Development of a system for salt removal, crop cultivation, and table salt production that does not rely on a large-scale irrigation and drainage network

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INTRODUCTION

In Northeast Thailand, 1,841,000 ha of soil is salinized (Somsri & Pirach, 2015). The origin of salts is geological (Mahasarakham Formation). The study area of this research, Ban Phai District, Khon Kaen Province, is located almost in the center of Northeast Thailand, where 336,000 ha of saline soils are distributed in the low-lying areas of the Korat Plateau（Arjwech et al., 2019）.

The study area is low-lying and has a small topographic gradient, which makes it difficult to improve drainage. In addition, the average landholding area of farm households is about 2-4 ha, and farmlands are irregularly arranged, making it difficult to construct a drainage network. Therefore, improvement of saline soils through large-scale irrigation-drainage network is difficult, and small-scale, individual measures for salt removal are needed.

The objective of this study is to develop and implement a system that can manage salt at the farm household level without relying on a large-scale irrigation and drainage network, and to improve the cash income of farmers by growing salt tolerant crops and producing table salt.

METHODOLOGY

This study was conducted on 2.6 ha of plots with salinization since April 2018 to the present. Our system (Kume et al., 2019) completes the irrigation and drainage system and salinity management at the farm household level (Fig.1). The main components of the system consist of 1) salt removal through rainfall leaching and drainage improvement during the rainy season, 2) salt-tolerant crop cultivation using rainfall and reservoir water, and 3) traditional table salt production using high-salinity groundwater.

The evaluation of the introduced system for salt removal and crop cultivation was done. Soil salinity was measured using EM38 and EC1:5 and pH were measured using soil collected from 0.05m-1.5m depth. Soil water extracts were used to measure EC1:5, pH, cations and anions using ion chromatography. Salt-tolerant crops were grown during the rainy season and crop length was measured.

RESULTS

Soil EC measured by EM38 decreased from an average value of about 1500 mS/m to 1100 mS/m within one year after excavation of the drainage channel as shown in Fig.2 (Nohara et al., 2021). The soil EC1:5 in the surface layer decreased from 6.0 dS/m to 1.8 dS/m as measured using soil samples. Soil pH did not change significantly before and after excavation of the drainage channel, and was about 8.0 from the surface layer to 1.5 m depth.

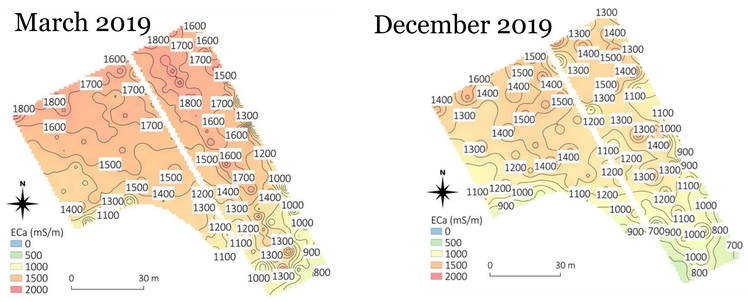

Fig 2. Changes in soil EC (salinity) from March 2019 to December 2019

Crop cultivation was started one year after the excavation of the drainage channel was completed. *Sesbania rostrata* grew up to 1.4 m in height (Fig.3) during the rainy season in farmland that was completely white with salts and devoid of vegetation before the study (Fig.4).

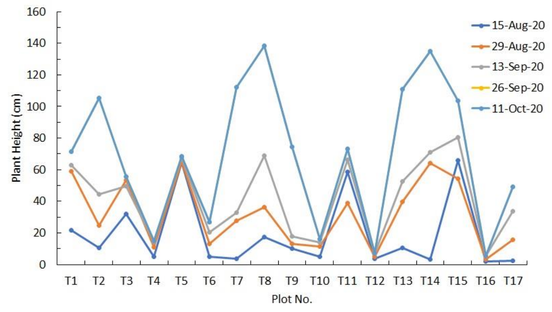

Fig 3. Result of plant growth experiment in 2020
(Plant grew in experimental field two year after the system installed)

Fig 4. As a result of soil improvement, crops are now able to grow

A workshop was held with local farmers who are using traditional methods for salt production. In the workshop, the system was introduced to the farmers, government heads, and students. Interviews revealed that produced table salt is sold to middlemen at 18 baht per kg.

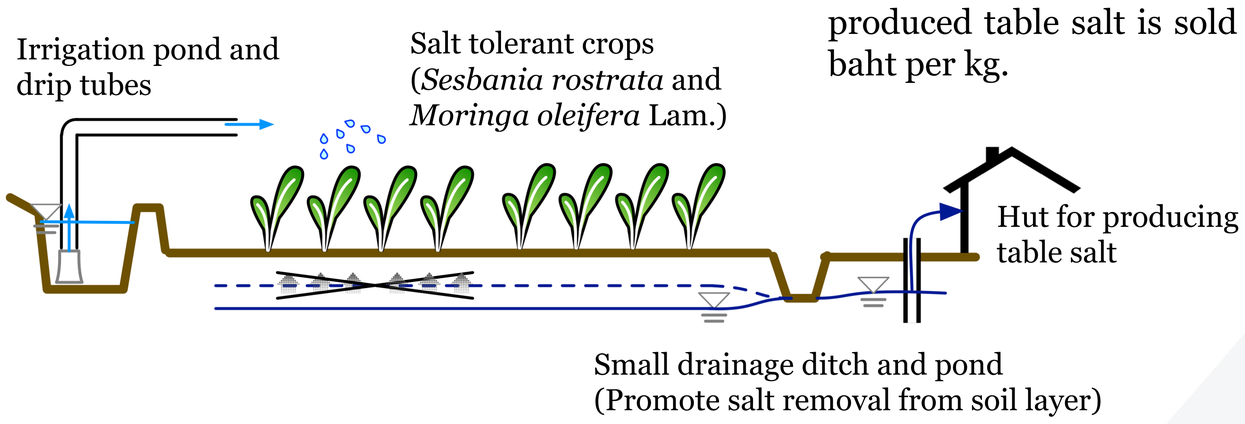

Fig 1. Installed our system which removes salt from soil layer by monsoon rainfall and drainage, grows salt tolerant crops (*Sesbania rostrata* and *Moringa oleifera* Lam.), and can produce table salt at the end of the system using high saline groundwater in dry season.

CONCLUSIONS

The system clearly reduced the soil salinity. This is due to the fact that rainfall in the wet season acts as water for leaching, and salts are discharged from the drainage channels. This indicates that the system is applicable to this region, which has both wet and dry seasons. During the cultivation of *Sesbania rostrata* in the rainy season, rainfall served not only as water for leaching but also as irrigation water for crop cultivation.

One of the unique salt management features of this system is the traditional table salt production that takes place at the downstream end of the study plots (Fig.5). Since it is difficult to cultivate crops during the dry season, table salt production and its sale is an effective way for farmers to earn cash.

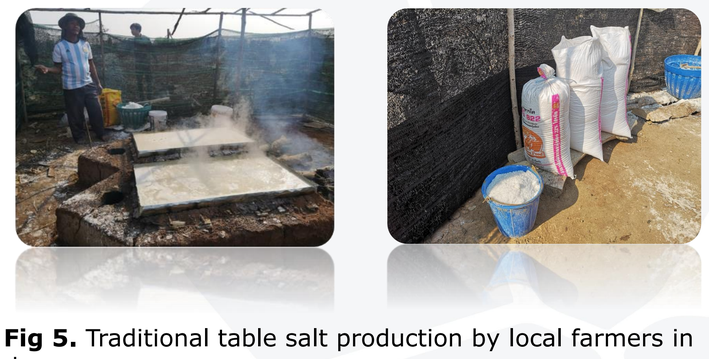

Fig 5. Traditional table salt production by local farmers in dry season

This system has a high potential to be introduced not only in Khon Kaen Province but also in other areas where it is difficult to construct a large-scale irrigation and drainage network. The accurate water and salt balance in the field will enable us to quantitatively calculate the amount of water used by rainfall and reservoir water. This will make it possible to cultivate crops in the dry season using reservoir water, which will further increase farmers' income.

ACKNOWLEDGEMENTS

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