



Food Security and Socio-economic Impacts of Soil Salinization in Northeast Thailand

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Abstract This study aimed to assess the impacts of soil salinity on the crop production system and to describe the food security and social and economic conditions in the salt-affected areas of Northeast Thailand. Ban Nong Na Woaw, Ban Phon Sim, and Ban Som Sanuk, all in the Northeast region of Thailand, were purposely selected because they had different salinity levels and different ecosystems. Random sampling method was used to select 90 households from the three villages and both quantitative and qualitative data were collected from January to June 2012 using a questionnaire, semi-structured interviews, and direct observation. Data were analyzed by means of descriptive methods. In all studied villages, the production system of rice among the farmers was not much different. Farmers used organic fertilizers and farmyard manure to alleviate salinity in their rice field. There were different types of agricultural and non-agricultural activities in the three studied villages practiced by the farmers in order to improve food security of their families. The average of rice yields was very low, about 1.5 ton/ha. The main income source was agricultural work among rural households. Domestic animals raised by most farm households in all villages were cattle, buffalo, pigs, chicken and crickets for home consumption and sale. In addition to salinity effects, periodic droughts, the heavy reliance on monsoons, lack of financial capital and low inputs uses were the other major constraints for the farmers in all villages. This finding suggests that farmers need to be advised to use farmyard manure and green manure in order to reduce salinity. But equally important is correct application and the timely use of urea fertilizer, better weeding, timely harvesting and proper threshing and winnowing. Since rice is the main source of livelihood for the farmers, extension agencies should provide farmers with financial and technical assistance such as salt tolerant rice varieties, knowledge and improved technologies.

Keywords salinity, food sufficiency, livelihood

INTRODUCTION

Soil salinity has become a serious problem throughout the world and around 20% of the world's cultivated land are affected (Sumner, 2000). In Northeast Thailand, approximately 17 % of the land is salt-affected due to salt bearing rocks (Land Development Department, 1991). mainly in Nakhon Ratchasima, Khon Kaen, Roi Et and Mahasarakham provinces (Department of Mineral Resources, 1982). Soil salinity has been accelerated by human activities such as deforestation, irrigation, salt-making and construction of roads and reservoirs (Mitsuchi et al., 1986). It has been one of the most important issues for local farmers who live in Northeast Thailand. Decreasing soil productivity caused by salinization has led to social tension, unemployment and reducing incomes of all social groups. Large-scale soil salinization affects many families in the area with small land holdings. Soil

salinization must also be seen as a human problem rather than one concerned solely with the destruction of ecosystems. While people are the main agents for salinization, they are also its victims.

Northeast Thailand has about 9.3 million hectares of agricultural land, of which approximately 7.9 million hectares are used for rainfed farming (Office of Agricultural Economic, 1998). Up to 75% of this land is devoted to rice, but the planted area varies considerably from year to year, mainly because of uneven water availability and salinity affected land (Arunin, 1984; Yuvaniyama et al., 1996). Besides, the soils in Northeast Thailand are characterized as universally infertile because of their light texture and low inherent nutrient contents (Jiraporncharoen, 1993). The low fertility of sandy soils in the region coupled with frequent drought, degradation and salinity has been accounted for the low yield (Kabaki et al., 2003) and consequently leads to the problem of food insecurity for the farmers.

Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (World Food Summit, 1996). The entire livelihood system of Northeast Thailand is farm-based. Farmers continue to make their living from manual trade and agriculture. Rice, cassava, and corn are the main crops grown under rainfed conditions by practicing traditional cultivation system, and rice is the staple crop of most farm households in the region. Due to certain constraints, low productivity has brought poverty leading to the lowest per capita income in this region of the country. Their dependency on agriculture and lack of knowledge on management might have caused problems of salinization which has a severe effect on soil fertility and crop productivity. Therefore, it requires an investigation in order to get a solution to this problem for a better livelihood of future generations. Much research work has been done on the management of salt-affected soils in Northeast Thailand. However, insufficient research has been undertaken on an evaluation of the food security and socio-economic aspects in salt-affected areas of this region. Yet rice sufficiency is the key to survival in Northeast Thailand as rice forms the greatest portion of daily food consumption for subsistence farmers. Therefore, this study aimed to assess the impacts of soil salinity on the crop production system and to describe the food security and social and economic conditions of the salt-affected areas of Northeast Thailand.

METHODOLOGY

Site selection

This research project was conducted in villages at Khon Kaen, Kalasin and Mahasarakam provinces in Northeast Thailand. The three selected study villages where farmers grow crops in salt-affected soils were Ban Nong Na Woaw, Khon Kaen Province; Ban Som Sanuk, Mahasarakam Province; and Ban Phon Sim, Kalasin Province, all in the Northeast region. These study sites were purposely selected because they have different salinity levels and different ecosystems.

Research design

Qualitative research is best known for the validity of its findings while quantitative research is strong in reliability, and both have strengths and weaknesses (Babbie, 1999; Dawson, 2002). In this study, the typical design was started out with a qualitative part including documentation and in-depth interview. The information from this part helped to develop the tool, a structured questionnaire, for the quantitative study. The quantitative cross sectional study was employed to get information about individual cognitive behaviors and household's socio-cultural and economic characteristics whereas the qualitative approach included in-depth interviews, focus group discussions, and meetings. It was used to gain the in-depth understanding about the situation, problems, causes of the problems, and needs. Therefore, both qualitative and quantitative research methods were used in this study and emphasis was given to the qualitative method.

Research tools

Research methods used in this study include a small questionnaire, semi-structured interviews, and direct observation. The small questionnaire was used in collecting quantitative data. Semi-structured interviews were used in collecting qualitative data and separate guidelines for key informants and household informants were used. This was because holding a well-prepared interview guide in hands, semi-structured interviews are more likely to cover all sub-topics of interest, and thereby reducing the potential risk of missing data. Direct observations were made in order to validate information given by informants (IFAD, 2002).

Data collection and analysis

For data collection and analysis, the interview and information collection process was used as follows: (i) key informant interview and group interview in village level (ii) household level in-depth interview and (iii) observations. Qualitative data was supported by documents and materials relating to the topics covered by the study and the quantitative component of the study. Field notes were converted into detailed notes each day in the field soon after completing all interview sessions of the day. Missing or contradictory information were noted down and verified the following day. When the entire data collection process was completed, descriptive methods were used in data analysis. Quantitative data was analyzed by applying descriptive statistics (mean, percentage, etc) with the help of Microsoft Excel.

RESULTS AND DISCUSSION

The characteristics of the households in the three studied villages in salt-affected areas of Northeast Thailand are shown in Table 1.

Table 1 Characteristics of the study households in the three studied villages in salt-affected areas of Northeast Thailand

Characteristics	Ban Nong Na Woaw (High salinity level)	Ban Som Sanuk (Moderate salinity level)	Ban Phon Sim (Low salinity level)
Sample household	30	30	30
Average age of respondents (year)	56.9 (39 ; 79)	56.3 (35 ; 76)	52.2 (27 ; 70)
Education (%)			
Primary school	60	60	50
Secondary school	40	40	50
Average household size (person)	4.0 (2 ; 6)	3.9 (2 ; 6)	4.6 (3 ; 8)
Landless households (%)	30	20	26
Average labors (person)	2.4 (1 ; 5)	2.6 (1 ; 5)	2.6 (1 ; 5)
Average number of dependents (person)	1.6 (0 ; 5)	1.6 (0 ; 4)	2 (0 ; 4)
Average cultivated area (hectare)	2.4 (0 ; 5.8)	2.1 (0 ; 5.6)	1.8 (0 ; 5.3)

Parentheses show minimum and maximum.

Rice production in the studied villages

As a staple food crop, rice has been grown in the three studied villages for generations. Due to the salinization, limitation of water resources, low soil fertility, high cost of capital investment for land preparation such as sowing, seedling, equipment, chemical fertilizer, pesticide, transportation and high cost of labor, the rice productivity is quite low. This situation has made the farmers face the problem of food insecurity. The villagers mentioned that the expenses of agricultural inputs have increased every year, especially fertilizer and pesticide.

In all studied villages, the production system of rice among the farmers is not much different. However, most farmers use urea fertilizer, but most of them cannot use the recommended dosage, 50kg N/ha, plus compound fertilizer. They use different brands of compound fertilizer with different organic ratio ingredients and various prices depending on the capital accessibility.

There are two varieties of rice grown in the studied villages namely Khao Dawk Mali 105 (KDML 105) and Kor Khor (RD 6), which are non-sticky and sticky rice, respectively. KDML 105 is named as Jasmine rice because its natural aromatic scent is similar to that of jasmine flower. KDML 105 is high quality rice and one of the promising economic crops for Northeast Thailand. Its demand is very high because of its better eating and cooking quality. RD 6 is grown and consumed in the Northeast Thailand region, especially in rural areas. In all studied villages, farmers grow RD 6 rather than KDML 105 because they like RD 6. It was mentioned that RD 6 is for household consumption, whereas KDML 105 is for sale.

Village food security

Despite the fact that Thailand produces more than enough food to meet domestic needs and is a major food exporter, abundant food supplies do not automatically translate into abundant food for the poorer groups of Thai society. Based on group interview in each village, there are different types of agricultural and non-agricultural activities in the three studied villages practiced by the farmers in order to improve food security of their families. Generally, there are different agricultural activities such as rice, cassava, corn, eucalyptus, etc. and non-agricultural activities such as retailer shop, daily labor, salt-making, but not all households get involved in those activities. It was noted that most of agricultural activities in the three villages are similar.

Socio-cultural conditions

Culture, beliefs and religious activities: All villagers are Buddhists and they strongly believe in Buddha's teachings. They value the ordination ceremony when their son or grandson becomes a novice monk. All of the temple donations are based on agricultural income. In a year when the weather conditions are favorable for high productivity of crops, their standard of living is better so they can use the surplus for donations. All of the families do their social, cultural and religious activities after harvesting their cultivated crops. At that time, they can use their crop products and also cash from selling these crops for donations. In the activities, the old persons and village headman play an important role. Even though the village headman has full authority, he shows respects to the old, honorable persons and follows the guidelines and suggestions from them. For the religious activities, monks play very important role in the village. In some social and cultural problems, monks can give the final decision for the village. Seasonal religious festivals are held under the guidance of the monks and elder person.

Economic conditions

Crops and livestock: The major crop grown in the three study villages is rainfed rice, but some farmers grow eucalyptus, cassava and corn. In all villages, no vegetables are grown in their fields, but they are grown in their home garden for household consumption. In all villages, rainfed rice is grown during the rainy season but there is no irrigated rice in the dry season. Domestic animals raised by most farm households in all villages that are cattle, buffalo, pigs, chicken and crickets for home consumption and sale.

Salt production: In the case of Ban Nong Na Woaw, some villagers make salt from the highly salt-affected soil. The old villagers reported that salt production had begun in a primitive manner for household consumption. In this method, the white crust of salt collected from the soil surface is dissolved into water and filtered. The dissolved salt then is crystallized by boiling. This salt-making is done in the off-farm season.

Occupation and income: The village economy is based on agriculture in all studied villages. Most

households in all villages are farm households, and very few households do non-farm work like government officials, public health workers, agricultural input retailer or small shopkeeper. The major source of income for the farm households in all villages is the cultivation of crops and keeping domestic animals like cattle and pigs also make a contribution to household income. Apart from the expenses on basic needs, household income is also spent on such social occasions as traditional festivals. They also spend certain amount money on their children's education, health, transportation, clothing, lightening, kitchenware, house maintenance, donation and personal use. In most cases, farm work is done using family labor, but hired labor is common during peak seasons like transplanting and harvesting of the crops.

Table 2 Comparison of soil salinity level, average rice yield and average household's income among all studied villages in the year 2011

Village	Salinity level [#] (EC _e , dS m ⁻¹)	Average rice yield (ton/ha)	Household's income (US\$/year)	Source of income
Ban Nong Na Woaw	High (>4)	1.56	2096	Farm-based, Non-farm
Ban Phon Sim	Moderate (2-4)	1.56	1935	Farm-based
Ban Som Sanuk	Low (<2)	1.62	2258	Farm-based

[#] Topark-Ngarm (2010) ; EC_e (Electrical conductivity of the saturation extract)

According to the group discussion, in all villages, the average of rice yields is very low about 1.56 ton/ha (250 kg/rai) (Table 2), as compared to other parts of the country (average of 2.9 ton/ha in the central region and 1.8 ton /ha in the Northeast region) (Office of Agricultural Economic, 1998). This low yield might be due to the salinity, low soil fertility and sandy texture soil. The main source of household income was farm-based. This study found that the average income of households from Ban Phon Sim village was the lowest amount when compared to other villages. In contrast, the average income of households from Ban Nong Na Woaw was the highest. The average income of household from Ban Nong Na Woaw was higher even this village has high salinity levels when compared to Ban Phon Sim village which has moderate salinity level because their average productive land areas are more than other villages. Besides, this village is not too far from the township (Ban Phai Township) and hence, farmers can access improved technology from agricultural service and other agencies and supplement to their income also come from other non-agricultural activity such as salt-making and waged labor.

CONCLUSION

The three studied villages face enormous widespread soil salinity as a consequence of soil and water resource degradation. Also, rising water tables resulting from deforestation have caused water-logging problems in many areas. The collected information shows that despite difficulties, farmers are continuing their efforts for the management of salinity to produce field crops. In order to alleviate salinity in their rice field, they apply organic fertilizer and farmyard manure such as cattle manure and chicken waste. However, the average of rice yields is very low about 1.5 ton/ha (250 kg/rai). In addition to salinity effect, periodic droughts, the heavy reliance on monsoons, lack of financial capital, low inputs uses are the major constraints for the farmers in all villages.

There are different types of agricultural and non-agricultural activities in the three studied villages practiced by the farmers in order to improve food security of their families. Domestic animals raised by most farm households in all villages are cattle, buffalo, pigs, chicken and crickets for home consumption and sale.

This finding could suggest that farmers are advised to use farmyard manure and green manure in order to reduce salinity, correct application of urea fertilizer, the timely use of urea fertilizer, better weeding, timely harvesting and proper threshing and winnowing. Since rice is the main source of livelihood system, development extension agencies should provide farmers with financial and technical assistance to make available salt tolerant rice varieties, knowledge and improved technologies in order to increase food sufficiency. Every project to be implemented in these villages should pay more attention to the most vulnerable landless and small farmer households.

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REFERENCES

- Arunin, S. 1984. Characteristic and management of salt-affected soils in Northeast Thailand. In: Ecology and management of problem soil in Asia. Food and Fertilizer Technology Center of the Asian and Pacific Region, Taiwan, Republic of China. 336-351.
- Babbie, E.R. 1999. The basics of social research. Wadsworth Publishing Company. Belmont, California, USA.
- Dawson, C. 2002. Practical research methods: A user-friendly guide to mastering research techniques and projects. How To Books Ltd., Oxford, United Kingdom.
- Department of Mineral Resources. 1982. Geologic map of Thailand. Department of Mineral Resources. Bangkok. Thailand.
- IFAD. 2002. Managing for impact in rural development: A guide for project M&E. Office of Evaluation and Studies (OE), International Fund for Agricultural Development. Rome. Italy.
- Jiraporncharoen, S. 1993. The use of chemical and organic fertilizers in crop production in Thailand. Extension Bulletin No. 370. Food and Fertilizer Technology Center, ASPAC, Thailand.
- Kabaki, N., Tamura, H., Yoshihashi, T., Miura, K., Tabuchi, R., Fujumori, S., Morita, H., Wungkashart, T., Watanatitawas, P., Uraipong, B., Arromratana, U. and Nagara, T. 2003. Development of a sustainable lowland cropping system in Northeast Thailand. Jircas working report No. 30.
- Land Development Department. 1991. Distribution of salt affected soil in the northeast region 1:100,000 map. Department of Land Development. Bangkok. Thailand.
- Mitsuchi, M., Wichaidit, P. and Jeungnijirund, S. 1986. Outline of soils of the Northeast Plateau. Their characteristics and constraints. Technical Paper No.1, 24-35. ADRC, Khon Kaen, Thailand.
- Office of Agricultural Economic. 1998. Ministry of Agriculture and Co-operatives. Agricultural statistics 31/1999, Bangkok, Thailand.
- Sumner, M.E. 2000. Handbook of soil science. CRC Press, Florida, USA.
- Topark-Ngarm, B. 2010. Saline soil. Department of Land Resources and Environment, Faculty of Agriculture, Khon Kaen University, Khon Kaen, Thailand, (in Thai).
- World Food Summit, 1996. Rome Declaration on World Food Security. World Food Summit, November 13-17, 1996. Rome, Italy.
- Yuvaniyama, A., Arunin, S. and Takai, Y. 1996. Management of saline soil in the Northeast Thailand. The Journal of Agricultural Science, 29, 1-10.