Environmental Study to Improve Salt Affected Land for Use as Agricultural Land with Polder Systems

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Summary

Excessively accumulated salt in the top soil is harmful to the growth of most agriculturally valuable crop plants. Salt-affected lands are found in almost two thirds of the cultivated agricultural lands in the world. Amelioration of those salt-affected lands is strongly required to obtain more produce to meet the higher demands for food of the increasing world population. We have introduced the polder system in salt affected areas in Thailand. The objectives of the research were to study the environmental changes and the phenomena occurring by the introduction of the polders. In order to do this, we set up an investigation in the polder. Laboratory experiments and theoretical development were also carried out for deeper understanding.

I Introduction of polders to salt affected area Three polders have been constructed in the salt affected area of Northeast Thailand. Each of them is surrounded by a canal. The soil excavated in making the canal was used to make a surrounding bank inside the canal. The salt and moisture content in the ridge soil showed clear seasonal changes, strongly affected by rainfall. But the salt concentration of the soil solution at a depth of 30 cm remained almost constant, about 1.5 to 3.0 %, during the 10 months of observation. Plant roots absorbed water from this brackish soil water leaving a certain amount of salt.

II Moisture and salt movement in the soil

a. Movements of water in soil induced by evaporation A 40 cm deep homogeneous salty soil was packed in an open top rectangular box and left evaporating under a transparent vinyl roof. Analyses of the water and salt distributions in the soil after 20 days of evaporation showed that about 3/4 of the water reached the soil surface moved in a liquid state and the other 1/4 as vapor.

b. Suppression of brackish soil water with overlaid rain water Different constant-rates of fresh water simulating rain was supplied on the open end salty soil columns. The infiltrated fresh water pushed the brackish soil water downward. Sharper changes in salt-content distribution at the boundary of the brackish and fresh waters were observed for the higher infiltration rates, which means the higher infiltration rates produced stronger salt dispersion.

III Effect of soil water characteristic nonlinearity on the water supply capability The exponential diffusivity function with respect to volumetric water content θ was assumed as $D \propto e^{\beta\theta}$ with constant β. A quasi analytical solution using Boltzmann transformation for radial coordinate and constant absorption rates was obtained and compared with numerical ones, which showed a fair coincidence between the two solutions, indicating that the quasi analytical one could be used more easily with good accuracy. High nonlinearity because of large positive β brought about very steep decrease in the soil-water potential for the adjacent soil to plant roots.

IV Conclusion

The polder system presented here may contribute to improving salt affected lands for agricultural use. Basic experimental observations and mathematical analyses showed us how salt accumulated in the top soil and how salt could be suppressed with rain water. The role of vapor movement in the soil during the evaporation period was confirmed as about 1/4 of total water transfer occurring in vapor state. The soil dryness often observed in the dry season might produce much more severe water conditions for water absorption by plant roots than considered previously because of the nonlinear nature of soil water permeability, thus the nonlinearity of water permeability should never be ignored.