SOIL SURVEY AND CLASSIFICATION

INTRODUCTION

Soil survey or soil mapping is the process of classifying soil types and other soil properties in a given area and geo-encoding such information .It is the study of the natural environment with special reference to the soil resources, providing information on the spatial distribution of major soil types, their properties, potentials and responses to management. Soil map is a major product of soil survey. It is mostly used in developmental planning compared with other natural resource surveys. It applies the principles of soil science, and draws heavily from geomorphology, theories of soil formation, physical geography, and analysis of vegetation and land use patterns .Primary data for soil survey are acquired by field sampling and by remote sensing .

PURPOSE AND USES OF SOIL SURVEY

It is used by farmers and researchers to help determine whether a particular soil type is suited for crops and what type of crops, or livestock and what type of management might be required.

The fundamental purpose is to make predictions i.e. to determine the important characteristics of soils, to classify soils into defined types and other classification units)**(SOIL CLASSIFICATION),** to establish and to plot on maps the boundaries among the different types of soils , to correlate and to predict the adaptability of soils to various crops**(LAND CAPABILITY CLASSIFICATION)**, and to aid farm planning in relocating field boundaries in order to make fields more nearly uniform . The following are principal elements in the farm plan that depend wholly or partly upon a proper interpretation of the soil maps : (a) major land use, (b) cropping patterns, (c) tillage methods, (d) protection, (e) water control, use and disposal on the land, (f) use and accumulation of organic matter, (g) reaction control under irrigation**(SOIL SUITABILITY CLASSIFICATION),** and (h) fertilizer application .

Non-agricultural uses include , road engineering , foundation engineering for buildings, site layout of buildings, waste disposal, general aspects of regional planning and location of urban expansion .Other uses are for : Rural land classification , Classification of social units of land (cropping, grazing, forestry, recreation, mining, urban, public service i.e. highways, railroads, etc.), land appraisal,-tax assessment, appraisal for loans, settlement of new land, guidance to prospective farm buyers, land-use planning-for irrigation, drainage, land acquisition, dams, run-off, rural zoning, assessing potentialities for special crops, forest management and international coordination .

SOIL CLASSIFICATION

Soil classification is the systematic categorization of soils based on distinguishing characteristics as well as criteria that dictate choices in use .In soil science, a natural system approach to classification groups soils by their intrinsic properties (soil morphology), behaviour, or genesis resulting in classes that can be interpreted for many diverse uses. As yet there is no worldwide, unified classification scheme for soil . There are many systems in common use based on certain principles viz: artificial or technical systems are based on the use of selected properties in differentiating classes; but the natural systems are based on all the properties of the soils. Morphological systems are based on the properties of the soil profiles, irrespective of origin, while genetic systems are based on the origin of the soils. There are several systems presently in use based on natural system approach. Some of them are, the French Soil Reference System based on presumed soil genesis, the Russian System strongly influenced by the zonality principle and climate, the USDA Soil Taxonomy which organized soils according to various soil formation factors, while emphasizing characteristics that can be precisely measured including diagnostic horizons, and the World Soil Classification developed by the FAO and was first published in form of the UNESCO Soil Map of the World (1974). Presently, the FAO and the USDA classifications are the most popular and most widely accepted for use in soil survey works all over the world.

In 1998, the FAO Classification was replaced by the World Reference Base for Soil Resources. The FAO soil map was a very simple classification system with units very broad, and most soils could be accommodated on the basis of their field descriptions .There were 106 Soil Units mapped as Soil Associations which form 26 World Classes. These are, Acrisols, Andosols, Arenosols, Cambisols, Chernozems, Ferralsols, Fluvisols, Gleysols, Greyzems, Gypisols, Histosols, Kastanozems, Lithosols, Luvisols, Nitosols, Phaaeozems, Planosols, Podzols, Podzoluvisols, Rankers, Regosols, Rendzinas, Solonchaks, Solonetz, Vertisols and Yermosols.

The USDA Soil Taxonomy was developed by the United States Department of Agriculture and the National Cooperative Soil Survey. It provides an elaborate classification of soil types according to their parameters using their properties and in several levels: *Order, Suborder, Great Group, Subgroup, Familyand Series.*

There are **12 Orders**that are differentiated by the presence or absence of diagnostic horizons of features that show the dominant set of soil forming processes that have taken place. Each Order groups together soils that differ little in the kinds and relative strengths of processes tending to develop horizons. The twelve Orders are*, Alfisols* – These are moderately weathered soils, with argillic horizon (clay accumulation) at depth with high CEC,formed under broadleaf forests, rich in iron and aluminum,**they are soils with clay B horizons and high base status***, Andisols***– from volcanic ash** and defined as containing high proportions of glass and amorphous colloidal materials, *Aridisols* – (from the Latin aridus for "dry**") formed in an arid or semiarid climate***, Entisols***– young soils** with little or no profile development, *Gelisols***– soils of very cold climate and containing gel-like permafrost** within two metres of the soil surface, *Histosols* – **consist primarily of organic materials, peat soils***, Inceptisols* – soils with altered horizons and have lost material by leaching, *Mollisols* – have a thick dark superficial horizon (epipedon) **rich in calcium saturated organic matter, mull humus** and are associated with temperate grasslands, *Oxisols* – characterized by very low CEC values, low base saturation and **extreme mineralweatheringsesquioxide-rich(oxic horizon)** typical of tropical rainforest, *Spodosols –* typical soils of coniferous forests,**soils with iron and humus B horizon**, free sesquioxides and organic matter move from the upper part of the horizon (elluvial zone) and accumulate at lower levels (illuvial zones*), Ultisols* –**sesquioxide-rich highly weathered soils** commonly known as red clay soils, and characterized by clay accumulation at depth (argillic horizon) with low CEC, and *Vertisols* – clayey soils that have deep wide cracks at some periods of the year, and are dominated by smectite clays, and include most black cracking and expanding tropical clay**, shrinking and swelling clay soils**.

Suborders – differentiated primarily by chemical or physical properties that reflect either the presence or absence of waterlogging or genetic differences due to climate and vegetation.

The **Great Soil Group** – defined by the presence or absence of specific diagnostic horizons and their sequence in the profile.

Subgroups – identified as a function of soil groups which rank as "central concepts", with the subgroups being intergrades either to other subgroups (typic, oxic, etc.).

Family – criteria at family level are soil properties, observable on the lower part of the profile, that are important to the growth of plants: such as texture, mineralogy, pH, consistence, permeability, etc.

Series – this is the lowest conceptual soil category, grouping soils with identical profiles.

TYPES OF SOIL SURVEY AND SCALES OF SOIL MAPS

Exploratory Surveys : These are rapid road traverses made to provide information about unknown regions. Scales vary from 1: 2,000,000 to 5,000,000 .

Compilations : These are soil maps based on abstraction from other surveys . Scales are usually 1,000,000 or smaller. The National Soil Map of Nigeria belongs to this category .

Reconnaissance Surveys (Low Intensity Detailed Surveys): The established scale is 1: 250,000 , but maps of 1: 500,000 to 1: 120,000 are included . They are usually integrated surveys making much use of aerial photograph interpretations . Mapping unit is mainly landform classes .

Semi-Detailed Surveys (Medium Intensity Detailed Surveys) : The range is 1:100,000 to 1: 25,000 , typically 1: 50,000 . Aerial photo interpretation is combined with substantial amount of field study . Mapping units vary from soil-landform classes to soil associations and series .

Detailed Surveys (High Intensity Detailed Surveys) : Scale range is 1:25,000 to 1: 10,000 inclusive and are produced mainly by field studies . Mapping units are soil series and phases of series .

Intensive Surveys : Scales are larger than 1:10,000 , usually 1:2,500 to 10,000 , typically 1: 5,000 . Grid or regular traverse methods of field survey are used . Mapping units are soil series and phases .

METHODS OF SOIL SURVEY : There are three main stages , pre-field preparations , field surveys and post-field operations .

Pre-field Preparations : These include , collation and study of existing data of the area i.e. maps, reports, topo-sheets and analytical data , general field reconnaissance , aerial photo assemblage and interpretation, and design and planning of field survey .

Field Survey : Activities include , **soil mapping operation and land evaluation operation** . The **soil mapping operation** involves identification and classification of the soil types present in the area, and surveying their distribution ,leading to the production of a soil map . The **land evaluation operation** includes field activities for assessing the potentials of the various soils for a range of alternative types of land use, and the identification of possible development hazards (Young, 1973a) .

There are two methods of field survey ,viz**: FREE SURVEY** and **GRID SURVEY** . In the **Free Survey ,**the surveyor uses his judgment of the objectives of the survey and all the available aerial photos and ground evidence to locate profile pits of the most useful and representative sites . The number of the profile pits depends on the requirements of the survey and the complexity of the soil pattern . The free survey is only feasible in "open" areas, in grass or arable regions. The surveyor uses a lot of observable field marks and taking auger borings in relation to every change of vegetation or edaphic features. Aerial photo interpretation will be of immense help in this method. In **Grid Survey**, observations are made at regular intervals along pre-determined traverses in the survey area. This method is especially useful for large scale high intensity detailed surveys and intensive surveys. However, there is no alternative to grid survey for areas under forest or broken topography where accessibility is difficult and areas where adequate aerial photos or topo sheets are not available. It is generally employed in dense forests and swamps where photo interpretation is often of limited usefulness and there is no way of finding one's position except by measurement. A 'rigid grid' pattern of cut traverses is essential with a central baseline, between regularly spaced straight traverses.

The grid survey is very tedious, expensive, and time consuming because it takes a lot of time cutting traverses through the forest, chiseling or augering at regular intervals . Advantages of grid system include; (a) traverses provide access between roads in the dense forests, (b) sampling points along the traverses can be located and mapped with accuracy, (c) the direction of the traverses can be arranged to cross the topographical 'grain' of the country, (d) the greater part of the field survey can be carried out by soil survey assistants with minimum supervision by the surveyor and (e) the traverse grid provides a uniform sampling point within which it is very unlikely that important soil types will be overlooked.

Field Observations: Soil profile observations include , description of the environment, general information on the soils and brief and detailed profile descriptions. Others include brief descriptions and classification of chisel holes, site descriptions –including vegetation / landuse, slope measurement, drainage and geology . Also, detailed descriptions of modal soil profiles and sampling for laboratory analysis must be carried out. Soil mapping operations involve , identification and classification of the soil types , their distribution and production of a soil map .

Post Field Operations: Aerial photo interpretation is revised in the light of field observations. The soil samples collected are analysed .The data are analysed . The survey report is written .The unit of mapping is usually the soil series .