# SOIL SURVEY AND LAND EVALUATION (SES-306), 3(2-1)

It is the crucial component of the earth. From ozone depletion, acid rains, global warming and Water pollution all processes are carried out on soil.

"Collection of natural bodies occupying on the earth surface that support plant growth and has properties due to integrated effect of climate and living organisms acting upon parent material as condition by relief over periods of time".

**RELIEF**

Difference in altitude between uplands and low lands of a rural community

**PARENT MATERIAL**

Unconsolidated chemically weathered inorganic and organic matter from which soil is developed.

**SOIL SURVEY**

It deals with systematic examination of soils in the field and laboratory, their description, classification, mapping and interpretation according to their suitability for different management systems. In detailed scientific inventories of the entire major physicochemical properties of soils. The soil characteristics studied in making a soil survey include:

- ✓ Size and arrangement of soil particles
- ✓ Kind and amount of minerals
- ✓ Organic matter
- ✓ Chemical reactions
- ✓ Slope
- ✓ Periodic or permanent wetness
- ✓ Kind and arrangement of horizons (soil layers)

**MAP**

A map is a representation of the earth, or part of it with respect to certain date.

- ❖ Type of map like:
- ✓ Topographic,
- ✓ Geological,
- ✓ Thematic etc

Type of map is shown on the top left while the sheet number and edition on the top right of the map.

**SOIL MAPPING**

It is a process of classifying soil types and other soil properties in a given area and geo-encoding.

**GEOCODING**

It is the process of assigning geographic identifiers (e.g. codes or geographic coordinates expressed as latitude-longitude) to map features. A soil map generally shows the distribution of soil types or other soil mapping units in relation to other prominent physical and cultural features of the earth's surface.

**MAPPING UNIT**

A map unit of an area-class map is a set of delineations (marking out). In which, all supposed to have the 'same' properties except for their geographic position. We need to be able to name map units consistently, in a way that users will understand. It is some what different from soil classification units used in soil taxonomy.

**HOMOGENEOUS MAP UNITS**

The map unit has the 'same' characteristics, and classify to the same named soil(s), at the level of the classification used in the map unit name.

**COMPOUND MAP UNITS**

In compound map units, there are significant areas of more than one contrasting class of soil, so that different locations in the map unit may classify as different soils, at the level of classification used in the map unit name.

The kind of map unit is made up of two or more *'homogeneous' constituents,* where 'homogeneous' is defined as the previous.

**SOIL SERIES**

A group of soils having similar soil horizons in characteristics and arrangement in the soil profile for the texture of the soil, and type of parent material

**PURPOSES OF SOIL SURVEY**

Provide you with independent and comprehensive data enabling you to make the best and least damaging use of land resources.

Soil survey of Pakistan will be delighted to help you in the following fields

- ✓ **Describe the characteristics of the soils in a given area**

Notice that the first point is that the soils themselves are the objectives of study and that their characteristics must be investigated.

- ✓ **Classify the soils according to a standard system of classification**

The purpose of this step is to correlate the soils in the given area to soils elsewhere, as well as to standardize the mapping within a single survey area. The standard system of classification may be an international, national, or local system.

- ✓ **Plot the boundaries of the soil on a map**

For almost all applications, the different kind of soils must be separated on a map, i.e., it is the geographical location of each soil that is interesting for the land user. Thus for each location on the map, its soil type is indicated (because it is enclosed in a polygon).

- ✓ **Make predictions about the behavior of soils**

Soil survey is fundamentally a utilitarian activity. This step can be defined narrowly, using only soils data, in which ease it is called soil survey interpretation, or it can be included in a broader activity of land evaluation, which uses other kind of land characteristics (climate, land use).

**IDENTIFICATION OF SOIL BOUNDARIES**

After establishing the mapping units and identified these units on the ground. Boundaries are drawn among them on accurate base maps or aerial photographs. Different kinds of soil must be separated on a map i.e., it is geographical location of each soil that is interesting for the land user. Thus for each location on the map, its soil type is indicated. Mostly soil boundaries can be located on the land surface by recognizing where changes in one or more of the genetic factors occurs

**Types of Boundaries**

Boundaries between polygons on an area-class map are of several types.

**ABRUPT vs. GRADUAL**

**Abrupt:** a more-or-less clear line in the landscape (and almost on the air-photo)

**Gradual:** a transitional zone. If wide enough then it could be mapped separately.

**NATURAL vs. ARTIFICIAL**

**Natural:** from a combination of soil-forming factors, recognized in the landscape. We draw the lines where we recognize significant changes in one or more soil forming factors.

**Example:** at a scarp between two terraces with similar parent materials but significantly different ages.

**Artificial:** from an externally-imposed criterion, e.g. classification system. For example, we may try to separate two soil series that differ only in their family particle size class, fine silty vs. fine loamy.

**HOW SOILS ARE MAPPED – THE SOIL SERIES CONCEPT?**

The soils vary in their characteristics so frequently that no two soil profiles in the world, however closely located these may be, are exactly the same.

**How then the soils can be mapped?**

The soils occurring in specific landscapes do have genetic relationships and may resemble in certain characteristics. When grouped on the basis of such characteristics, we may find the same kinds of soils extending over sizeable areas, which can be delineated, and shown on a map.

Such characteristics that are fairly stable over long periods of time are selected for grouping and classifications of soil for mapping purposes. The basic unit of soil classification used for mapping is called as the **Soil Series**

The characteristics selected for soil grouping into different soil series are those which remain virtually unchanged for a reasonable period, say about 50 years, are not significantly affected by normal manipulation of soils by man (minor leveling, irrigation, cultivation, fertilization, removal of surface stones, etc) and are strongly related with regard to the soil genetic processes.

**These characteristics are:**

a) Kind, thickness and arrangement of horizons; and

b) For each horizon

- ✓ Structure,
- ✓ Texture, (except of the topsoil),
- ✓ Colour
- ✓ Reaction
- ✓ Consistence
- ✓ Content of carbonates and other salts

- ✓ Content of humus (organic matter) and
- ✓ Mineralogical composition

For classification into a soil series, the soils should be similar, morphologically, physically and chemically, with respect to all these characteristics at least in their control sections

## WHAT IS A TOPOGRAPHIC MAP

A map is a way of representing on a two-dimensional surface, (a paper, a computer monitor, etc) any real-world location or object. Many maps only deal with the two dimensional location of an object without taking into account its elevation. Topographic maps on the other hand do deal with the third dimension by using contour lines to show elevation change on the surface of the earth.

Contours are the imaginary lines that points of equal elevation on the surface of the land above or below a reference surface, such as mean sea level. Contours make it possible to measure the height of mountains, depth of the ocean bottom, and steepness of slopes.

### Using a Topographic Map

- ✓ Every point on a contour line has the exact elevation. As a result of this every contour line must eventually close on itself to form an irregular circle.
- ✓ Contours lines can never cross one another. Each line represents a separate elevation, and you can't have two different elevations at the same point.
- ✓ Moving from one contour line to another always indicates a change in elevation. To determine if it is a positive (uphill) or negative (downhill) change you must look at the index contours on either side.
- ✓ On a hill with a steady slope, there are always four middle contours for every index contour. If there are more than four index contours it means that there has been a change of slope and one or more contour line has been duplicated. This is most common when going over the top of a hill or across a valley.
- ✓ The closer contour lines are to one another, the steeper the slope is in the real world.
- ✓ A series of closed contours (the contours make a circle) represents a hill.
- ✓ Contours lines crossing a stream valley will form a "V" shape [pointing in the uphill (and upstream) direction.

### Calculating a Slope

Determining the average slope of a hill using a topographic map is fairly simple. Slope can be given in two different ways, a percent gradient and an angle of the slope. The initial steps to calculating slope either way are the same.

- ✓ Decide on an area for which you want to calculate the slope (note, it should be an area where the slope direction does not change; do not cross the top of a hill or bottom of a valley).
- ✓ Once you have decided on an area of interest, draw a straight line perpendicular to the contours on the slope. For the most accuracy, start and end your line on, rather than between, contours on the map.
- ✓ Measure the length of the line you drew and, using the scale of the map, convert that distance to feet.
- ✓ Determine the total elevation change along the line you drew (subtract the elevation of the lowest contour used from the elevation of the highest contour used). You do not need to do any conversions on this measurement, as it is a real-world elevation change.

To calculate a percent slope, simply divide the elevation change in feet by the distance of the line you drew (after converting it to feet). Multiply the resulting number by 100 to get a percentage value equal to the percent slope of the hill. If the value you calculate is,

## ESTIMATING ACREAGE

Area can be expressed in square miles, acres, blocks, square feet, or any other square unit of linear measurement. This section discusses different methods for estimating acreage (area formula, dot grid, comparison, and GPS receiver).

**Area Formula:** The most common method for calculating area is using formula:

Length x width = area

Multiply the length by the width to get the area

$$\text{Area} = \frac{32 + 16}{2} \times 48 = 1152$$

### Expressing Map Scale

There are two methods of expressing the scale of map:

**a. Representative Fraction**

Map scale expresses the size relationship between the feature shown on a map and the same features on the earth's surface. Scale is generally expressed as ration or fraction such as 1: 100000 or 1/100000 and in this form is known as the representative fraction or the RF of a map. The numerator of the Representative Fraction (which is always quoted as 1) represents the map distance, and the denominator represents the ground distance. An RF of 1:100000 therefore means that the map distance will be 1/100000 of that actual ground distance or that a distance of 1 centimeter on the map will be 100000 centimeters, or alternatively, 1000 meters or 1 kilometer on the ground.

**b. Scale Bar or Linear Scale**

A method of measuring ground distances from a map is to use the scale bar or linear scale that is usually provided on most maps illustrated.

**MEASURING DISTANCE ON A MAP**

There are many ways of measuring distance on a map using dividers, a length of string, a rule, etc. Two simple methods using a strip of paper are described below:

**Measuring straight distance**

To measure the distance in a straight line between two points on a map, lay the straight edge of a piece of paper against the two points and mark the distance on the paper. Next, lay the paper along the linear scale with the right hand mark against on the primary divisions and the left hand marked against the secondary divisions to the left. The total distance is zero, plus the distance to the left of the zero, the distance in Figure 3-2 is 600 meters

**Mapping legends:**

Each of the more-or-less homogeneous areas of the map must be given a *name* and its properties *described.*

**Mapping legend:**

The set of map unit names is the *mapping legend.* This provides names by which we can refer to areas on the map, e.g. the polygon represents an association of EC < 1.50 dS $m^{-1}$ and EC > 1.50 dS $m^{-1}$.

**Descriptive legend:**

A set of descriptions of their properties is the *descriptive legend.* This is the link between the map and the statements that we can make about the map units. e.g. In this polygon the EC is always greater than 1.5 d $Sm^{-1}$.

**Interpretative legend:**

In this case a statement about the map unit for a specific purpose. i.e. a result of land evaluation. e.g. This area is not suitable for raising rice due to high EC.