**Sandy Soils**

**Soil science:**

Soil science is the study of the soil as a natural resource on the surface of the Earth including soil formation, classification and mapping; physical, chemical, biological, and fertility properties of soils; and these properties in relation to the use and management of soils.

**Branches of Soil Science**

There are two main branches of soil science **Pedology and Edaphology**.

**Pedology** is the study of soil in its natural setting.

**Edaphology** is the study of soil in relation to soil-dependent uses.

Both branches apply a combination of soil physics, soil chemistry, and soil biology.



**Soil Chemistry:** The study of chemical constituents, chemical properties and chemical reactions in soils.

**Soil Physics:** The study of physical properties of soils as well the measurements and control of physical properties that take ough the soil.

**Soil Biology:**  Soil biology deal with soil ecology-ganisms micro-organisms, its classificatio, its population and its role in transformation.

**Soil Pidology:**  The study of soil as a natural body from the point of view of pidology (morphology, formation, chemistry, classification and as a part of the landscape).

**Soil:** the upper layer of earth in which plants grow, a black or dark brown material typically consisting of a mixture of organic remains, clay, and rock particles.

**Land reclamation:** the process of restoring land that has been mined.

Treatment of one or more defects to make changes or improvements in the topographic, physical, chemical and biological properties of the soil to make the soil more suitable for the requirement of the plants in which it is grown.

Conversion of land from unproductive land to productive land and/ or from less productive to more productive land.



**Sandy Soils:** Sandy soils are occurence in arid and semiarid regions.

**Arid Regions:** Arid regionns could be simply defined as "**regions when evaporation exceeds precipitation**″.

It means **Desert or semi-desert** lands.

Sandy soils are the result of the weathering of a variety of rocks such as granite, limestone and quartz.

**Characteristics of sandy soils:**

Sandy soils are characterised by:

1. The organic matter content is very low, and the rate of decomposition is very high.
2. The water holding capacity is very low.
3. The air capacity is very high.
4. The natural fertility is usually low.
5. Most of sandy soils are structureless
6. Their coarse textures as well as their single grain structures give place to the wind erosion.
7. The Soil profile is not unique to the horizons because it is not developed especially in arid zones due to drought conditions, water scarcity, scarcity of vegetation cover, and low biological and chemical activity, which lead to poor land formation.
8. Infiltration rate is very high due to the high proportion of macro pores. It ranges usually between 2.5 - 25 cm h-1 and may increase to 10 - 200 cm h-1.
9. The bulk density of sandy soil isysually high and ranges between 1.55-1.8 Mgm-3.
10. The surface area of its particles is low and therefore the surface reactions of its particles are low.
11. The cation exchange capacity of sandy soils is low resulting in low fertility (60-100 mmolc / kg of soil).

Sandy soils have low organic matter, light texture and loose structure, which cause them to drain quickly and not hold water well. This can lead to low fertility. Water drains so quickly through sandy soil that it washes away most of the nutrients. On the other hand, the sandy soils have high air capacity and high permeable.

Therefore, the reclamation and improvement of sandy soil is achieved by maximizing its advantages, reducing its defects and treating its most important problems. A greatest management, nutrient availability and water in an economic way make thess soils a fertil environment for plant growth and can be exploited economically.

**Problems of Sandy Soils, its causes and its reclamation**

**Problems:**

I. Low fertility of sandy soils.

II. Low ability to retain water (low holding water).

III. Erodability to wind and /or water erosion.

**I- Low fertility of sandy soils:**

**Causes:**

1. Most of sandy soils are made of quartz metal SiO2, which is predominant in the sand and is more than 85% of this soil. It is clear from the chemical structure that the plant does not recieve (absorb) any of the necessary nutrients.
2. The quartz metal (SiO2) is very resistant to weathering.
3. Low soil content of organic matter.
4. Low soil content of clay.
5. The reduced cation exchange capacity of the soil and therefore the weakness of its ability to retain the nutrients added to it through fertilization.

**Reclamation:**

**Improving of soil fertiity:** To increasing fertility of sandy soils, the following points should be concsidered:

1. Large quantities of organic matter should be added to the soil.
2. The use of farm manure (organic residues and green manure) should be an important part of the management program of these soils. These organic manures are a source of plant nutrients and improve the physical properties and bioactivity of the soil.
3. Addition of soil conditioners either natural such as bentonit or butimin or synthetic (organic polymers) such as PAM or PVC and Evergreen 500.
4. Mineral fertilization is another way to improve fertility of sandy soils.
5. Addition of slow release fertilizers such as urea and sulfur coated urea.
6. Signifficant losses of the applied nutrients may occure through leaching (especially NO3- ) or through precipitation due to the reaction with CaCO3 (especially Fe, Mn and Zn), therefore it is recommended to spray the plants growing in the sandy soils with solutions containing the required elements in a chelation form instead of applying these elements to the soil.

**Advantages of using bentonite as a natural conditioner:**

1. Forming a fixed soil structure which resist water and wind erosion.
2. Increases the cationic exchange capacity of the soil and hence increasing its ability to retain the nutrients added to it through fertilization.
3. Increases soil ability to retain water.
4. Do not disable agricultural management process in the soil.
5. It has no harmful effect on plants and animals and therefore on humans.

**II- Low ability of sandy soils to retain water (low holding capacity).**

Sandy soils are characterized by low moisture retention capacity under low or high tension. In addition t, the applied water is tended to loss, especially with the increase in the amount of water added due to the high infilteration rate and increased permeability of these soils. Therefore, it is necessary to minimize the loss or waste of water as much as possible

**Causes:**

1. Micropores are low.
2. Clay content is low
3. Organic matter content is low

**Reclamation:**

The ability of sandy soils to retain water is increased by reducing water loss by using the appropriate irrigation method or by reducing the various losses such as lossing by infilteration and evaporation.

**Minimizing the waste of water:**

1. Minimizing the waste of water during irrigation:

The appropriate irrigation method should be selected to minimize water loss when irrigation is performed. It is preferable to use irrigation methods such as sprinkler irrigation and drip irrigation to provide only water requierments for crops. Sprinkler and drip irrigation methods can be used to irrigate these coarse textured and highly permeable soils. Water will be used more efficiently and leveling costswill be reduced.

1. Minimizing the waste of water by alteration of soil properties
2. Lowlands are exposed to water from the highlands. Therefore, mixing sandy soils with some soil conditioners such as (organic matter,farm manure and clay) as deep layer at about 50cm depth at a rate of 15 m3fed-1, reduced infilteration rate.
3. Addition of the Nile mud to sandy soils under cultivation changed it graadually towards fine textured soils. The change was associated with the increase in the moisture retentis and maximum water holding capacity.
4. The use of irrigation methods such as sprinkler irrigation and drip irrigation also prevents the loss of water by deep filtration.
5. Minimizing the waste of water by evaporation from soil surface
6. Treating sandy soils with petrolium emulsion reduces the evaporation rate from soil surface.
7. Covering the sandy soil surface by gravel and polyacrylamide reduces the evaporation rate from soil surface.

In mulch- coverd sois, evaporation rate was reduced only in the early stage of the drying process, but in the later this effectiveness is reduced.

  **III. Erodability to wind and /or water erosion.**

Generally, sandy soils are exposed to erosion due to the presence of these soils in flat desert areas without obstacles or blocks that limit the speed of wind or heavy rainfall depending on climatic conditions. Sandy soils are subject to wind erosion due to the disintegration of their structure, which consists of loose sand grains and the lack of cementic materials such as (clay, organic matter, iron oxides, and aluminum) and because of low vegetation cover, which provides protection to the soil surface.

**Causes:**

1. Wind.
2. Water.
3. Human activity.

**Reclamation:**

Erosion can be control by one or more of the following methods.

1. Cultivate the plant windbreakers.
2. Artificial and plant windbreakers are constructed in the form of one or more rows of trees and shrubs around the reclamed area as barriers and windbreaks to reduce wind speed and reduce destructive energy of winds (cultivation of castor plants and Acacia cyanophylla and cactus).
3. Fast-growing and drought-tolerant shrubs are grown. After growing shrubs, trees are planted to increase the density of the vegetation cover.
4. Minimize agricultural management process such as tillage that will raise the soil surface, to the lowest possible level (minimum tillage).
5. Increase soil structure if possible.
6. Addition of organic matter.
7. Avoid overgrazing, which leads to soil erosion from the vegetation cover.

**Sand dunes**

Sedimentation of the sand on the surface under the influence of the wind to the formation of sand dunes is a common phenomenon in these soils. Egypt suffers from the movement of sand and its march towards the cultivated land in the northern Delta in Baltim and in the oases and areas adjacent to the western desert.

**Suitable crops for cultivation in sandy soil**

Most crops grow well in sandy soils and the surrounding climatic conditions have the greatest impact on the success of one crop.

Crops suitable for planting in such soils are selected and preferably with high monetary value.

Plants that require less water are preferred.

Leguminous plants are preferred due to the stabilization (fixation) of nitrogen in the form of organic can not be easily lost from the soil.

The most important crops grown in these areas are wheat, barley, peanuts, sesame, sorghum, and vegetable crops such as tomatoes, watermelons and potatoes as well as fruit crops such as grapes, mangoes, guava, plums and some citrus trees.

**Projects of reclamation of sandy soils in Egypt**

1. The southern sector of El-Tahrir region ( 100thousand feddans)
2. Salihia Desert Area (250 thousand feddans)
3. West Nubaria area about (300 thousand feddans)
4. The new valley: about (45 thousand feddans) in the oases of Farafra, Dakhla and Kharja.