

MANAGEMENT AND MONITORING OF VETIVER GRASS PLANTATION IN THAILAND BY USING VETIVER GRASS TRACKING SYSTEM

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ABSTRACT

The Land Development Department (LDD) has developed the Vetiver Grass Tracking System (VGT) since 2011 whose main purpose is to manage and monitor the database of vetiver grass plantations in various parts of Thailand. VGT is a spatial Geographic Information System (GIS) designed into 14 fields of vetiver planting data, which the 26 agencies in both government and private sectors can access, edit and retrieve all information directly via the LDD website. The vetiver grass planting data in 14 fields can be separated by location and geographic coordinates, ecotype, number of tillers, pattern and benefit of vetiver plantation including figures and video displaying the activities. As the result of vetiver plantation throughout of the country during the year 2011-2014, presently the database in VGT has a total of 5,311 records (sites). Currently there are totally 418 million tillers planted from 2011-2014 and the number continually increases from 39 million tillers in 2011 to 133 million tillers in 2014. The Northern part of Thailand has the most number of planted tillers equal to 145 million tillers (34.75%). The level planted in the Central plain is equal to 107 million tillers (25.79%). In the Northeastern and Southern parts of Thailand there are 92 million tillers (22.08%) and 72 million tillers (17.38%) respectively. The pattern and purpose of vetiver plantations in the agricultural areas is mainly in protection of soil sediment into reservoirs (2,481 records or 60.09%), soil erosion prevention with 1,999 records (29.04%) and improvement of soil fertility and soil moisture conservation with 95 records (2.30%). LDD is the government agency that supports the vetiver tillers and technically supports the vetiver plantations to other agencies. The VGT database shows that *Chrysopogon zizanioides* is the predominant species with 4,092 records (97.45%) planted in Thailand. In addition, the database is designed to be easily used, and is, convenient and effective for officers and the general public to access for information on vetiver grass plantation in various parts of Thailand including maps and attribute data at <http://www.ldd.go.th>. Moreover, policy makers can use the VGT database as a tool to monitor and manage implementation activities and plans, to promote future vetiver use and continually advocate for the utilization of vetiver for soil and water conservation, soil improvement and environment preservation.

Keywords: Management and Monitoring, Vetiver Grass, Thailand, Vetiver Grass Tracking System (VGT)

Introduction

Soil and environment deterioration are major problems especially in the agricultural area of Thailand, which have resulted in the decreasing of agricultural yields and exceeding of soil erosion in large parts. However, His Majesty the King's far-sighted ingenuity for high potential and significance of vetiver grass in natural resources management, the development and promotion of vetiver grass utilization has been initiated and spontaneously participated by various agencies in the study, research, results expansion and information dissemination on vetiver grass plantation throughout twenty-three years. The Land Development Department (LDD) has launched the campaign on vetiver grass plantation for land and water conservation project since 1993 and to commemorate the 84th Anniversary of HM the King's Birthday on 5th December 2011, which has been widely participated by various agencies. Also in the same year, the Vetiver Grass Tracking System (VGT) was developed by the Land Development Department in order to manage and monitor the vetiver grass plantation in various parts of the country.

The LDD policy extremely emphasized to enhance and implement the development and campaign of the utilization of vetiver grass project under the Royal Initiatives, by taking part in the committee and sub-committee founded to perform such activities under the Office of the Royal Development Project Board (ORDPB). The missions entrusted to the LDD management involve the technical matters, the follow-up and evaluation, the promotion and dissemination of information, all of which are to respond the Royal Initiatives with more accuracy, completeness, efficiency and proficiency to conform to the current situation. Besides, the LDD is the main agency propagate and produce the vetiver tiller in both bared root and in plastic bag, and provide such vetiver tillers and technical assistance to other government agencies and farmers in local area every year.

The VGT is a spatial Geographic Information System (GIS) designed into 14 fields of vetiver planting data, which the 26 agencies in both government and private sectors can access, edit and retrieve all information directly via the LDD website. These 14 fields of vetiver planting data can be separated by location and geographic coordinates, ecotype, number of tillers, pattern and benefit of vetiver grass plantation including figures and video displaying the activities. The purpose of this study is to manage and monitor the database of vetiver grass plantations in various parts of Thailand during the year 2011-2014 by VGT. The number of annual vetiver grass tillers at the national and regional levels, together with the maps of vetiver grass plantation, its utilization patterns in agricultural areas and its ecotypes are monitored.

Materials and Methods

The VGT is a spatial Geographic Information System (GIS) designed into 14 fields of vetiver planting data, which the 26 agencies in both government and private sectors can access, edit and retrieve all information directly via the LDD website. The vetiver grass planting data in 14 fields can be separated by location and geographic coordinates, ecotype, number of tillers, pattern and benefit of vetiver plantation including figures and video displaying the activities. As the result of vetiver plantation is collected throughout of

the country during the year 2011-2014. To access into the VGT, it requires a computer that supports data display by general free web browsers. The VGT can access by 2 channels, which are website of the LDD (www.ddd.go.th) under the topic “Executive Information System (EIS) in respect of Land Development” as in the center of the screen, and go in to menu “Data of Vetiver Grass Plantation Monitoring (in both MIS and GIS format)”; or access to the system directly by typing the <http://eis.ddd.go.th/vgtrep/vgtrep.asp>.

However LDD and other 26 agencies can access to add, retrieve and edit these 14 fields of databases by select item from the menu. In the item “Summary with Multiple Conditions” the screen will display dialog box to select duration of planting, select desire province or all and also select desire agency or all. The VGT program will provide and display all of the data which are selected. As the result of summary of vetiver grass plantation in every province and every main agencies during the selected range of time shall be displayed. The selected data can be downloaded in the form of spreadsheet and database file.

The importance information in the VGT is number of tillers, geographic coordinate sites, ecotypes and planting patterns of vetiver grass in each location. In general, the summarized data in each year of implementation is analyzed at regional level consisted of 15 provinces in the North, 21 provinces in the Northeast, 27 provinces in the Central Plain and 14 provinces in the South. Moreover the summarized data of each agency and at province level are also emphasized and observed by LDD and other agencies.

The location of vetiver grass plantation in each record of database is retrieved by GPS as the geographic coordinate sites, which are generated into location of vetiver plantation map by using GIS application in VGT program. The created maps can generated in the national and regional level (4 regions), and also at province, district and sub-district levels as shown in this paper. All database of number of tillers, planting patterns and ecotypes of vetiver grass in this VGT program during 2011-2014 can export in both MIS and GIS data compatible with general spreadsheet and database program

Results and Discussion

The Land Development Department shall process the data from the VGT to demonstrate the number of planted vetiver grass of each year. Data of the vetiver grass plantation is shown at the national level; the regional level *including* the North, Northeast, Central Plain, and South; the provincial level *including* 15 provinces in the North, 21 provinces in the Northeast, 27 provinces in the Central Plain, and 14 provinces in the South. The report shall include location maps of the vetiver grass plantation in four regions and demonstrate the case studies to show location of vetiver grass plantation in the province, districts, and sub-districts. Such data shall be reported to the Committee and the ORDPB so that they can monitor vetiver grass plantation in Thailand and set out operation plans to further develop and promote the utilization of vetiver grass under the Royal Initiatives. The report will disseminate to various organizations and general public so that they can monitor the progress made on the vetiver grass plantation.

1. Numbers of Vetiver Grass Tillers Planted in Thailand

The Land Development Department has monitored the vetiver grass plantation in Thailand by VGT program since 2011. It is found that the vetiver grass plantation in Thailand has increased continuously to the total of 39 million, 114 million, 130 million and 133 million tillers in the fiscal years 2011, 2012, 2013 and 2014 respectively, as showed in detail of each year in Table 1 and Figure 1. During these four years, the accumulate number of vertiver grass plantation in Thailand has reached 418 million tillers (Table 1).

Table 1 Number of vetiver grass tillers planted in each region of Thailand during 2011 – 2014

Region	Year				Total tillers	
	2011	2012	2013	2014	Number	%
North	7,608,124	39,925,034	55,742,600	42,047,870	145,323,628	34.75
Northeast	14,769,000	21,896,508	20,034,070	35,648,640	92,348,218	22.08
Central Plain	9,806,900	26,923,015	37,208,767	33,897,740	107,836,422	25.79
South	7,022,134	26,177,500	17,542,500	21,914,400	72,656,534	17.38
Total	39,206,158	114,922,057	130,527,937	133,508,650	418,164,802	100.00

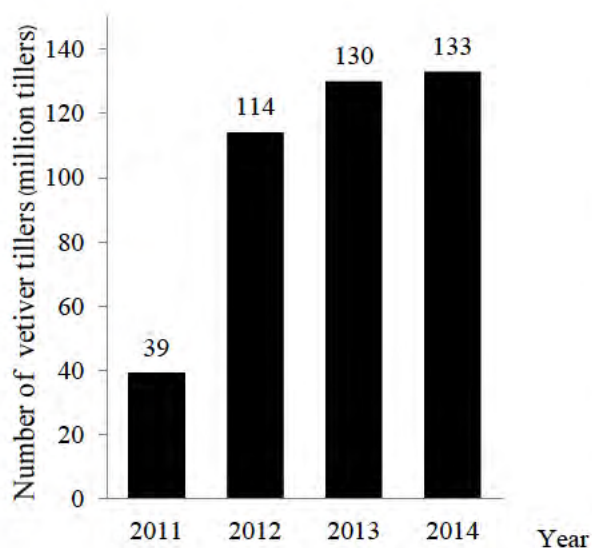


Figure 1 Number of vetiver grass tillers planted in each year during 2011-2014 in Thailand

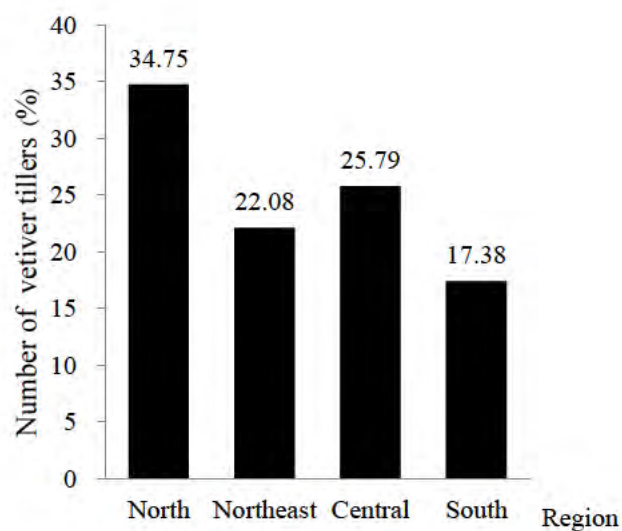


Figure 2 Number of vetiver grass tillers planted in each region of Thailand during 2011-2014

Of this total amount, the vetiver grass plantation in the Northern part of Thailand takes the largest portion with 145 million tillers (34.75 % of total amount). It was followed by the Central Plain, the Northeast and the South with 107 million, 92 million and 72 million tillers, thus accounting for 25.79%, 22.08% and 17.38 % respectively as showed in Table 1 and Figure 2. This is due to the fact that the most areas of the Northern part are

sloping and undulating area; therefore, large numbers of vetiver grass are planted to prevent soil erosion. As for the Central Plain which comes in the second rank, the areas are mostly low land and large numbers of water resources are constructed outside the irrigation areas, totaling 50,000 sites annually. It is necessary to grow at least two or three rows of vetiver grass around these ponds to prevent sedimentation.

The Land Development Department has produced the maps to demonstrate the areas of vetiver grass plantation during the year 2011 - 2014 at the national level and the regional level (*i.e.* the North, the Northeast, the Central Plain and the South) as showed in Figure 3. Also produced the maps in the case studies of vetiver grass plantation at the provincial level (Chiang Mai province); the district level (Mae Taeng district of Chiang Mai province); and the sub-district level (Inthakhil sub-district of Mae Taeng district, Chiang Mai province) as showed in Figure 4.

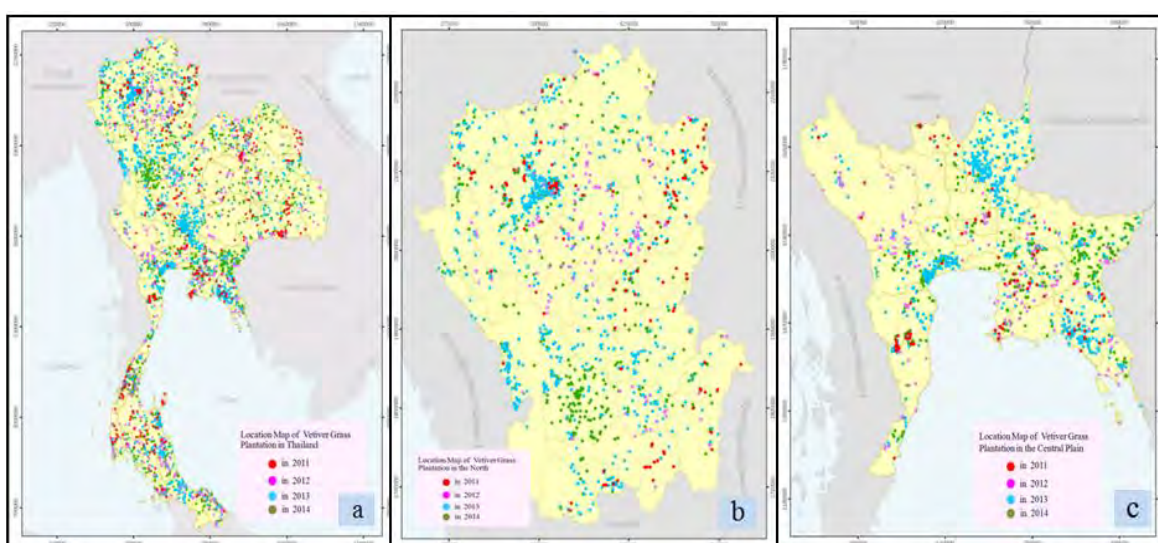


Figure 3 Location map of vetiver grass plantation during 2011-2014 (a) national level (b) regional level in the North and (c) regional level in the Central Plain

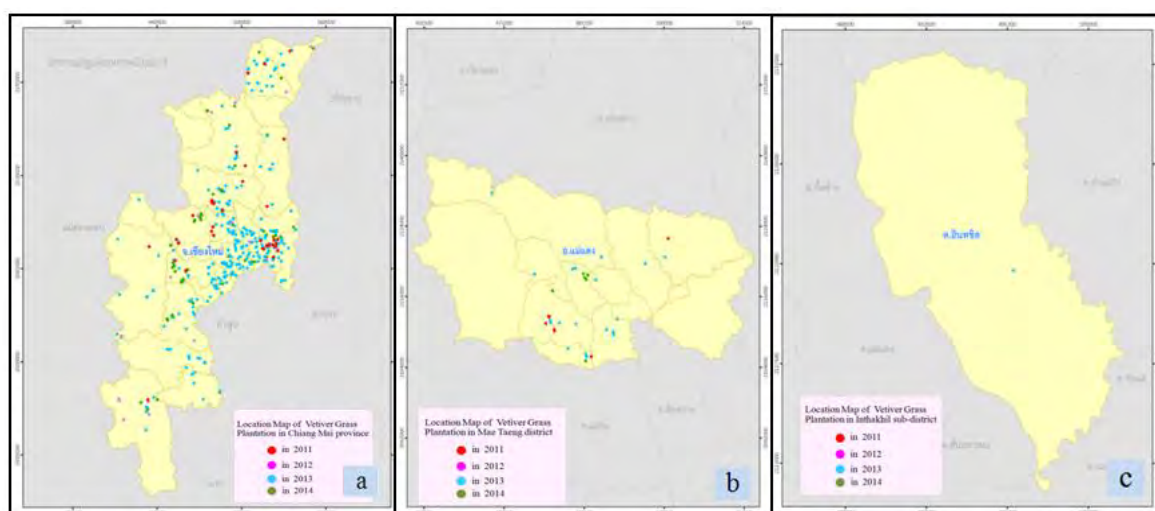


Figure 4 Location map of vetiver grass plantation during 2011-2014 of case study : (a) Chiang Mai province (b) Mae Taeng district and (c) Inthakhil sub-district

2. Utilization Patterns of Vetiver Grass in the Agricultural Areas in Thailand

In Thailand, vetiver grasses are utilized in agricultural areas in different patterns, which can be categorized into four major groups as follows:

1. Planting of vetiver grass for prevention of soil erosion at sloping areas, side slope of roads, both sides of road in the crop fields, as showed in Figure 5 (a) on the contour lines (b) on the rim of terraces (c) side slope of road and (d) both sides of farm road.



Figure 5 Planting of vetiver grass for prevention of soil erosion at sloping areas

2. Planting of vetiver grass for prevention of sediment into reservoirs, farm ponds, rivers, canals, streams, drainage channels and drainage ways, as showed in Figure 6 (a) reservoirs (b) drainage channel (c) water way and (d) the rim of raised bed areas.



Figure 6 Planting of vetiver grass for prevention of sediment into reservoirs

3. Planting of vetiver grass for improvement of soil fertility and preservation of soil moisture in cash crop areas, as showed in Figure 7 (a) vegetable crops (b) upland crops (c) fruit crops or perennial trees and (d) around planting areas.



Figure 7 Planting of vetiver grass for improvement of soil fertility and preservation of soil moisture in cash crop areas

4. Planting of vetiver grass for rehabilitation of the environment at waste water ponds and contaminated and poisoned areas, as showed in Figure 8 (a) waste water pond and (b) contaminated and poisoned areas.



Figure 8 Planting of vetiver grass for rehabilitation of the environment waste water ponds and contaminated and poisoned areas

During the years 2011-2014, vetiver grasses planted in agricultural areas of Thailand can be categorized into four major groups. The first group is to prevent the soil erosion; the second to prevent sediments into water resources; the third group to increase soil fertility and preserve its moisture content; and the fourth group is for other purposes.

Percentages among these four patterns of vetiver grass utilization are 29.04%, 60.09%, 2.30% and 8.57% respectively as showed in Table 2.

It appears that vetiver grass plantation in Thailand has mostly served the purposes of preventing soil sediments into water resources with the number of 2,481 sites (60.09%), followed by the preventing soil erosion with 1,999 sites (29.04%). In this regard, the Land Development Department has launched policy to promote construction of water resources outside the irrigation areas so that the farmers shall be provided with water during the dry season. In each year around 50,000 ponds are built and at least two or three rows of vetiver grasses are planted around each pond to prevent soil sediment. Moreover, vetiver grasses are planted on sloping areas, side slope of roads and both sides of roads in the crop fields to protect them from soil erosion in the rainy season.

Table 2 Number of records of utilization patterns of vetiver grass in the agricultural areas in Thailand during 2011-2014

Utilization patterns of vetiver grass	Year				Total	
	2011	2012	2013	2014	Records	%
prevention of soil erosion	212	166	432	389	1,199	29.04
prevention of sediment into reservoirs	252	411	1,040	778	2,481	60.09
improvement of soil fertility and preserve of soil moisture	4	62	26	3	95	2.3
others	38	91	80	145	354	8.57
Total	506	730	1,578	1,315	4,129	100

3. Ecotypes of Vetiver Grass Planted in Thailand

The Land Development Department and related agencies surveyed and collected vetiver grass from the natural habitat and 112 samples of vetiver were found spreading over the country. The samples were classified into 2 types as lowland vetiver (*Chrysopogon zizanioides*) and upland vetiver (*Chrysopogon nemoralis*). Based on the preliminary classification, there were 28 ecotypes. These ecotypes were observed in the experimental plot for suitable character in growth cannot propagate by seed and conservation of soil and water, and 10 ecotypes were selected with dominant characteristics to utilize for extension and promotion in the implementation project. They can growth rapidly and survive in drought condition and easy to produce tillers in propagation process. The selected 10 ecotypes were used for the implementation project as lowland vetiver grasses are Sri Lanka, Kamphaengphet 2, Suratthani and Songkhla 3, and upland vetiver grasses are Loei, Nakhonsawan, Kamphaengphet 1, Roi ET, Ratchaburi and Prachuab Khirikhan.

During 2011-2014, the vetiver grass plantation in Thailand totals 4,199 records, of which 4,092 records (97.45% of total number) belong to *C. zizanioides* and 107 sites (2.55%) are of *C. nemoralis* as showed in Table 3. This is contributed from the fact that *C. zizanioides* are easily to grow, germinate and propagate in large numbers by shoots. Therefore, the Land Development Department has produced tillers of *C. zizanioides* in greater numbers than *C. nemoralis*. Besides, the leaf surface of *C. zizanioides* is covered

with wax, making it soft and shiny. On the contrary, the leaf surface of *C. nemoralis* is covered with less wax, making it rough, abrasive and dull, thus cutting wounds in the skin. However, the result of research activities by LDD staffs showed that *C. zizanioides* can grow faster and survive better than *C. nemoralis*, especially in the initial stage of plantation and also the most farmers prefer the types of *C. zizanioides* rather than *C. nemoralis*.

Table 3 Records of ecotype of vetiver grass planted in Thailand during 2011-2014

Type	Year				Total	
	2011	2012	2013	2014	Records	%
<i>C. zizanioides</i>	480	771	1,648	1,193	4,092	97.45
<i>C. nemoralis</i>	22	40	7	38	107	2.55
Total	502	811	1,655	1,231	4,199	100.00

4. Recommendation and Benefits

It is essential for officers of LDD and each agency which directly involved in this project accurately, completely and regularly adds and records the implemented data of each site to ensure the implementation and monitoring of vetiver plantation in Thailand in respect of result expansion to develop and promote the utilization of vetiver grass under the Royal Initiative. In this case, the VGT usage manual and the vetiver grass monitoring manual (in the form of MIS and GIS) can download from the first page of website of the Land Development Department <http://www.ldd.go.th>. However, the 26 vetiver grass planting agencies are appreciated for cooperation in filling up the vetiver grass plantation data accurately into the VGT which is the key element in achievement of the implementation and monitoring of the vetiver grass plantation in Thailand.

The VGT program will support information from the database and provides as one stop service at Land Development Department by showing total number of vetiver grass plantation, sorts of vetiver grass utilization, and species of vetiver grass planted in Thailand each year, at the national and the regional level, together with the location map of vetiver grass plantation that shall be used to set up the operation plans to further develop and promote utilization of vetiver grass under the Royal Initiative, and also to publicize the information to organizations and general public.

Agriculturists, students, and general public are able to access and search information on vetiver grass plantation in various areas and are able to learn types of vetiver grass utilization for land and water conservation. General public people can access and search for information on vetiver grass plantation easily, conveniently and effectively in the form of spatial and attribute data pass through LDD websites. They can choose the suitable utilization patterns of vetiver grass in their agricultural area. Moreover, the database of vetiver grass plantation in VGT are processed for supporting the implementation plans and activities to continually campaign and promote of utilization of vetiver grass in the concept of sustainable development.

Conclusion

The Land Development Department (LDD) has developed the Vetiver Grass Tracking System (VGT) since 2011 whose main purpose is to manage and monitor the database of vetiver grass plantations in various parts of Thailand. VGT is a spatial Geographic Information System (GIS) designed into 14 fields of vetiver planting data, which the 26 agencies in both government and private sectors can access, edit and retrieve all information directly in the LDD website.

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The numbers and maps of annual vetiver grass plantation at the national and regional levels are shown. The pattern and purpose of vetiver plantations in the agricultural areas is mainly in protection of soil sediment into reservoirs (2,481 records or 60.09%), soil erosion prevention with 1,999 records (29.04%) and improvement of soil fertility and soil moisture conservation with 95 records (2.30%). LDD is the government agency that supports the vetiver tillers and technically supports the vetiver plantations to other agencies. The VGT database shows that *C. zizanioides* is the predominant species with 4,092 records (97.45%) planted in Thailand.

In addition, the database is designed to be easily used, and is, convenient and effective for officers and the general public to access for information on vetiver grass plantation in various parts of Thailand including maps and attribute data at <http://www.ddd.go.th>. Moreover, policy makers can use the VGT database as a tool to monitor and manage implementation activities and plans, to promote future vetiver use and continually advocate for the utilization of vetiver for soil and water conservation, soil improvement and environment preservation.

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