

SOIL & WATER MANAGEMENT

RECLAMATION OF ALKALI SOILS OF INDO-GANGETIC PLAINS



A barren vast stretch of alkali affected areas

Alkali soils (also called sodic) contain sufficient amount of exchangeable sodium (ESP), more than 15% to cause soil dispersion and increase in the soil pH (>8.5), thereby adversely affecting both the physical and nutritional properties of the soil. This also brings significant reduction in crop growth. The conductivity of the soil saturation extract is usually less than 4 dSm^{-1} . Highly deteriorated alkali soils may have pH as high as 10.7. Nearly 28 lakh hectares area is affected by sodicity and are primarily spread in the Indo-Gangetic alluvial plains in the states of Haryana, Punjab, Uttar Pradesh and parts of Bihar and Rajasthan. The Central Soil Salinity Research Institute (CSSRI), Karnal has developed an economically viable, environment friendly and socially acceptable package of reclamation technology.

RECLAMATION TECHNOLOGY

Reclamation of alkali soils basically requires partial or complete removal of exchangeable Sodium and its replacement by Calcium. This can be accomplished in many ways depending on local conditions, available resources and the kind of crops to be grown on the reclaimed land. If the cultivator can spend very little for reclamation and is willing to wait for many years before he can get an economic crop yield, reclamation can be accomplished simply by growing rice during *kharif* season followed by a *rabi* crop (wheat), along with the incorporation of farmyard/green manures.

However, to obtain reasonably quick soil reclamation and economic crop yields cropping must be preceded by:

- Application of a chemical amendment preferably gypsum in required quantity.
- Thereafter leaching for removal of salts, mostly sodium sulphate, derived from the reaction of the amendment with the alkali soil.
- Adoption of rice-wheat-dhaincha (*Sesbenia aculeata*) as green-manuring crop.

On-farm development

- Proper land leveling is a must for initiating the reclamation. Provide strong bunds on all sides of the farm to control ingress of water from the adjoining areas. The on-farm development works should be done in early summer before on-set of rains. Do not go in for deep ploughing.
- Gypsum (Calcium Sulphate), is by far the most commonly used soil amendment. Though many other soil amendments (sulphur, sulphuric acid, calcium chloride, aluminium sulphate, etc.) could also be used but these are more expensive than gypsum and therefore, uneconomic to use. Press mud from sugar factories using sulphitation process can also be used for reclamation of sodic lands. Iron pyrites is still another promising amendment provided it contains about minimum of 8% water-soluble sulphur.
- The amount of amendment must be applied based on soil analysis. However, 12–15 tonnes of gypsum per hectare (which is only 50% of gypsum requirement of 0–15 cm soil) is sufficient enough to reclaim upper 15 cm soil depth of a highly deteriorated soil (pH as high as 10.7) for successfully growing rice-wheat in rotation. About 25% less gypsum may be applied by applying 10–15 t/ha FYM along with gypsum. Salt tolerant rice varieties (CSR-10, CSR-13, CSR-27) and wheat (KRL 1–4, KRL 19) can also be grown successfully by using gypsum @ 25% gypsum requirement.
- The amendment should be uniformly applied in whole field and thoroughly mixed within the top 10 cm soil, followed by ponding of irrigation/ rain water for about 10–15 days to promote leaching and create better soil ionic environment.
- After the excess water has disappeared and the land has been properly cultivated and fertilized, rice should be transplanted without puddling, ensuring 3 to 4 seedlings per hill and maintaining 15 to 20 cm distance between the hills. Raise nursery on good soil. The crop should be managed as per the normal crop management practices. As far as possible, reclamation should start with rice as the first crop. Wheat, barley and berseem are the best choices for continuing the reclamation process during *rabi* season. Recommended crop varieties should be planted at the appropriate time. It is desirable to go in for a green-manure crop during summer, which besides improving soil physical conditions can also save about 60–70 kg/ha of Nitrogen in the following rice crop.



Gypsum application



A first crop of rice after reclamation

- While growing wheat crop during *rabi* season, ensure that there is no stagnation of standing water. Apply light but frequent irrigation (total quantity of irrigation water remains the same).

OTHER MANAGEMENT TIPS

Efficient, balanced and integrated nutrient management is an integral part of reclamation of sodic lands. Therefore, to sustain productivity during and after reclamation the following recommendations must be practised:

- These soils are highly deficient in organic matter and Nitrogen. During the first few years after reclamation, crops are fertilized with about 25% more Nitrogen compared to recommended dose for normal soil. Split application of Nitrogen through urea (1/3rd as basal, 1/3rd each at 21 and 45 days crop growth) should be given. In rice, basal dose of urea should be applied before puddling under pre-submerged conditions to reduce ammonia volatilization losses and to enhance Nitrogen use efficiency.
- Apply 25 to 40 kg Zinc Sulphate per hectare to rice for first few years and then it should be applied on soil test basis.
- Farmyard manure, organic residues and green manures help in increasing the productivity. It is extremely important to integrate the use of organic resources and chemical amendments.
- Though sodic soils initially are high in available phosphorus, both rice and wheat require phosphorus fertilization @ 22 kg P/ha after 4–5 years, when available phosphorus comes down to critical soil test value i.e. 12 kg/ha to sustain productivity and to maintain soil fertility.
- Maintain submerged conditions during rice and well drained conditions during wheat/barley/berseem to avoid water stagnation and damage to the crops, by ensuring light and frequent irrigations.

SOURCES OF GYPSUM AVAILABILITY

Gypsum is being marketed by the Land Reclamation and Development Corporations established in many States. The farmers can contact the State Departments of Agriculture as well. The addresses of a few firms supplying gypsum are also given below. This is in no way is a recommendation of any particular source.

Gypsum Supplying Firms :

1. The Fertilizer Corporation of India Ltd., Paonta 'A' Road, Jodhpur (Rajasthan).
2. J & K Minerals Ltd., Mining Department, House No. 33, Block 'B' Sector C, Gandhinagar, Jammu, J & K.
3. Hindustan Copper Ltd., P.O. Khetri Nagar, Rajasthan.
4. Bikaner Gypsum Ltd., Bikaner, Rajasthan.
5. The Himalaya Stone and Lime Co., Rishikesh, (Dehradun), D.P.
6. Akhil Lime and Minerals, 4-Raja Road, Dehradun, D.P.

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