NATIONAL OPEN UNIVERSITY OF NIGERIA

SLM 303

Introduction to Pedology and Soil Physics

Module 2

SLM 303 (Introduction to Pedology and Soil Physics) Module 2

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Module 2 Soil-Forming Rocks and Minerals and Weathering of Rocks and Minerals

Unit 1 Soil-Forming Rocks

1.0 Introduction

Although many of us don't think about the ground beneath us or the soil that we walk on each day, the truth is, soil is a very important resource. Processes take place over thousands of years to create a small amount of soil material. Unfortunately the most valuable soil is often used for building purposes or is unprotected and erodes away. To protect this vital natural resource and to sustain the world's growing housing and food requirements it is important to learn about soil, how soil forms, and natural reactions that occur in soil to sustain healthy plant growth and purify water. Soil is important to the livelihood of plants, animals, and humans. However, soil quality and quantity can be and is adversely affected by human activity and misuse of soil.

Certain soils are best used for growing crops that humans and animals consume, and for building airports, cities, and roads. Other types of soil have limitations that prevent them from being built upon and must be left alone. Often these soils provide habitats for living creatures both in the soil and atop the soil. One example of soils that have use limitations are those that hold lakes, rivers, streams, and wetlands. Humans don't normally establish their homes in these places, but fish and waterfowl find homes here, as do the wildlife that live around these bodies of water.

Natural processes that occur on the surface of Earth as well as alterations made to earth material over long periods of time form thousands of different soil types. In the United States alone there are over 50,000 different soils! Specific factors are involved in forming soil and these factors vary worldwide, creating varied soil combinations and soil properties worldwide.

2.0 Objectives

At the end of this unit, you should be able to:

- explain the soil-forming rocks and minerals

3.0 Main Content

3.1 Soil- Forming Rocks and Minerals

The formation of soil happens over a very long period of time. It can take 1000 years or more. Soil is formed from the weathering of rocks and minerals. The surface rocks break down into smaller pieces through a process of weathering and is then mixed with moss and organic matter. Over time this creates a thin layer of soil. Plants help the development of the soil. How? The plants attract animals, and when the animals die, their bodies decay. Decaying matter makes the soil thick and rich. This continues until the soil is fully formed. The soil then supports many different plants.

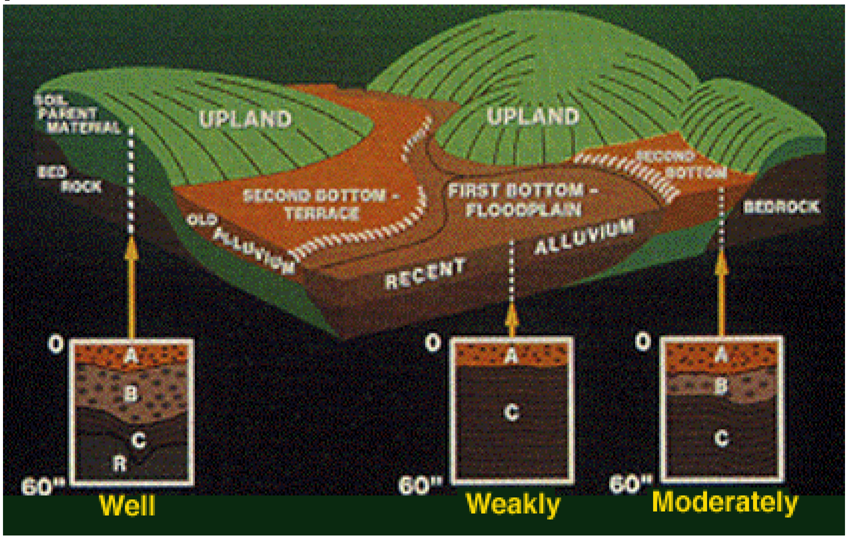
Certain soils are best used for growing crops that humans and animals consume, and for building airports, cities, and roads. Other types of soil have limitations that prevent them from being built upon and must be left alone. Often these soils provide habitats for living creatures both in the soil and atop the soil. One example of soils that have use limitations are those that hold lakes, rivers, streams, and wetlands. Humans don't normally establish their homes in these places, but fish and waterfowl find homes here, as do the wildlife that live around these bodies of water.

Natural processes that occur on the surface of Earth as well as alterations made to earth material over long periods of time form thousands of different soil types. In the United States alone there are over 50,000 different soils! Specific factors are involved in forming soil and these factors vary worldwide, creating varied soil combinations and soil properties worldwide:

The Five Soil -Forming Factors

1. **Parent material**: The primary material from which the soil is formed. Soil parent material could be bedrock, organic material, an old soil surface, or a deposit from water, wind, glaciers, volcanoes, or material moving down a slope.
2. **Climate**: Weathering forces such as heat, rain, ice, snow, wind, sunshine, and other environmental forces, break down parent material and affect how fast or slow soil formation processes go.
3. **Organisms**: All plants and animals living in or on the soil (including micro-organisms and humans!). The amount of water and nutrients, plants need affects the way soil forms. The way humans use soils affects soil formation. Also, animals living in the soil affect decomposition of waste materials and how soil materials will be moved around in the soil profile. On the soil surface remains of dead plants and animals are worked by microorganisms and eventually become organic matter that is incorporated into the soil and enriches the soil.
4. **Topography**: The location of a soil on a landscape can affect how the climatic processes impact it. Soils at the bottom of a hill will get more water than soils on the slopes, and soils on the slopes that directly face the sun will be drier than soils on slopes that do not. Also, mineral accumulations, plant nutrients, type of vegetation, vegetation growth, erosion, and water drainage are dependent on topographic relief.
5. **Time**: All of the above factors assert themselves over time, often hundreds or thousands of years. Soil profiles continually change from weakly developed to well developed over time.

Differences in soil -forming factors from one location to another influence the process of soil formation



(Image courtesy of the United States Department of Agriculture, Soil Conservation Service)

Parent Materials

Soil forms from different parent materials; one such parent material is bedrock. As rocks become exposed at Earth's surface they erode and become chemically altered. The type of soil that forms depends on the type of rocks available, the minerals in rocks, and how minerals react to temperature, pressure, and erosive forces. Temperatures inside the Earth are very hot and melt rock (lithosphere) that moves by tectonic forces below Earth's surface. Melted rock flows away from the source of heat and eventually cools and hardens. During the cooling process, minerals crystallise and new rock types are formed. These types of rocks are called igneous rocks, the original parent material rocks formed on Earth. Igneous rocks, under the right environmental conditions, can change into sedimentary and metamorphic rocks. Volcanoes produce igneous rocks such as granite, pumice, and obsidian.

Sedimentary rocks are formed when older rocks are broken apart by plant roots, ice wedges, and earth movements and become transported by glaciers, waves, currents, and wind. The transported particles then become bound together (cemented) as secondary minerals grow in the spaces between the loose particles and create a new, solid, sedimentary rock. Sandstone, limestone, and shale are types of sedimentary rocks that contain quartz sand, lime, and clay, respectively.

Metamorphic/Crystalline rocks form when pressure and temperature, below Earth's surface, are great enough to change the chemical composition of sedimentary and igneous rocks. Metamorphic rocks, such as quartzite, marble, and slate form under intense temperature and pressure but were originally quartz sandstone, limestone, and shale.

Other types of parent material that mineral soils form from are called **Recent Cover Deposits** and include alluvium, colluvium, eolian deposits, glacial deposits, lacustrine (lake) deposits, loess deposits , marine deposits, and volcanic ash deposits.

4.0 Conclusion

Soil is important to the livelihood of plants, animals, and humans. However, soil quality and quantity can be and is adversely affected by human activity and misuse of soil.

5.0 Summary

Although many of us don't think about the ground beneath us or the soil that we walk on each day, the truth is soil is a very important resource. Processes take place over thousands of years to create a small amount of soil material. Unfortunately the most valuable soil is often used for building purposes or is unprotected and erodes away. To protect this vital natural resource and to sustain the world's growing housing and food requirements it is important to learn about soil, how soil forms, and natural reactions that occur in soil to sustain healthy plant growth and purify water.

6.0 Self-Assessment Exercise

1. Discuss the characteristics of soil -forming rocks and minerals
2. Write on soil -forming factors.

7.0 References/Further Reading

Birkeland, Peter W.(1999). *Soils and Geomorphology*.(3rd ed.). New York: Oxford University Press.

Lutgens, Frederick K. *et al.(*2002). *Essentials of Geology*. 8th ed. Englewood Cliffs, NJ: Prentice Hall.

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Unit 2 Weathering of Rocks and Minerals

1.0 Introduction

As you drive or ride in a car, take a train or plane, ride a bike ride, or go for a nature walk you see the spectacular and varied landscapes on Earth's surface. As Earth's crust is built up by volcanic and tectonic forces (thrusting and deformation of Earth's crust), weathering forces simultaneously reduce landforms and release minerals from rocks. Natural weathering processes occur around us every day, continually rearranging and building landforms on Earth's surface.

2.0 Objectives

At the end of this unit, you should be able to:

- explain weathering of rocks and minerals
- describe chemical weathering processes.

3.0 Main Content

3.1 Weathering of Rocks and Minerals

Weathering is the process of the breaking down rocks. There are two different types of weathering: Physical weathering and chemical weathering. In physical weathering, it breaks down the rocks, but what it's made of stays the same. In chemical weathering, it still breaks down the rocks, but it may change what it's made of. For instance, a hard material may change to a soft material after chemical weathering.

3.2 Chemical Weathering Processes

Chemical weathering occurs as minerals in rocks are chemically altered, and subsequently decompose and decay. Increasing precipitation (rain) speeds up the chemical weathering of minerals in rocks, as seen on tombstones and monuments made of limestone and marble. In fact, **water is an essential factor of chemical weathering**. Increasing temperature also accelerates the chemical reaction that causes minerals to degrade. This is why humid, tropical climates have highly weathered landforms, soils, and buildings.

Carbonation and Solution: this weathering process occurs when precipitation (H_20) combines with carbon dioxide (CO_2) to form carbonic acid (H_2CO_3). When carbonic acid comes in contact with rocks that contain lime, soda, and potash, the minerals calcium, magnesium and potassium in these rocks chemically change into carbonates and dissolve in rain water. Karst topography, originally named after the Krs Plateau in Yugoslavia where it was first studied, is a result of this type of chemical weathering that possesses characteristic sinkholes, caves, and caverns.

- **Hydrolysis**: this chemical weathering process occurs when water (H_20), usually in the form of precipitation, disrupts the chemical composition and size of a mineral and creates less stable minerals, thus less stable rocks, that weather more readily.
- **Hydration:** water (H_20) combines with compounds in rocks, causing a chemical change in a mineral's structure, but more likely will physically alter a mineral's grain surface and edges. A good example of this is the mineral Anhydrite ($CaSO_4$). Anhydrite chemically changes to Gypsum ($CaSO_4$-$2H_20$) when water is added. Gypsum is used in the construction industry, to build buildings and houses.
- **Oxidation:** this process occurs when oxygen combines with compound elements in rocks to form oxides. When an object is chemically altered in this manner it is weakened and appears as "oxidized." A good example of this is a "rusting" sign post. The iron in the metal post is oxidizing. Increased temperatures and the presence of precipitation will accelerate the oxidation process.
- **Spheroidal Weathering:** water penetrates through cracks in rocks and dissolves the cement that binds particles together and also erodes sharp edges and corners of rocks, making a rock appear spheroidal. Physical weathering processes, such as frost wedging, can then act upon the enlargened cracks in rocks.

3.3 Physical Weathering Processes

Rocks that are broken and degrade by processes other than chemical alteration are physically or mechanically weathered. A rock broken in to smaller pieces exposes more surface area of the original rock. Increasing the exposed surface area of a rock will increase its weathering potential.

- **Animals and Plants:** Animals burrow into Earth's substrate and move rock fragments and sediment on Earth's surface, thereby aiding in the disintegration of rocks and rock fragments. Fungi and Lichens are acid-producing microorganisms that live on rocks and dissolve nutrients (phosphorus, calcium) within rocks. These microorganisms assist in the breakdown and weathering of rocks.
- **Crystallisation:** As water evaporates moisture from rocks located in arid climates mineral salts develop from mineral crystals. The crystals grow, spreading apart mineral grains in the process, and eventually break apart rocks.
- **Temperature Variation:** minerals in rocks expand and contract in climates where temperature ranges are extreme, like in glacial regions of the world, or when exposed to extreme heat, like during a forest fire. Crystal structures of minerals become stressed during contraction and expansion and the mineral crystals separate. For instance, repeated cycles of freezing and thawing (known as Freeze-Thaw) of water in rock cracks further widens cracks and splits rocks apart. Frost-wedging forces portions of rock to split apart.
- **Unloading and Exfoliation**: Cracks in rocks appear when pressure is released as overlying rocks or sediment are removed, thus allowing the expansion of the newly exposed rock. Exfoliation occurs as sheets or slabs of the cracked rock slip off and become further eroded. Domes form as the unloading and exfoliation weathering processes continue. Half Dome at Yosemite National Park, California is a result of unloading (pressure-release jointing) and exfoliation

4.0 Conclusion

A rock that is weathered into new minerals but still looks somewhat like the parent rock is called a saprolite. If the saprolite fragments are subsequently removed from the site by water, wind, gravity, or ice, erosion has taken place.

5.0 Summary

Weathering is the alteration of rocks to more stable material from their exposure to the agents of air, water, and organic fluids. No rock is stable or immune to weathering. Many pathways and agents are involved in weathering, but most can be grouped into two main processes: mechanical and chemical weathering.

Mechanical weathering includes processes that fragment and disintegrate rocks into smaller pieces without changing the rock's mineral composition. Chemical weathering is the alteration of the rock into new minerals. Both pathways constitute weathering, but one process may dominate over the other.

The two processes can be demonstrated with a piece of paper. It can be torn into smaller pieces, which is analogous to mechanical weathering. It also can be burned into carbon dioxide and water, which is analogous to chemical weathering.

6.0 Self-Assessment Exercise

1. Describe the physical weathering processes.
2. Write on chemical weathering processes.

7.0 Reference/Further Reading

Birkeland, Peter W.(1999). *Soils and Geomorphology* (3rd ed.). New York: Oxford University Press.

Lutgens, Frederick K. et al.(2002). *Essentials of Geology*, 8th ed. Englewood Cliffs, NJ: Prentice Hall.

Tarbuck, Edward J.& Frederick K. Lutgens.2002). *Earth: An Introduction to Physical Geology*. Englewood Cliffs, NJ: Prentice Hall.

Unit 3 Profile Description and Soil Survey

1.0 Introduction

A soil survey describes the characteristics of the soils in a given area, classifies the soils according to a standard system of classification, plots the boundaries of the soils on a map, and makes predictions about the behaviour of soils. The different uses of the soils and how the response of management affects them are considered. The information collected in a soil survey helps in the development of land-use plans, evaluates and predicts the effects of land use on the environment.

You might ask what a soil profile is. A profile is a side view of a person. So a soil profile must be the side view of soil. There are no fixed number of horizons a soil profile would much depend on the age and weathering processes going on in the soil. A soil could have the following horizons for example:

- **Horizon:** (1st layer). This is the top layer of soil. Animals live on this layer. It is made of fresh to partially decomposed organic matters. The colour varies from brown to black.
- **A Horizon:** (2nd layer). The top part of this soil is made of highly decomposed organic matter mixed up. The colour range from brown to gray.
- **E Horizon:** (3rd layer). This layer is made up of mostly sand and silt down migration of particles it has lost most of its minerals and clay due to eluviation.
- **B Horizon: (4th** layer). Unlike the other horizons, this one has more clay and bigger bedrock. It is reddish brown or tan in colour.
- **C Horizon:** (5th layer). This layer has mostly weathered bedrock. It is the cracked and broken surface of the bedrock.
- **R Horizon:** (Last Layer). This is the last layer in the profile. It is made of unweathered rocks

2.0 Objectives

At the end of this unit, you should be able to:

- describe the sequential development of a soil from the various horizons
- list profile differences in various soil types
- relate differences in soil profile development to differences (possible) in land use.

3.0 Main Content

3.1 Profile Description

Soil Profile refers to the layers of soil; horizon A, B, and C. Horizon A refers to the upper layer of soil, nearest the surface. It is commonly known as topsoil. In the woods or other areas that have not been plowed or tilled, this layer would probably include organic litter, such as fallen leaves and twigs. The litter helps prevent erosion, holds moisture, and decays to form a very rich soil known as humus. Horizon A provides plants with nutrients they need for a great life.

The layer below horizon A is the B. Litter is not present in horizon B and therefore there is much less humus. Horizon B does contain some elements from horizon A because of the process of leaching. Leaching resembles what happens in a coffee pot as the water drips through the coffee grounds. Leaching and in the case of cultivated soil, soil mixing may also bring some minerals from horizon B down to horizon C.

If horizon B is below horizon A, then horizon C must be below horizon B. Horizon C consists mostly of weatherised big rocks. This solid rock, as you discovered in Soil Formation, gave rise to the horizons above it.
Soil profiles look different in different areas of the world. They are affected by climate and other things

Soils are structural and functional elements of terrestrial ecosystems, which are formed in a historical process of development through the interaction of geological, climatic and biotic factors at the respective site. Soil is the fundamental source of life for all living beings. As the physical and chemical properties of soils exert great influence in the distribution and development of vegetation, it needs to be studied and evaluated from time to time. The soil forming process is very slow and time taking. It takes normally thousands of years for the soil formation. Therefore, we are studying the past activities while analysing the soil profile at present. The parent material, topography, geological processes, climatic conditions, vegetation and human interferences play major roles in formation and development of soil profiles in particular area. Similarly, our activities at present will certainly influence the soil profiles in far future.

Geological factors include the type of parent material and its mineral composition, the relief of the area, its exposition and the groundwater regime. Climatic factors include the level of solar radiation, precipitation, humidity, air temperature and wind speed and the characteristics of the hydrological regime that result from these factors. Soils are affected by human activities, such as industrial, municipal and agriculture, that often result in soil degradation and loss or reduction in soil functions. In order to prevent soil degradation and to rehabilitate the potential of degraded soils, reliable soil data are the most important prerequisite for the design of appropriate land-use systems and soil management practices as well as for a better understanding of the environment. This is the main objective of soil science.

Types
Sand, silt, and clay are the basic particles in a soil. Most soils are made up of a combination of the three. The texture of the soil, how it looks and feels, depends upon the amount of each particle in that particular soil. The type of soil varies from place to place on our planet and can even vary from one place to another in your own backyard.

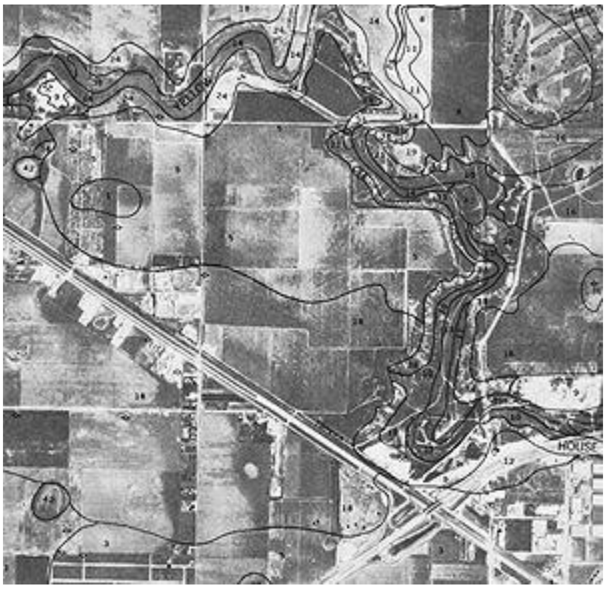
Conservation
Soil erosion, caused by wind and rain, can change land by wearing down mountains, creating valleys, making rivers appear and disappear. It is a slow and gradual process that takes thousands, even millions of years. But erosion may be speeded up greatly by human activities such as farming and mining. Soil develops very slowly over a long period of time but can be lost very quickly. The clearing of land for farming, residential, and commercial use

can quickly destroy soil. It speeds up the process of erosion by leaving soil exposed and also prevents development of new soil by removing the plants and animals that help build humus.

Today's farmers try to farm in a way that reduces the amount of erosion and soil loss. They may plant cover crops or use a no-till method of farming. Soil is an important resource that we all must protect. Without soil there is no life.

3.2 Soil Survey

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 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 the soil survey are acquired by field sampling, supported by remote sensing, (principally aerial photography).



Sample of an aerial photo from a published soil survey

The term *soil survey* may also be used as a noun to describe the published results. In the United States, these surveys have been published in book form for individual counties by the National Cooperative Soil Survey. The information is used by farmers and ranchers to help determine whether a particular soil type is suited for crops or livestock and what type of management might be required. An architect or engineer might use the engineering properties of a soil to determine whether or not it was suitable for a certain type of construction.

Soil survey components

Typical information in a published soil survey report includes the following:

- a brief overview of the county's geography
- a general soil map with a brief description of each of the major soil types found in the area along with their characteristics
- detailed aerial photographs with specific soil types outlined and indexed
- photographs of some of the typical soils found in the area

- tables containing general information about the various soils such as total area, comparisons of production of typical crops and common range plants. They also include extensive interpretations for land use planning such as limitations for dwellings with and without basements, shallow excavations, small commercial buildings, septic tank adsorptions, suitability for development, construction, and water management.
- tables containing specific physical, chemical, and engineering properties such as soil depth, soil texture, particle size and distribution, plasticity, permeability, available water capacity, shrink-swell potential, corrosion properties, and erodibility.

A soil survey report should carry or contain information that is specific to a given form up land use. This is usually determined by the Terms of reference (TOR) after survey.

4.0 Conclusion

Soil surveys provide a field-based scientific inventory of soil resources that includes soil maps, information on the physical and chemical properties of soils, and information on the potentials and limitations of soil for various uses.

5.0 Summary

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 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.

6.0 Self-Assessment Exercise

1. What is Soil Profile?
2. Discuss the importance of a knowledge of the soil profile to a farmer who wants to undertake large-scale crop production.
3. What are the soil survey components?

7.0 References/Further Reading

Soil Survey Staff (1993). "Soil Survey Manual". *Soil Conservation Service.* U.S. Department of Agriculture *Handbook 18*. http://soils.usda.gov/technical/manual/print_version/complete.html. Retrieved 2006-07-02.

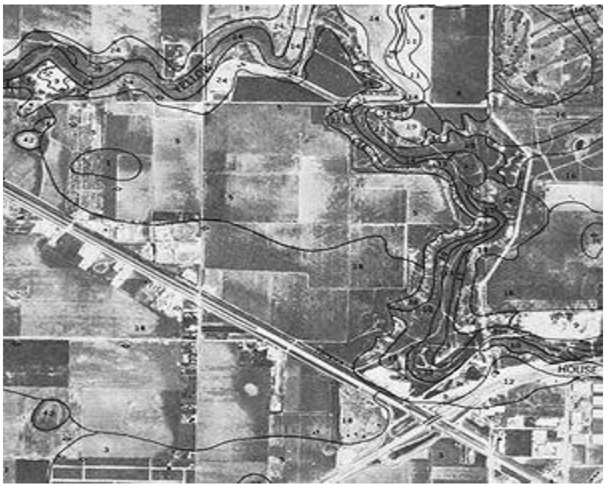
William D. Lee (1999). "The Early History of Soil Survey in North Carolina". http://www.soil.ncsu.edu/about/century/earlyhistory.html. Retrieved 2006-07-01.. This article is a reprint of the original paper: Lee WD. 1984. The early history of soil survey in North Carolina. Raleigh (NC): Soil Science Society of North Carolina. 28 p.

Unit 4 Soil Mapping

1.0 Introduction

A map unit is a collection of areas defined and named the same in terms of their soil components or miscellaneous areas or both. Each map unit differs in some respect from all others in a survey area and is uniquely identified on a soil map. Each individual area on the map is a delineation.

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 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 the soil survey are acquired by field sampling, supported by remote sensing, (principally aerial photography).



Sample of an aerial photo from a published soil survey

2.0 Objectives

At the end of this unit, you should be able to:

- analyse the procedure of soil survey/soil mapping.

3.0 Main Content

3.1 Soil Mapping

The term *soil survey* may also be used as a noun to describe the published results. The information is used by farmers and ranchers to help determine whether a particular soil type is suited for crops or livestock and what type of management might be required. An architect or engineer might use the engineering properties of a soil to determine whether or not it was suitable for a certain type of construction.

Soil survey components
Typical information in a published soil survey includes the following:

- a brief overview of the areas geography
- a general soil map with a brief description of each of the major soil types found in the area along with their characteristics
- detailed aerial photographs with specific soil types outlined and indexed
- photographs of some of the typical soils found in the area
- tables containing general information about the various soils such as total area, comparisons of production of typical crops and common range plants. They also include extensive interpretations for Land use planning such as limitations for dwellings with and without basements, shallow excavations, small commercial buildings, septic tank adsorptions, suitability for development, construction, and water management.

It should be noted that a particular soil survey report would carry information relative to the use of the soil as contained in the Teams of reference (TOR). This means that a report intended for agricultural use would be use on agronomic soil data as compared to the report meant for engineering purposes which could develop more on engineering properties as outlined above.

Tables containing specific physical, chemical, and engineering properties such as soil depth, soil texture, particle size and distribution, plasticity, permeability, available water capacity, shrink-swell potential, corrosion properties, and erodibility.

4.0 Conclusion

Soil mapping is one of the pillars to the challenge of sustainable development"

There is a need for accurate, up-to-date and spatially referenced soil information. This need has been expressed by the modelling community, land users, and policy and decision makers. This need coincides with a enormous leap in technologies that allow for accurately collecting and predicting soil properties.

5.0 Summary

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 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 the soil survey are acquired by field sampling, supported by remote sensing, (principally aerial photography).

6.0 Self-Assessment Exercise

1. What is soil mapping ?

2. Discuss the importance of a knowledge of the soil mapping to agriculturist.
3. State the steps involved in soil mapping.

7.0 References/Further Reading

Buol, S.W.*et al*. (2003). *Soil Genesis and Classification*. 5th ed. Iowa State Press - Blackwell, Ames, IA.

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Unit 5 Soil Classification

1.0 Introduction

Soil classification deals with the systematic categorisation of soils based on distinguishing characteristics as well as criteria that dictate choices in use.

2.0 Objectives

Appliction in the field is a challenge due to the complex nature of soil formation and the inherent capacity of the soil resource. Classification of soil is obvious to farmers and researchers to enable effective utilisation by the farmer, scientific communication, easy study for research among others. This unit is to provide you with simple soil classification at a glance.

3.0 Main Content

3.1 Soil Classification

Soil classification is a dynamic subject, from the structure of the system itself, to the definitions of classes, and finally in the application in the field. It can be approached from both the pespective of pedogenesis and from soil morphology. Differing concepts of pedogenesis, and differences in the significance of morphological features to various land uses can affect the classification approach. Despite these differences, in a well-constructed system, classification criteria group similar concepts so that interpretations do not vary widely.

Soil is classified into categories in order to understand relationships between different soils and to determine the usefulness of a soil for a particular use. One of the first classification systems was developed by the Russian scientist Dokuchaev around 1880. It was modified a number of times by American and European researchers and developed into the system commonly used until the 1960s. It was based on the idea that soils have a particular morphology based on the materials and factors that form them. In the 1960s, a different classification system began to emerge, that focused on soil morphology instead of parent materials and soil forming factors. Since then, it has undergone further modifications.

- The first unit of classification is the order.
- All soils fit into one of ten orders.
- Each order is broken down into a suborder, which is broken down into great groups, then subgroups, and then families.

Orders

Orders are the highest category of soil classification. Order types end in the letters sol. In the US classification system, there are 10 orders:

- Entisol - recently formed soils that lack well-developed horizons. Commonly found on unconsolidated sediments like sand, some have an A horizon on top of bedrock.
- Vertisol - inverted soils. They tend to swell when wet and shrink upon drying, often forming deep cracks that surface layers can fall into.
- Inceptisol - young soils. They have subsurface horizon formation but show little eluviation and illuviation.
- Aridisol - dry soils forming under desert conditions. They include nearly 20% of soils on Earth. Soil formation is slow, and accumulated organic matter is scarce. They may have a subsurface zone (calcic horizons) where calcium carbonates have accumulated from percolating water. Many aridiso soils have well-developed Bt horizons showing clay movement from past periods of more moisture.
- Mollisol - soft soils.
- Spodosol - soils produced by podsolisation. They are typical soils of coniferous and deciduous forests in cooler climates.
- Alfisol - soils with aluminum and iron. They have horizons of were clay accumulates, and form where there is enough moisture and warmth for at least three months of plant growth.
- Ultisol - soils that are heavily leached.
- Oxisol - soil with heavy oxide content.
- Histosol - organic soils.

Other order schemes may include:

- Andisols - volcanic soils, which tend to be high in glass content.
- Gelisols - permafrost soils.

For soil resources, experience has shown that a natural system approach to classification, i.e. grouping soils by their intrinsic property (soil morphology), behaviour, or genesis, results in classes that can be interpreted for many diverse uses. Differing concepts of pedogenesis and differences in the significance of morphological features to various land uses can affect the classification approach. Despite these differences, in a well-constructed system, classification criteria group similar concepts so that interpretations do not vary widely. This is in contrast to a technical system approach to soil classification, where soils are grouped according to their fitness for a specific use and their edaphic characteristics

4.0 Conclusion

Soil classification means that one finds categories of soils that are based on general characteristics as well as criteria that decide about the use that is possible.

5.0 Summary

Soil classification can be approached from both the perspective of pedogenesis and from soil morphology. But in both cases interpretations do not vary widely. Soil (sometimes called dirt) is the combination of rock, mineral fragments (pieces) made by weathering (wind, rain, sun, snow, etc.), and organic matter (living things), water, and air. Soils are important to our ecosystem for six main reasons: first, soils are a place for plants to grow; second, soils control the speed and the purity of water that moves through them; third, soils recycle nutrients from dead animals and plants; fourth, soils change the air that surrounds the earth, called the atmosphere; fifth, soils are a place to live for animals, insects and very small living things called microorganisms; sixth, soils are the oldest and the most used building materials.

6.0 Self-Assessment Exercise

1. Why do we have to classify soils?
2. Discuss the system of soil classification.
3. Describe the various orders in soil classification.

7.0 References/Further Reading

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