

# Spatial Decision Support System for Provincial Development by the use of the Principles of Self-Sufficiency Economy

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## Abstract

*This paper presents the implementation of a spatial decision support system for local government decision-making in provinces in Lower North-East Thailand. The concept to develop the spatial decision support system was based on the principles of the Self-sufficiency Economy. Four provinces were selected for the study – Ubon Ratchathani, Yasothon, Sisaket, and Amnat Charoen. The study involved evaluation of information needed, development of the spatial decision support system, and evaluation of strategic planning for the areas. The system was implemented using UMN MapServer and PHP programming. The usability of the system was evaluated by the local governors and community developers. The results of the testing showed that the users' satisfaction with the system was at a good level. It is anticipated that local governments' use of the system will allow formulation of strategic plans to develop the provinces in relation to identified issues and prioritize areas for preparation of development, resources allocation and public service planning according to the principles of Self-sufficiency Economy.*

## 1. Introduction

Self-sufficiency Economy is a philosophy that concentrates on the middle path as a principle for appropriate conduct by people at the levels of families, communities, and nations to accommodate changes in line with globalization (Puntasen, 2006; Thammasat Institute for Social and Environmental Development, 2006). Thailand's economy collapsed in mid-1997 (The Economist, 2000) and the financial crisis affected the people and private organizations in the country. Many people were unemployed and companies faced bankruptcy. The causes of the Thai financial crisis were weaknesses in domestic macro-economic fundamentals, weakness in the financial system, and unstable political and social institutions. His Majesty, King Bhumibol Adulyadej's philosophy of Self-sufficiency Economy was given to the Thai government and Thai citizen as a policy for working and living. The Thai government has promoted Self-sufficient Economy in developing the country. Self-sufficiency has three qualifications, moderation<sup>1</sup>, reasonableness<sup>2</sup>, and the need for self-immunity<sup>3</sup>, to protect against impacts arising from internal and external shocks. To achieve this, local government has implemented several projects according to the principle. In order to strengthen the country,

communities and people in the provinces must be developed in a sustainable way. Information related to a province, such as Gross Provincial Product (GPP), provincial data, household data, personal data, public health data, educational data, and environment data are useful for monitoring and developing the provinces. One of the main limitations of existing Management Information Systems is related to their lack of spatial presentation of these data. The application of a spatial decision support system with due consideration and prudence is essential. A spatial decision support system can assist local government to identify and address the problems of the area. The main objectives of this research were 1) to develop the data center to collect data of the lower north-east area in economic, public health, education, resources and environmental terms; 2) to provide the data to the citizens, provincial administrators, and local governors who were interested in retrieving the data; 3) to exchange the data between the various government organizations and 4) to enable the local government to use the data in analysis and allocate resources in an efficient way in the area to promote the principles of Self-sufficiency Economy.

<sup>1</sup> Moderation means not too little and not too much at the same time. It can be practiced in such a way that there is no exploitation of oneself and/or others.

<sup>2</sup> Reasonableness means both evaluating the reasons for any action and understanding its full consequences with prudence.

<sup>3</sup> Self-immunity means being prepared to cope with various potential short- and long-term impacts and changes that may take place.



## 2. Literature Review

### 2.1 Self-Sufficiency Economy

Self-sufficiency Economy is a philosophy that stresses the middle path as an overriding principle for appropriate conduct by people at all levels of families, communities, and nations to accommodate changes in line with globalization. Sufficiency has three qualifications, moderation, reasonableness, and the need for self-immunity, to protect against impacts arising from internal and external shocks. To achieve this, application of knowledge with due consideration and prudence is essential. In particular, great care is needed in the utilization of theories and methodologies for planning and implementation at every step. This is known as knowledge condition. At the same time, it is essential to strengthen the ethical integrity of the nation so that all parties, particularly public officials, academics, and business persons at all levels, adhere first and foremost to the principles of honesty. In addition, a way of life based on patience, perseverance, diligence, wisdom, and prudence is indispensable to create a balance and to be able to cope appropriately with critical challenges arising from extensive and rapid socioeconomic, environmental, and cultural changes in the world. This is known as ethical integrity. (These definitions are derived from the speeches of King Bhumibol of Thailand with permission for knowledge dissemination)<sup>4</sup>. As a result, national development based on Self-sufficiency Economy has the basis of a moderate, careful approach. To achieve this, a country must consider moderation, reasonableness, self-immunity, knowledge application, prudence, and ethical integrity in the processes of planning, decision-making, and taking action. The expected consequence is a balanced holistic development between globalization and localization, and sustainability. Figure 1 provides a summary of self-sufficiency economy<sup>5</sup>. There are three circles of qualifications (moderation, reasonableness, and self-immunity) and two conditions (knowledge condition and ethical integrity) to achieve the self-sufficiency economy principle. These create a balance in life, economy, society, and environment, making them secure and sustainable.

### 2.2 Related Work

Many studies have developed spatial decision support systems for provincial development. A spatial decision support system (Mongkolsawat et al., 2005) was developed to provide information covering four main issues commonly found in

North-East Thailand: agricultural land use, conservation areas, amelioration of degraded lands, and disaster protection. The program development was based on the Avenue language of Arc View GIS with the objective of developing menus that allowed end users to apply it to meet their specific needs.

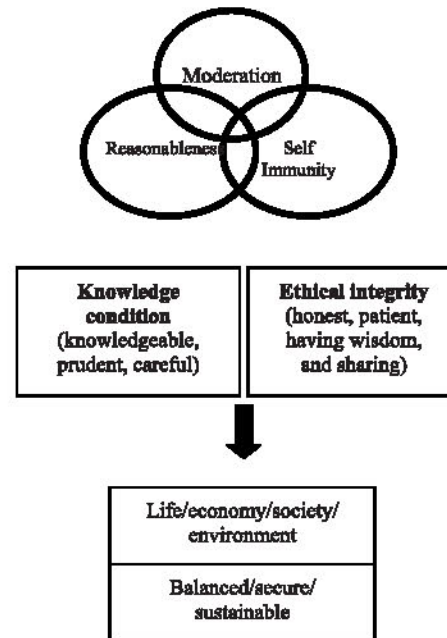


Figure1: provides a summary of self sufficiency economy philosophy

Spatial information systems have also been used in various government projects in provincial development and local administration. Amarakul and Sanyong (2000) developed a GIS application on the strategy for sustainable development in Phitsanulok province. The system was developed as a tool for making decisions on project planning, government budget, the balance of using, developing rehabilitation and conservation of natural resources, and the environment. Suksawang and research team (2001) developed a decision support system for provincial development planning for Pathumthani province. The decision support system in this research comprised three main elements 1) GIS databases of social issues, networks, and environment 2) analytical tools, and 3) a policy evaluating model at the provincial level. A GIS for local administration in Sakonnakorn province (Rungjang et al., 2005) was developed using ArcView to support local administration in Sakonnakorn province, Natongwattana and Plalho.

<sup>4</sup> Sufficiency Economy - Shared Learning - Building-up Network - Expansion of Result, ed. Silaporn Buasai (Bangkok: Thailand Research Fund, 2006), p. 8.

<sup>5</sup> Ibid. pp. 9-11

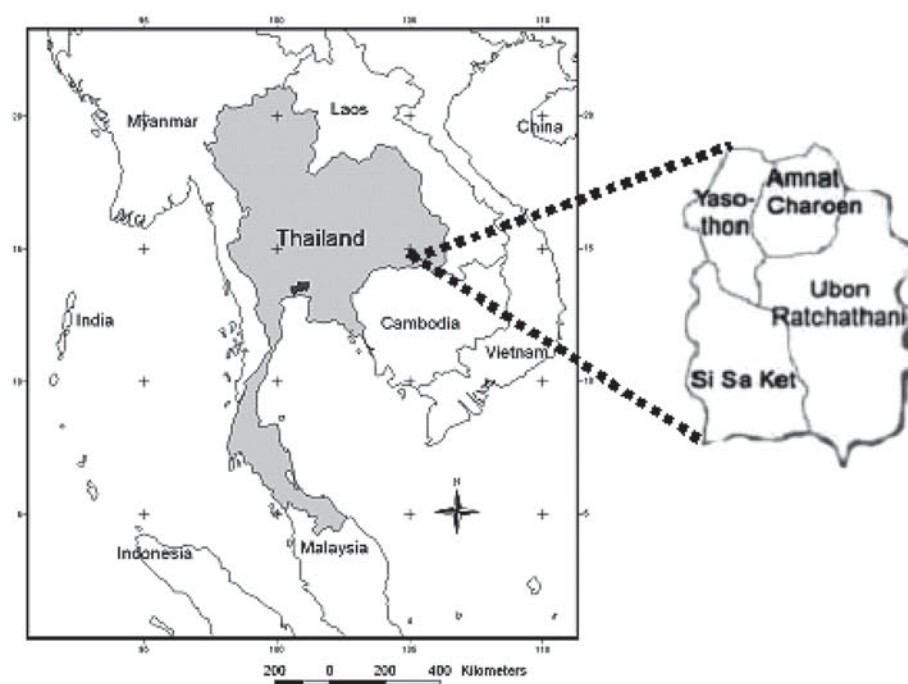


Figure 2: Location of the study area

The system gave an enriched presentation of spatial data, land use, and infrastructure that encouraged the assessment and collection of taxes and revenues and pressing for payment. The Information Technology and Communication Center, Ministry of the Interior (2006) developed a web-based GIS for provincial development planning. This project aimed to manage data for use in provincial planning and provide geospatial information services. None of the developed systems applied to the principles of Self-sufficiency Economy in their provincial development. The proposed system that is the subject of this paper was developed with the primary aims to apply the principles of Self-sufficiency Economy in a provincial development system to support decision-making and to sustain development of the areas. Without this system evaluation of an area's self-sufficiency requires provincial officers to compare data from several places, mostly in table and/or text formats, an often difficult task for analysis and planning. In addition, the system was developed using Web based GIS which, compared to typical desktop GIS Decision Support System, allows all interested parties access to data in all places and at all times.

### 3. Methodology

#### 3.1 Study Area

The Lower North-East was selected for study. Four provinces were selected for the case study, Ubon Ratchathani, Yasothon, Sisaket, and Amnat

Charoen. Ubon Ratchathani covers 15,744.8 km<sup>2</sup>, Yasothon covers 4,161.7 km<sup>2</sup>, Sisaket covers 8,840.0 km<sup>2</sup>, and Amnat Charoen covers 3,161.2 km<sup>2</sup>. The location is centered on latitude 15°13'41"N and longitude 104°51'34"E. As shown in Figure 2.

#### 3.2 Materials

This research used UMN MapServer and PHP for programming and user interface design. The database management system used in the research was PostgreSQL.

#### 3.3 Data Preparation

The data consisting of provincial data, household data, personal data, public health data, educational data, and environment data, were collected from the National Statistical Office of Thailand, Basic Needs for Thailand Data (Jo Po Pho), the Ubon Ratchathani provincial government, the Forestry Department of Thailand, and the Environment Department of Thailand. In this research, data from the years 2006 to 2008 were used. The data were divided into two formats: spatial data, which consists of data in map format; for example: district boundaries, provincial boundaries, villages' locations, rivers, roads, and reservoirs, and non-spatial data, which consists of tabular data relating to economic, public health, education, resources and environmental data.



**Provincial Data:** Provincial data consist of population numbers, educational level of population, careers and incomes of population aged between 18 and 60 years, GPP, agricultural statistics, transportation statistics, monetary statistics, populations' knowledge of accidents and fire protection, accident statistics, household security statistics, and poverty data.

**Household Data:** Household data consist of population income/person/year, population expense /person/year, financial savings data, loan data, house ownership data, land ownership data, adequacy of water supply for drinking and household use, house safety data, and family loving and caring data.

**Personal Data:** Personal data consist of data related to alcohol addiction, smoking addiction, care for the elderly population, care for disabled population, number of people with personal incomes no lower than 20,000 baht/year, marriage registration, religious activity of population aged 6 years and over, population's participation in public activity, and population's participation in elections.

**Public Health Data:** Public health data consist of data on pre-natal care, post-natal care, number of new-born babies with weight greater than 2,500 grams, number of new-born babies who got breast feeding for at least four months, number of 0-5 year-

old babies who got appropriate food, number of one year-old babies who got complete vaccines, number of 2-11 year-old children who got complete vaccines, availability to population of good and safe food, population's knowledge of appropriate use of drugs, population aged up to 35 years old receiving annual health checks, healthy home environments, and epidemics.

**Educational Data:** Educational data consist of data on population aged 3-5 years old attending nursery school, population aged 6-15 years old receiving nine years of compulsory education, population who, after graduating from compulsory education, proceed to higher education, and population aged 15-60 who can read and write.

**Environmental Data:** Environmental data consist of data on pollution, forestry statistics, fishery statistics, forest areas to population ratios, water resource areas, energy resources, and natural resources statistics.

### 3.4 System Development

#### 3.4.1 System development process

The system development processes were divided into 4 steps. The process started from data collection and analysis, system design, database design, and graphical user interface design. Figure 3 illustrates the development process of the system.

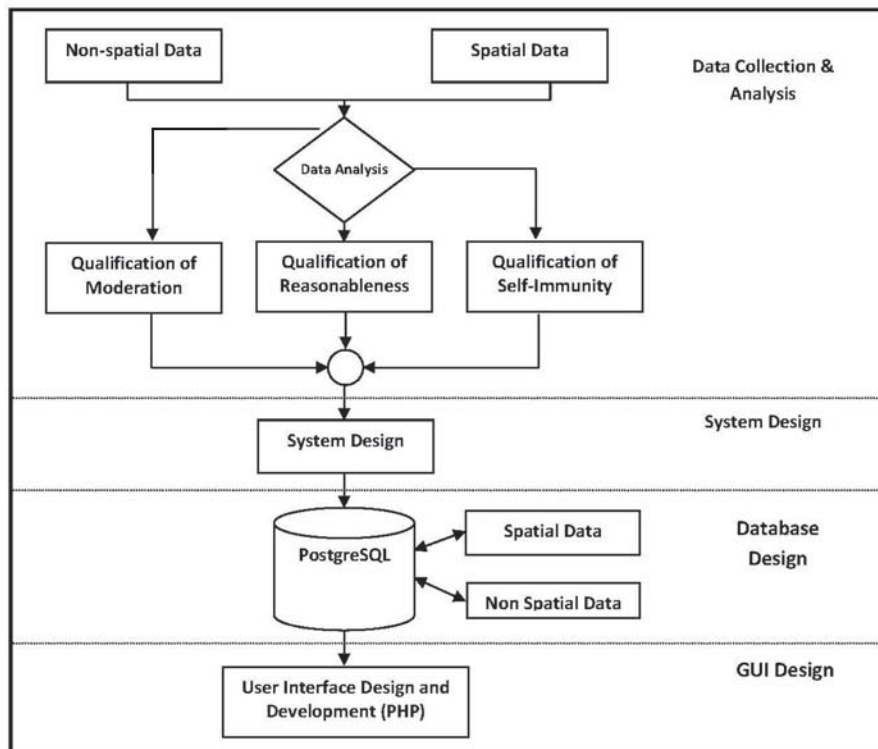


Figure 3: System Development Flowchart

### 3.4.2 Architecture of the system

This section proposed a framework for a spatial decision support system for provincial development. The design of the framework was guided by user requirements from the local governors that were obtained through structured questionnaires and interviews. The proposed architecture of the system is illustrated in Figure 4. The system consisted of a user interface, security module, MapServer, area analysis module, self-sufficiency economic qualifications analysis module, and a database management system (DBMS), which contained spatial and non-spatial databases.

### 3.4.3 Database design

Database design was divided into two parts: spatial and non-spatial databases. The spatial part involved district area data (spatial and attribute), while the non-spatial part focused on economic, public health, education, resources, and environmental data.

### 3.4.4 User interface design

UMN MapServer and PHP were used for this task. PHP was used to design and implement the map layer. The map display functions were linked to the graph using PHP. Figure 5 illustrates the user interface of the system. The user of the system can select an area of interest to view more detailed data in percentages and bar graph formats.

## 4. Results and Discussion

### 4.1 Using GIS in Area Analysis

The spatial decision support system was developed for the analysis to develop a province. The most important feature of the system was an analysis of area data according to the three qualifications of Self-sufficiency Economy, moderation, reasonableness, and the need for self-immunity.

- **Qualification in moderation:** This qualification determines the appropriate resources to achieve the objectives with a focus on the local ones. The local people should have a better use of their own community and resources. The qualification has a system to show the different types of data. The system can help to clarify the different resources in each community which make it easier for the local government to take decisions.
- **Qualification in reasonableness:** This qualification helps to identify the awareness and abilities of people which should help to contribute in any project. For example, a better education and knowledge background may help in certain kinds of projects and activities.
- **Qualification of self-immunity:** This qualification helps to emphasize the manner in which people increase their cooperation for themselves and others. This situation means that people with moderation, reasonableness, and self-immunity would not be selfish and would not be involved in illegal business, leading to a peaceful society. The study created a GIS application that can be used as a guide for clarifying Self-sufficiency Economy areas. This clarification was achieved by using the graduated color function to subdivide numerical data into a set of different categories. Users can select the required data layer to analyze based on Self-sufficiency Economy indexes. The priority development areas present in visual spatial and attribute data. However, users should have a good knowledge of Self-sufficiency Economy principles to accurately find and analyze the data. The spatial decision support system was customized with PHP scripting using MapServer environment. As an example, Figure 6 shows classification for the qualification of self-immunity, the percentage of people (15 to 60 years) who can read and write. By selecting an area, the system then shows the data in a bar graph as illustrated in Figure 7. In this way, the spatial decision support system may be valuable for the local government and community. The spatial decision support system for provincial development by the use of the principles of the self-sufficiency economy can support the local government and community developers in decision-making as below.
- **Poverty eradication;** the system can provide information for example on population income, population living expenses, population debt, and population careers based on the areas. This helps the local government understand the living situation of the population and provides suitable support for them. In addition, the government can use data to make new policy in solving loan problems and inadequate income for living.
- **Social development;** the government can use the spatial decision support system to allocate budget and provide services to citizens in the areas of population education and population careers. The government knows which areas have education lower than the national education standard and the government can make a decision to provide suitable help for those areas.
- **Improve public health and population structure;** the spatial decision support system



can help government in planning of public health improvements. The system can provide information, for example, of the population's access to good and safe food, epidemics, accidents, and population health. This helps the government make better decisions to promote suitable healthcare programs for citizens.

- **Environmental management;** for example analysis of the effect of development on the environment, selection of areas for forestry reservation, natural resource conservation, environmental protection, environment

preservation policy, pollution control, and monitoring.

- **Sustainable development;** the government can use information to develop the provinces by improving their management of resources, the environment, improvement of local enterprises, social welfare, education, public health, and the provincial economies based on the principles of Self-sufficient Economy. If the development grows in ways that are suitable for the community background, it will promote sustainable development of the provinces.

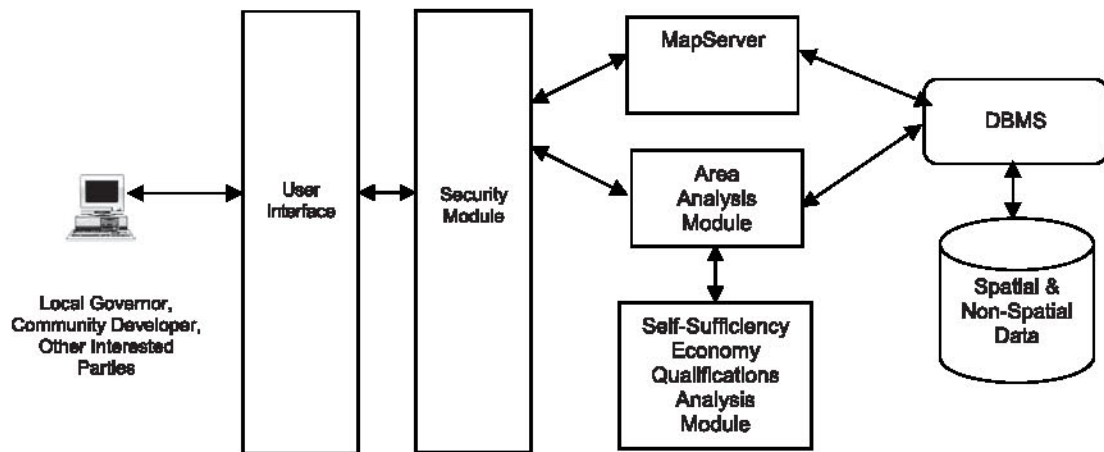


Figure 4: Architecture of a Spatial Decision Support System

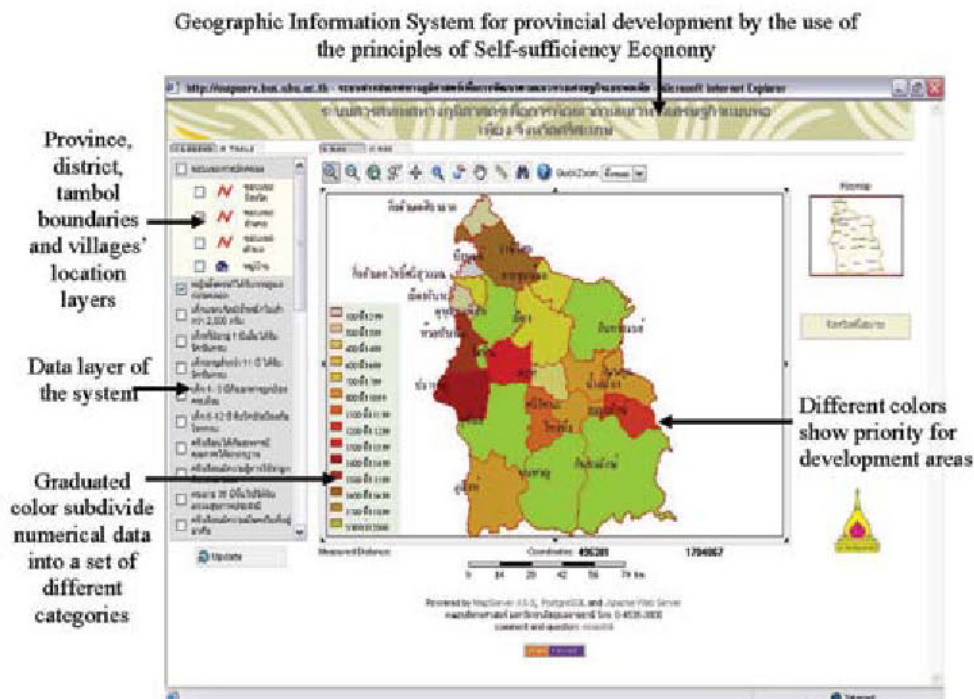


Figure 5: Spatial Decision Support System user interfaces

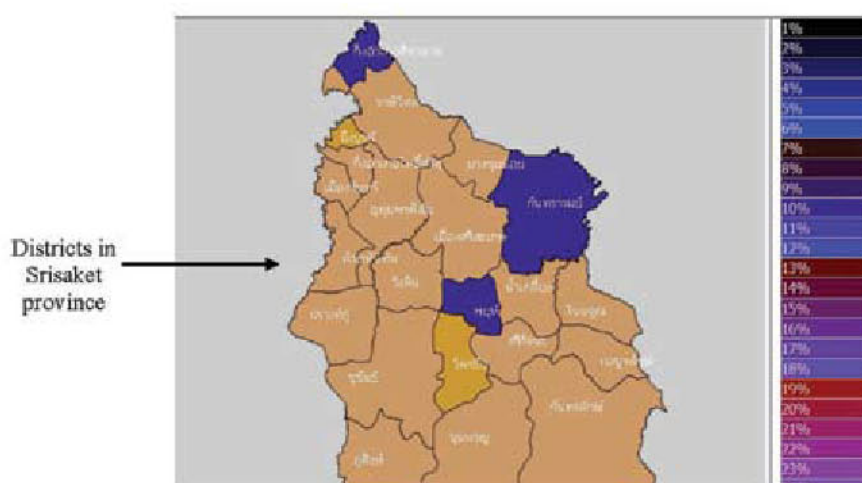


Figure 6: Classification of qualification of self-immunity, the percentage of people (15 to 60 years) who can read and write

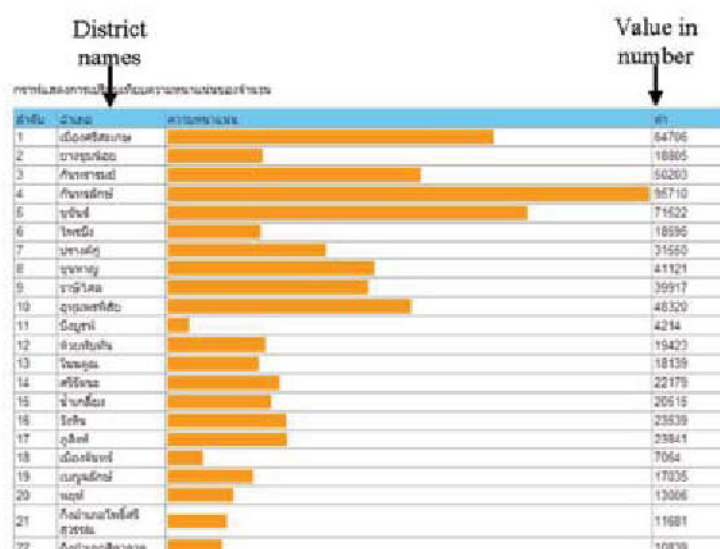


Figure 7: shows the outputs by using bar graph

#### 4.2 System Evaluation

The system was evaluated by 30 purposefully selected local government officers. The selection criteria included local administrators and officers who worked in the development areas in Ubon Ratchathani, Yasothon, Sisaket, and Amnat Charoen provinces. In addition, the selected officers were experienced in using computers and had GIS knowledge. The participants were given the opportunity to use the system and then asked to complete questionnaires that were designed to determine the usability of the system. Usability is the extent to which a computer system can be operated by users to achieve specified goals effectively and efficiently, while promoting feelings

of satisfaction in a given context of use (International Standards Organization, 1999). The series of items that comprised the usability questionnaire were based on a number of widely used measures (Hartson et al., 2003, Lewis, 1995 and Park and Lim, 1999). Items on the questionnaire used to assess the system were based upon user perceptions of such standard measures of usability as: system usefulness (impact of system on job performance, productivity and effectiveness of information); information quality (information provided by the system is clear and easy to find, and the messages that inform the user of errors are understandable); and interface quality (measures of



organization of the information on the screens, ability to find information and the interface design and satisfaction with the interaction). Tests of validity and reliability were carried out on the questionnaire. The validity of the questionnaire was controlled using the content-analysis method (Henerson, 1987). Items for the questionnaire were selected and adapted from the IBM computer usability satisfaction questionnaires: psychometric evaluation and instructions for use (Lewis, 1995). Items for the questionnaire were reviewed and tested by 3 experts in the area of system development and 5 local governors in the provincial development sector. Items were deleted, added, or modified based on the information obtained from these critiques. The IBM computer usability satisfaction questionnaire scale was used to interpret the level of acceptance with "1" as the highest level of acceptance and "7" as the lowest level of acceptance. This research considers a level of acceptance lower than 3.5 as a positive response as pointed out by Hernerson (1978). The system evaluation average scores were 2.70 for the system usefulness, 2.87 for the information quality, and 2.19 for the interface quality. The general rating average is <3.5 on a scale of 7 points indicating a good level of satisfaction.

## 5. Conclusion

In this research, the design and implementation of a spatial decision support system for provincial development were highlighted. The system was developed based on the principles of Self-sufficiency Economy and provided data on economy, population income, population expenses, public health, resources, and environment. It can support the local government in decision-making on the efficient allocation of resources and budget to the provinces. In addition, local government can use data to solve problems, such as poverty eradication, social development, improvement of public health and population structure, environmental management, and promote sustainable development. The usability of the system was evaluated by local governors and community developers. The results of the testing showed that the users' satisfaction with the system was at a good level. Suggestions for further study are 1) the data collection should cover all the provinces in the North-East area thus providing better information for decision-making, and 2) spatial data infrastructure standards should be considered to make the data available for sharing in Thailand.

## Acknowledgements

The author would like to thank the Thailand Research Fund for allocating budget for this research project. Sincere thanks to Bob Tremayne and T. J. King for their assistance in preparing this paper.

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