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RECLAMATION AND MANAGEMENT OF SALT AFFECTED SOIL: REVIEW

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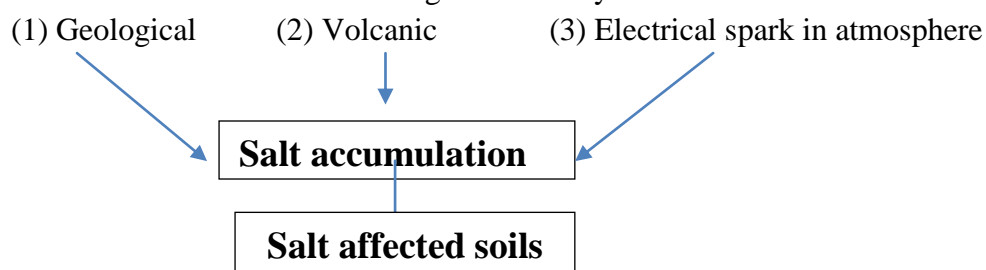
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Introduction

The soil of the arid and Semi-arid regions contains high concentration of either soluble salt or exchangeable sodium or both due to poor leaching base farming cation resulting soil pH is more than 7 and soil colloidal complex dominated by these cations like Ca^{++} , Mg^{++} , K^+ and Na^+ , and anions SO_4^{--} , Cl^- , CO_3^{--} and HCO_3^- . Accumulation of salts of various composition and solubility in soil beyond the certain concentration can lead to problem in the soil physical condition and fertility which in term adversely affected the plant growth and thereby crop productivity is group under salt affected soil from agriculture point of view and required as a special reclamation and management practices (Pal, 2016). The origin and nature of salts in soils we can show diagrammatically:



(1) Geological: Due to weathering of primary minerals found in the soils and in the exposed rocks of the earth's crust. These are the original and direct source of all the salts constituents.

(2) Volcanic: Cl^- and SO_4^{--}

(3) Electrical spark in atmosphere: SO_4^{--} , NO_3^- and CO_3^{--}

(4) Biological activity: CO_3^{--} , HCO_3^- and NO_3^- in biological activity through different types of micro-organisms and produced different types of acids and these acids release anions.

Table 1: Effect of salinity and alkalinity on soil and plant

S. No.	On Soil	On Plant
1	Poor structure	Water imbalance in the plant

2	Poor aeration	Ion imbalance
3	Slow soil permeability	Toxicity from Na ⁺ and Cl ⁻
4	Slow bacterial activity	Slow uptake of Ca and Mg by plant
5	Poor physical condition of soil	Osmotic effects
6	Deficiency of micro-nutrient	

Distribution of salt affected soil

World – 952 million hectares (Szabocs, 1974)

India- 7.42 million hectares (Abrol and Bhumbra 1972-73)

Table 2: State wise distribution of Salt affected soil in India

S. No.	States	Area (mha)
1	Uttar Pradesh	1.295
2	Gujrat	1.214
3	West-Bengal	0.850
4	Rajasthan	0.728
5	Punjab	0.688
6	Maharashtra	0.534
7	Haryana	0.526
8	Orissa	0.404
9	Karnataka	0.404
10	Madhya Pradesh	0.224
11	Andhra Pradesh	0.042
12	Other states	0.040
	Total area	6.949 or 7

Classification of salt affected soil

On the basis of soil pH, electrical conductivity of saturated soil (ECe), sodium adsorption ratio (SAR), exchangeable sodium percentage (ESP) these soil categories under four type which given in the Table-3 with some characters.

Formation of salt affected soil

There are different processes which are play role for the formation of salt affected soil

Salinization: The process of accumulation of soluble salt in the surface soil and formation of salic endopedon is called salinization and the soil so farmed is called saline soil.

Alkalization: Accumulation of Na⁺ ion on soil colloidal complex and formation of natric endopedon is called alkalization. Example:

Desalinization: Leaching of Soluble salts and Na cation from surface layer and soil pH is about 6 the process is called degradation.

Sources of Salt accumulation

There is different source of salt accumulation

1. Arid and Semi-arid regions
2. Low rain falls, high temperature, and high evaporation occurs

3. Irrigation by saltier water up to long period
4. Present of hard pan in sub-soil
5. High water table
6. Basic parent material
 - i. Basic igneous rock (45- 55 % Si) e.g. basalt, Gabbro
 - ii. Sub-basic igneous rocks (55 – 60 % Si) e.g. Andesite, Diorite
7. Use of basic fertilizer up to long period
8. Ploughing in same depth up to long period

Reclamation and management of salt affected soil

For any reclamation technique to be permanent, three essential requirement have to meet with (Kelly, 1951).

- I. The land must be prevented from reverting to original condition
- II. Salt of alkali must be removed from red zone
- III. The repair of the damage, already done to the soil, should be substantial

A. Physical measures or mechanical measures

1. Scrapping of surface soil up to between 15-30cm depth and it is suitable for patches field
2. Leaching of soluble salts below the plant root zone. It is more suitable method in Indian condition.
3. Flushing
4. Trenching

B. Cultural operation or Agronomical operation

1. Deep tillage with the help of soil turning plow to open the hard pan
2. Growing of salt toll rent crops
 - (i) High salt toll-rent crop e.g. Barley, Dhaicha, and Cotton etc.
 - (ii) Medium salt toll-rent crop e.g. Bajra, Arhar, Rice wheat and Maize etc.
 - (iii) Low salt toll-rent crop e.g. Moong, Urd, Lentil, Cowpea and Onion etc.
3. Adopted suitable crop rotation.
4. Salt free water should be use for irrigation purpose
5. Light irrigation is better than heavy irrigation
6. Application of organic residues @ 4 tonnes/hac on surface soil to reduce the evaporation and improve soil moisture
7. Sprinkler irrigation better than other irrigation
8. Zero tillage method better than Rota-vater

C. Biological Measure

1. Application of FYM @ 50 tonnes/ha
2. Growing of green manure crop e.g. Dhaicha
3. Use of Molasses (Sira) it is by product of sugarcane
4. Use of 2.5 tanne/ha of dry powder of Satyanashi weed (*Argimon maxicana*)
5. Use of “Usar Tor Masala” it is organic amendement

D. Chemical Measures

The main aim of reclamation of salt affected soil through chemical amendment is to replace exchangeable Na^+ ion with Ca^{++} ion. The different soil amendment is used to reclamation of salt affected soil given below:

1. Calcium soluble salts

- (1) Phosphogypsum ($\text{CaSO}_4 \cdot \text{Ca}_3(\text{PO}_4)_2$) it is a byproduct of industry and contain 90 % gypsum
- (2) Calcium Chloride ($\text{CaCl}_2 \cdot 2\text{H}_2\text{O}$)

2. Acid or acid formers

- (1) Iron Pyrites (FeS_2)
- (2) Element sulphur
- (3) Lime sulphur (CaS_5)
- (4) Ferrous sulphate ($\text{FeSO}_4 \cdot 7\text{H}_2\text{O}$)
- (5) Aluminium sulphate ($\text{Al}_2(\text{SO}_4)_3 \cdot 18\text{H}_2\text{O}$)

S. No.	Particulars	Saline Soil	Alkali Soil	Saline-sodic Soil	Degraded Soil
1	Soil pH	<8.5	>8.5	>8.5	About 6 surface soil, About 8.5 sub-surface soil
2	SAR	<13	>13	<13	<13 surface soil >13 sub-surface soil
3	ESP	<15	>15	>15	>15
4	EC (dSm^{-1})	>4	<4	>4	<4
5	Soluble Salt (%)	>1	<1	>1	<1
6	Dominated Salt	SO_4^{--} , Cl^- , & NO_3^- of Na and CO_3 and HCO_3 are also found in small amount	Na_2CO_3	Both	Na_2CO_3 in lower layer
7	Content in Soil	High soluble salt in Sodium	High exchangeable sodium on soil colloidal complex	Sodium clay and soluble salt	H^+ ions on upper layer and Na^+ ions in lower layer
8	Soil colure	White-brown colure in surface soil	Black in surface soil	-----	Black colure in sub-surface soil
9	OM	Slight less than normal soil	Very less amount due to dispersion of OM	Less	Less
10	Forms by the process	Salinization	Alkalinisation	Both	Degradation or solidification

References

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