Volume 3, Issue 5, May 2013 ISSN: 2277 128X
International Journal of Advanced Research in Computer Science and Software Engineering
Research Paper
Available online at: www.ijarcsse.com

GeoInformatics for Fuel Consumption Distribution in Thailand

Suwannee Adsavakulchai
School of Engineering, University of the Thai Chamber of Commerce
Thailand.

Abstract— Fuel consumption distribution is one of the factors for policy makers to do strategic planning. Currently, all reports are commonly presented in terms of tables and graphs, that maybe difficult for making decision. This study developed the Geographic Information Systems and Intranet system to demonstrate the fuel consumption map for each province in Thailand by using ArcGIS 9.0, PHP and MySQL as tools. The regression model was developed to forecast fuel consumption using SPSS for the statistical analysis. The three- year data in 2000-2003 is used for the data analysis and two-year data in 2004 and 2005 for the model validation. The parameters for model development are Gross Provincial Product (GPP), provincial population and provincial areas. It can be concluded that the correlation coefficients of fuel oil consumption related in Gross Provincial Product (GPP), provincial population and provincial areas are 0.98, 0.82 and -0.12, respectively. Moreover, the fuel consumption model is about 90% accuracy.

Keywords— fuel consumption map, ArcGIS 9.0, PHP and MySQL, regression model

I. INTRODUCTION

The trend of Thailand's fuel consumption has increased even the price fluctuates. In order to attain continuous and sustainable economic development, it is necessary that fuel supplies be adequate at reasonable prices and secure. Then the strategies for Thailand's fuel consumption will focus on fuel data analysis in term of fuel consumption distribution all the country. There are several parameters related to fuel consumption that are Gross Provincial Product (GPP), provincial population and provincial areas. In this study, to develop the fuel forecasting model is using SPSS as a tool.

GeoInformatics provide the appropriate tools for analyzing the effective factors on spatial data and non-spatial data. GeoInformatics are powerful computer-based tools for the capture, storage, management, retrieval, query, analysis and presentation of spatial data. GeoInformatics ability as spatial data processing and analyses tools available can be used to manage a wide range of Information. GeoInformatics facilitates the integration of disparate data sets, creation of new and derivative data sets, and development and analysis of spatially explicit variables. The integration has the potential to become a powerful analytical toolbox enabling regional and social scientists to gain fundamental insight into the nature of spatial structures of regional development. Increasing levels of interest in these coupled systems, which often referred to as spatial decision support systems (SDSS) which make up to wide application areas. (Batty, Longley, 1996). In this study, ArcGIS 9.0 is one of the GeoInformatics tool to analyze the geographic data and related information data that is easy to use and presentation. The main objective of this study was to develop GeoInformatics for Fuel Consumption Distribution and fuel forecasting model in Thailand.

II. METHODOLOGY USED

There are three steps in this study as follows: in the first step, requirement analysis is done, in which the needed spatial and attribute data are identified. The information is gathered and entered to ArcGIS 9.0 software. In the second stage the input data is analysed and the required information layers are made (Harder, 1997). In the last stage by examining the output information from the second stage conclusions and necessary suggestions are made.

The basic data used in this study are:

- the digital topographic maps of Thailand.
- the information related to fuel consumption from the whole country, Gross Provincial Product (GPP), provincial population, provincial area and fuel value

ArcGIS 9.0 software is then used to generate:

- The development of the base map for generation of GIS files.
- The fuel consumption is specified and their attributes is linked to each spatial feature.
- Buildings information layer containing the polygons of Gross Provincial Product (GPP), provincial population, provincial area and fuel value

- The spatial decision support systems (SDSS) has wide range of application areas

Fuel forecasting model development

- Using multiple regression under SPSS for Windows Version 12.0 as a tool for fuel forecasting model development and

Web application for fuel consumption

- To develop web site by using PHP and MySQL as tools

III. RESULTS AND DISCUSSION

Correlation among parameters

In this study, the parameters are Gross Provincial Product (GPP), provincial population, provincial area and fuel value. The correlation among parameters in the year 2000-2003 is shown in table 1

Table 1: The correlation coefficient among parameters

Correlation coefficient	fuel value	GPP	provincial population	provincial area
fuel value	1.000	0.981	0.819	-0.122
GPP	0.981	1.000	0.800	-0.147
provincial population	0.819	0.800	1.000	0.285
provincial area	-0.122	-0.147	0.285	1.000

Fuel forecasting model development

From table 1, to develop fuel forecasting model using regression model and the result from the data in the year 2000-2003 as following:

$$\text{Fuel value} = (0.059 \times \text{GPP}) + (0.002 \times \text{population}) - 699.45 \qquad r^2 = 0.98$$

To validate the model using the data in the year 2004-2005, there are some errors as shown in table 2

Table 2 : The validation of the model

Year	% error
2004	11.62
2005	7.65
mean	9.57

Spatial analysis for fuel consumption distribution in Thailand

To do overlay technique from each parameter i.e. Gross Provincial Product (GPP) (Figure 1), population (Figure 2), provincial area (Figure 3) and fuel value (Figure 4), the results demonstrate that the fuel consumption distribution in Thailand is shown in Figure 5 (actual) and 6 (forecast).

Web application for fuel consumption

Web application allows you to search fuel consumption in each province as shown in Figure 7-9.

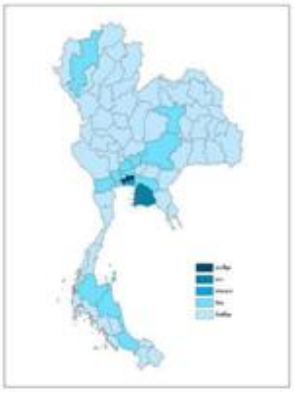

Figure 1: GPP

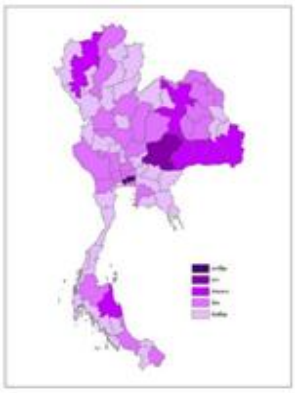

Figure 2: population

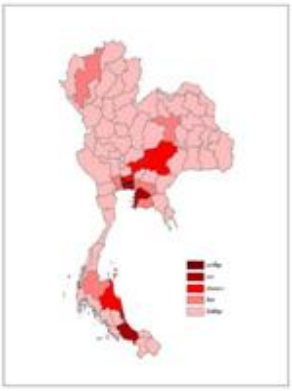

Figure 3: area

Figure 4: fuel value

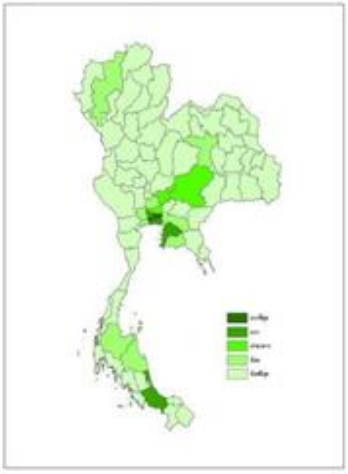

Figure 5: Actual fuel consumption

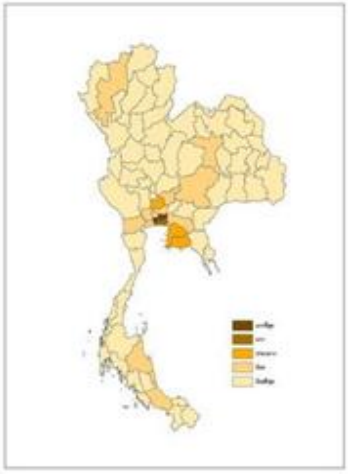

Figure 6: Fuel consumption forecasting

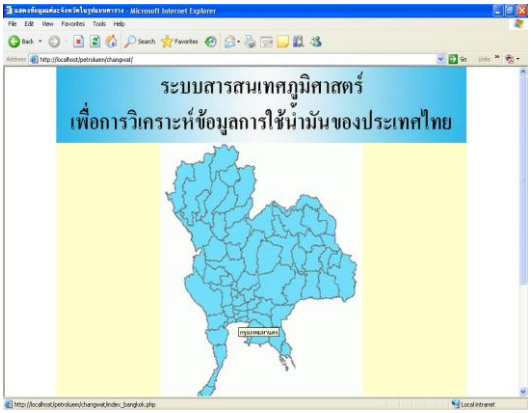

Figure 7: Main page

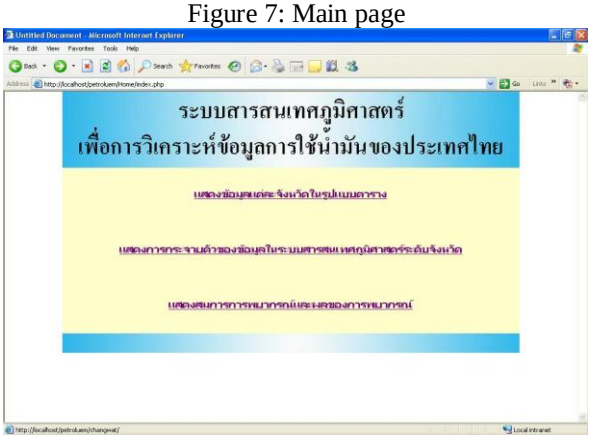

Figure 8: fuel consumption distribution in Thailand

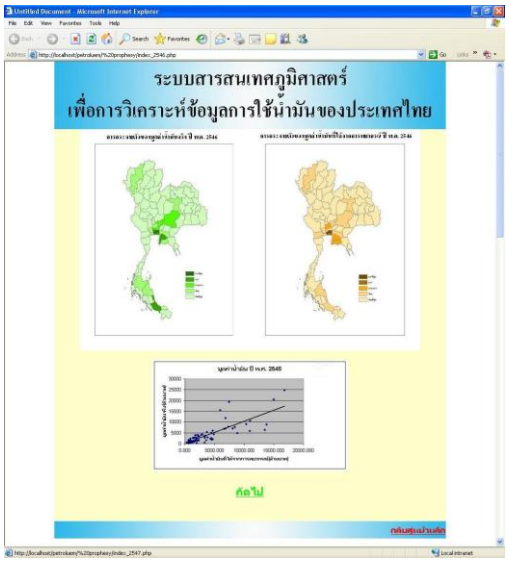

Figure 9: Comparison between actual and forecasting fuel consumption in Thailand

IV. CONCLUSION AND RECOMMENDATION

The correlation be tween fuel value and related parameters are as following: fuel value and Gross Provincial Product with r = 0.98, fuel value and provincial area with r = -0.12 and fuel value and provincial population with r = 0.82. The Fuel forecasting model is about 90% accuracy. The GeoInformatics knowledge and it is practical software's can be useful in spatial analysis for fuel consumption distribution in Thailand in term of map and table. Web application for fuel consumption can demonstrate all information and related parameters. It is suggested to study this subject by considering other parameter such as traffic. This is because that it impacts on fuel value especially in Bangkok and big cities i.e. Chiangmai, Nakhon Ratchasima, etc.

ACKNOWLEDGEMENT

The author wishes to sincere thank Ms. Benyatip Luangsod for data collection and analysis. Also I would like to thank you Assistant Professor Dr. Supachet Innet for kindly support.

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