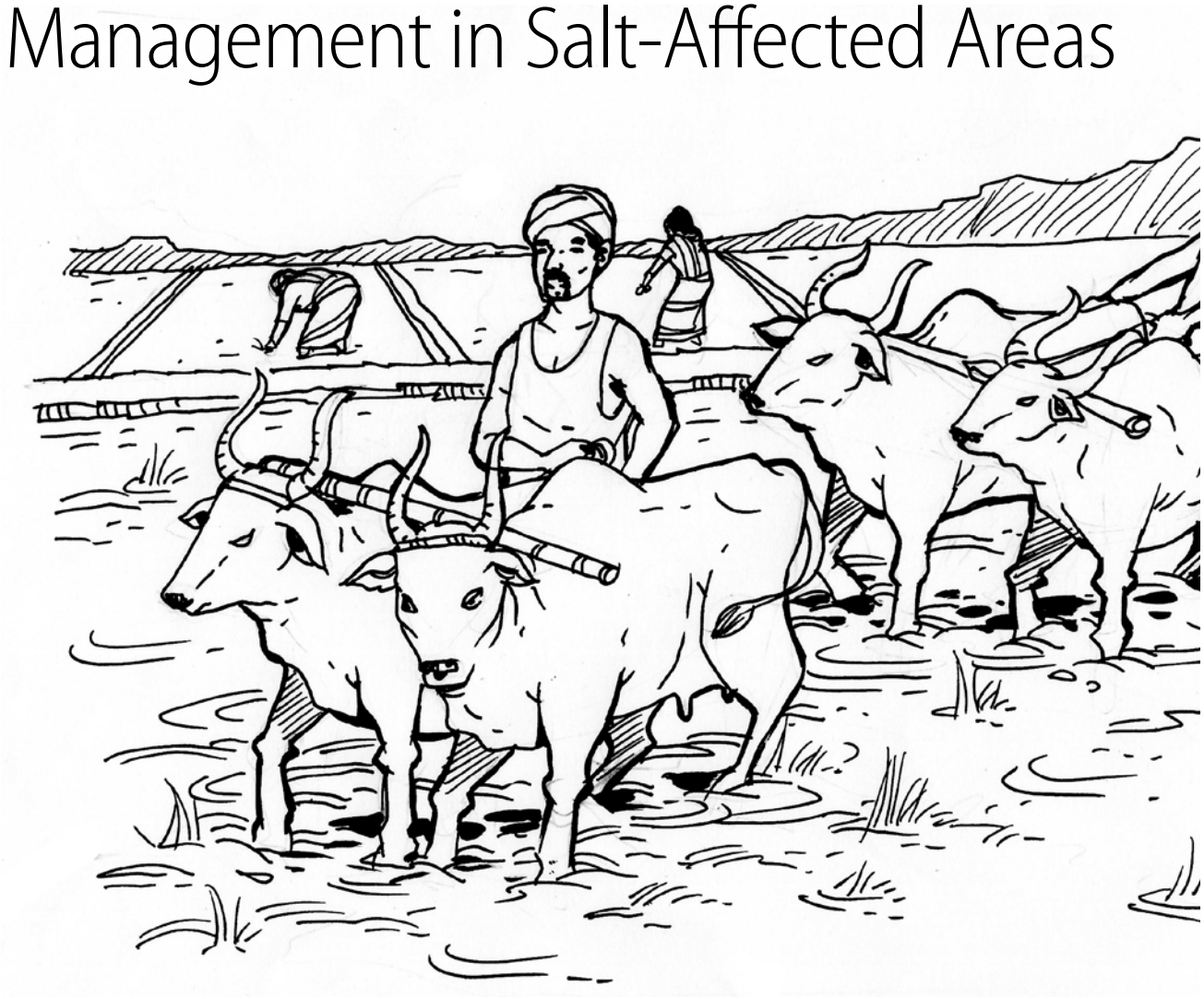
Improving Variety and Crop Management in Salt-Affected Areas



Almost 100 million hectares of coastal and inland agricultural lands are affected by soil salinity and alkalinity. Approximately 22 million hectares of saline areas are in Asia, with 11 million hectares in India alone. Low food production and poverty are high in these areas. Food production can be increased through proper technological intervention, including improvement of the condition of the soil and adapting new crop varieties for more saline soils. Because of their vast scale, a modest improvement of yields in such soils can ensure food security for millions of hungry and impoverished people.

Saline and sodic soils are different in nature (although both are caused by an excess of sodium) and require different soil management techniques. In saline soils, sodium is present as sodium chloride, or common salt, and reduces the availability of water for plants. At high enough concentrations, it can be threatening to crops. In sodic soils, much of the chloride has been washed away, leaving behind sodium ions attached to tiny clay particles in the soil. These clay particles do not stick together when wet, making soil susceptible to erosion and impermeable to both water and roots.

Planting salt-tolerant crops to adapt to soil salinization

Coastal salinity, caused by seawater intrusion and shallow saline water tables, is severe during the dry season. On the other hand, flooding in the monsoon season limits cropping to rice. Saline and sodic soils are widespread in inland areas and are progressively expanding because of improper water management. Rice is suitable for rehabilitating salt-affected soils because it can grow under flooded conditions and has a high potential for genetic improvement. Rice productivity in salt-affected areas could be increased by 1-2 t/ha, providing food for millions of the poorest people and making use of some of the least exploited land and water resources.

A CGIAR CPWF project on productivity of salt-affected areas attempted to enhance land and water productivity of rice-based cropping systems in salt affected areas by integrating genetic improvement and management strategies that are environmentally sustainable and socially acceptable. With 11 partners in five countries, the project made considerable contributions through its activities. This paper is limited to work done in Coastal Orissa and Faizabad, Uttar Pradesh, India. Improved salt-tolerant rice varieties, crop and natural resource management practices and rice-based cropping systems were validated through farmer participatory research.

The following key approaches were used by the project in India:

- Identification of salt-tolerant rice and other crop varieties
- Use of farmers' observations in identifying tolerant varieties and effective farming techniques
- Participatory varietal selection (PVS) for rice varietal improvement
- Participatory experiments on new farming practices, in particular water and nutrient management

Coastal Orissa, India

About half of India's salt-affected coastal lands are in Orissa and in neighboring West Bengal. In coastal Orissa, salinity is severe due to seawater intrusion and shallow saline groundwater, especially during the dry season. During the wet season, rainfall and river flow help to flush out some of the salt, making rice cropping possible, but yields remain low because of the saline conditions. Average rice production is barely enough to secure food for 4 to 9 months for a typical family, leaving farmers no choice but to purchase rice during the lean months. The recommendations from this CGIAR

CPWF research project were to 1) adopt new salt-tolerant rice varieties for the wet season and plant them earlier than traditionally done; 2) adopt the new varieties in the dry season; and 3) allocate 10% of the dry season area to non-rice crops (e.g., sunflower).

Faizabad, Uttar Pradesh, India

The important cropping seasons at Faizabad are kharif (the wet season from March to October) and rabi (the dry season from November to April). The average annual rainfall is less than 1000 mm. The major cropping patterns in the area are rice-wheat, rice-potato, rice-pea and mustard, sugarcane-wheat and rice-oilseed followed by pigeon pea. Animal production is also an integral component of the farming system.

Recommendations from the research include 1) improving production from sodic soils by using 'pressmud,' an easily accessible organic by-product of sugar factories, which is rich in sulphur and zinc; 2) planting salt-tolerant rice varieties (Usar Dhan 3 and CSR 23); and 3) propagating the legume cover crop, *Sesbania*, as a soil amendment. The third recommendation is suitable for areas with access to water from tubewells. In a span of 3 years, about 30 farmers evaluated the technology on their sodic land with a soil pH ranging from 9.2 to10.2 (moderately to highly alkaline). An average yield increase of 0.5-0.8 t/ha was noted, depending on the amount of pressmud amendment used. The benefits were greater for the more alkaline soils, where rice plants would not normally grow if there was no soil amendment. Net profits ranged from Rs 500-3500 per hectare (US$13-88) for a single rice crop, compared with land that is normally barren. Farmers preferred the medium-duration varieties, Usar Dhan 3 and CSR 23, which allowed the

cultivation of a second rabi-season crop, such as wheat, potato or pulses. However, women noted that Usar Dhan 3 was not as tasty as the other varieties. Farmers with guaranteed irrigation from tubewells used both *Sesbania* and pressmud, while farmers without irrigation adopted the pressmud technology. Farmers also obtained higher yields from the second seasonal wheat crop after applying pressmud and *Sesbania* mixtures.

Eastern Uttar Pradesh, India

In Eastern Uttar Pradesh, sodic soils are a major problem in rainfed areas. Approximately 1.3 million hectares of rice fields are affected. The problem becomes more severe during the dry season, preventing farmers from growing a second crop of rice. Aside from sodic soils, farming households also have to deal with drought and flooding. Most of the farmers are resource-poor and have marginal landholdings (less than a hectare). Few farmers have supplementary irrigation. Sodic soil reclamation with inorganic amendments, like gypsum and pyrite, are effective but these amendments are expensive for poor farmers.

The successful use of pressmud and *Sesbania* technology on the CSR 23 and Usar Dhan 3 rice varieties in Faizabad is now being promoted in Eastern Uttar Pradesh.

Women contributed almost 60% of the total labor in rice production. The project sought the participation of women in focus group discussions, surveys and participatory variety trials to get their feedback on the technology. Female informants provided more descriptive information than men, saying that the improved soil quality increased the crop yields of rice and wheat. With the excess in production, they were able to sell their crops, thereby increasing their food security. Farmers in Eastern Uttar Pradesh, who used pressmud and *Sesbania*, noted that rice and wheat yields increased by 30-50%. CSR 23 was good for sodic soils in terms of duration, plant height, threshability, milling recovery, taste and for producing puffed rice. Usar Dhan 3 was less preferred due to its inferior taste.

Southwestern Bangladesh

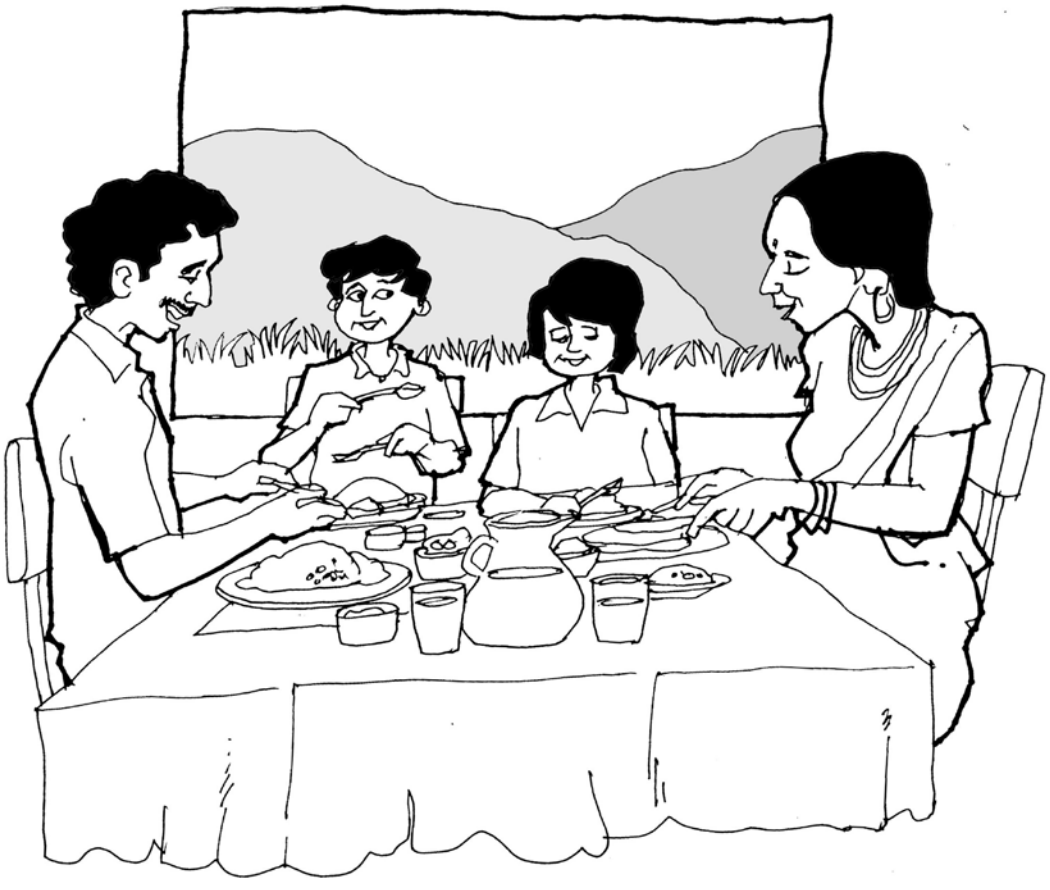
Fast-maturing rice varieties, water harvesting and proper management of irrigation water were recommended for this area. Diversification of rice-based systems doubled the cropping intensity and increased the annual grain yield. Farmers' responses to the adoption of the new multi-cropping system were positive, resulting in a rapid increase in demand for seed in the area.

Key findings

- Planting early provides farmers with at least a 30% increase in yield.
- The use of early-maturing and high-yielding salt-tolerant rice and non-rice varieties, associated nutrient management techniques and cheap soil amendments helped farmers to intensify crop production and increase yields.
- New cropping combinations, like rice-sunflower, show potential for adoption.

Lessons learned

- Technological improvements, including the use of new salt-tolerant varieties of rice and other crops and organic soil amendments, proved to be relatively inexpensive for farmers to adopt. Results could be observed in just 2 years.
- The inclusion of female farmers not only helped achieve higher crop yields but also increased women's confidence in using new salt-tolerant rice varieties and nutrient management technologies. Women were recognized as legitimate farmers.
- As farmers witness the occurrence of higher yields as a result of using the new salt-tolerant rice varieties, demand for their seeds increases. Guaranteed access to seeds becomes necessary, and this can be ensured by supporting the multiplication efforts of local farmers.
- The commercialization of new salt-tolerant rice varieties can be hastened by easing the regulations on variety release. This is necessary in countries where subsidies are only provided to farmers who grow officially released varieties.



Conclusion

With the use of simple technologies and appropriate plant varieties, farmers can grow crops in once barren saline and sodic lands. Planting salt-tolerant rice varieties, practicing multi-cropping and using soil amendments contributed to the higher yield. Using these techniques to adapt to saline and sodic soils can help improve the food security of poor households.

Contact Person

Abdelbagi M. Ismail (a.ismail@irri.org)

Partner Organizations

Bangladesh Rice Research Institute
Central Rice Research Institute, India
Central Soil Salinity Research Institute, India
Cuu Long Delta Rice Research Institute, Vietnam
International Centre for Biosaline Agriculture, UAE
International Crops Research Institute for the Semi-Arid Tropics
International Rice Research Institute
Narendra Dev University of Agriculture and Technology, India
Rice Research Institute of Iran
University of California Davis, USA

Key Reference

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Tags: PN7; Productivity in Salt-affected Areas

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