Study on Vetiver Grass Planting in Problem Soils and Spatial Database Performed in the Office of Land Development Area

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Abstract

This survey research collects vetiver grass planted in problem soils and a spatial database is created, based on soil information found in the areas of responsibility of Land Development Regional Office 6, which include Chiang Mai, Lampang, Lamphun, Mae Hong Son, and Land Development Center of the Royal Initiative Project. It examines soil qualities that may hinder land utilization. The research started in October 2008 and finished in September 2011. A case study of soil and water conservation in slope areas was conducted and divided into three phases: 1) preparation, 2) survey of vetiver grass, and 3) information analysis and publicizing. The preparation phase includes spatial area of study selection, soil and problem soil collection, and collection of information on vetiver grass. The second phase covers survey of vetiver grass, identification of spatial areas of random sampling of vetiver grass and soils, and database systematization. The third phase is the analysis of soils and vetiver grass from the selected areas with the use of GIS program to found a spatial database, the publicizing of information on soils and vetiver grass, and the conservation of soil and water in slope areas. The findings reveal similar features of problem soils for agriculture in the four provinces studied, i.e., upland sandy soils without organic pans, lowland shallow soils depth to pebble or gravel, upland shallow soils depth to laterite concretions, gravel or rock fragment, upland shallow soil depth to marl, upland shallow soils depth to bedrock and slope complex. Vetiver grass was, thus, recommended to Land Development Department volunteers, organizations, schools and the general public to be planted in order to prevent soil erosion along slopes and ponds, streams and road sides. The survival rate of vetiver grass planted by Land Development Department (LDD) volunteers was higher, especially that planted in the Soil Development Learning zone and in the Royal Initiative Project. However, the survival rate of vetiver grass planted in schools was relatively low. Hence, knowledge on how to plant the grass should be offered to people prior to planting in order to increase the survival rate.

Introduction

Problem soils are those which are not suitable for cultivating as well as land which cannot be utilised. The survey mapping of problem soils by Land Development Department in 2004 showed five types of problem soils, i.e. salt affected soils, sandy soils, shallow soils, acid sulfate soils, organic soil and soil with more than 35 percent of steepness. The survey covered 96,006,984 rai of land (153,611.17 square kilometres or 15,361,117.44 hectares), which is considered a very large area of land (Land Development Department, 2006). If land is not utilised properly, soil erosion is

inevitable. The most effective solution to the problem of soil erosion is by conservation of soil and water with combination of vetiver grass planting. The vetiver grass assists in slowing down the ground water flow which causes the soil to erode and keeping soil particles and organic matters with it. By this means, the soil becomes fertile and useful for crops grown in the area. It can be said that the vetiver grass can be utilised for soil quality improvement in either uplands or lowlands and assists in keeping soil moistness. It also helps reduce pollutions in the environment (Land Development Department, 2007). Boonchee *et al.* (1997) experimented alley cropping fenced with pigeonpea and leucaena at the width of five metres and growing corn at five metres wide in between. It revealed that runoff was 320.9 cubic metres per hectare, and soil loss was 0.62 tonnes per hectare. Croping vertically along slopes brought about 567.6 cubic metres per hectare of runoff and 8.49 tonnes per hectare of soil loss. It, therefore, clearly showed that the volume of runoff and soil loss reduced, when compared with typical cultivating, by 44 percent and 93 percent respectively. Soil and water conservation should be applied with a mechanical method and a cultivating method consecutively. At present, vetiver grass has been generally accepted for its effective control of soil loss (Greenfield, 1995). Kaewthip *et al.* (2006) studied the utilisation of vetiver grass for high land development in the Royal Initiative Project in northern Thailand. They found that vetiver grass was used in land development along with soil and water conservation. Vetiver grass was planted in lines along earth steps in cultivating areas. Vetiver leaves were used to cover vegetable and strawberry beds as well as an ingredient in making compost. Vetiver grass assists soil moistness retention and adds fertility to the soil in cultivating beds. Soil with vetiver grass growing is found to have increased volume of organic matters by 15.52 percent. Useful phosphorus and potassium volumes increased by 45 and 130 milligrams per kilogram respectively. Vegetable produces increased by 38.62 percent, which led to an increase in income by 15.26 percent. Aphinda and Aneksamphan (2007) examined the growth and survival rate of vetiver grass planted in different altitudes on sites of the Royal Initiative Project in northern Thailand. The findings revealed that at the altitude lower than 800 metres all vetiver grass could grow well and adjusted itself nicely to the environment. Mae Hae, Mai Huai Wai, Yipun, Monto and Mae La Noi species were adaptable well between the altitudes of 800 and 1,000 metres. Only Mae Hae, Mai Huai Wai and Yipun were able to grow at the altitude over 1,000 metres.

Soil and water conservation is to utilise soil and water resources appropriately with effective methods in order to bring about highest benefits and sustainability (Land Development Department, 2001). At present, the Land Development Department uses two types of soil and water conservation, i.e. technical method and organic method, which consist of 36 schemes of directions. Whichever direction will be used is considered in terms of landscape, water resource and maximum benefit bearing for a particular area. Kanchanadul *et al.* (1994) examined soil loss by applying different direction schemes of soil and water conservation to corn and red bean cultivation on steep slopes at Mu 7, Ban Sahakorn village, Muang Ngai sub-district, Chiang Dao district, Chiang Mai. They discovered that the suitable direction scheme was by cultivating plants that have different yield seasons, in combination with lines of sponge trees mixed with pigeonpea (ma hae bean), vetiver grass, or heaps of dead leaves and plants. They found that the direction scheme studied was effective in preventing soil loss and in the mean time improving soil quality. Soil loss occurred at the least degree and was not statistical significance. The

average soil loss was between 631.3 and 551.7 kilograms per rai a year. In addition, Limthong (2008) discovered that growing vetiver grass in combination with soil and water conservation assisted in retention of soil pieces that are eroded because of ground water flow. Soil pieces that come with the flow get stuck along lines of vetiver grass, which slows down the flow and lets the running water to be absorbed by earth. Vetiver roots expand fast and intertwine densely, which help add moistness to the soil as well as absorb chemicals and nutrients in the soil since they possess many useful micro-organisms. The stems and leaves can be used as covering material for keeping soil moistness and as compost.

The Land Development Department has promoted the use of vetiver grass among farmers for many years, but a spatial database system that shows maps of the grass planting areas has never been created although the grass is distributed largely every year. Therefore, a database which shows the distribution areas, the amount of grass distributed, and its species should be created in order to systematize the distribution of the grass and to reduce the repeated distribution to the same areas in each fiscal year. The database will feature appropriate species of the grass for particular areas with certain problem soils and the direction schemes the grass is utilised, for example, growing around ponds, trees, or along roads or tracks. It will also record problems of the soil in different areas and whether the vetiver grass is able to cope with the problems as well as provide suitable solutions or advice for the farmers such as the suitable species of the grass and planting direction scheme for a particular area.

Materials and Methods

Survey and Vetiver Grass Database Creation

This is a survey and an analysis of soil properties that hinder soil utilisation. The procedure of the study is divided into three phases.

Phase 1: Preparation

Areas for the study were selected from the sites within the responsibility of Land Development Regional Office 6 (LDD 6). They included Chiang Mai Land Development Station, Lampang Land Development Station, Lamphun Land Development Station, Mae Hong Song Land Development Station, and the Royal Project's Land Development Center. The total area is 49,828 square kilometres (31,142,500 *rai* or 4,982,800 hectares). Information of soils was collected and grouped in terms of their colour, upper and lower contents, depth, drainage, topography, problems of soils in the studied sites, and problem soil contents and sites. Information of vetiver grass distribution was collected in terms of grass species, number of distribution, and distributor organisations.

Phase 2: Vetiver grass survey

Species of vetiver grass, cultivating patterns, and methods of utilisation were collected by random sampling. Then, they were recorded and classified by their species, cultivating patterns, number of distributed grass in each site, and comparative survival rates. Samples of soils were randomly collected and analysed for their chemical properties, i.e.

soil reaction and fertility. After that, the information was scrutinised in details for correctness before importing to the database.

Phase 3: Data analysis and distribution

The analysis was conducted by correlating the soil data with the vetiver grass data in the geographical information system computer programme. Then, the correlated data sets were proved for correctness and created in a spatial database and distributed to interested individuals.

Results and Discussion

1. Vetiver grass data, cultivating patterns, species, and survival rates

The data of vetiver grass in Chiang Mai was divided into five groups according to organisation types or growers: Soil Doctor volunteers (Mor Din volunteers), farmers, Royal Initiative Project's stations or centres, academic institutions, and others. The Soil Doctor volunteer group consisted of 35 people and was offered 321,305 vetiver grass sprouts, most of which were grown for transplanting to support Chiang Mai Land Development Station. The rest were grown in various sites such as around ponds or by roadsides in order to prevent soil erosion. The farmer group included 16 people who received 1,334,612 sprouts. They were grown around ponds or bushes of fruit trees. Fourteen academic institutions grew the sprouts around ponds, by roadsides, and in lines on slopes. The Royal Initiative Project used the grass in the amount of 4,338,929 sprouts in combination with the soil and water conservation to grow on sites of its 12 stations. The last group consisting of 6 people grew the sprouts around ponds and by roadsides. The total amount of vetiver grass sprouts used was 6,788,770 and distributed to 83 growers in all.

In regard to species and survival rate, the species of most vetiver grass grown was *Sri Lanka*. More varieties of species of the grass were observed on the sites of the Royal Initiative Project, to which the Operation Center for the Royal Project's Land Development in collaboration with Chiang Mai Land Development Station offered their sprouts. Among them included *Mae Hae* and a royal-bestowed species. The survival rate of the grass grown on the sites of the Royal Initiative Project was higher by 91 percent than those grown by other organisations or growers. On the contrary, the grass grown by academic institutions had the lowest survival rate by 45 percent as shown in Table 1.

The data of vetiver grass in Lampang was divided into five groups according to organisation types or growers: Soil Doctor volunteers, farmers, academic institutions, land development learning centres, and others. Four Soil Doctor volunteers were given 193,000 vetiver grass sprouts to grow on transplanting beds as requested by Lampang Land Development Station. Some were grown around ponds, by roadsides, and around bushes of fruit trees. Seventeen farmers were given 890,000 sprouts to grow around ponds and by roadsides while two academic institutions obtained 200,000 sprouts to grow as barriers on newly moulded grounds around their campuses in order to prevent soil slides and around their ponds. Five land development learning centres used 119,000 sprouts to grow on their transplanting beds, around ponds, and by roadsides. The last

group included two persons who grew the grass as natural fences on slopes. In all, 1,552,000 sprouts were distributed to 30 growers.

The grass' species grown was the royal-bestowed one alone. The survival rate of those grown on the sites of land development learning centres was 88 percent, relatively close to that of the ones grown by the Soil Doctor volunteers, which was 83 percent. Those grown by the academic institutions and farmers had the survival rates by 70 percent and 60 percent respectively as shown in Table 1.

The data of vetiver grass in Lamphun was divided into three groups according to organisation types or growers: Soil Doctor volunteers, farmers, and municipal learning centres. Nineteen Soil Doctor volunteers were given 1,009,500 sprouts, most of which were grown for transplanting as requested by Lamphun Land Development Station. Some were grown around ponds to prevent soil erosion and around bushes of fruit trees. Nine farmers received 373,000 sprouts to grow around ponds and by roadsides. Six municipal learning centres used 414,940 sprouts to grow around ponds and by roadsides to prevent soil erosion. In all, 1,797,440 sprouts were distributed to 34 growers.

The species grown was *Sri Lanka*. The highest survival rate of the grass was 85 percent, grown by the Mo Din volunteers whereas those grown by the municipal learning centres and farmers had the survival rates by 68 percent and 61 percent respectively as shown in Table 1.

The data of vetiver grass in Mae Hong Song was divided into five groups according to organisation types or growers: Soil Doctor volunteers, farmers, academic institutions, the Royal Initiative Project's centres and others. Seven Mo Din volunteers were given 417,500 sprouts to grow on transplanting beds as requested by Mae Hong Son Land Development Station. Some were grown as barriers on slopes and around ponds. Twelve farmers received 315,000 sprouts to grow as barriers on slopes, around ponds, and by roadsides. Four academic institutions grew the grass as barriers on slopes and around ponds to prevent soil erosion. Five centres of the Royal Initiative Project used 408,000 sprouts to grow on a reproduction scheme in order to distribute it to farmers, as a demonstration site in combination with soil and water conservation scheme, and as barriers on slopes. Three others obtained the grass sprouts to grow around ponds and as barriers on slopes. In all, 1,293,500 grass sprouts were distributed to 31 growers.

Table 1 Species, survival rate of vetiver grass in Chiang Mai, Lampang, Lamphun, and Mae Hong Son

	Chiang Mai		**Lampang**		**Lamphun**		**Mae Hong Son**	
Grower	Species	Average survival rate [percent]	Species	Average survival rate [percent]	Species	Average survival rate [percent]	Species	Average survival rate [percent]
1. Soil Doctor volunteers	Sri Lanka	77	Royal-bestowed	83	Sri Lanka	85	Sri Lanka	86
2. Farmers	Sri	58	Royal-	60	Sri	61	Sri	46

	Lanka		bestowed		Lanka		Lanka	
3. Academic institutions	Sri Lanka	45	Royal-bestowed	70	-	-	Sri Lanka	43
4. Centres/stations of Royal Initiative Project	Sri Lanka/ Mae Hae/ Royal-bestowed	91	-	-	-	-	Sri Lanka	84
5. Land development learning centres	-	-	Royal-bestowed	88	-	-	-	-
6. Municipality learning centres/ public places	-	-	-	-	Sri Lanka	68	-	-
7. Others	Sri Lanka	73	Royal-bestowed	25	-	-	Sri Lanka	80

Most grass sprouts grown was of *Sri Lanka* species. There were, however, transplanting beds and demonstration sites of a variety of the grass species in the Royal-initiative Service Centre for Land Development on Pai Basin and the Royal-initiative Pang Tong Service Centre for High Land Development. The survival rates of the sprouts grown by the Soil Doctor volunteers and by the Royal Initiative Project were high by 86 percent and 84 percent respectively whereas those by the farmers and academic institutions were relatively low by 46 percent and 43 percent respectively as shown in Table 1.

In regard to the grass sprouts used for distribution, most were of *Sri Lanka* species, except for such species as *Mae Hae* and the royal-bestowed one which can be grown at high altitudes on the sites of the Operation Centre for Land Development of the Royal Project which are situated in the high lands. The *Sri Lanka* was suitable, recommended by the Land Development Departement, for growing in the northern region. The land development stations did not select certain grass species for growing on their sites, but it was the organisations which supported the grass sprouts themselves that chose which species were to be distributed, considering that they were enduring and could cover up a whole area. No attempt had been made in reproducing the grass and developing more species that could grow well in different landscapes. Three operating land development stations included Chiang Mai Land Development Station, Lamphun Land Development Station, and Mae Hong Son Land Development Station. Only Lampang Land Development Station distributed the royal-bestowed species.

Therefore, the grass survival rate would increase if there were selection of species that are suitable for particular sites, knowledge transfer to farmers or interested individuals, and right nurturing. Furthermore, it is evident that the grass grown, which has been nurtured continuously by the growers who have knowledge about it especially during the first period of growing, would have a high survival rate. The grass could grow very well

that its roots worked to keep the soils intact from erosion. They also penetrated the subsoil or the shallow soil with gravels which they helped improve their structures. With the grass grown about and its roots extended as a network, watering plants was more effective since the soils had more fissures. Water could travel more easily in the soils and reach the roots of plants for use in the photosynthesis process. This resulted in a better growth of the plants. The grass roots assisted in soil moistness retention that led to reduced watering times.

2. Correlations of vetiver grass with soil data

The survey of the vetiver grass in Chiang Mai as shown in Figure 1 revealed that most planting sites were complex slopes with different soil traits that are associated with rock types and steepness of the landscapes that has an average over 35 percent, and the soil belongs to the 62nd soil group. It was found that all the three species of the vetiver grass had relatively high survival rate. In addition, growing the grass in communities where the shallow soils exist with gravels or pebbles in hilly landscapes in Mae Rim district were found to have a high survival rate because there were grown in the inhabited areas. Next, the grass grown in the sandy soil without the layer of organic matters in the hilly landscape of Hot district revealed a relatively low survival rate by 30 percent. Besides, the grass grown in the 5th soil group, i.e. Hd-siclA revealed a relatively high survival rate as shown in Table 2.

The survey of the vetiver grass in Lampang as shown in Figure 2 revealed that the royal-bestowed species was mostly grown in the upland shallow soils depth to laterite concretions, gravels or rock fragment, which are commonly found in Hang Chat and Mae Phrik districts. The 35th soil group, i.e. Hang Chat series [Hc] was found, and the survival rate of the grass grown was relatively high by over 50 percent. Moreover, the 48th soil group, i.e. Mae Rim series [Mr] was also found, and the average survival rate of the grass grown was approximately 70 percent, which was fairly acceptable as shown in Table 2.

The survey of the vetiver grass in Lamphun, Figure 3, revealed the use of the Sri Lanka species grown in the soils of various traits. The majority were grown in the lowland basic soils. The 40th soil group, i.e. San Pa Tong series [Sp-slB] was found in the areas of Muang district whereas the 48th soil group, i.e. Mae Rim series [Mr-g-gslC] was found in the areas of Ban Hong, and Li districts. The survival rate was over 80 percent due to the grass being grown by Soil Doctor volunteers in transplanting beds of the Land Development Department as shown in Table 2.

The survey of the vetiver grass in Mae Hong Son, Figure 4, revealed that most of the grass was grown in complex slopes. The soil traits were various depending on the types of rocks. The steepness of slopes on average was over 35 percent. The soil group belonged to the 62nd. The vetiver grass grown was of the Sri Lanka species. The survival rate was approximately 75 percent. The grass was grown as barriers on slopes by Soil Doctor volunteers, farmers, and school people. The grass grown in the transplanting beds of the extension centre of the Royal Project, Mae La Ma Luang, Sop Moei district had a high survival rate. Besides, the 48th soil group, i.e. Mae Rim series [Mr] was found in Khun Yuam and Mae La Noi districts. The survival rates of the vetiver grass grown in transplanting beds by Soi Doctor volunteers are shown in Table 2.

Table 2 Correlations of vetiver grass with soil data

	Chiang Mai	Lampang	Lamphun	Mae Hong Son
Soil group	62/5 [Hd-siclA]/ 48 [Mr]	35 [Hc]/ 48 [Mr]	40 [Sp-slB]/ 48 [Mr-g-gslC]	62/ 48 [Mr]
Limitations	Sharp slope, high erosion/ low fertility, prolonged inundation/ shallow soil, sandy soil	Low fertility, slope prone to be eroded easily/ shallow soil	Sandy soil prone to be eroded easily/ shallow soil	Sharp slope, high erosion/ shallow soil
Densely found areas	Mae Rim, Samoeng, Mae Wang, Mae Ai, Doi Saket, Fang, Chom Thong, Hot, Mae Chaem, Muang, Saraphi, San Pa Tong, San Kamphaeng, Mae Rim, Hot	Hang Chat, Mae Phrik	Ban Hong, Li	Pang Mapha, Mae Sariang, Sop Moei, Khun Yuam/ Khun Yuam, Mae La Noi
Vetiver grass species	Sri Lanka, Mae Hae, Royal-bestowed	Royal-bestowed	Sri Lanka	-
Survival rate	Relatively high/ relatively high/ relatively low	Relatively high/ fair	Relatively high	Fair/ high

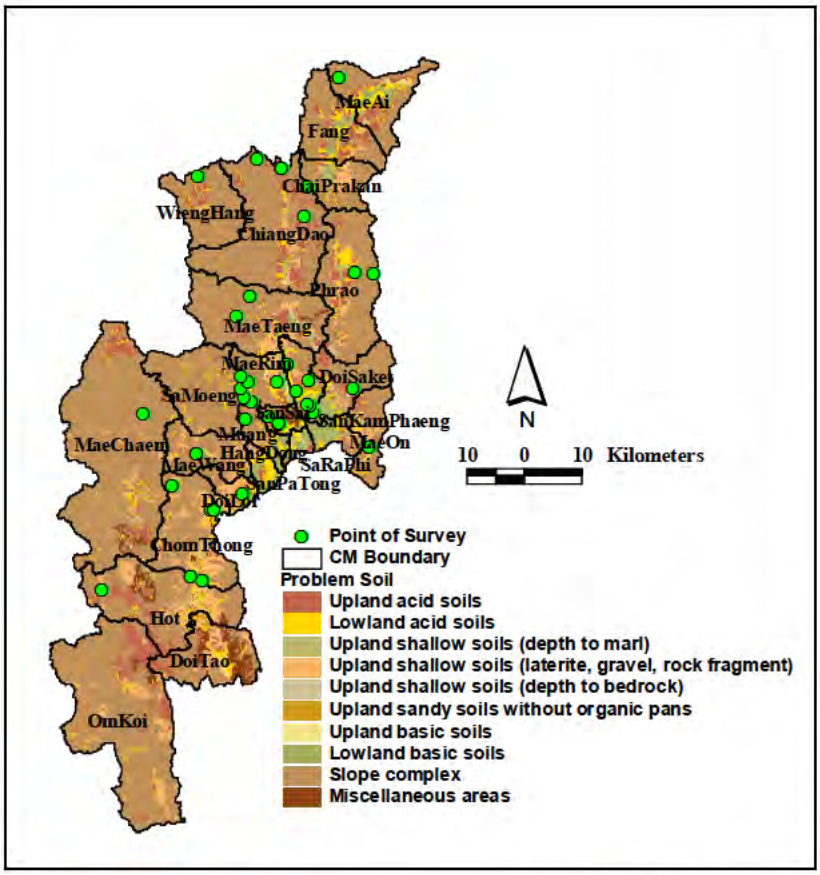

Figure 1 Survey of vetiver grass in Chiang Mai province

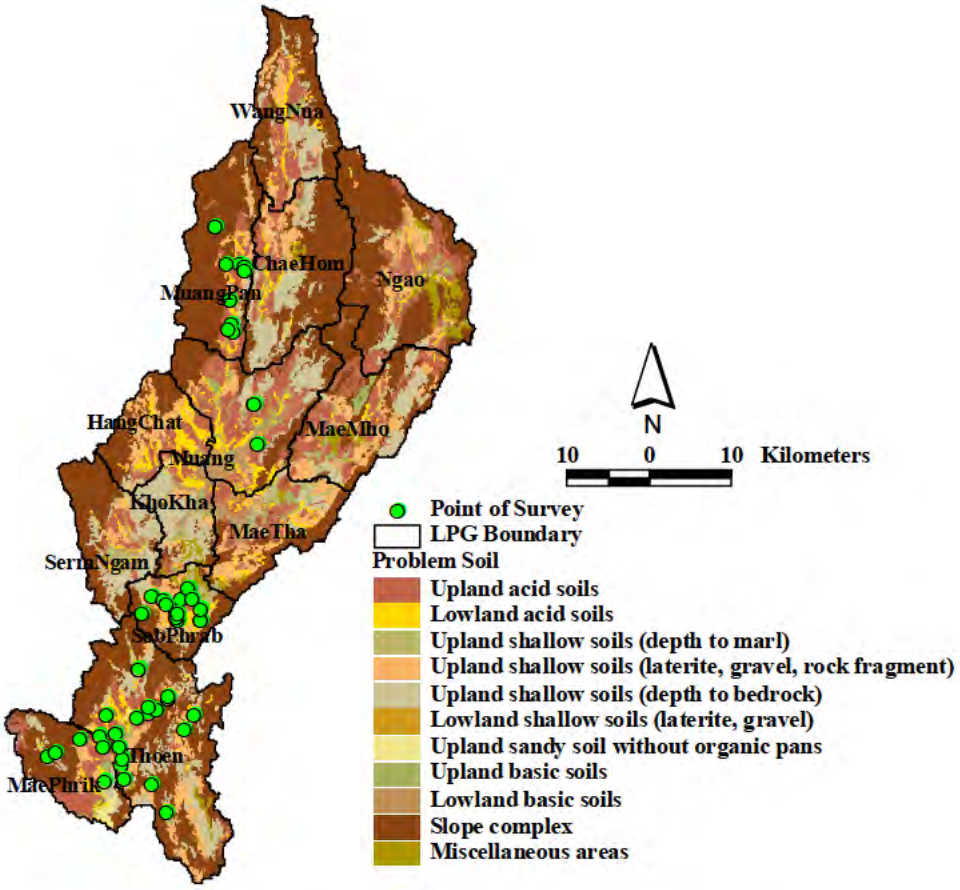

Figure 2 Survey of vetiver grass in Lampang province

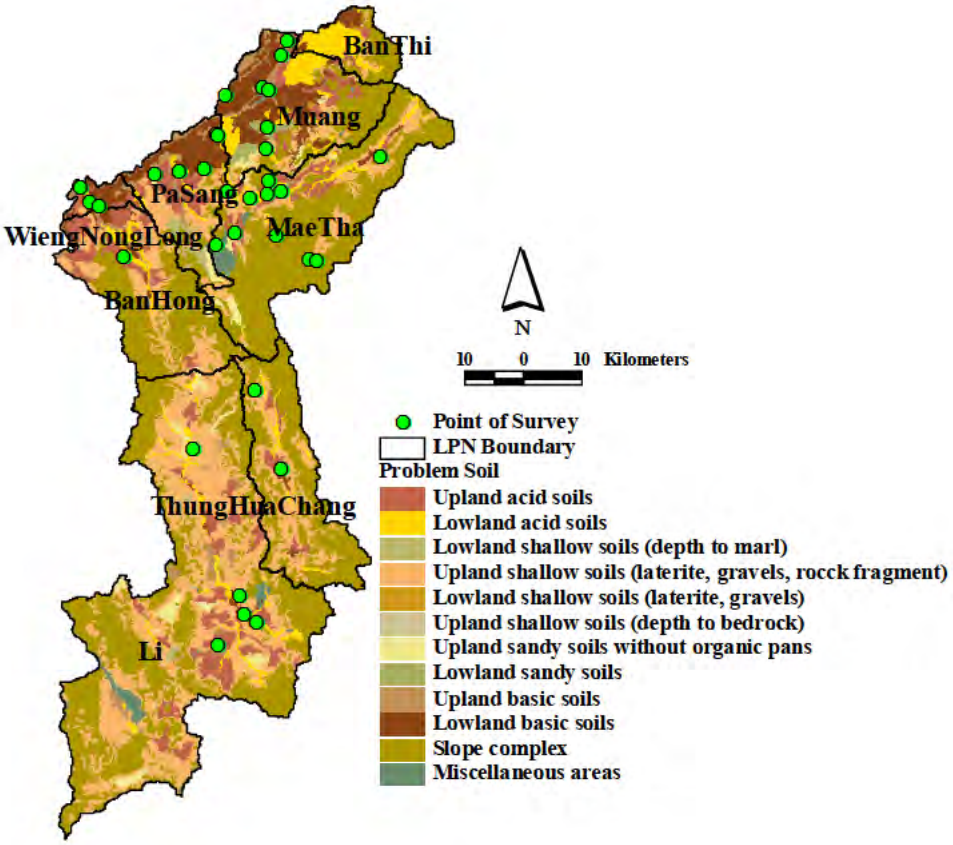

Figure 3 Survey of vetiver grass in Lamphun province

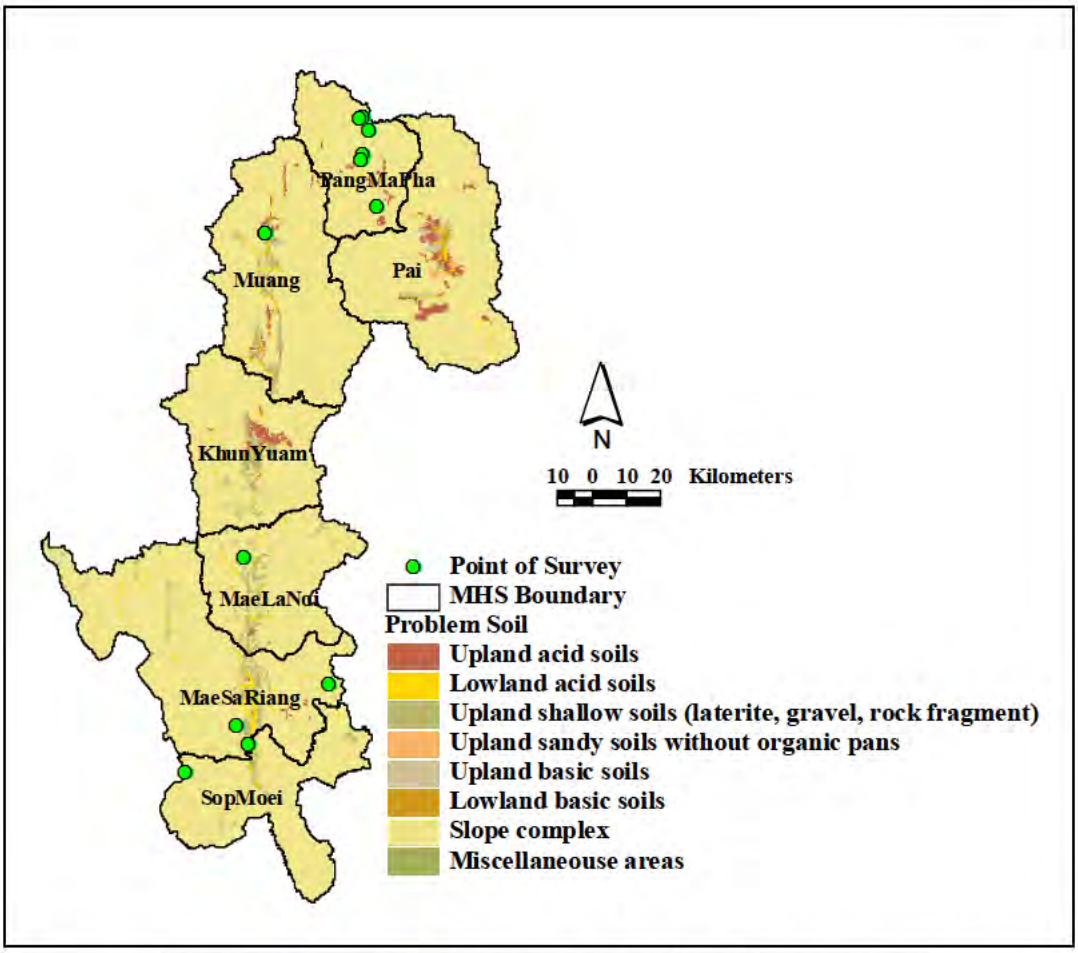

Figure 4 Survey of vetiver grass in Mae Hong Son province

Conclusions

The survey of the vetiver grass grown in the problem soils and the creation of the spatial database within the areas of responsibility of the Land Development Office Regional 6 in 2009 revealed that the most encouraged promoting scheme of the vetiver grass planting was through Soil Doctor volunteers and schools. The utilisation of the grass was various. The most popular one was to use the grass for preventing soil erosion on slopes. The grass was typically planted in combination with the water and soil conservation along the earth steps on slopes. In 2010, the vetiver grass planting in the areas of Lamphun and Lampang was found to be promoted among Soil Doctor volunteers, learning stations of land development, and schools. Not only the grass was used for reproduction as requested by the authorities but also it was used as natural fences or barriers for preventing soil erosion on slopes, around ponds and streams, and by roadsides. The soil series which supports the growth of the grass and its survival rate was the Mae Rim series. In 2011, the study conducted in Mae Hong Son revealed that the grass planting was promoted to Soil Doctor volunteers, the Royal Initiative Project, and local farmers. The utilisation of

the grass was various. The popular one was to plant it in combination with the water and soil conservation scheme and as barriers for preventing soil erosion on slopes. Furthermore, reproducing of the grass was promoted so as to distribute the grass in great amounts to the public. Planting the grass as a demonstration site was also conducted in order to offer knowledge to people. In terms of growers, the survey conducted in the four provinces revealed that the planting by schools was prone to have a low survival rate. Hence, knowledge on how to plant and nurture the grass should be offered to school people more seriously.

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