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APPLICATION OF POLDER SYSTEM TO THE IMPROVEMENT AND THE MANAGEMENT FOR BARREN SALINE LANDS

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ABSTRACT

Inland saline soils in the Northeast region of Thailand have been noted for many decades. Such soils are characterized by white fluffy salt crystal formed on the soil surface. They are sandy in texture, low CEC, low content of organic matter and low buffering capacity, Rice or other crops grown on these saline soils are physiologically affected resulting in poor growth and yield. Several amelioration treatments have been implied to improve the properties of inland saline soils, but most of them still can not make the reclaimed area become sustainable productive land. The polder system suggested in this report has the aim of turning barren/waste land into sustainable farm land. Its major strategy is to create an artificial ecosystem favorable for farm production. Starting in 1994 a team of scientists from Khon Kaen University, Department of Land Development and Tokyo University of Agriculture have conducted research project (team) and constructed polders at Khon Kaen area to realize a polder system on inland farm land in the polder in the Northeast. Major components of the polder structure consists of a) barriers (dikes and vegetations) to protect the polder from soil erosion and water run off, coming from outside; b) drainage system inside the polder to release excess water during rainy season and irrigation system during dry season; c) introduced vegetations to improve properties of soil inside the polder and d) sustainable crops and animals production system inside the polder. The action plans for researches to study the polder system are also presented herein.

INTRODUCTION

Northeast Thailand occupies the area of 15.14 million hectares or approximately 33% of the total area of the country. The Northeast region covers a broad concentric structure, Korat Plateau which contains two evaporite basins, Korat and Sakon Nakorn (Figure 1). Inland saline soils in the region have been noted for decades. Such soils are characterized by white fluffy salt crystal formed on the soil surface. The dominant salt is NaCl from rock salt. These saline soils are generally sandy in texture with low CEC (less than 10 meq/100 g dry soil), low content of organic matter and low

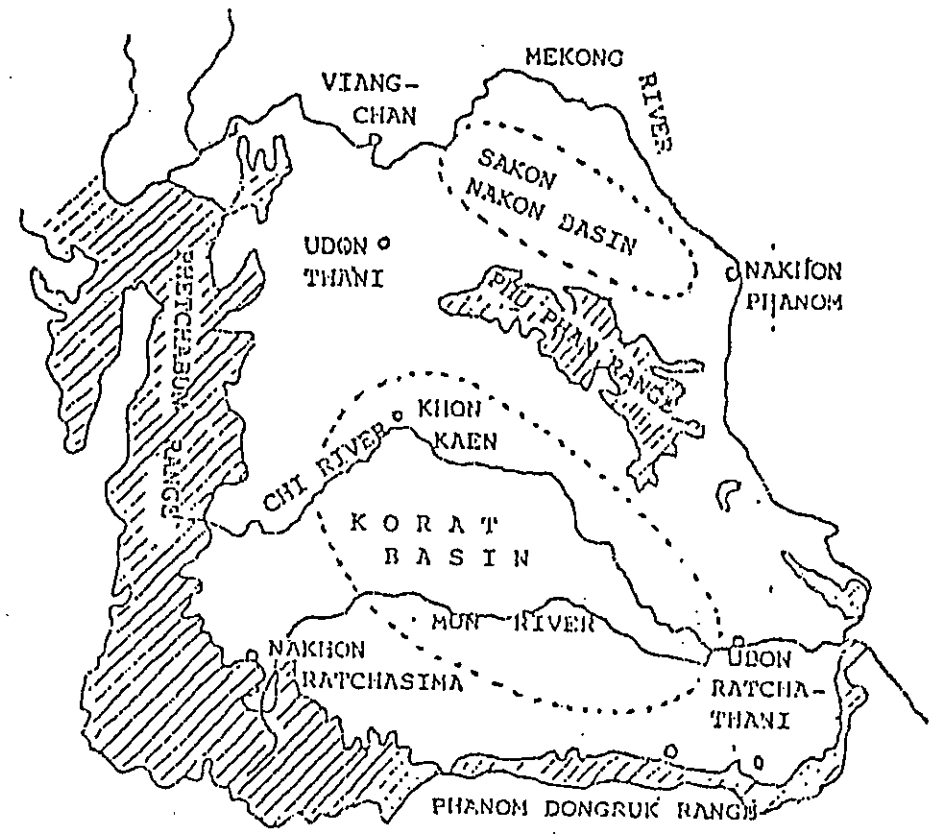

Figure 1 Physiography of the Northeast Thailand

buffering capacity. In all cases shallow level of brackish water is found underneath the inland saline soil area. The formation and distribution of saline soils of salt-affected areas in the Northeast Thailand had been reviewed elsewhere (Sinanuwong and Takaya, 1974 a, b).

It had been estimated that salt-affected soils in the Northeast covered an area of 234,660 hectares or about 5% of paddy soil in the region (Vijansorn and Panichapong, 1987). The areas affected by salt formation keep increasing due to improper management of the area, intrusion of high salinity irrigation by a major cause of local salt manufacture, deforestation in the region. Rice or other crops grown on this saline soils are physiologically affected resulting in poor growth and yield. Therefore, to prevent further deterioration and to reclaim the degrading soil resources, the inland saline soil areas in the Northeast must be improved with various possible

means to bring it back to productive arable land.

PREVIOUS ATTEMPTS TO AMELIORATE INLAND SALINE SOILS IN THE NORTHEAST

At least for the past two decades several amelioration treatments had been implied to improve the physical and chemical properties of inland saline soils in the Northeast. Those, for few examples, included the application of lime, converter slag or composts into the plow layer, the placement of crude oil or rice husk below the plow layer (Patcharapreecha *et al.*, 1990) mulching (Topark-Ngarm, 1988), effect of vegetation on some soil properties in salt affected area (Murase *ed al.*, 1994) and recently the "cut-off zone" technique (Toparkngarm and Sugi, 1993).

The techniques mentioned above have been succeeded to certain degrees depending on the location, type of soil salinity, water supply and weather, following application of the technique. However, most of those techniques are still encountered one problem which is "unsustainability" of the reclaimed area. Although the recent technique, "cut-off zone", which soils are digged up and created a new pile of surface soil with some coarse materials laid down underneath to cut off the uprise dissolved salt, is able to introduce crops into the reclaimed area but the adverse weather as heavy rainfall causing water run-off or flooding in the rainy season and lacking of water supply in dry season unintentional invading of domestic animals into the area can easily ruin the technique leaving unsustainability of the improved land. To become a sustainable productive land the salt-affected areas should be improved simultaneously with the productive (for crop and/or animal production) and preventive (for maintenance) techniques.

POLDER SYSTEM

Concept

The polder system is conceptualized in the aim of turning barren land into sustainable farmland. The major strategy is to create an artificial ecosystem favorable for farm production on unproductive waste barren land. To start doing this, the natures and problems of the existing barren land have to be assessed and analyzed in detail in order to select the proper methods/techniques to overcome the problems. For the inland salt-affected areas in the Northeast its major problems lie on:

1. Poor soil properties (physical, chemical and fertility)
2. Salinity of the soils
3. Shallow brackish ground water
4. Very few or in existing of natural vegetation
5. Water run-off, flood, soil erosion in the rainy season
6. Drought in the dry season
7. No proper improvement or management on the area.

These problems have been assessed

in long term studies by a cooperative research scientist group of Japan Society for the Promotion of Science (JSPS), Department of Land Development, Ministry of Agriculture and Cooperatives and Khon Kaen University. With knowledges and experiences gained from the studies, the group recently suggest Polder System as one of the appropriate techniques to improve and turn the barren saline soil area into sustainable farmland.

Structure

The structure of polder should be made simple enough for construction.

Building a polder can be started by making a low dike encircle a reasonable size of waste barren land to be improved. Shape of any polder can by varied but it has to fit into topography of the location since the surrounding dike will act as a trap to water run-off or flood caused by heavy rain. Inside the polder area there should have drainage canals to release stack water occurred during rainy season. The excess water or run-off inside the polder is a main cause in preventing seed regeneration of the natural or introduced vagetations. Some borrow pits can be constructed to be used as culture ponds for raising salt tolerance water animals (as fishes, shellfishes) and also for algae.

The next step is introducing vegetations into the polder area. On the dike's bank around polder area, a broad belt of trees, bushes or thorny weeds should be established as another-barrier for heavy rainfall. At the first stage, vegetations introduced to the area inside the polder can be some salt-tolerance pasture grasses or pasture legumes or even natural weeds which are expected to improve structure and texture of the soil. The other advantages of pasture species are that it can serve as animal feeds as well as cover turf lawn when planted on banks of the dikes or drainage canals. Mangroves can be another type of vegetation worth to introduce into the saline soil (Topark-Ngarm *et al.*, 1991). Mangroves are capable of utilizing brackish water as well as providing materials for firewood and other miscellaneous uses. However, the suitable species of such vegetations mentioned need to be studied and researched before introduction into the polder.

Later, perhaps two or three years after the introduction of vegetations the barren saline land could be improved then crop production can be initiated inside the polder. It can be started earlier if salinity of the soil in the polder is not too strong. Organic substances should be used to further support the newly reclaimed soil which is still rather poor in texture and fertility. For upland crops or vegetables production the "cut-off saline zone" technique is suggested to be applied at least at the initial period. When the polder system is fully operated creating a new favorable artificial ecosystem with better soil resources then the farmers can use their own conventional methods of growing crops and raising animals. With some understandings and

regular maintenances of the polder system, the farmers in the Northeast in the near future can farm their previously salt-affected areas or barren lands successfully and sustainably.

Action Plans

Although the nice concepts and strategies in creating an artificial ecosystem favorable to farming on inland saline soil in the Northeast have been thought of for some years ago but the actual implementation to establish the polder system only start in 1994 at Khon Kaen by a team of scientists from Khon Kaen University, Department of Land Development, Tokyo University of Agriculture. At initial stage, the action plan includes four (4) research studies as follows:

I. Natures of vegetations to be introduced into the polder system
   a. Survey and identify all plants native to the Northeast region especially in salt-affected areas.
   b. Screen the possible salt tolerance species.
   c. Test the species on their growing ability and seed regeneration under saline conditions.
   d. Select the promising species.

II. Land improvement inside polder by introduction the vegetation.
   a. Study protective effects of vegetations on water run-off, flood and salt dispersion.
   b. Study effects of vegetations on improvement of soil properties.
   c. Study overall of vegetations in environmental control.

III. Polder construction and environmental control.
   a. Construct polder
   b. Study effects of size and shape of polder in controlling water flow and soil erosion.
   c. Study the roles of polder structure
   d. Study irrigation plans *i.e.* irrigation person, irrigation volume and conservation of irrigation water.
   e. Observe and gather relevant information such as amount of rainfall, rate of evaporation, movement of ground water.

IV. Cropping system in polder
   a. Study structure of ridge.
   b. Study varieties of crops to be grown.
   c. Study effects of "cut-off saline zone" technique.
   d. Study effects of supporting organic and farm yard manure.
   e. Study soil fertility status in the polder system.

These action plans have been implemented concurrently in separated experiments conducted in Khon Kaen areas. As when all results are obtained and interpreted then a prime overview of polder system on saline barren land in the Northeast will be presented again.

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