

Soil is the thin upper layer of the earth's crust which has been weathered from the parent's material and decomposed animals and plants. Soil support plants growth and animal life.

FACTORS INFLUENCING SOIL FORMATION

Soil formation is sometimes called Pedogenesis.

The formation of soil is mainly initiated by weathering process. There are several factors which influence soil formation these are as follows:

A) PARENT ROCK MATERIAL

This is one of the chief factors of soil formation. It determines soil type, color, depth, rate of soil formation, structure, texture, porosity and soil fertility.

Parent rock influence soil maturity, therefore hard rocks take a long time to mature while soft rocks take a short time to mature. Shallow and poorly productive

B) CLIMATE

The most variable elements under climate are temperature, precipitation (rainfall) and wind

- Temperature affects decomposition of organic matter hence it influences the development of soil profile
 - Rainfall and wind encourage the formation of soil due to their role in the erosion process
 - On the other hand rainfall adds moisture which encourages chemical and physical weathering
- c)

C) LIVING ORGANISM

Some plants have nodules with bacteria which add nitrogen into the soil hence improve aeration of soil. Microorganisms are active in the decomposition of the organic matter to form humus on the other hand burrowing of animals and plant roots facilitate the state of both physical and chemical weathering hence lead to the formation of soil easily.

D) RELIEF (TOPOGRAPHY)

The role of relief in soil formation is mostly in indirect way. Relief influences climate and vegetation. The most important aspect of topography in soil formation, steep slopes areas soils are shallow due to erosion while on a gentle slopes and low land areas soils are deep due to deposition of materials. e) TIME

This involves the duration that has been taken in the process of soil formation. Time determines the maturity of soil, when soil formation has taken a long time, soil tends to be mature i.e. they are deep and well developed.

IMPORTANCE OF SOIL

Soil is virtual life support to both flora and fauna organism, because all the organisms depend on the soil as their source of food. soil is therefore important to both plants and animals' life in various ways including the following: –

- (i) Animal life support; soil acts as plant habitat in which animals uses plants as food for their survival.
- (ii) Building materials soil is used directly in making of bricks, tiles and white wash, The materials are used in building of houses ,bridges and other structures.
- iii) Source of minerals some soils contain minerals which can be extracted for commercial purposes. For example, Titanium is obtained from soil deposit of Kwale near Mombasa in Kenya Bauxite, which is mined in Guinea in West Africa
- (iv) Cultural and medicinal values

Some soils are cultural value in some communities e.g red ochre and clay are used for body decorations by Maasai communities and clay mixed with herbals and being used for medicines

(v) Farming and settlement fertile soil influence cultivation of crops. settlement distribution also depends on arable fertile soil where as people tend to dwell in areas with food availability.

(vi) Habitat for organisms

soil functions as a habitat for organisms such as burrowing rodent, earthworms and termite. These organisms perhaps are significant in the process of soil formation

SOIL CONSTITUENTS (COMPONENTS)/COMPOSITION

Soil is made up of the following components;

1. Organic matter

This forms 5% of the total volume of soil and is made up of plant and animal remains. This forms humus as a result of decomposition of animals and plant remains.

IMPORTANCE OF HUMUS

i) Improving the structure of the soil and its water retaining capacity limits the leaching process and improves the soil acceleration

ii) Storing and supplying nutrients to the plant like nitrogen, phosphorus, potassium, calcium – high production.

iii) Humus regulates the temperature of the soil and soil Ph

iv) The living micro-organisms help in decomposition.

2. Inorganic matter

This forms 45% of the total volume and is made up of minerals from the parent rock. Minerals constitute several nutrients which are needed by plants.

3. Soil water

Forms 25% of the total volume and it is one of the most important soil components. It is derived essentially from rainfall especially from infiltration and through flow.

IMPORTANCE OF WATER

a) It regulates temperature in the soil

b) It helps in the solution and transfer of nutrients in the soil

c) Too much water in the soil leads to the leaching of mineral nutrients in the soil

d) It controls chemical processes like weathering as well as mechanical weathering.

4. Soil air

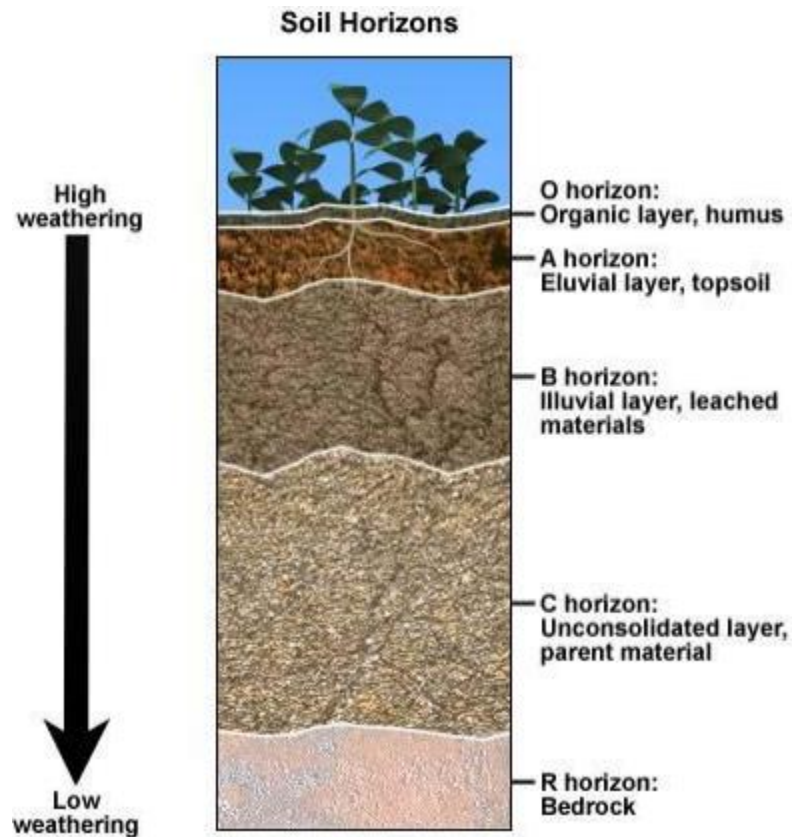
It forms 25% of the total volume. It consists of the soil atmosphere from which plants and soil organisms obtain oxygen for their metabolism and dispose of carbon dioxide and other gases

SOIL PROPERTIES

A: PHYSICAL PROPERTIES

1. SOIL PROFILE

This is the vertical section from the surface to the parent rock characterized by distinct layers usually of different texture and colors.



A- horizon

Is the topmost layer and can include organic matter to form humus. Horizon 'A' varies in color from place to place for example dark, grey etc. this zone is also called the zone of Ellevation from which materials are washed down ward. It is in this place where leaching process takes place.

LEACHING

Is the washing down of nutrients in solution from the topmost layer to another layer

B- horizon

This zone is also known as the zone of accumulation. In this layer the materials washed from 'A' horizon are deposited or accumulated.

C- horizon

Is the partially weathered parent rock from which the soil develops, it is underlined the D horizon which is the fresh [unweathered] parent rock.

D-horizon (Bedrock)

It is the unweathered parent rock. it is the parent in sense that it is the source of the in organic content of the soil

2. SOIL DEPTH

Soil depth varies from place to place depending on maturity. Maturity is influenced by the nature of the rock as well as duration of the soil forming processes which have been operating.

Soil depth is important for agricultural activities. Thus, deep soil is important for agricultural activities while shallow soil is not good for cultivation.

3. SOIL COLOUR

Soil color is determined by the materials and the mineralogical composition from which the soil is derived and organic matter content. It varies from one place to another.

Soil color can be classified and described in terms of;

- a) Dark [black, grey, dark brown etc] and cinnamon
- b) Bright [yellow, orange, red, reddish brown and yellow brown]
- c) Light [white, whitish grey]

4. SOIL TEXTURE

This refers to the degree of coarseness of soil (especially soil mineral particles). It can also be referred to as variations in the particle size, caliber or mechanical composition

According to the soil texture, soil can be classified as;

- a) Coarse sand (2 to 0.2mm)
- b) Fine sand
- c) Silt (0.02mm)
- d) Clay (less than 0.002mm)
- e) Loan soil is a mixture of sand, clay and silt.

NB; measuring of soil texture can be done through the use of finger testing

IMPORTANCE OF SOIL TEXTURE

- 1) It influences soil porosity, permeability, structure and retention capacity

- 2) It influences plant growth and root penetration
- 3) It influences the cultivation during agricultural activities
- 4) It influences soil resistance against erosion
- 5) It influences soil fertility

5. SOIL POROSITY

These are the total volume of the pores or empty spaces between particles of the soil materials especially in the soil. Soil porosity is mainly influenced by soil texture, organic matter, soil structure, individual undisturbed soil aggregate compounds referred to as peds.

IMPORTANCE OF SOIL STRUCTURE

- i) It determines water retention capacity and aeration
- ii) It is an indicator of soil fertility or suitability for agricultural activities, settlement locations and construction
- iii) Good structure facilitates the activities of the micro organism
- iv) It influences the cultivation process
- v) It influences the plant growth by influencing the root penetration and water retention

-Therefore, it is quite fundamental to note that the best soil is that which influences the water holding and aeration capacities of the soil.

6. SOIL STRUCTURE

This is the arrangement of soil particles into aggregate compounds particles. Individual undistributed soil aggregate referred to as peds.

7. SOIL TEMPERATURE

Soil has a certain degree of temperature and this tends to vary from one place to another due to the variation in the climatic condition.

IMPORTANCE OF SOIL TEMPERATURE

- 1) It controls biochemical and chemical processes especially the decomposition of organic matter and plant growth. Thus, plant growth and decomposition tend to be fast in warm areas and slow in cold areas, this is due to the fact that growth cells and microorganisms tend to be very active in the warm areas unlike in the cold areas where they tend to be inactive or less active.

2) It also determines the existence of microorganisms in certain areas. In extremely hot areas and cold areas may not support the survival of animals and other micro organisms

3) It controls the amount of moisture in the soil where there is high evaporation soil moisture is less or the soils are dry

B: CHEMICAL PROPERTIES

These include soil properties like soil reaction (PH), reaction exchange and leaching.

1) Soil reaction (soil PH)

This is the term used to describe the degree of acidity and alkalinity in the soil and it is related mainly to climate. This degree of acidity and alkalinity is expressed in the PH value which is the measure in terms of hydrogen ions concentration held by the soil colloid. Soil PH scale range from 1 to 14 where ph 7 is neutral, the condition below 7 is acidic while the condition above 7 is alkalinity which means it has more alkalis.

IMPORTANCE OF SOIL PH

- i. It helps in determining the selection of crops and agricultural distribution
- ii. It affects plant growth such that where there is too much acidity there will be poor plant growth. This is because the increase of acidity leads to the increase in leaching with affects soil structure

LEACHING

This is another chemical property of soil referring to the process in which nutrients are washed down in solution from the top – soil laver. During leaching process the base are washed down leading to concentration of hydrogen ions which in turn cause the increased acidity in the top soil.

Leaching is very effective in wet conditions

SIMPLE HYPOTHETICAL PROFILE FOR MATURE SOIL

The soil profile varies from one place to another depending on the variation in environment conditions.

For example under deciduous forest, soil with little organic matter can be produced (brown either or brown forest soil) while in mid latitude grasslands deep black earth soil (chernozem) is formed.

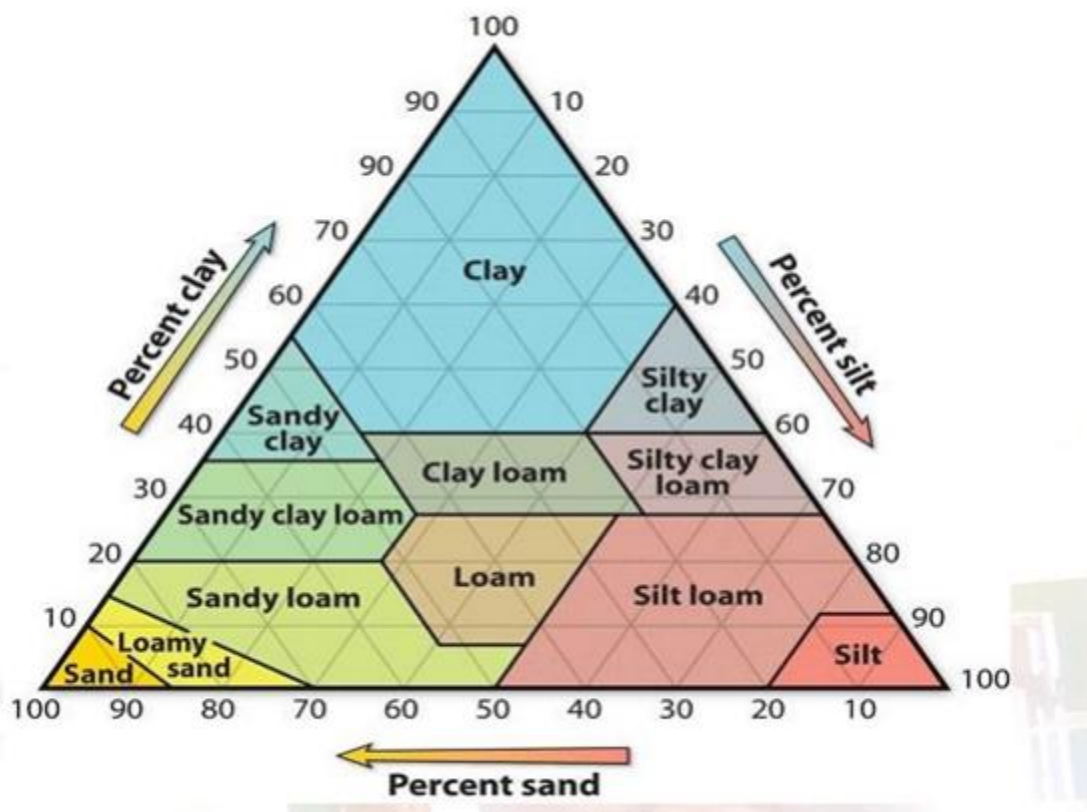
Chernozem has a lot of organic matter. In the desert area the soil profile usually lack the Ao horizon due to scarcity or absence of vegetation.

SIMPLE SOIL CLASSIFICATION

Soil classification refers to the grouping of soil according to specific characteristics, such as properties or factors like climate also soil can be classified according to the age, texture and color. One common classification is that based on texture.

According to the soil texture triangle, there are three main texture namely sand, silt and clay. This is based on the size of their particles as discussed earlier. Their percentage content of each one of these determines the type of soil according to texture. Note that sandy soil have sand content of over 45% clay soil have above 27% while silt soil have silt content of above 40%.

SOIL TEXTURE TRIANGLE



SAND

This soil consists mainly of coarse and fine sand and contains very little clay such that it is not

sticky when wet and is loose when dry, percentage of sand is above 85, that of clay is up to 10 and silt is

up to 10. When such soil is rubbed, it does not leave any film on the fingers.

LOAMY SAND: This consists most of sand but with sufficient clay such that it gives it a slight plastic

quality when it is very moist. When it is rubbed between fingers it leaves a slight film of fine material,

sand particles account for 70% to 90% clay up to 15% and silt up to 30%.

SANDY LOAM: This soil has high percentage of sand between 43% and 85% with clay content of up to

20% and silt up to 50%. It moulds easily when it is sufficiently moist but does not stick easily to the

figures.

LOAM

In this soil, sand and silt dominate an average of 40% each while clay account for about 20% on average. It moulds easily when it has sufficient moisture and does stick to the fingers to some extent.

SILT LOAM

It has a high percentage of silt of between 50% and 87% sand between 13% and 50% and clay up to 27%. It is moderately plastic and not very sticky it has a smooth soapy feeling due to high content of silt.

SAND CLAY LOAM

This has over 45% sand, up to 28% silt and clay between 20% and 35%. It can be a bit sticky because of the clay content but quite porous because of the sand.

CLAY LOAM

Sand content between 20% and 54% silt between 15% and 53% clay between 27% and 40%. This one has sticky distinction when moist because of clay.

SILT CLAY LOAM

The amount of sand is between 27% and 60%, silt between 40% and 78% and clay between 27% and 40%. The high silt content makes it smooth and has a soapy feeling. It is less sticky than clay loam or silt clay.

SILT

This have over 80% silt particles, up to 20% sand and less than 12% clay. It is predominantly smooth and has a typical soapy feeling of silt.

SANDY CLAY

Sand between 45% and 65% silt up to 20% and clay between 35% and 55%. In the presence of sufficient moisture this soil is plastic and sticky clay and sand is dominated.

CLAY

The proportion of sand goes up to 45%, while that of silt is up to clay account for above 40%. The soil is sticky when moist has a plastic feel. It can be rolled into threads when moist and can be molded into different shapes. And can retain fingerprint.

SILT CLAY

Sand up to 20% silt between 40% and 60% and clay between 40% and 60%. This soil is composed of almost fine particles throughout. It is smooth and has to some extent the soapy feel of silt but has a degree of stickiness because of the high proportion of clay

SOIL EROSION

Soil erosion is the wearing away, detachment and removal of soil material from one place to another place through the agents like water, wind, ice etc

AGENTS OF SOIL EROSION

1) Water

This is the most important agent of soil erosion

Erosion by water involves:

- Splash erosion caused by rain drops
- Sheet erosion which involves the removal of the maximum cover of soil by surface water
- Sill erosion which leads to the formation of small channels called sills on the surface
- Gully erosion that leads to the formation of deep troughs called gullies due to severe under cutting
- River erosion that takes place in the specific channels called river valley

2) Wind

This is another agent of soil erosion. It takes place in arid and semi-arid areas or where the soil is loose

3) Ice

It is also another agent of soil erosion. It takes place in cold areas where there is the formation of ice

4) Gravity

This leads to the gradual movement of weathered material down the slope without involving transporting agents.

TYPES OF SOIL EROSION

1) Normal geological erosion

It is the wide spread type of erosion that occurs wherever there is a natural flow of energy and matter on the earth's surface without man's influence. It is normally very slow and so infectious to the soil cover of the world.

2) Accelerated soil erosion

Is the type of erosion associated with man's activities [man included] it is spectacular in nature therefore it has attracted man's attention

FACTORS AFFECTING /ACCELERATING SOIL EROSION

1) Climate

Where there is heavy rainfall erosion tends to be severe while where there is low rainfall erosion is low

2) Topography

On steep slopes soil erosion can be fast while on gentle slopes the rate of erosion tends to be low

3) Nature of soil

This depends on the characteristics or features like texture, structure, permeability e.tc. Unstable soils with coarse textures are prone to severe erosion than fine textured stable soils

4) Vegetation cover

Where there is dense vegetation soil erosion is less or low rate unlike where there is scanty or no vegetation cover.

HUMAN FACTORS

5) Good management of the soil

Which involves the way human beings use soil wisely and skillfully and undertaking conservation measures to reduce or mitigate erosion through afforestation.

6) Poor management

That involves unwise use of soil through over cultivation, over grazing and deforestation.

7.) The increase in pollution

This leads to the over exploitation of resources especially minerals, forests and over cultivation.

EFFECTS OF SOIL EROSION

Soil erosion is a serious challenge which has many effects on social and economic activities. Some of these effects are explained below: –

(i) Loss of productive soil.

When the top productive soil is eroded it is lost forever only the unproductive stony soil is left behind the consequently is the lowering of agriculture productivity of land.

(ii) Depict of vegetation cover.

The eroded land cannot hold the plants including crops are washed away or are buried in the deposit soil way from their original location.

(iii) Destruction of structures. when erosion takes place bridges can being taken away from their original areas. other structures like road, railways, as well as buildings can collapse after erosion of soils.

(iv) Pollution to environment.

Eroded soil that is carried into rivers lake s and oceans may contain chemical pollutants collected by water from farm and dumping grounds, hence resulting to loss of aquatic organisms.

POPULATION GROWTH AND SOIL EROSION

When the region is severely affected by soil erosion, where crop production impeded when useful soil is carried away, the region experience shortage of food. Even the vegetable that used to grow wild become non-existence, this causes famine and malnutrition with inadequate nutrition, child mortality rate goes up and population growth is impeded.

Soil erosion renders the land unsuitable for habitation when gullies develop the land is unsuitable for settlement and farming. The foundation of existing buildings and roads are eroded

Soil erosion leads to lowering of the water table in a region. This causes destruction of the vegetation in the water catchment areas and leads to shortage of water resources, the wells may dry up this means that women and children have to travel long distance in search of water that means children may not go to school general health of both women and children becomes poor this may lead to early death and linear population

Also, when land become more eroded it can lead land to be unfertilized therefore it accelerates rural-urban migration especially for men who migrate to urban areas. Then led to increase of the population in urban area than the rural areas where man power decrease due to rural urban migration.

SOIL EROSION CONTROL MEASURES

Soil erosion is a geological process, however when it exceeds normal rate, that is when it becomes a problem. we cannot talk about stopping soil erosion. The following are some of the measures that can be taken to control soil erosion.

(i) Afforestation and reafforestation

Afforestation is the planting of trees where no forest has been known to exist. Reafforestation /Reforestation is the process of planting trees on land that previously had a forest the trees help to hold soil particles together so that they cannot easily blown away by the wind or carried away by running water.

(ii) Control of bush fires

When the grassland, are burnt the soil is directly exposed to agents of erosion, IF the piece of land has to be cleared for cultivation the old grasses and bushes should be cut down and grasses put aside in heap, this will prevent soil from erosion

(iii) Controlling overgrazing

There should be matching the number of livestock kept in a piece of land with the carrying capacity of land. The land can also be divided into paddocks i.e individual division of blocks of land and there after animals are grazed in one paddock at a time, they then transferred to another division in later days.

TECHNIQUES FOR SOIL CONSERVATION

When using the land, it must at the same time be properly maintained by apply proper farming techniques to reduce erosion and then to improve it productive capacity. Therefore, a number of ways of doing this for example

(a) Crop rotations

This practice offers protection to the land from soil erosion and good chance to cover its original fertility crop rotation makes it possible to have the land occupied with crops most of the year. In addition, the loss of crop most of the year. In addition, the loss of nutrient elements by leaching is minimized and losses from erosion are greatly reduced

Erosion hazard are important factor in determining the kind and sequence of crops to be grown in a rotation of a particular piece of land and area where erosion can easily occur due to either slope or soil characteristic, permanent crops such as trees or pasture should be planted rotation will not provide erosion protection on steep slopes.

(b) Contour farming

Contour farming is ploughing, planting and cultivating across the slope following the contours, generally on gently sloping land each contour row can be viewed as a small dam that checks the speed of non-off water and reduce erosion on well-drained soil. Contour farming is simple and easier of all the supplemental soil conservation

(c) Strip cropping

This is a system in which crops are grown in strips that are arranged across the general slope or at right angle to the path of the prevailing wind. The strip don not necessarily have to follow contours.

(d) Terracing

A terraced is an embankment of earth or stone or other suitable materials or combination of these materials made across the slope for the purpose of controlling run-off.

Terrace decrease the length of the slope thus reducing erosion and run-off. There are two types of terraces

(i) Level terrace

Is a ridge built generally on sandy soil with little or no grade it is designed to hold water in the field until absorbed it adopted in areas where rainfall and soil characteristics are such that there is only slight danger of water accumulating on the soil and breaking the soil surface.

(ii) Channel terraces

Consist that are cut across the slope these channels carry the excess rain water fro the fields but at a low speed thus minimizing erosion. They are commonly constructed in regions that receive heavy rainfall.

(e) Planting of trees and grasses

Trees and grasses can act as wind breakers and can also control water erosion. In controlling erosion caused by wind trees or grasses may be planted in strips so that soil particles carried by wind may be deposited on or near the grass strip.

f) Controlled grazing

Overgrazing can be dangerous as most or all the vegetation can be removed with resultant exposure of the land to erosion rotational grazing with the optimum number of animals in one area can help to maintain the vegetation cover.

(g) Mulching.

Mulching act as a huge sponge which absorbs the water that fall on to it and release it slowly and harmlessly to the underlying soil if there is no protective cover over a wide area erosion may occur rapidly.