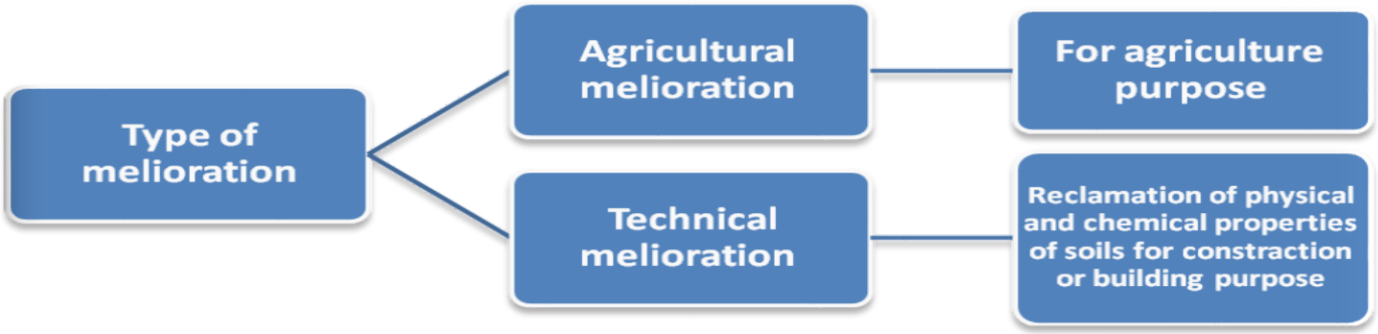
Soil Reclamation

Soil Reclamation is the process of restoring the quality of soil, including its lost fertility, minerals, nutrients, and moisture, to make it suitable for intensive use again. The reclamation of soil aims to enhance its nutrients and fertility, ultimately increasing land usability and improving agricultural activities such as cropping and irrigation.

Soil reclamation refers to the process of restoring degraded or contaminated soil to a state that can support plant growth and ecosystem functions.

The reclamation means melioration this English word coming from Latin word (melioration) which means improving for this reason reclamation of soils can be define as a science which studies the soil improvement, or conversion of undesirable soil properties to desirable properties for plant growth.

The melioration can be divided in to two types: -



Soil Reclamation is carried out for the development of layers, termed soil horizons, distinguished by differences in color, structure, texture, and chemistry.

There are numerous Biological, Chemical and Biogeochemical processes are employed to execute Soil Reclamation through Paedogenesis. Methods used for soil reclamation depend on the quality of the soil and objective of soil reclamation.

The soils which require reclamation; the soils which need reclamation are the soils

which not suitable for cultivation depending on soil factor which involves the following soils: -

1. **Saline soils.**
2. **Saline Sodic soils.**
3. **Acid soils.**
4. **Gypsiferous soils.**
5. **Water logged soils.**
6. **Sandy soils.**
7. **Desert soils.**
8. **Calcareous soils.**
9. **Sandy soil.**
10. **Heavy or Clay soil**

Objectives of Reclamation:

1. To increase crop yield per unit area
2. To improve farmers' living standard

Principles of Soil Reclamation

1. **Assessment**
   - **Soil Testing**: Chemical, physical, and biological analysis to determine contamination and degradation levels.
   - **Visual Inspection**: Identifying erosion patterns, compaction, and vegetation health.
2. **Restoration Techniques**
   - **Organic Amendments**: Adding compost, manure, or green manures to improve soil fertility and structure.
   - **Bioremediation**: Utilizing microbes and plants to break down or absorb contaminants.
3. **Physical Rehabilitation**
   - **Techniques**: Plowing, terracing, and aeration to improve soil structure and aeration.

Methods of Land Reclamation:

1: Physical Methods

1-Sub soiling 2-Deep ploughing 3-Sanding 4-Horizon mixing 5-Profile inversion

2: Biological Methods

Growing of crops on problem soils and/or their incorporation at the stage of maximum biomass productivity.

3: Chemical Methods

It includes the application of

– Gypsum, Sulphur, Sulphuric acid, and Hydrochloric acid etc

Reclamation Methods

1. **Phytoremediation**
   - **Definition**: Use of plants to absorb or degrade contaminants.
   - **Examples**: Sunflowers for heavy metals, hyper accumulators for various pollutants.
2. **Soil Amendments**
   - **Organic Amendments**: Benefits of compost, manure, and bio char in enhancing soil fertility and microbial activity.
   - **Inorganic Amendments**: Lime for acidity correction, fertilizers for nutrient replenishment.
3. **Cover Cropping**
   - **Purpose**: Preventing erosion, improving soil structure, and enhancing nutrient cycling.
   - **Examples**: Legumes for nitrogen fixation, rye or clover as ground cover.
4. **Bioengineering Techniques**
   - **Description**: Use of vegetation in engineering solutions for erosion control and slope stabilization.
   - **Examples**: Vegetative swales, living walls, and green roofs.

Prerequisites for Land Reclamation:

Good surface drainage, Leveled soils, Availability good quality water Chemical amendments

Reclamation of Saline Soils:

Reclamation of saline soil is done by applying excess water to the soil surface. The removal of salts may be accomplished either by continuous ponding of water on soil surface or by intermittent leaching.

Reclamation Requirement: It is amount of water required for reclamation, usually depends upon

- Salts concentration
- Soil texture
- Soil structure
- Trenching

Saline Soils

1. EC. In more than (4 $dS.m^{-1}$).
2. SAR is less than (15).
3. pH is less than (8.5).

The salt affected soils can be classified to the following classes depending on EC. And SAR values: -

Classes	*EC ($dS.m^{-1}$)*	*SAR*
Normal Soils	**Less than 4**	**Less than 13**
Saline Soils	**Equal or more than 4**	**less than 13**
Sodic Soils	**Less than 4**	**More than 13**
Saline Sodic	**More than 4**	**More than 13**

But the saline soil can be classified depending on salinity as follow [salinity of soil saturation extract]: -

Soil classes	*EC. ($dS.m^{-1}$)*
Non saline	**0 – 2**
Slightly Saline	**2 – 4**
Moderately Saline	**4 – 8**
Strongly Saline	**8 – 16**
Very Strongly Saline	**>16**

Sometime EC can be measure from [1:1] solution or [1:5] solution in this case the saline soil can be classified as follow: -

Soil classes	***EC. ($dS.m^{-1}$)***
Non saline	**< 4**
Slightly Saline	**4 – 8**
Moderately Saline	**8 – 16**
Very Strongly Saline	**>16**

Saline soils have different colorful names like: -

1. White alkaline.
2. Black alkaline.
3. Slick spots.
4. Summer snow.

The above names come from the surface appearances as soils become salt contaminated

Salt affected soils and their reclamation: -

-The original and compositions of soluble salts.

-The taxonomy of salt affected soils.

-How soluble salt content is measured and reported.

-The approximate salt contents that case damage to plants.

-How damage to plants caused by soluble salts.

-The principles used in the reclamation soils.

Reclamation and management of saline soils: -

1-Salt leaching: -

When the concentration of salts in the root zone is very high, crop growth may be entirely prevented. To improve crop growth in such soils the excess salts must be removed from the root zone. The term reclamation of saline soils refers to the methods used to remove soluble salts from the root zone.

Methods commonly adopted or proposed to accomplish this include the following

Scraping: -

Removing salts that have accumulated on the soil surface by mechanical method. This method might temporarily improve crop growth, salts still poses a major problem.

Flushing: -

Washing away the surface accumulated salts by flushing water over the surface is sometimes used to desalinize soils having surface salt crusts. Because the amount of salts that be flashed from a soil is rather small, this method does not have much practical effect

Leaching:

this is the most effective procedure (method) for removing salts from the root zone of soils. Leaching is most often accomplished (done by pounding fresh water on the soil surface and allowing it to infiltrate. Leaching is effective when the salty drainage water is discharged through subsurface drains that carry the leached salts out of the area under reclamation, leaching may reduce salinity levels in the absence of artificial drains when there is sufficient natural drainage.

It has been known for generation that for irrigation agriculture to remain viable over time, sufficient drainage must be provide to avoid an adverse salt buildup in the soil. This necessary has led to the concept of leaching requirement [LR].

The [LR] can be expressed as the ratio between the needed volume of drainage (Vdw) and irrigation water (Viw): -

$$LR = V_{dw} / V_{iw}$$

$\mathbf{V_{dw}}$ = Volume of drainage water.

$\mathbf{V_{iw}}$ = Volume of irrigation water.

$\mathbf{EC_{iw}}$ = EC of irrigation water.

$\mathbf{EC_{dw}}$ = EC of drainage water.

$$Di = Cu / 1 - LR$$

Di = Depth of irrigation water.

Cu = Consumptive use.

LR = Leaching requirement.

Application of solar pumping (SP) and subsurface drainage system for reclamation of saline land (SPSD). This method used for improvement of saline lands in North eastern Thailand at [2000] and obtained the following results: -

1. Reducing the ground water level and its EC. In the testing field.
2. The system had leaching effect to reduction of soil Stalinization after examination of EC_w in testing field after rainfall.
3. Application of solar pump and subsurface drainage would be an effective way for improvement of saline land.

Example. Estimate the leaching requirement when electrical conductivity (EC) value of a saturated extract of soil is 10 m mho/cm at 25% reduction in the yield of a ·crop. The EC of irrigation water is 1.2 m.mho/cm. What will be the required depth of water to be applied to the field if the consumptive use requirement of the crop is 80 mm? EC value of the leaching water may be suitably assumed**.**

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Using organic mulch: -

Reclamation of saline soils particularly when only rainfall or limited irrigation is used can be hastened by application of surface organic mulch because mulch slowly surface evaporation, salt movement to the soil surface in evaporation water is decreased and the net down word movement of salt is increased.

The general rule to reclaim soils affected by salt are the following: -

1-Establish drainage.

2-Replace excess exchangeable sodium.

3-Leach out most of the soluble salts.

Saline soils are relatively easy to reclaim for crop production if: -

1. Adequate amount of good water quality is available.
2. Internal and surface drainage are present.
3. Salt disposal dump (sinks) is available.

Q1/ Calculate depth of soil an irrigation water having electrical conductivity of ($3dSm^{-1}$) when electrical conductivity of drainage water is ($8dSm^{-1}$) and Consumptive equal 34.3 cm.

Q2/ Irrigation water contains (414, 120 and 24 $mg.l^{-1}$) of [Sodium, Calcium and Magnesium] respectively calculate:-

a) SAR value of the irrigation water.

b) Classified soil. Approximate EC value in $mS.m^{-1}$.

Q2/ Irrigation water contains (125 and 21 $mg.l^{-1}$) of [Calcium and Magnesium] respectively and SAR value of the irrigation water equal 3 calculate:-

a) Sodium cation value of the irrigation water.