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Mapping and Soil Mapping

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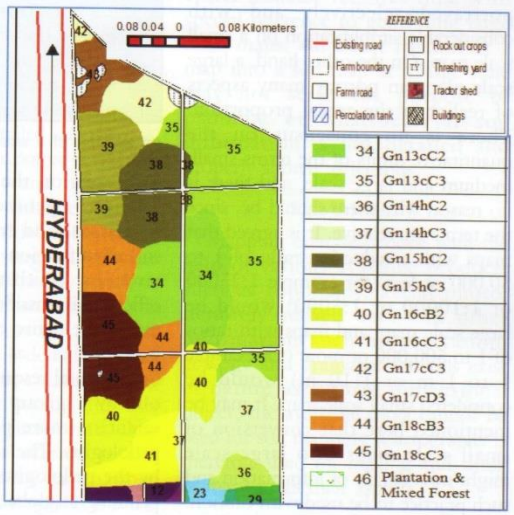
SOIL science and pedology in terms of soil genesis, mineral transformation and soil taxonomy is often linked with mapping. Mapping refers to developing different polygons in the form of features of natural or artificial objects as observed on the surface. Various available products such as topo maps, aerial photo, remotely sensed data and other collateral information on vegetation, geology and drainage help in mapping exercise. In the parlance of geographical features, remote sensing data with very high resolution are recommended to be used for this purpose. Since most of these tools depict only the surficial features, these tools make it easy in drawing the boundaries of different feature classes. Interestingly, soils exist in nature as a three dimensional object, and are spread below the surface which cannot be seen with the above-mentioned tools used for mapping the surface features.

Written and verbal languages allow us to develop ideas and express them in a variety of ways, ranging from tightly-structured scholarly treaties to literary creations and dramatics. Our desire for spatial imagery of objects in the surroundings is as normal as breathing. When we communicate with someone by describing a special relationship, we accept our description to evoke a similar image in that persons mind. The best way to be sure that it will happen is to provide a visual representation of the geographical setting which is called a map. Cartography is the making and study of maps in all their aspects. Cartography is concerned with reducing the spatial characteristics of a large area, a portion or all of the earth, or another celestial body – and putting it in a map form to make it observable. The same techniques can be used to enlarge microscopic objects to make them visible. Although it is uncommon to refer to these enlarging activities as cartography, the resulting images are sometimes called map. Even then, ordinary map is much more than a mere reduction. It is a carefully-designed tool for recording, calculating, displaying, analyzing, and understanding the interaction of objects. Nevertheless, its most fundamental function is to bring things into an observable form of map.

When a small sheet is used to show a large area (for example the map of India or the whole world on an A4 size paper) that map is considered to be a small scale map; on the contrary, if a map on A4 size paper shows only a small part of the actual ground surface (for example,<

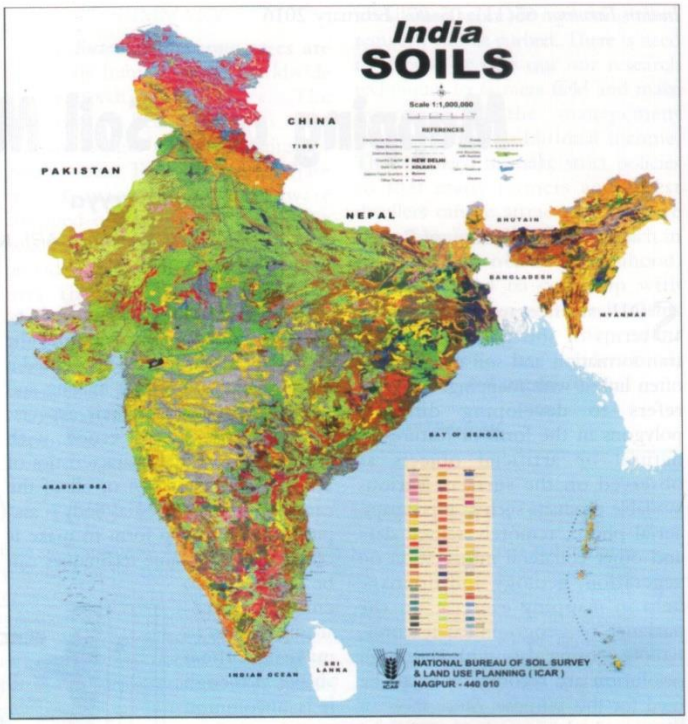


An example of a large scale map of Gunegal Farm (part), Hyderabad (*Source: Chandran et al.* [4]) (Note the details of one soil unit, Gn13cC2: Gunegal 13 [loamy-skeletal, mixed, isohyperthermic, Typic Haplustalfs): shallow, Sandy loam (c), gently sloping (3-5 %) (C), moderate soils erosion (2)]. *Surface phase of a (sandy), St1 [slightly stony (3-5%], St2 [strongly stony (35-40%] mentioned as and when found in soils.*

Maps range from tiny portals on postage stamps to enormous mural like wall maps used by civilian and military security groups to keep track of events and forces. They all have one thing in common which is to add to the geographical understanding of the viewer. A detailed map of a small region, depicting its landforms, drainage, vegetation, settlement patterns, roads, geology or a host of other detailed distribution, including soils, communicates the relationships necessary to plan and carry on many types of work.

1 sq. km or 100 hector or say a small farm) it is described as a large scale map. The terms large and small maps, when combined with scale, refer to the relative sizes at which objects represent, not to the amount of reduction and zooming involved. We can also think of map scale as the ratio between map and the ground distance. Thus, 1 cm on a map to 100 cm on the ground is a large ratio whereas 1 cm on a map to 1 km on the ground is a small ratio. Accordingly, when little reduction is involved and features such as roads are large, the map is termed as a large scale map. When great reduction has been employed, as for a small scale map, most of the smaller features on the earth cannot be shown at a size proportional to the amount of reduction, but must be greatly magnified and symbolized to be seen at all. Consequently, reality must be portrayed selectively and with considerable simplification on a small scale map. On the other hand, a large scale map can portray many aspects of reality in the actual proportion. There is no consensus on the quantitative limits of the terms small, medium and large scale, and there is no reason why there should be, since the terms are relative. It is agreed that maps with a reduction ratio of 1 to 50,000 or less (for example 1:25000 or 1:10000 or 1:5000) would be large scale map, and maps with ratios of 1 to 500,000 or more (for example 1 to 1 m or 1:10 m) would be considered small scale map. It may be mentioned here that conversion of small scale maps into large scale might miss details of information and such practice to be used with caution.

Mapping involves determining the geographic locations of features on the earth, transforming these locations in the position on a flat map through use of a map projection, and graphically symbolizing these features. Soil survey is a process for describing soil characteristics of an area, involving classification of soil, plotting the boundaries on a map and also interpreting soils for its applications in agriculture or other activities. The basic reason why soil survey is important because resource inventory with special reference to

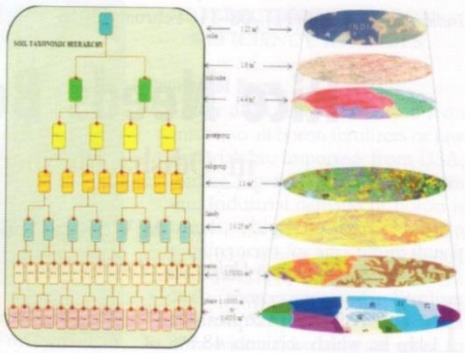


An example of a small scale map showing 1649 mapping units at the soil subgroup level

soil resets on the principles of soil science, geomorphology, soil formation, and mechanism to help soil classification following US soil taxonomy which was accepted as an official soil classification system. This makes the entire exercise of resource inventories as a basic and fundamental research which is carried out by a group of dedicated soil scientists more precisely known as pedologists. The soil maps generated by the pedologists are used for crop planning at global, national, regional, and farm levels. The soils and their characteristics in a soil map can be seen only when a soil profile is opened, examined, sampled, analysed, interpreted to classify and to record the details of soils. Detailed morphological information and site characteristics from the first-hand information on soils from a routine mapping exercise is carried out studying the characteristics of the surface features, say for a landscape. On this count, a geologist may have an advantage of mapping rock outcrops, hills, and mountains visible on the surface without digging the earth. Pedologists may not enjoy such comfort since soils need to be studied in field to examine the soil profile down the depth below surface. A soil is then classified according to its morphological, physical, chemical, and mineralogical properties. The objective of soil taxonomy is to have a hierarchy of clans that permit us to understand the relationship between soils and also between soils and the soil forming factors whereas US taxonomy groups soils according to different hierarchies; thus soil taxonomy makes a close relation with the scale of soil map depending on the level of information required.

The primary objective of converting a map into a soil map is to put soil information in it and at the same time revising the boundaries of the base map (prepared by a mapper with the knowledge of remote sensing and cartography or both). The scale of mapping has a close relation with the category of soil information shown in US soil taxonomy as already mentioned. The

concept of soil taxonomy centers on the basic theme of differentiating one soil from the other and the factors affecting its formation. It has been conceived as means of communication on soils to other branches of science, in general and soil science (pedology), in particular. Soil taxonomy has been described as a classification system which is mainly concerned with the relationships among soils. Soils are classified into six category levels from broadest to the narrowest, viz. orders, suborders, great groups, subgroups, family and series in soil taxonomy. The lowest category is the series which is based on the kind and arrangement of horizons and finer differences in soil properties. The soil series are again divided into phases on the basis of surface stoniness, slope, erosion and/or other attributes that are not diagnostic in soil taxonomy but are important for land use. It seems, therefore, that soil taxonomy of the United States Department of Agriculture (USDA) is an elaborate, universally acceptable, hierarchical system of soil classification showing well-defined differentiating criteria based on measurable soil and associated land characteristics. Most of the higher categories in soil taxonomy depend on various properties that are produced by distinct soil forming processes. The essence of the system lies in the fact that the nomenclature of different taxa can itself provide information on soil forming processes. The other important aspect of the US taxonomy is that it is an open-ended system and thus can accommodate any new concepts developed over time through concerted global research efforts. The type of soil information is thus embedded in the basic concept of US taxonomy as evidenced by clear definition of order, sub-order, great group, sub-group, family, series and phase. Each of these categories is mutually inclusive down the line as we reach the base of the pyramid to a large scale soil map showing soil phase information. This statement requires retrospection in terms of detailing soil information system and incorporating it in the large scale soil map. In other words, a large scale soil map (say 1:10000 or 1:5000 scale) requiring phase level soil information should not end up with a mere mention of only one soil information showing surface and sub-surface phase; the entire pedigree of soil information with that phase must be explained in the detailed soil map.



A pyramid-like relation between soil taxonomy detailing soil parameters and the scale of soil map [[6]USDA(2006); [7] IARI(1951); [8] Sehgal *et al.* (1996);[5] Staff, NBSS (2002);[9] Madhya Pradesh Soils,1998; [10] Anonymous (2013); [4] Chandran *et al.* (2006)]

Philosophically, a potter constructs an idol using clay and other raw materials and then with the chanting of an exact *sloka*, this idol is made conceptually a living and divine creature (*PranPratishtha)* which is worshiped by all. *Prana pratistha* is the theological term for a rite or ceremony by which a deity is infused or brought to inhabit a statue or icon of that deity and it is only after this rite is properly performed that worship should be offered to the statue. Analogically, a mapper develops only a base map and it is the duty of the pedologists to put life into it with the detailed soil information and to convert it into a soil map. If it does not happen, the mapper may go scot free while the poor pedologists will be blamed. The entire exercise requires time with special reference to generating large scale maps. An effort to convert a map into a soil map at a large scale may not serve the purpose of planning or whatsoever if soil information is not detailed and properly shown as legends.

SUMMARY

Mapping exercise is done with the help of various available products such as topomaps, aerial photo, remotely sensed data and other information such as vegetation, geology and drainage. As soils exist in nature as a three dimensional object, the available tools cannot be used for soil mapping. Cartography is therefore used for making and study of maps in all their aspects.

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