

Application of Vetiver Role for Soil and Water Conservation in the Northeast of Thailand

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Abstract:The Land Development Department (LDD) has undertaken vetiver programmes since 1990. Many researches have concentrated on finding the best-performing varieties and the best management methods. The research aspects have also searched for vetiver grass varieties suitable for various ecotypes, its advantage to control erosion, retain soil moisture, and improve soil productivity. The proven results have been demonstrating in the study center and disseminating to farmers.

The northeast Thailand composes of 17 million hectares, which is one-third of the country. This region is known to be the poorest one in Thailand due mainly to poor soil and persistent drought. Most soils are sandy, low in plant nutrients, poor physical and chemical properties. In nature, these sandy soils are also salty. Nowadays, the salt affected areas are about 17 % of the region and increasing year by year due to deforestation. To solve the main problem of drought, farmers must construct their own farm ponds. However, being sandy with poor soil structure, erosion can take place easily and soil sediments will be eroded into the ponds. This results in the pond becoming shallow faster and nutrients that get into the pond cause Eutrophication processes that often results in poorer water quality. Planting vetiver on the inner side steep bank of farm ponds can be managed easily by farmers, resulting in less soil sediments flowing into farm pond and could improve farm water quality.

The research and development studies on vetiver grass have been done for about 21 years now. Although it has been a long time, the grass has created a number of benefits which are highly effective. It is such a miracle that this kind of grass can produce benefits for different area conditions may it be the plains or the mountains, shallow soil or deep soil. It appears that the root of this grass can go down up to 5 to 6 metres and does not spread to the sides which means that it is not dangerous to the root system of the plants that are useful. The vetiver hedgerows across a slope can reduce soil erosion. Research programmes on vetiver ecotypes, cultivation and management have been conducted in Thailand since 1990. One result has shown that planted along contour lines of 20/40-% slopes at elevations of 500/1,200 m with 1,200/1,300 mm. annual rainfall, they can prevent soil erosion as well as slow down water runoff, thus enhancing soil moisture.

According to Thailand's experiences, various rows of vetiver from 0 to 3 were established along the inner side of the steep pond bank with more than 100 % slope. Songkhla-3 ecotype was planted with spacing of 30 cm between rows and 10 cm between plants. Results indicated that the ratio of sediment collected from 0:1:2:3 rows of vetiver plots was 4:3:2:1 respectively. Planting at least 2 rows of vetiver was found to be satisfactory in reducing sediments hence decreased soil erosion, which resulted in better water quality under sandy and saline soils of northeast Thailand. In relation to nutrients leached into the ponds, nitrogen, phosphorus and potassium concentrations in the soil sediments were not significantly different among the treatments. However, nutrient loss varied according to sediment dry weights, i.e. nutrient loss increased with the quantity of sediment. Planting 3 rows of vetiver reduced nutrient loss into the pond effectively.

Key words: Soil and water conservation, Farm ponds, Sandy and saline soil in Northeast Thailand

Introduction

Northeast Thailand, the selected study site covering an area of approximately 170,000 sq km. lies between 14° 14' to 18° 27' North latitude and 101° 0' and 105° 35' East longitude (Figure 1.). Geologically, the most extensive area are formed by a thick sequence of Mesozoic sediment, the Korat group ranging in age from upper Triassic to Tertiary. The region is bound by the prominent topography or low hill on the west and the south. The flat to gently undulating alluvial plains are formed in the north and south of the region and is divided by the Phu Phan Range into 2 basins, Sakon Nakhon in the North and Korat basin in the south. These two basins are underlain by the Maha Sarakham geologic Formation. Mean annual rainfall averages 1200 mm. in the south east and 1800 mm. in the Northeast of the region. Land use is restricted to rice, field crops (cassava & sugar cane) and forest. The scattered trees and isolated patches of remnant forest can be found on the gently undulating topography of the alluvial plains. The dense forest, mainly Dipterocarp sp and Evergreen sp covers extensively on the mountainous area and sloping land mostly the National Parks and Wildlife Sanctuaries. Soils are inherently low in fertility and have light texture with low cation exchange capacity

Northeast Thailand is a square shaped plateau almost completely surrounded by mountain ranges and divided into two basins (Khorat Basin, Sakon Nakhon Basin) by a relatively small mountain range (Phu Phang Range). These basins are composed of hilly, undulating and flat low-lying regions. In the flat low lying region, large rivers (e.g. Mun River, Chi River) flow along these mountain ranges. According to Koppen's system, the climate belongs to tropical savanna with an alternation of rainy and dry seasons. In the rainy season, erratic and small rainfall shows two peaks. In the past, a large part of Northeast Thailand was covered with the forests of Dipterocarpaceae. Deforestation has proceeded gradually in old times and rapidly in recent years in parallel with intensification of human activities.

Most of the arable soils in Northeast Thailand are typical tropical sandy soils. Their main primary and secondary minerals are quartz and kaolinite, respectively, because parent materials have been strongly weathered. As a result of the destruction of natural vegetation to make room for cultivation, the soil organic matter is low resulting in low cation exchange capacity (CEC) and low pH. Amelioration of these soils requires liming, fertilization and application of organic matter and 2:1 type clay minerals. Each of these ameliorating techniques encounters respective problems. Rather many farmers are using animal dung as an organic fertilizer for cash crops and/or rice seedlings. This practice has some limitations. Green manure has been considered to be useful, though its extension has not been successful due to lack of proper techniques of cultivation and utilization of suitable plants. A part of the arable soils in the region are salt-affected, salinization being intensified by deforestation. Reforestation is not always effective in desalinizing the salt-affected soils, because the degree of salinization varies markedly according to the position in the relief and both short- and long-term strategies are needed.

The objective of this paper was to review the application of vetiver role for soil and water conservation, reducing the quantity of soil sediments and plant nutrients that get into farm ponds in the affected and sandy areas of Northeast Thailand.

Vetiver Grass Application

Vetiver grass promotion for soil and water conservation was established in 1991, which His Majesty King Bhumibol Adulyadej of Thailand advises to the government agencies who directly response in this matter to research and field trial on utilization and efficient of vetiver on soil conservation and restoration of soil resources. The purposes of vetiver

application are as: soil and water conservation, soil fertility restoration, soil moisture prolongation and soil organic matter improvement.

The Land Development Department (LDD) has undertaken vetiver programmes since 1990. Many researches have concentrated on finding the best-performing varieties and the best management methods. The research aspects have also searched for vetiver grass varieties suitable for various ecotypes, its advantage to control erosion, retain soil moisture, and improve soil productivity. The proven results have been demonstrating in the study center and disseminating to farmers.

Utilization of vetiver grass for soil and water conservation is not difficult for farmers to apply on their own land. It is particularly easy if farmers develop a clear understanding of the benefits and seriously believe in the need to conserve soil resources for generating higher and more productive yields. This and the fact that vetiver helps to prevent erosion and siltation of water sources all contribute to creating benefits for the entire society.

Cultivation is so simple that it can be implemented by people from diverse professions. Propagation is done by separating the shoots or culms which can be carried out frequently because vetiver growth develops very quickly.

Vetiver can be cultivated practically anywhere because it has very few constraints. However, for severely critical conditions such as areas along the coast with high salinity or on peat soil with high acidity, the soil needs to be treated by adding limestone or lime dust before planting vetiver tillers. Methods of Vetiver Cultivation for Soil and Water Conservation.

To serve as an earth embankment for soil and moisture conservation : The steps here begin in early rainy season by ploughing the soil to prepare for vetiver cultivation along contours across the slopes. A furrow is prepared to grow vetiver at a 5 cm. inter-plant spacing; and then 1 culm or 1 to 3 shoots per hole are transplanted. Cover the base of vetiver tightly and leave a distance of no more than 2 m. of inter-row spacing vertically. Vetiver clumps will be established between 4 to 6 months or 1 to 3 cultivating seasons. In case where vetiver is grown on a dry area, the grass should be cut to 30 to 50 cm. high once every 1 to 2 months in order to accelerate the growth of vetiver clumps.

To control gully erosion and water dispersion : Vetiver tillers for transplanting must be well established in order to effectively protect ditches from eroding and in the process, create an embankment for retaining water. The tillers should be developed in plastic bags until they grow in big clumps and are strong enough before transplanting in the ditches. The transplant hole is either dugged horizontally across the ditch or in a reverse direction of water flow. Sandbags or stones can be used to support the embankment and reinforce the hedgerows. The inter-plant spacing should be even closer than the first method with an inter-row spacing of no greater than 2 m. vertically. After an embankment is created, vetiver is planted extendingly on both sides in order to disperse water onto farm areas.

To preserve moisture in orchards: Vetiver should be grown when fruit trees are still young or even before they are planted. The spacing between the vetiver rows depends on the inter-plant spacing between the fruit trees. Vetiver hedgerows are developed along the rows of the fruit trees, leaving a space of 1.5 m. in between. Not only that the hedgerows help prevent erosion and preserve moisture, but also that the cut leaves increase the effectiveness in retaining moisture and improving soil fertility by being regularly used as mulch around the tree bases.

To filter silts around pond edges :The first vetiver row is grown at the highest water level mark. Then one or two more rows are planted above the first, with the definite level depending on the depth of the pond edges. The inter-plant spacing is 5 cm. and vetiver is planted continuously in a row. At the initial stage of cultivation, dead tillers should be replaced in order to strengthen the clump growth. As water is approaching the pond, silts will

be trapped by the hedgerows first while water is allowed to flow down into the pond. Vetiver root system will bind the soil together and prevent the pond edges from eroding.

According to Santibhab et al reported that N, P and K were leached through vetiver rows into the pond attached to the sediment but in small quantities due to low initial concentrations. When vetiver rows thickened, nutrient losses decreased but these were not significantly different between the treatments. The plants took up most nutrients. Nutrient losses into the pond were not enough to cause Eutrophication levels, which lead to poorer water quality. On steep slopes (more than 100%) the inner bank of farm ponds in saline sandy soils which are slightly acidic with low fertility, growing vetiver helps to reduce soil sediment erosion into farm ponds. The more vetiver rows, the less sediment collected. Planting 1, 2 and 3 rows of vetiver can reduce soil sediment erosion into ponds as much as 47.5, 84.4 and 153.8 tons/Ha. respectively.

In addition, vetiver can be planted along roadsides, road shoulders, and irrigation canals as well as on slopes to cling the soil together and restore fertility of the land.

Saline Soil Management

Two major measures, (i) prevention and (ii) improvement and reclamation were implemented in salt - affected areas. Prevention and reclamation measures are used in strongly saline soils areas. In the Northeast where strongly salt - affected soils occur, biological control as reforestation which include screening of suitable salt - tolerant varieties of plants with deeper rooting system and high consumptive use of water are recommended to prevent spread of soil salinization. These plants have been grown in recharge areas to reduce amount of excess water that percolated to the water table. This lowers the saline groundwater table to the depth that capillary rise will not bring saline water up to the soil surface. Reforestation minimized salt - affected area in the project site. The application of Vetiver extension is also introduced to prevent spread of soil salinization in saline soil area.

Land Development Zone

The new strategy operation of soil conservation on farmland is being done in the program of Soil and Water Project Design based on Watershed Management System (Land Development Zone) by regional service centres throughout the country. The soil conservation practices have been implemented both structural and agronomic types. The most common of the former of soil conservation measure in the field terrace has been widely used in low slope area. Bench terrace is less common measure. Hillside ditches seem to be more potential. At present, various types of agronomic practices are implemented. These are compost application, green manure, cover cropping, cropping systems, mulching, tillage practices, tree planting and agro-forestry. The application of vetiver programs are launched thru Land Development Zone.

Soil Doctor System

For the improvement of soil and water resources, LDD has launched some projects such as the training of agriculturalist, information technology services to small districts, the increase of agricultural productivity and the development of water sources in rural areas. Participation from farmers and local people is required in such soil and water conservation projects especially on the part of spreading the recommendations of LDD and information survey of household/person. "Soil doctors" have been established since 1995 in order to increase the efficiency of the activities of LDD. The soil doctors are in charge of coordinating of land development among farmers in the village, transferring soil and water conservation technologies including vetiver programs to their neighbors and participating in some

activities of LDD. Vetiver propagation and multiplication project is one example of vetiver promotion to soil doctor system.

Conclusion

In conclusion, the application of vetiver cultivation for soil and water conservation on farm land are primarily to prevent or reduce surface soil erosion, to conserve soil moisture, to enhance organic content, to translocate plant nutrients underground by covering the soil with vetiver leaves, and to mark the boundaries of an area. Vetiver culms can be used to filter silts and allow only some portion of water to flow through. As for the roots, they will penetrate vertically into the soil and serve as a wall to let water seep down, loosen the soil, and enhance proper ventilation underground. The leaves that are used to cover the soil will increase organic content and preserve soil moisture. When the leaves have fully been decomposed, it will release nutrients valuable to vegetables, floral plants and ornamental plants. Vetiver is also grown on raised beds to prevent erosion of the edge while the leaves are used as soil cover in place of hay. If certain areas in which fruit or perennial trees are already planted and appear to sustainably remain fertile and abundant, then it is not necessary to grow vetiver. For areas in which fruit trees are grown but still have some spaces between them, vetiver can be grown in a long line across the slope to preserve moisture and prevent soil erosion. Or otherwise, vetiver can be grown in a semi-circular pattern to receive water flow and trap silts outside the shade area between the trees or at least 1.5-2.0 m. away from the bases of the trees

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