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Acceptance Letter

Paper ID: **TICEAS-378**
Title: **Preparation of Data Base by Plots nd Mapping of Land Utilization in the Water Conservation Project Area of Her Majesty the Queen, Northern Thailand**

Dear **Jukkaphong - Poung-ngamchuen & Preeda Nathewet,**

We sincerely appreciate your paper submission. On conclusion of the peer-reviewed process, we are pleased to inform you that your paper is accepted for **Oral presentation** at Tokyo International Conference on Engineering and Applied Sciences (TICEAS 2014) in Tokyo, Japan. Decisions were made based on a double-blind review process. The exact time and room of your presentation session will be specified in the TICEAS Conference Program online at http://www.ticeas.org/ **in the middle of October 2014.**

TICEAS 2014 policy and procedures require at least one author to register for and attend the meeting to present the paper when it is accepted. The registration deadline is October 10th, 2014. If we do not receive your registration with payment by October 17th, 2014, your paper will be withdrawn from the Proceedings.

If you have any further questions, please do not hesitate to contact the secretariat of TICEAS 2014 by sending your email ticeas@ticeas.org with your **manuscript ID number listed above on all communications.** Again, congratulations on the acceptance of your paper. On behalf of the Program Committee, we look forward to your full participation in the TICEAS 2014 Conference.

Yours Sincerely,
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Preparation of Data Base by Plots and Mapping of Land Utilization in the Water Conservation Project Area of Her Majesty the Queen, Northern Thailand

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ABSTRACT

Data base preparation of land utilization of farmers under Water Conservation Project area has been studied in 3 watersheds of three provinces, northern Thailand. The study was divided into 5 stages: 1) explore and collect field data; 2) retrieve data and develop area data base; 3) analysis of soil properties; 4) analyze appropriateness for cultivation; and 5) design and develop the supporting system for decision-making on cultivation. A set of questionnaires was used for data collection from 842 farmers' households. The collected data were analyzed by using descriptive statistics. Geo-informatics technology was employed for field survey. Data base preparation and analysis of appropriateness for cultivation was conducted together with Analytic Hierarchy Process (AHP). The results indicated that each of three watershed areas was different in terms of topographic condition, culture, and race, however, the major income for those farmers was from cultivation. MapWindows GIS program which was able to cope with VB.net 2008 program was used to design and develop the information system of the project. It had potential in adding and correcting data in the form of .dbf data table (Thai version). Data could be retrieved into 3 forms: data adding, analysis of data classification, and common data analysis. Main criterion was determined: 1) topographic condition; 2) climate condition, 3) physical properties of the soil; 4) chemical properties of the soil; and 5) water sources.

Keywords Water Conservation Project, Her Majesty the Queen, data base by plots

1. Introduction

The "Water Conservation Project" or "Rak Nam Project" is the one responsive to the Royal Initiatives of Her Majesty Queen Sirikit, Thailand. This aims to convince people living on the high land to be aware of the importance of trees, water, and soil

as the sources of water or streams. Besides, it can make them have appropriate and sustainable livelihoods [1]. This project covers 6 provinces of northern Thailand and it mostly is the wildlife sanctuary area and national park. People often have problems about land right of possession for livelihood which cause conflicts with concerned government agencies. Meanwhile, they lack of confidence in farming in the national reserved forest. However, the determination of appropriate land utilization is a way to reduce the conflicts and prevent natural deterioration [2]. This can be done by using the Global Positioning System (GPS) [3]. This system can show various forms of data presentation e.g. environment and resources, infrastructure information, cadastral information, and socio-economic information [4].

This study covered 3 watershed areas in 3 provinces of northern Thailand. It focused on the preparation of data base related to land utilization, and condition analysis, farming area, socio-economic system, and upstream forest rehabilitation and conservation. In addition, it seeks for a guideline to protect forest resources of each area by the coordination between government agencies and local people.

2. Methodology

This study covered 3 watershed areas in 3 provinces of northern Thailand namely: Maesa Nga (Mae Hong Son province), Ping Noi (Chiang Mai province), and Khun Nan (Nan province). The sample group consisted of 842 households living in 3 watershed areas. It consisted of 5 steps: 1) survey and data collection by using a set of questionnaires and GPS technology; 2) preparing and designing data base by using the application of geo-informatics technology (Geographic Information System: GIS and Global Positioning System: GPS); 3) investigation of soil properties for plant cultivation (i.e. soil texture, bulk diversity, and porosity) and composite sampling for an by analysis of chemical and physical properties of the soil; 4) an analysis of appropriate soil properties and topographic areas by using Geographic Information System (GIS) and Analytic Hierarchy Process (AHP) [5]; and 5) preparing and developing area information by using MapWindow GIS together with VB net 2008.

3. Results and discussions

3.1 Fundamental data of the sample group

Maesa Nga Watershed (Mae Hong Son province): target groups were Mok Cham Pae (a) and Maesa Nga (b) villages (320 households). Most people were elementary school graduates and most agricultural workforce was male. Most of them had their own farm land (70.8% (a) and 67.2% (b) respectively, and 172 (a) and 119 (b) plots, respectively). They relied on irrigational canal and built a cement ditch for water supply (Fig. 1). They mostly grew cash crops i.e. rice, garlic, and soybean. The land

which soybean was grown had a high level of acidity with a moderate level of organic matter. The farmers also used chemical fertilizer together with compost. Agro-chemicals used were: insecticides, fungicides, and herbicides. For production costs, the following were found: 1) organic and chemical fertilizers (4,852-6,450 Baht per year); 2) agro-chemicals (1,960-2,910 Baht per year); 3) land rental for farming (7,965-8,496 Baht per year); 4) workforce (7,65-8,496 Baht per year); and 5) farm machinery rental (4,329-6,644 Baht per year). The following were problems encountered: infertile soil, lack of workforce, high cost of workforce, drought, epidemic, low yields, and high production costs.

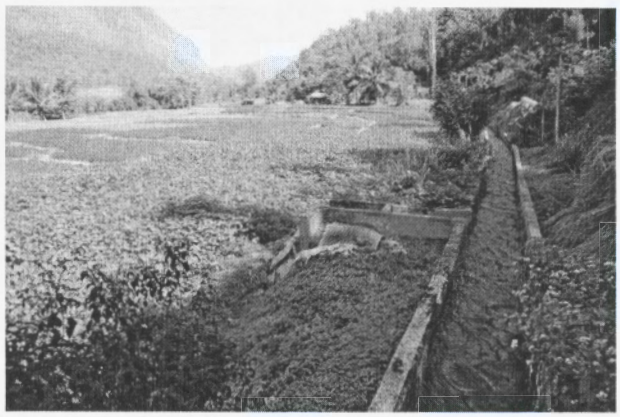

Fig. 1 Cement ditch for water supply

Ping Noi Watershed (Chiang Mai province): target group was Baan Maehae Tai setosa Bordae village (136 households). Population in this area was Karen hill tripe. More than three-fourths (77.20%) of people were not educated. The proportion of male and female workforce was almost the same. They had their own farm land (5.1-1- rai on average). There were 613 farm land plots with 6.5 rai each plots. Most farmers grew cash crops i.e. rice, kidney bean, maize, and vegetables. The soil there had a low-moderate level of acidity. There was a moderate level of an amount of organic matter. Also there was a low level of an amount of potassium. Farmers used various kinds of chemical fertilizers and also weed killers. For production costs, it was found that farmers spent 7,178.33 Baht on average (mostly on chemicals and chemical fertilizer). They had problems about water sources for farming, lack of agricultural knowledge and high product costs.

Khun Nan Watershed (Nan province): target groups were Baan Sajuk and Baan Sakiang villages (217 households). Almost one-half (44.00%) of people were not educated and most (96.30%) agricultural workforce were male. Most grew plants edible i.e. rice and vegetables, but very few grew cash crop i.e. mulberry and fruit trees. Their farming was under rained condition and production costs were 5,053.09-6,759.46 Baht per year on average. They mostly spent money on chemical

fertilizer, agro-chemicals, and workforce. They had a low level of agricultural problems. The following were problems encountered: lack of water source, drought, and a low price of yields.

3.2 Developing and designing of the area data base system

This study was developed the data base by gathering the information for main data preparation. Each main data consisted of Sub-data (Table 1).

Table 1 Data base and main data

List of data base	Main data
Soil	Soil texture, water drainage, and depth of top soil
Water	Main streams having water throughout the year
Topographic condition	Slope of the area
Climate condition	An amount of rain and temperature
Land utilization	Name of land owners, crop types, and yields (kg. per rai)
Change of land utilization	Land utilization in 2002 and 2013 and change of land
Chemical property of soil	pH, organic matter, available P, exchangeable K, Ca, Mg, extractable Fe, Mn, Cu, and Zn
Management	Name/surname of plot owners, crop types, time span of current crops, historical background of land utilization, size of farm land, soil/fertilizer management, economic data of each household, etc.

Soil data base: the cultivation area of the 2 in 3 watersheds was slope complex [6]. However, Ping Noi and Khun Nan watershed was highly risky to soil erosion. Most soil physical in Maesa Nga area was clay loam soil and sandy loam soil. There was a moderate level of water drainage and uncertainty of physical properties in Ping Noi and Khun Nan watersheds [7]. Thus, data on soil texture, water drainage, and depth of top soil could not be utilized.

Water data base: Maesa Nga watershed had 3 main streams having water throughout the year (within the distance of 500 meters of cultivation area) (Fig. 2). Ping Noi watershed had 4 main streams but some cultivation areas was far away more than 1,500 meters from water resources, resulted in agricultural problem during dry season. Khun Nan watershed had only one main stream which was far away from the community (Fig. 2). However, farmers could make use of its tributaries.

Topographic data base: it was found that, almost one-half (46.66%) of Maesa Nga watershed was slope for 5-12 percent. Farmers mostly grew rice, soybean, and garlic. More than one-half (54.54%) of Ping Noi watershed was slope complex for more than 35 percent and rice/maize were mainly grown. Most of Khun Nan watershed

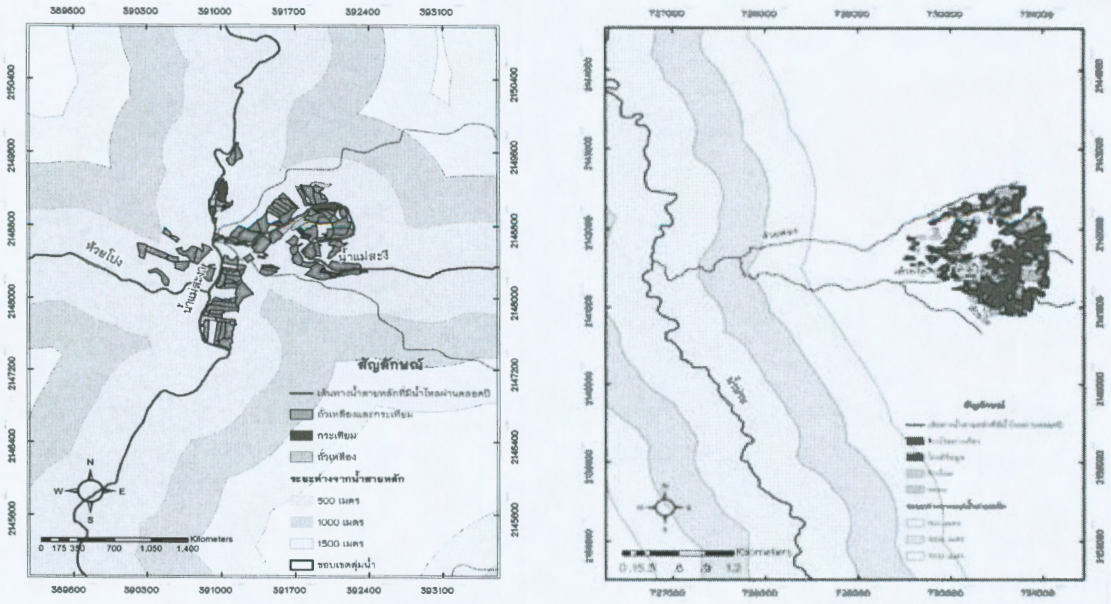

Fig 2. Stream ways in Maesa Nga (a) and Khun Nan (b) watershed

(86.02%) was slope complex for more than 20 percent and inappropriate for cultivation. Farmers mainly grew rice and maize.

Climate data base: Maesa Nga watershed had a highest temperature during March-May and a lowest temperature during October-January. This had a negative effect on crop growing. Ping Noi watershed had a highest temperature of each month for more than 30°C which had a negative effect on rice growing. A lowest temperature was during January-March. Khun Nan watershed had a lowest temperature during January-March and a highest temperature in April.

Data base on land utilization of each plot: in Maesa Nga watershed, farmers mainly grew rice and soybean/garlic as rotation crops. Few of them only grew rice. For Ping Noi watershed, there were 4 types of cultivation: only grew rice, grew rice and maize, grew soybean, and grew kidney bean. In Khun Nan watershed, farmers mainly grew rice but they also grew maize and domesticated farm animals.

Data base on change of land utilization: Maesa Nga watershed had not much of change of land utilization. They mostly grew rice and there was a little forest encroachment. For Ping Noi watershed, it was rice of forest and farmers grew rice. In Khun Nan watershed, there was change of land utilization from forestry to rice growing so there was an increase in deforestation. Farmers grew local rice varieties having low responsiveness to fertilizer [8].

Data base on chemical property of soil: rice growing areas in Maesa Nga watershed had an appropriate level of pH. However, garlic and soybean growing areas had a low level of pH. It was found that, rice growing areas had an appropriate level of pH but not in maize. For Khun Nan watershed, farmers only grew rice. Maize growing area

had a low level of pH but an appropriate amount of some necessary nutrient i.e. potassium.

3.3 An analysis of appropriate physical characteristics for cash crop production

An analysis of area potential for cash crop production has been studied. Steps of the analysis were as follows: 1) Criterion setting (Table 2) 2) Criterion weighting (Table 3-5) 3) Criterion standardization comprised 4 levels in accordance with FAO [9]: 1=very appropriate, 0.8=moderately appropriate, 0.4=little appropriate, and 0=inappropriate and 4) An analysis of a level of appropriateness for cultivation as shown in Fig. 3.

Table 2 Criterion setting used for an analysis of appropriateness for cash crop production

Main criteria	Sub-criteria
Topographic condition	Slope
Climate condition	An average amount of rainfall per year and an average monthly temperature
Physical property of soil	Soil type, depth of top soil, and water drainage
Chemical property of soil	pH OM avai.P exch. K Ca and Mg extr. Fe Mn Zn and Cu
Water sources	Distance of main streams having water throughout the year

Table 3 Determination of criterion weighting

Factors	Criterion weighting of cash crops in locale of the study		
	First rice crop	Soybean	Garlic
Physical properties			
Slope	0.082	0.046	0.046
Soil texture	0.237	0.118	0.118
Water drainage	0.190	0.117	0.239
Depth of top soil	0.163	0.048	0.046
Chemical properties			
Soil pH	0.070	0.183	0.183
% N	0.136	0.082	0.075
% organic matter	0.054	0.094	0.078
Avail. P	0.035	0.168	0.061
Excha. K	0.035	0.144	0.153
Total	1.000	1.000	1.000

Table 4 Determination of criterion weighting based of physical properties

Factors	Criterion weighting of cash crops
Slope	0.106
Soil texture	0.447
Water drainage	0.283
Depth of top soil	0.164
Total	1.000

Table 5 Determination of criterion weighting based on chemical property of soil

Factors	Criterion weighting of cash crops
Slope	0.275
Soil pH	0.109
% N	0.218
% organic matter	0.087
Avail. P	0.138
Excha. K	0.173
Total	1.000

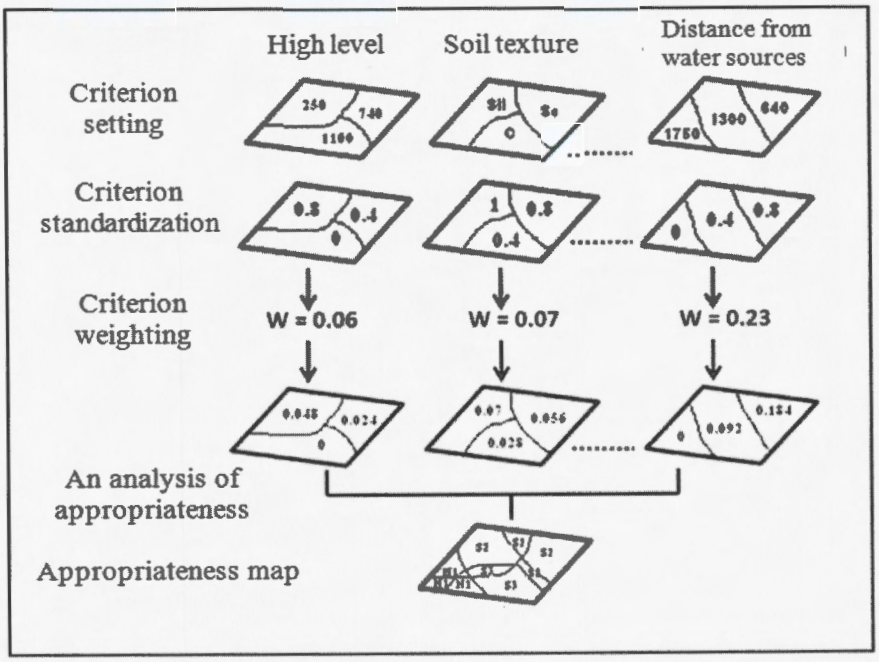

Fig. 3 Steps of an analysis for finding an area suitable for cultivation

It was found that, most area of Maesa Nga watershed (85.49%) was suitable for rice growing. This was particularly on the dry season because there was water throughout the year. However, it was not suitable for garlic (87.51%) and soybean (87.06%) growing. This was because the area was clay, not good water drainage. For Ping Noi

watershed, it was found to be not suitable for maize growing. For Khun Nan watershed, the appropriateness for cash crop growing was different due to different slope, soil erosion, and far away from water sources.

3.4 Designing and developing the area information retrieval system

The team of researchers had designed and developed the area information retrieval system called "Water conservation Information Project system". This was window based using MapWindows GIS (open source software). It had ActiveX Control which coped with VB.net 2008 [10] (Fig. 4).

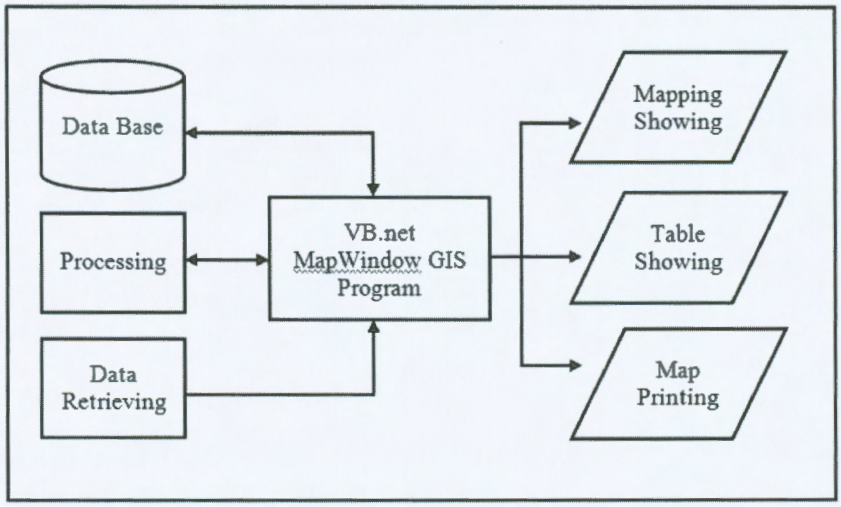

Fig. 4 Steps of designing and developing the area information retrieval system

The concept of this program was to promote and to lighten the load of concerned government agencies. User will be able to apply this program easily and could helps them in planning, raw data, and support their decision-making in land and natural resources utilization. The system could be linked between user and area information by GIS technology. Data retrieving in various forms i.e. data showing, information sorting, and data description could be supported. Moreover, the program supports the data analysis, mapping showing, and tabulation output. Also, printing could be served in map, table, and content forms. It will help to make the right information for decision-making support related to soil and water resources for crop production management of the study areas.

The developed program was designed for easily installation in Thai version. The program covered 3 watershed areas information. It will show the boundary of each area i.e. fundamental data by plots which contained main data and sub-data (Fig. 5). The program support data adding, improving, erasing, and saving. Besides, the program also support map drawing (Fig. 6) which will show map ratio. Moreover, user could determinate the map ratio by themselves. And map printing could be

instructed after all (Fig. 7). The entire icons also show in Thai language.

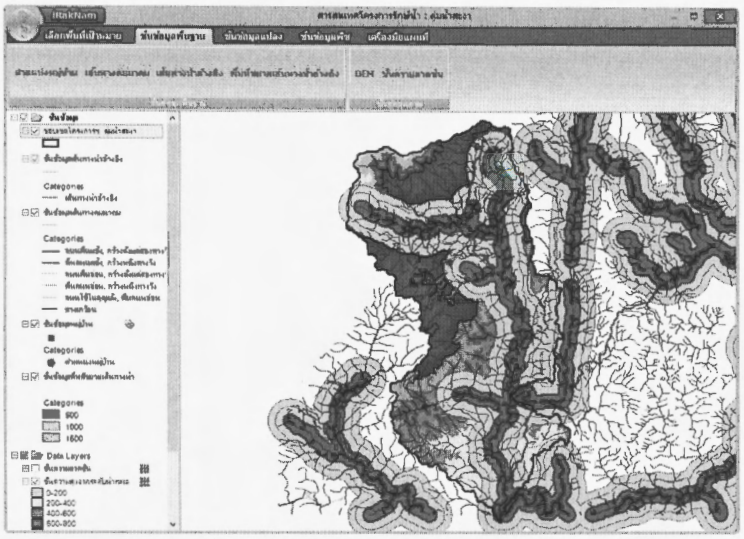

Fig. 5 Main data and sub-data showing windows

Fig. 6 Map drawing windows

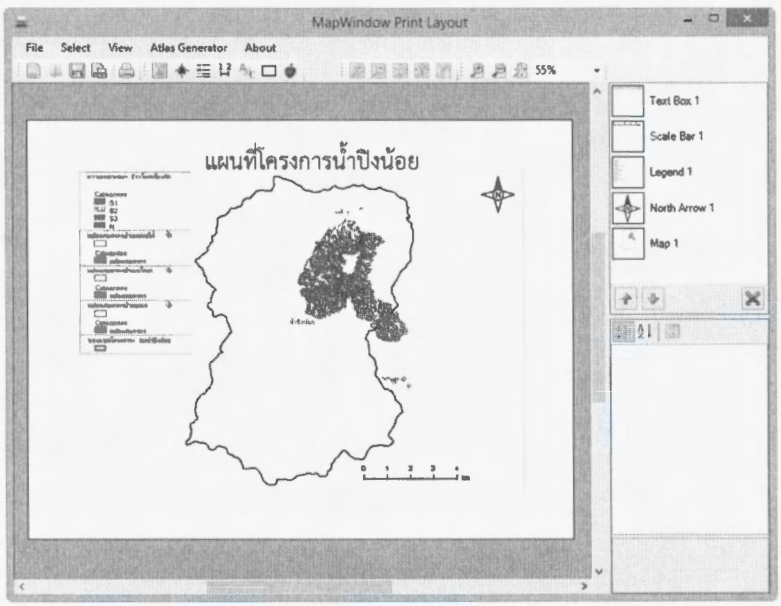

Fig. 7 Map printing windows

The program was useful to the concerned government agencies in term of application of the data. The program was so simple, easily understood, so that, user could access to the program faster. Moreover, this program was figure to the communication in terms of updated-data for more understanding. The researcher was established the data area-based for efficiency collaboration with the "Rak Nam Project Information System" by Window-based and prepare guide book for the concerned user.

4. Conclusion

This study aimed to prepare data base on land utilization and spatial land plots of farmers. This was based on an analysis of land conditions, farming area, and socio-economic system of farmers in the 3 watersheds of upper northern Thailand. Results of the study provided area data which were beneficial to farming. In addition, concerned government agencies could be able to analyze these data in terms of potential in cash be able to analyze these data in terms of potential in cash crop growing. However, results of the study showed that Maesa Nga watershed needed agricultural extension in terms of knowledge about soil improvement together with the application of organic and chemical fertilizers. Most area of Ping Noi watershed was slope, so rice terrace practice should be promoted. Most area of Khun Nan watershed was mountainous and cool so temperate cash crops and vegetables should be promoted. However, there was the problem of lack of water during the dry season. Therefore, the irrigational system needed to be developed. Rak Nam Project Information System was constructed for transport facilitation to the government agencies in terms of updated-data for an analysis of appropriate physical characteristics for cash crop production. The researchers hope that, the program could serve and help the farmers for land utilization.

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