanent demarcations but can be identified on the basis of colour and texture.

Diagram.

Factors development of soil profile include;

i) **Climate. Rainfall, temperature, relief, nature of the parent rock.**

ii) **Living organisms and man.**

SOIL CATENA

This is the horizontal sequence of soils along a slope. This sequence of soils varies with relief. It shows different characteristics in terms of colour, depth, texture and water content (exp. Along a slope, the soils at the top hill will be different from those in the valley bottom.

ILLUSTRATION OF SOIL CATENA.

Differences between soil profile and soil catena.

Soil profile	Soil catena
Largely influenced by climate.	Mainly controlled by relief and gradient.
Vertical section.	Its arrangement basically centres around ..... in soil types.
Basically, concerned with vertical changes in colour and mineral content.	

SOIL EROSION.

This is the removal soil material as well as its transportation from one place to another by agents of soil erosion such as wind, running water and ice (glacier).

There are two types of soil erosion;

1. **Geological erosion.** **This takes place whenever there is flow of energy and matter on the surface. (exp. It is a slow process and it is not dangerous to the soil since the rate of removal is matched with the rate of new soil formation.**

i2 Accelerated soil erosion. **This is when geological erosion is speeded up by man's activities in this case the rate of soil removal is greater than the rate of soil formation (most dangerous).**

Areas affected by soil erosion in East Africa.

North eastern Uganda …. Karamoja

Eastern Uganda …… Teso land and Mbale

North Eastern Kenya…… Turkana land

Northern Tanzania……. Sukuma land

Kenya-Tanzania border…… Misaim land

Tanzania…… Kondoa province

Causes of soil erosion.

a). Lack of vegetation cover. **Vegetation cover reduces the impact of raindrops, secondly it restricts surface run off and soil transportation, thirdly vegetation aggregate soil**

hence greater infiltration, therefore absence of vegetation accelerates surface run off.

b). Heavy rainfall. It increases volume of water hence increase in surface run off especially where slopes are very steep and lack vegetation.

Diagram

c). Steepness of slopes.

d). Deforestation

e). overstocking

f). over cultivation. Over cultivation down slope brings about manmade channels.

g). uncontrolled bush burning

h). over population leading to need for more land.

i). monoculture, road construction, cultivation along river valleys, mining, quarrying. Over cropping, biotic factors, strong winds, ploughing along steep slopes

EFFECTS OF SOIL EROSION

Negative effects

- **Loss** of soil fertility leading to unproductive soils which leads to low crop yields thus famine and hunger.
- Creates waste lands with gullies that hinder construction of transport and communication routes, and mechanisation,
- Wind erosion leads to water and air pollution due to sand and dust.
- Slitting of river valleys leads to flooding thus destruction of property and lives
- Results into limited vegetation cover because badly eroded soils are unable to support plant growth which results into reduced transpiration, scarcity of pastures for animals
- Dust particles carried by wind are deposited on social infrastructures like roads, buildings etc leading to increased costs of maintenance

Positive effects

- Alluvial soils are transported and deposited in low lands which are fertile and can be used for farming/growing of crops.
- Soil erosion exposes inselbergs which attract tourists thus promote tourism industry
- Soil erosion exposes minerals that can be mined like granites and limestone when mined and exported revenue is earned.
- Removal of top soil exposes the parent rock to agents of weathering leading to formation of fresh /new soils

STEPS TO CONTROL SOIL EROSION ***Soil conservation measures*** **(for research)**

SOIL TYPES IN EAST AFRICA

Soil types in east Africa fall into three major categories namely; zonal, intrazonal, and azonal.

Zonal soils refer to the well-developed and mature soils resulting from maximum effects of climate and organic matter upon the parent rock over a long time. Zonal soils commonly occur on gently sloping and well drained areas of east Africa, such as the Lake Victoria basin, the lower slopes of the highland land areas of east Africa etc. Examples of such soils the pedocals i.e. those rich in $caco_3$, pedalfers e.g. lateritic soils the tropical red earths and tropical black earths.

Intrazonal soils are soils that occur where special conditions of parent rock, drainage, and relief exert a stronger effect on the resultant soil type than other factors like climate and vegetation. Examples include;

- bog/peat soils (composed of accumulated decayed vegetation) /hydromorphic soils (soil that resist moisture /water repellents) /glycols soils in marshy areas of east Africa/water logged conditions e.g. meadow and glei (sticky soil).
- Saline soils (holomorphic soils) have high levels of soluble salts such as solonchaks (pale /grey soil found in arid regions/sub humid /poorly drained conditions i.e. the word is Russian for salt) and solonetz soils rich in sodium
- Calcareous /soils calcimorphic soils formed from limestone parent rock (composed of calcium carbonate)
- Intrazonal soils mainly occur in coastal areas of east Africa (bog and peat) and river flooded plains (silt and mud), saline soils in semi desert areas(calcareous)

Azonal soils are young soils, less developed without a clear soil profile.

They are soils that have not been exposed to soil forming processes for a long time therefore they are immature.

They are skeletal soils with shallow profiles and show similar characteristics of the original parent rock.eg rendzina (lime rich soil with dark humus) and terra rossa (well drained reddish, clayey to silty with a neutral ph. Mainly in Mediterranean regions)

Azonal soils are divided into two groups i.e.latosols(high content of iron and aluminium mainly found in tropical rain forests) and regosols (unconsolidated parent material of alluvial origin), derived from unconsolidated material such as alluvium, sand, volcanic ash etc. examples of azonal soils include,

- Screed soils/mountain soils found on mountain slopes formed from accumulation of weathered angular rock fragments
- Alluvial soils river born materials e.g. silt, mud, sand etc
- Marine soils as a result of wave action e.g. mud, clay
- Glacial soils /moraine due to glacial action till soils, fluvial glacial soils
- Windblown soils (acolin) e.g. loess, dune soils etc(sands)
- Volcanic soils recent lava ash soil