

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

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Summary

The polder system has been introduced as a method to improve salt affected lands to change them to agricultural lands. A polder is surrounded with a canal and a bank which protect flooding. The inside land is to be used for cultivation after removing the salt from the soil. Farmers may culture fish in the canal and produce distilled water with simple solar distillation systems. Through the investigation for the titled project, we obtained the following results and conclusion.

1. Observations of water and salt in the polder soil and their analysis

In a strongly NaCl-salt affected area in Khon Kaen, northeast Thailand, a high-ridge test plot including layers for cutting off the capillarity has been constructed in July 1994. Water and salt contents in the soil were measured periodically to analyze the fate of water and salt for a year, that is the first rainy season from July to October, the dry season to March, and to June, the early stage of the next rainy period. The amount of soil moisture decreased continuously up to February and increased from April. Contrary, the amount of salt decreased during the rainy period and then continuously increased through the dry and the next rainy season up to June. The salt concentration of the solution in the top 5 cm decreased to 1.7% in the rainy season and increased to 20% in the dry season, then decreased again to maintain 12% since April. The orientation of the liquid water movement through the bottom of the 30 cm crop zone was downward by 0.2-0.4 mm/d up to October then changed to upward by 0.2 mm/d up to June. The latter led the salt increase in the crop soil. The main driving force of the upward water movement was the severe loss of water from the soil surface which maximum was observed as 0.5 mm/d in the early stage of the dry season, between October and December. Soon after the beginning of the dry period, the top soil became so dry that liquid water could not move easily and the vapor movement prevailed in the top 10-15 cm of the soil. Evaporation of water from the soil body was strongest at the depth of 5-20 cm zone with the maximum of 3.7 kg/(m³·d), which promoted loss of water from ridge soil and concentrated the soil solution.

2. Development of a simple distillation device to utilize solar energy

A simple distillation device to utilize solar energy like a plastic house produced distilled water with the daily maximum of 2 L/m² when the daily solar radiation was 16 MJ/m². One liter of distilled water is sold with 60 yen, which thus may become a good way to earn cash other than domestic uses.

3. Development of soil moisture sensor to be used for saline soil

A new probe-type heat-pulse sensor was developed to measure volumetric heat capacity. The sensor measured volumetric heat capacity within 10% error for soils from air dry to saturated water condition. Merits of this sensor are freedom from salt content because of heat method and the linear relationships between soil moisture content and the volumetric heat capacity. In using the sensor, we should be careful that the measurement will be affected with bulk density and distortions of the probe.

Conclusion

Increase of salt in the ridge soil during the dry and the successive early stage of the next wet seasons was derived from the rise of brackish water from the bottom of the crop soil. The main driving force of water rise was the strong loss of soil water from the soil surface. The strongest evaporation of water from the soil body occurred in the deeper soil. The rain fall entered into air dried ridge-soil in the early stage of the wet season was not enough to wash out salt from soil but utilized to maintain more capillary rise of underlying brackish water. Improvement of saline soil is not so easy because of tremendous amount of saline under ground water. A master plan should be designed to include harvesting of good quality water, precise irrigation, drainage of leached water and the protection of water loss by surface mulches in order to improve the agricultural production in the salt affected land. Here obtained knowledge should be utilized in making the master plan better.