SOIL CHARACTERIZATION USING DIAGNOSTIC PROPERTIES

The following are the characters of the pedologically important properties used in categorizing soils:

SOIL CHARACTERIZATION

Soil Profile Description:

Depth – (cm)

Colour

Mottling

Texture

Structure

Consistence

- **Cutans (clay coatings)**
- **Cementation**
- **Pores**
- **Rocks/mineral fragments**
- **Pans**
- **Roots**
- **Biological activity**
- **Inclusions**
- **Boundaries (horizon boundaries)**

- **Colour** – determined by the state of the iron and/or OM. Hematite (Fe_2O_3) is responsible for the many soils developed under strongly aerobic conditions in tropical and sub-tropical areas.
- The mineral responsible for most of the inorganic colouration in aerobic soils is goethite (FeO-OH), with colours ranging from reddish-brown to yellow as its hydration increases.

Many grey, olive, and blue colours occur in the soils of partially or completely anaerobic situations and originate through the presence of iron in the reduced or ferrous state.

The colour of the upper horizons usually changes from brown to dark brown to black, as the OM content increases.

MnO_2, Mn, or elemental carbon following burning may also lead to dark colours.

Ca_2CO_3 and some salts like Ca, K, Mg, Na ,Al may produce pale grey and white colours.

- **Munsell Soil Colour Charts**, an international document is used for reading soil colours.
- It reads colours in **3 variables** called **hue, value (brilliance) and chroma.**
- **Hue** – the dominant spectral colour or its equivalent, i.e. yellow, red, yellowish-red, etc.
- **Value** – the apparent lightness as compared with absolute white, and it is a function of the intensity of light.
- **Chroma** – the purity of hue, the saturation, or apparent degree of departure from grey or white.

- The colour of a given soil is determined by comparing the sample with the standard set of colour chips on the Munsell Soil Colour Charts.
- The 3 properties of the soil colour is given in the order: hue , value and chroma,
- **Example**: 10YR 6/4, 10YR is the hue, 6 is the value and 4 is the chroma.

- **Texture** – the relative size of the soil particles, the relative proportion of sand, silt and clay. It is described in the field by the 'Feel' method, rubbing the moist soil between the fingers and thumb.
- **Soil Textural Class Names** include: **Sand, Loamy sand, Sandy loam, Loam, Silty loam, Silt, Sandy clay loam, Clay loam, Silty clay loam, Sandy clay, Silty clay** and **Clay.**

- **Structure** – refers to the aggregates or fragments, into which the soil mass will crack and break under conditions of the natural drying out of an exposed face.
- **Structure** is classified on the basis of **shape, size** and **grade of distinctness of peds.**
- **4** primary types of structure: **PLATY** – with particles arranged around a plane, generally horizontal.

- **PRISMLIKE (PRISMATIC**) – with particles arranged around a vertical line and bounded by relatively flat vertical surfaces.
- **BLOCKLIKE or POLYHEDRAL (BLOCKY)** – with particles arranged around a point and bounded by flat or rounded surfaces which are casts of the moulds formed by the faces of surrounding peds.
- **SPHEROIDAL or POLYHEDRAL** – with particles arranged around a point and bounded by curved or very regular surfaces that are not accommodated to the adjoining aggregates.

- **Subtypes of prismlike**: **Prismatic** – without rounded upper ends, and **Columnar** – with rounded caps.
- **Subtypes of blocklike**: **Angular blocky** – bounded by planes intersecting at relatively very sharp angles, and **Subangular blocky** – with mixed, rounded and plane faces with vertices mostly rounded.
- **Subtypes of spheroidal**: **Granular** – relatively non-porous, and **Crumbs** – porous.

- **Structure also has 5 classes**:
- Very fine or very thin
- Fine or thin
- Medium
- Coarse or thick
- Very coarse or very thick
- i.e. coarse subangular blocky sandy clay loam

- **Consistence** – handling properties, the stability, refers to the type and degree of cohesion and adhension between soil particles, i.e. the resistance of the soil to deformation and rupture.
- Usually determined by pressing the soil between the first two fingers and the thumb, and feeling as well as observing the changes that take place at three specific moisture contents viz: dry, moist and wet.

- Terms used to describe consistence include: **Compact, Firm, Soft, Friable, Hard, Sticky, Loose, Plastic.**
- **INCLUSIONS –** Stones and Gravels (quartz gravel, concretions and nodules) . These are soil inclusions greater than 2mm diameter.
- Inclusions are classified under: **Chemical nature** i.e. quartzite gravels, **Shape** i.e. angular, subangular, rounded, shady, tubular, **Size** i.e. boulders >20cm, large stones 10-20cm, medium-sized stones 5-10cm, small stones 2.5-5cm, very small stones 1.25-2.5cm, coarse gravel 0.62-1.25cm, gravel 0.31-0.62cm **and Quantity** i.e. abundant, many, common, few and very few.

- **BOUNDARIES** – A change in colour is the principal and most easily observed property that is used to delimit horizon boundaries, other properties such as structure, texture and inclusions are used.
- Vertical change from one horizon to the other varies in distinctiveness and outline as follows:

- **Abrupt** – change takes place within 2cm
- **Sharp** – change takes place within 2-5cm
- **Clear** – change takes place within 5-10cm
- **Gradual** – change takes place within 10-20cm
- **Diffuse** – change takes place within 20cm
- **Outline of the Boundaries**
- **Smooth** – almost straight
- **Wavy** – gently undulating
- **Lobate** – with regular lobes
- **Irregular** – strongly undulating
- **Tongue** – forming tongues into the underlying horizons

- **<u>SITE CHARACTERIZATION</u>**
- **Information on the Site**
- (a) Profile number
- (b) Soil name (series name)
- (c) Higher category classification
- (d) Date of examination
- (e) Author(s) of description
- (f) Location
- (g) Elevation (in metres)

(h) Landform:

(i) Physiographic position of the site

(ii) Landform of surrounding country

(iii) Microtopography (if any)

(i) Slope on which profile is sited

(j) Vegetation or landuse

(k) Climate

- **General Information on the Soil**
- (a) Parent material
- (b) Drainage
- (c) Moisture conditions in the soil
- (d) Depth of groundwater table (metres)
- (e) Presence of surface stones, rock outcrops
- (f) Evidence of erosion
- (g) Presence of salt or alkali
- (h) Human influence

- **USDA DIAGNOSTIC HORIZONS**
- **Argillic B Horizon**: an illuvial horizon containing more clay than the horizon above, with the increase in clay occurring within a vertical distance of 30cm or less.
- **Cambic B Horizon**: an altered horizon, with higher clay content than the underlying horizon, or stronger chroma or redder hue than the underlying horizon.

- **Oxic B Horizon**: has an apparent CEC of fine earth fraction of 16 cmol or less per kg clay by NH4OAc.
- **Albic E Horizon**: clay and free iron oxides have been removed (bleached horizon)
- **Ochric A Horizon**: too light in colour, has too high a chroma and too little OM
- **Mollic A Horizon**: has a base saturation of 50% or more, with OM content at least 1% throughout the thickness of mixed soil.

- **Histic H Horizon**: an H horizon that is >20cm but <40cm thick, with 75% or more by volume of organic materials, i.e. Histosols
- **Umbric A Horizon**: similar to mollic A horizon, but with a base saturation of less than 50% by the NH4OAc method.
- **Natric B Horizon**: saturated with exchangeable sodium of more than 15% within the upper 40cm of the horizon, i.e. Aridisols
- **Spodic B Horizon**: more than 2.5cm thick and is continuously cemented by a combination of OM with Fe or Al or both, i.e. Spodosols

- **Calcic Horizon**: a horizon of accumulation of Ca2CO3, which may be in C, B or A horizon.
- **Gypsic Horizon**: a horizon of secondary calcium sulphate enrichment more than 15cm thick, and has at least 5% more gypsum than the underlying C horizon.
- **Sulphuric Horizon**: forms as a result of artificial drainage and oxidation of mineral or organic materials which are rich in sulphides, and characterised by a pH < 3.5 (H2O 1:1), and mottles with a hue of 2.5Y or more and a chroma of 6 or more.

- Some of the diagnostic horizons may form on the surface – Diagnostic Surface Horizons, these are:
- **Anthropic epipedon, (human influence**)
- **Histic epipedon, (tissue – plant)**
- **Mollic epipedon, (soft)**
- **Ochric epipedon, (pale)**
- **Melanic epipedon, (black)**
- **Plaggen epipedon, (sod)**
- **Umbric epipedon, (dark)**