INTRODUCTION TO PEDOLOGY,MINEROLOGY AND SOIL PHYSICS

Soil is the uppermost layer of the earth formed from the different breakdown of rocks that supports life .

SOIL FORMING ROCKS AND MINERALS

Rocks are consolidated inorganic minerals/materials of the earth's crust.The inorganic materials hold moisture ,air and it's the home of different organism.

There are 3 types of rocks from which agricultural soil is derived

(1) Igneous rocks
(2) Sedimntary rocks
(3) Metamorphic rocks

(1). IGNEOUS ROCKS:

These rocks are formed from molten magma,the material is in molten form because of high temperature and pressure in the core of the earth's crust due to the earth's movement and other natural occurrences,line of weakness,cracks and joint ,exists in the earth's crust.

2 main types of igneous rocks are formed included ;

i.Rocks that solidified quickly due to rapid change in temperature at the surface of the earth known as volcanic or extrusive rock

ii.Intrusive/plutonic- include those which solidifies slowly under high pressure .

Igneous rocks are composed of primary minuscule as light color quartz,muscovite and feldspar and dark colored biotite,augite and hornblend. In general, Dark colored minerals contains iron(FE) and magnesium (Mg) and are more easily weathered.

(2). SEDIMENTARY ROCKS:

These are formed from the weathered materials of other rocks.these materials are compacted/cemented to form a sedimentary rock.

The sediments derived from the weathering,transportation and deposition of rocks.There are 3 types ;

i. Coarse texture sediments e.g conglomerate

ii.Fine grain sediment-Clay

iii.Other sediments-Limestone,solicious deposits,rock salt,coal and various iron(FE) carbonate.

These sediments are transported and deposited in the bottom of the prehistoric seas,lakes and slope of the landscape.

(3). METAMORPHIC ROCKS:

May be derived from the metamorphosis from pre-existing igneous rock .They are normally formed when forces of heat,pressure and chemical charge takes place at some depth in the earth's crust.Some of the changes that takes place includes ;

i. Igneous rock and gnesis
ii.Limestone
iii.Sand stone and soft shale e.g quartize and slate .

WEATHERING

Weathering includes the physical,chemical and biological processes which results in breakdown and decomposition of rocks near the earth's surface.
Weathering combines the processes of destruction and synthesis of waste mantle,redolite which may eventually develop into soil.

PHYSICAL WEATHERING

Rocks are merely breakdown by mechanical means into smaller ones and eventually into sand and silt particle that are commonly made up of individual minerals without appreciably affecting their chemical composition.
3 types of physical weathering ;
i. Granular disintegration: Rocks are divided into tiny grains to form sand or very fine gravel.

ii. Exfoliation: This is when thin,curved sheets fall away from the rock surface.

iii.Block separation:When rock breakup into large fragments related to bedding planes or joints
Physical weathering is brought about by the following mechanical means;
(1).Temperature
(2).Water and ice
(3).wind
(4).plant and animals

*CHEMICAL WEATHERING
*BIOLOGICAL WEATHERING

In chemical weathering,the rock is decomposed and these are either removed or left to accumulate in the soil.Chemical weathering is most intense where climate is wet and hot and much more effective than Physical weathering.

Chemical weathering is enhanced by water,oxygen and the organic and inorganic acid that results from biochemical activities.These agents acts in concert to convert primary minerals e.g feldspar and micas to secondary minerals e.g silicate clays and release plant nutrient elements in soluble form.
The mechanism of Chemical weathering includes;
i.Hydration
ii.Hydrolysis
iii.Redox reaction
iv.Solution/Dissolution
v.carbonation
vi.Alluviation

FACTORS INFLUENCING SOIL FORMATION

(1). Parent material
(2).Climate

(3).Biota
(4).Topography
(5).Time

1.PARENT MATERIAL:
Unconsolidated chemically weathered mineral/organic matter from which A and B horizons soil may developed by pedogenic processes.
The nature of parent materials profoundly influences soil characteristics.Parent material also influences the quantity and type of clay minerals present present proportionally affect the type of soil to be formed.

2.CLIMATE:
Most influential factor acting on parent material because it determines the nature and intensity of weathering.The principal climatic variables influences soil formation are effective precipitation and temperature.The greater the depth of water penetration the greater the depth of weathering and soil development.
Both temperature and moisture influences the organic matter content (OMC) of spoil through their effect and balance between plant growth and microbial decomposition.

3. LIVING ORGANISMS/BIOTA:
Organic matter accumulation biochemical weathering,profile mixing,nutrient cycling and aggregate stability are all enhanced by the activities of organism in or on the soil.
Burning and tillage by human for crop production can significantly modify soil formation and also influence of microbial activities alter the process of spoil formation.

4.TOPOGRAPHY:
Relates to configuration of land surface and is described in terms of different in elevation,slopes and landscape positions.Steep slopes generally encourages erosion of surface layers and allow less rainfall to enter the soil before running off.

5.TIME:Soil forming processes take time to show their effects.It takes time to be disintegrated by physical or chemical processes and more time for the weathered rocks or parent material to be colonized or utilized by lower and high plants and animals
The composition of organic matter takes time with the proper mixing of material to form real or mature soil.

COMPOSITION OF THE SOIL.

Soil is made up of mineral and organic matter,water and air in the following proportion.

The minerals and organic matter constitute the solid phase ,water constituents the liquid phase and air constitute the gaseous phase

PROFILE DESCRIPTION.

A soil profile is the vertical exposure of soil of the sequence of horizons of the soil

individual.The horizon differs in morphological,physical,chemical and biological properties such as color,texture,moisture,consistence,structure and microbial population,Organic matter,clay contents,minerals ETC.
Profile consists of succession of vertical layers (horizons) seen in a cut-earth's face .Road-cut,quary-pits,Freshly rugged pit ,drainage and irrigation channels reveals the horizon and can be used to study the soil profile.

IMPORTANCE OF SOIL PROFILE IN SOIL SURVEY WORKING

(1). It reveals the soil difference from one part of the landscape to the other.

(2).It helps to indicate the presence and extent of drawing the boundary lines

(3).It helps in determining the potential of different soil with regards to selected land use style .

(4).It reveals obstruction such as bed rock or indulated laterite,scale pan,badly eroded or bulldozed top soil.

DESCRIPTION OF A SOIL PROFILE

(1).A freshly dug profile with dimension of 1m by 1m by 1.5m is desirable unless the depth is impenetrable layer,it could be shallower to 1.5m

(2).Pit should be sited at least 50m from the roads,quarries,construction site and other features likely to disturb or contaminate the soil profile .

(3).Two sides from the pit for observation and entrance/Accessiblity should be kept free of the soil .

(4).At least 3 pit in each major kind of soil should be examined .

(5).A step like structure should be constructed to avoid dumping in and out which cause injury and contamination.

GENERAL SITE INFORMATION AND ENVIRONMENTAL PROPERTIES.

In describing the soil profile,general information regarding the characteristics of the sites and the detailed characterization of horizon properties must be recorded and should included the following.

(1). Sampling date and period .
(2).Geographical location of profile pit
(3).Soil mapping unit identification
(4).Profile pit identification number
(5). Elevation
(6).Climatic characteristics of the area

(7).Soil parent material
(8).Geology and geomorphology
(9).Topography position and slope
(10). Vegetation
(11).Erosion hazards (Type and degree)
(12).Drainage condition
(13).Surface soil tissues
(14).Depth to water table position
(15)Depth to impenetrable layers such as rocks .

SOIL PROFILE FORMATION.

(1).Eluviation
(2).Illuviation
(3).Transfer
(4).Transformation.

A .Eluviation:This is the addition of organic compound and erosion sediment to the soil when they are decayed ,they mixed with some minerals to form dark coloration for the top soil horizon.

B. Illvuation:This is the movement of the soil mineral nutrient from the top soil horizon down to the next horizon leading to some changes in the horizon

C. Transfer : This is the movement of the silicate clay minerals from the sub-soil to the next horizon.

D. Transformation:This is a process where by the clay minerals undergo pedogical alterations and weathering to release nutrients and form compounds such as aluminum (Al),Iron(Fe),Maganese (Mn) and oxides to the soil .

TYPES OF SOIL HORIZONS.

(1). Master horizons
(2).Diagnostic horizons

1.Master horizon:6 master horizons are recognized and occur one after the other from the surface to the bedrock.They are designated using capital letter O,A,B,C and R.

2.Diagnostic horizons :This occurs at the soil surface and are called EPIPEDONS .The epipedons include the copper part of the soil darken by organic material ,there are surface and sub-surface horizons including mollic epipedons,mellanic pipelines,Histic epipedons,Anthropic,Umbric epipedons,ochic epipedons.

SOIL SURVEY

O Horizon
A Horizon
E Horizon
8 Horizon
C Hoizon
R Herizon

Soil survey is the identification,delinearation ,mapping and classification of asoil types to scale on a landscape and as well as showing their distribution by representing them to scale on soil map.

1.Mapping -Identifying different soil types having its own characteristics and management.

2.Classification:Grouping of the soil of the same properties together based on the identified properties such as biological,chemical ,morphological and physical.

IMPORTANCE OF SOIL SURVEY

helps in provision of Data on the composition and properties of soil.
Provision of systematic bays for the study of crop and soil relationships
Helps to determine capability and suitability of soil in crop production and other form of land use .
Enables us to know the number of hectares of land available for crop production

METHOD OF SOIL SURVEY

There are 3 caterias sized fir different method of soil survey i.e
-purpose of soil survey
-Regularity of the observation
-scale of mapping .

(1).Schematic method:
These are soil survey which results in generalized soil make and derived from intruitive exploration.The mapping scale is mostly 1:1,000,000.They are useful for promoting public awareness.

(2).Exploratory method :
This is a soil surgery to identify the form of development within a region. It is a low intensity survey based on rapid transverse to provide information about otherwise unknown region.The mapping scale range from 1:250,000 to 1:1,000,000.

(3).Reconnaissance survey :
This is a low intensity surgery usually conducted ducted for large and very large area .The major purpose is to identify possible areas for future intensive soil survey work.The scale ranges from 1:100,000 to 1:250,000.

(4).Semi-Detailed survey :
This is a a medium intensity soil survey and it's used to survey a moderately large area.It is carried out to identify specific area apparently suited to specific firms of agricultural development.This mapping is done by Aerial photo interpretation.The scale ranges from 1:25,000 to 1:100,000.

(5).Detailed Soil survey :
These are high intensity soil survey with accuracy.The location of soil or landscape can be identified even with their boundaries .This method is useful for one area to another .The scale is in between 1:10,000 to 1:25,000.

(6).Very detailed soil survey :
This is a very high intensity survey carried out on a small area .It is concerned with precise location of high cost project .The scale greater than 10,000. (1>10,000).

STEPS IN SOIL SURVEY PROJECTS

1.Office work/Preliminary investigation
2.Field survey
3.Field work
4.Laboratory work
5.Soil survey report writing or recommendation.

1-.Office Work:The operations performed at the initial stage is involved ;
(a)Assemblage of information related to the general site e.gross mao ,geological map,Vegetation Characteristics,Topography and land use map of the area.

(b)Climatic data temperature:Relative humidity,wind and rainfall etc .

(c)Definition of the area to be surveyed and the practical task of the survey.

(d)Selection and procurement of instruments and other equipment.

2-Field Survey : This stage involves visiting the farm to have the first hand information of the project area also arranging fit a base camp where the survey team and other resources will stay.Also identification of sample area ,Sample materials and equipments And final budget .

3-Field Work: This phase /Stage involves ;

(a) Cutting and pegging of the base lines (Transverse)

(b)Augering of soil description point

(c) Entainssoil profile digging and description

(d) Profile measurement e.g Bulk density ,available water capacity,infiltration rate etc.

(e) Collection of soil samples from different horizon

4-Laboratory work:
This stage includes ;
(a) Soil samples collected on the field are analyzed for physico-Chemical properties and micro-biological processes using standard laboratory procedures.

(b)Soils are analyzed for parameters such as PH,Organic carbon ,OM,Available phosphorus,Total Nitrogen,CEC etc .

(c) The morphological and physico-Chemical properties of the soil are employed to classify the soil .

4-Soil survey report writing or recommendation:
This phase/Stage includes ;
(a) Representation of different mapping unit and appropriate scale and keys to represent the features for easy interpretation.

(b) Explanation of how to use the soil map and report

(c) A general description of the area .

(d)Description of each mapping unit

(e)Classification and suitability evaluation of different mapping unit for different purposes.