Agro-forestry System in Salt Affected Area in Khon Kaen Province, Northeast of Thailand

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Abstract One of the severe environmental problems facing in the northeast of Thailand is salt affected soil. In the total area of the northeast region at 16.928 million hectare, 2.848 million hectare is salt affected land, in which the Mahasarakham rock salt layer laid at the depth of 100-200 meters. The salt affected soil is causing various economic and social problems in the rural areas. As the salt affected soil was not so serious during 1940's when the land was covered with forests, attention has been paid to an agro-forestry system, which is one of alternative agriculture combining with forests. It is expected to reduce the intensity of salinity in the area. However, planting trees does not provide short term benefits comparing to growing field crops, so agro-forestry is hardly to be accepted by local people. Thus, the integration of salt tolerant trees and other crops could be the most beneficial for farmers and soil environment. Accordingly, this study was focused on identifying what effective agro-forestry systems are in salt affected area. Existing agro-forestry practices in Khon Kaen Province were investigated in this study. The agro-forestry practices were conducted in patch forests, paddy bunds, plantations associated with animal husbandry, home gardens and vegetable gardens. The dominant trees in these locations were *Sindora siamensis, Shorea obtusa, Eucalyptus camaldulensis, Bambusa bambos* and *Mangifera indica*. Also, the numbers of variety of trees planted in the salt affected areas were lower than that in the non salt affected areas. Based on the investigated results, it was proposed that agro-forestry practices with higher varieties of trees should be made in salt affected area.

Keywords salt affected soil, agro-forestry, Northeast of Thailand

INTRODUCTION

Salt affected soil is one of the severe environmental problems in the northeast of Thailand. The total area of this region is 16.928 million hectare while the salt affected land covers 2.848 million hectare. Salt components have been transferred to soil surface from Mahasarakham rock salt layer at the depth of 100-200 meters (Yuwaniyom, 2003).

Khon Kaen Province is one of the provinces in the northeast of Thailand which faces salt affected soil problem. Around 71.18 percent of the total area of 1.088 million hectare is used for agriculture, in which 8.03 percent is salt affected land and 19.87 percent has rock salt underneath (Table 1). Especially, salt affected soil problem is severe in Phra Yun District, Ban Fang District, Muang District and Ban Phai District (Khon Kaen Province, 2005).

Several organizations in Thailand and overseas have introduced the utilization of salt-tolerant trees and crops to solve or to mitigate this problem. However, local farmers have not adapted planting trees, as it takes long time to gain the profit (Vittayakorn, et al, 1994).

Table 1 Salt affected area of Khon Kaen province

Salt affected	Area (ha)	Percent
Agricultural area	774,864.79	71.18
Salt affected area	87,414.50	8.03
Area under salt rock	216,304.62	19.87
Total area	1,088,599.04	100.00

Source; Land Development Department. 2008.

Agro-forestry, an alternative agriculture, has been practiced in the northeast of Thailand. In this practice, trees are planted together with field crops in various applications. Even after harvesting the crops, the land is still covered with trees providing windbreak, fuel woods, shades, construction materials and foods to local people.

In 2007, Ruaysoongern studied about agro-forestry systems in the northeast of Thailand and categorized into following 25 groups, 1) agro-forestry in home garden, 2) agro-forestry in big paddy bund, 3) agro-forestry around pond, 4) agro-forestry around water edges, 5) agro-forestry surrounding water resource, 6) agro-forestry with water resource, 7) agro-forestry along water source, 8) agro-forestry in backyard, 9) tree plantation with undergrowth crops, 10) trees along natural water way, 11) trees with vegetable garden, 12) vegetable in paddy head land, 13) trees around fence line, 14) garden around farm shelter, 15) trees along ditch construction, 16) trees for farm border, 17) agro-forestry in salt affected area, 18) agro-forestry in flood prone area, 19) integrated trees and fruit trees, 20) bamboo plantation, 21) *Meliantha suavis* plantation, 22) *Meliantha suavis* around pond, 23) integrated vegetable with trees, 24) economic sufficiency practice and 25) orange plantation in arid areas.

While there were some researches regarding agro-forestry system in Thailand, there were few investigations focusing on agro-forestry practices in salt affected area. So, the objective of this study is to categorize the existing agro-forestry practices in salt affected areas in Khon Kaen Province.

MATERIALS AND METHODS

The field investigation on existing agro-forestry practices in salt affected areas was conducted in September, 2009 in Khon Kaen Province, Thailand. Aerial maps were used for identifying the land utilization. After the land utilization was distinguished, agro-forestry practices were categorized based on the plot of 20 m x 20 m. Then, observing plant profiles of each plot were done as well as conducting a hearing survey to farmers regarding their land utilization.

RESULTS AND DISCUSSION

Trees grown with agro-forestry practices on salt affected land can be observed in patch forests, paddy bunds, plantations associated with animal husbandry, home gardens and vegetable gardens.

Patch forest is a small area of natural forest surrounded by naked land (Fig.1). Trees remain in small clusters along the stream or body of water. The villagers can collect fuel woods and foods such as leaves and flowers. Moreover, the patch forest provides other edible plants like mushrooms or shoots. The samples of tree from patch forest were *Sindora siamensis, Dipterocarpus obtusifolius, Xylia xylocarpa* and *Lannea coromandelica*.

As shown in Fig.2, farmers in the northeast of Thailand prefer to keep trees in their paddy bunds for getting shades, foods, medicines and construction materials. All of the trees found in the paddy bunds were considered important due to their commercial value. Farmers realize that they can gain profits from selling these trees in the future. Even the tree's product like resin is commercially valuable. *Shorea obtusa* was the dominant tree found in the paddy bunds.
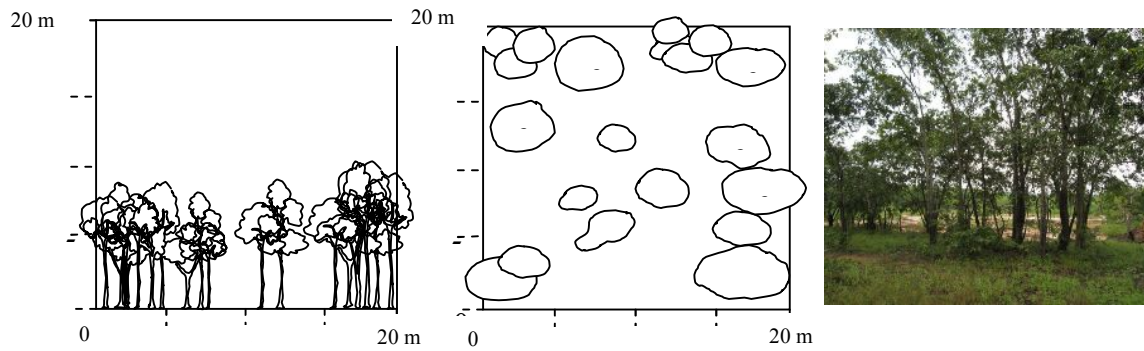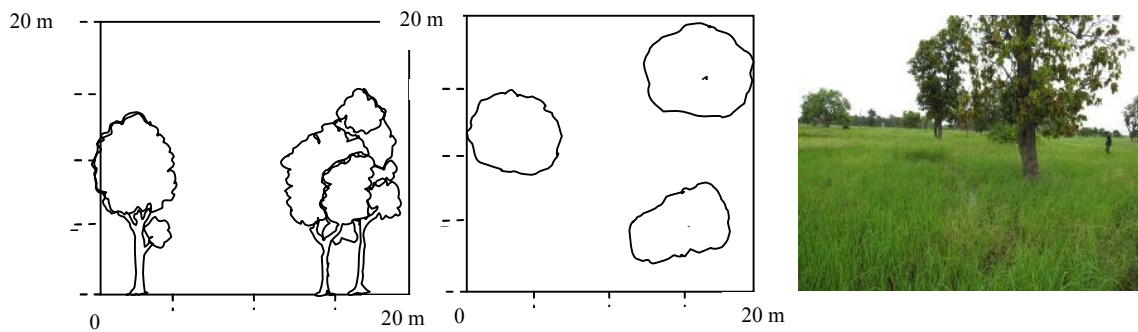
Fig. 1 Trees in patch forests
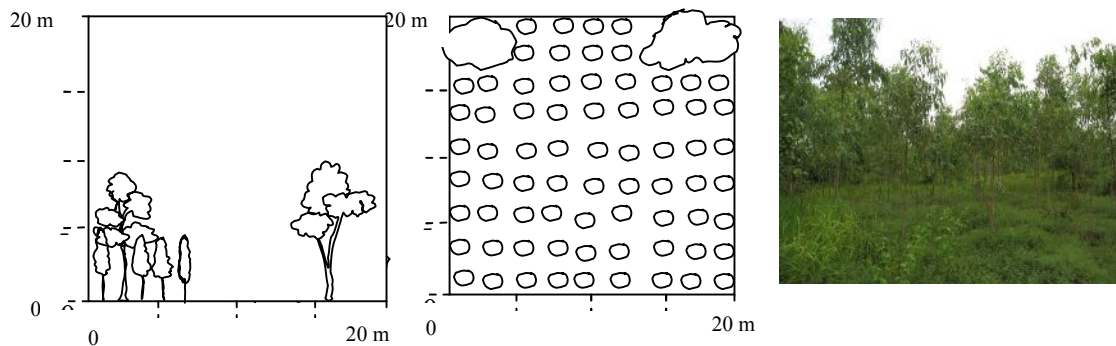

Fig. 2 Trees in paddy bunds

Fig. 3 Trees in plantations associated with animal husbandry

Some farmers with large areas of farmland planted certain varieties of tree and let their cows graze in the plantation for weed control (Fig. 3). The cows also provide natural fertilizer, cow dung, for the tree growing in the plantation. The samples of the tree from the plantation were *Eucalyptus camaldulensis, Tectona grandis* and *Pterocarpus macrocarpus*.

As shown in Fig. 4, some farmers who have sufficient area in their home gardens planted several kinds of tree for foods, construction materials, fuel woods, bio-pesticides and herbal medicines. The examples of tree in the home gardens were *Bambusa bambos* and *Thyrsostachys siamensis* for handicraft, garden fences and temporary construction materials, *Sindora siamensis* for construction materials and furniture, and *Azadirachta indica* for construction materials, fuel woods, foods, herbs and bio-pesticides. Similarly, *Annona squamosa* was used for edible fruits, herbs and bio-pesticides. Fast-growing *Anthocephalus chinensis* was for temporary construction materials and *Pennisetum purpureum* for fodder.
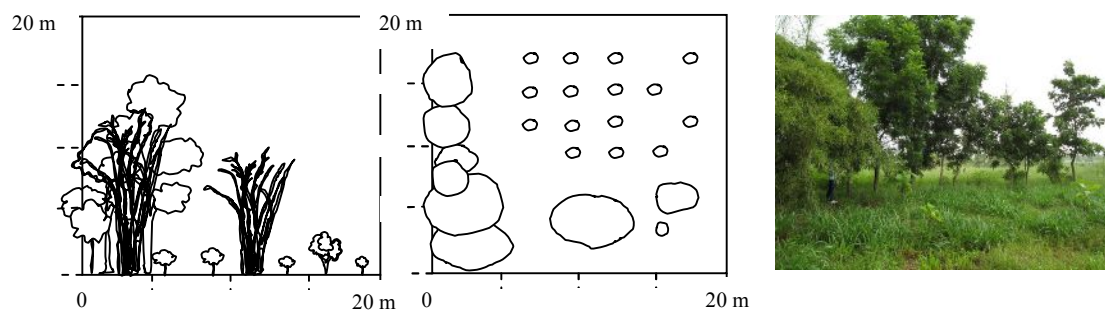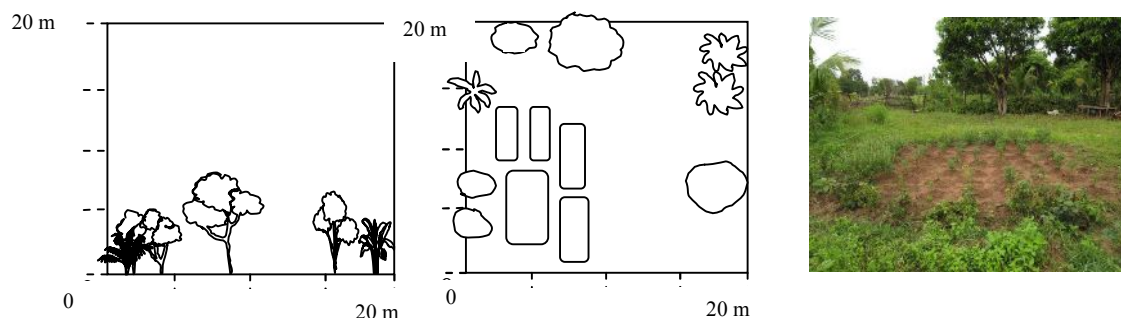
Fig. 4 Trees in home gardens

Fig. 5 Trees in vegetable gardens

Table 2 The utilization of dominant trees found in salt affected area

Number	Name of tree	Utilization
1	*Sindora siamensis*	construction
2	*Shorea obtusa*	construction, resin
3	*Eucalyptus camaldulensis*	construction, pulp paper
4	*Bambusa bambos*	construction, handicraft
5	*Mangifera indica*	edible fruit

In small vegetable gardens as shown in Fig. 5, farmers planted several kinds of tree together with vegetables. While waiting for the trees to be commercially valuable, farmers make profits from vegetables. The trees of *Mangifera indica, Cocos nucifera, Musa sapientum* and *Anthocephalus chinensis* were used for edible fruits and temporary construction materials. The types of vegetable planted with the trees were *Capsicum frutescens, Ocimum canum, Vigna unguiculata* and *Cucurbita moschata*.

The results of the field investigation in Khon Kaen Province indicated that tree varieties of agro-forestry practices in salt affected area ranging from 1 to 8 were smaller than that in the north at 16 varieties, the east at 11 varieties or the south at 15 varieties (Phothitai, 1993). So, it was proposed that farmers should increase the diversity of tree specie especially salt tolerant tree together with salt tolerant vegetable or field crop in each agro-forestry practice in salt affected area.

CONCLUSION

Existing agro-forestry practices in Khon Kaen Province were investigated in this study. The agro-forestry practices were conducted in patch forests, paddy bunds, plantations associated with animal

husbandry, home gardens and vegetable gardens. The dominant trees in these locations were *Sindora siamensis*, *Shorea obtusa*, *Eucalyptus camaldulensis*, *Bambusa bambos* and *Mangifera indica*.

Also, the varieties of tree planted in the salt affected area were lower than that in the non salt affected areas. Based on the investigated results, it was proposed that agro-forestry practices with higher varieties of tree should be made in salt affected area.

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