ECONOMIC CROPS PREDICTIVE SYSTEM USING ARTIFICIAL INTELLIGENCE AND GIS

Phanakron Kaewme[1*] Phaisarn Jeefoo[2] Sukchatri Prasomsuk[3] and Phuwitson Phumsaranakhom[4]

[1 *] Applied Geoinformatics, School of Information and Communication Technology (ICT), University of Phayao, 19 Moo 2, Maeka, Muang, Phayao 56000 – Thailand
Email: kaewmeeppy@gmail.com
[2]Research Unit of Spatial Innovation Development (RUSID), Geographic Information Science, School of Information and Communication Technology (ICT), University of Phayao, 19 Moo 2, Maeka, Muang, Phayao 56000 – Thailand
Email: phaisarn.je@up.ac.th / p.jeefoo@gmail.com
[3]Information Technology, School of Information and Communication Technology (ICT), University of Phayao, 19 Moo 2, Maeka, Muang, Phayao 56000 – Thailand
Email: sukchatri.pr@up.ac.th / skchatri@hotmail.com
[4]Computer Engineering, School of Information and Communication Technology (ICT), University of Phayao, 19 Moo 2, Maeka, Muang, Phayao 56000 – Thailand
Email: narongchai.mo@up.ac.th

ABSTRACT

This research presents a prototype development of geospatial database system for Pua distinct, Nan province, northern part of Thailand with the purpose to support an effective agricultural data management by integration of GIS technology and AI for agriculture area. The fourteen types of economic crops were studied, collected, and cleansed, including rice paddy, rainy season corn drought, tapioca, garlic, ginger, shallot, longan, lychee, rubber, palm oil, which there are different information in Pua district, Nan province area of each year. This system operates on any platform system whereat consists of three main functions are geographic map, statistical information with prediction, and information document format of all cropping areas in a form of annual report. The development tools were used by QGIS, Sumlime Text, intelXDK and cloud technology as database system including real-time Google map. The survey of satisfaction application usage showed that the confident users with the system very highly or ($\bar{X}$= 4.00, S.D. = 0.78).

1. INTRODUCTION

At present, with the area of Thailand being suitable for agriculture, it is undeniable that "plants" are what provide Thai people with food to feed their stomachs and also generate income for households, extending to generating income for the country until it becomes is “Economic crops” that many farmers take as a career. These cash crops are not just human consumption but also to be used to raise animals and other uses in order to get the most value. This is the good fortune of Thailand, with the right space and climate, it can grow a variety of different plants in a way that many countries can't. Help build the economy of Thailand better from "Economic Crops". Therefore, these plants are still referred to as cash crops today. as well as making money for farmers and the country continuously. Thailand is a country where most of the population is engaged in agriculture. Most of the areas are growing cash crops such as rice, cassava, corn, sugarcane, rubber, etc. From the past to the present, the government has always given importance and support in terms of knowledge and financial assistance to farmers. These economic crops grow in different regions.

Remote Sensing has made substantial contribution in flood monitoring, mitigation and damage assessment that leads the disaster management authorities to contribute significantly. Geographic Information Systems (GIS) technology is ideally suited as a tool for the presentation of data derived from continuous monitoring of locations and used to support and deliver information to environmental managers and the public. GIS based spatial analysis and visual elements are used frequently in recent years for detection of flood hazard areas and for preparation of maps. GIS applications area based on database and which analysis tools have logical and mathematical relationships between the layers (Kourgiala & Karatzas, 2011).

GIS technology has been developed in such a way that spatial information is stored and efficiently retrieved and modelling issues are appropriately embedded to support decision making and operational needs. The added value of GIS technology usage in managing crisis evens is directly connected to the profits expected from the exploitation of such technologies designed for supporting decision making related to the geographical space, especially in the case of the operational field that intensely needs to make important decision of spatial nature (Buckeridge et al., 2002; Gavin, 2002; Vakalis et al., 2004).

Mobile GIS is a mature technology which takes geospatial technology beyond the walls of an office (Jeefoo, 2020). Therefore, mobile applications have extended to field use which allows the user easy access, storage, updates, analysis, and real-time visualization of field data. Till recently, mobile GIS application were mainly used as a navigation or location-aware system. Mobile GIS technology nowadays offers a potential alternative to fill the gaps of traditional GIS systems. With Mobile GIS technology, officers and many other field workers have the potential to access the enterprise geospatial data from the server-side to accomplish their tasks with high level of accuracy. More importantly, it is also possible to update these geospatial enterprise data in real time (Choosumrong et al., 2016).

The aim of this research is developed the Economic Crop System (ECS) by using free and open source software (FOSS) in Pua district, Nan province northern part of Thailand.

2. MATERIAL AND METHOD

2.1 Study area

Pua district, Nan province in the northern part of Thailand (Figure 1) was selected as the study area. Pua district comprises of 12 subdistrict and 107 villages and covers an area of 918 sq.km. with geographical location between 2100000 N to 2140000 N and 690000 E to 730000 E. It is mostly covered with forested mountain, with an approximate elevation of 430 meters about mean sea level.

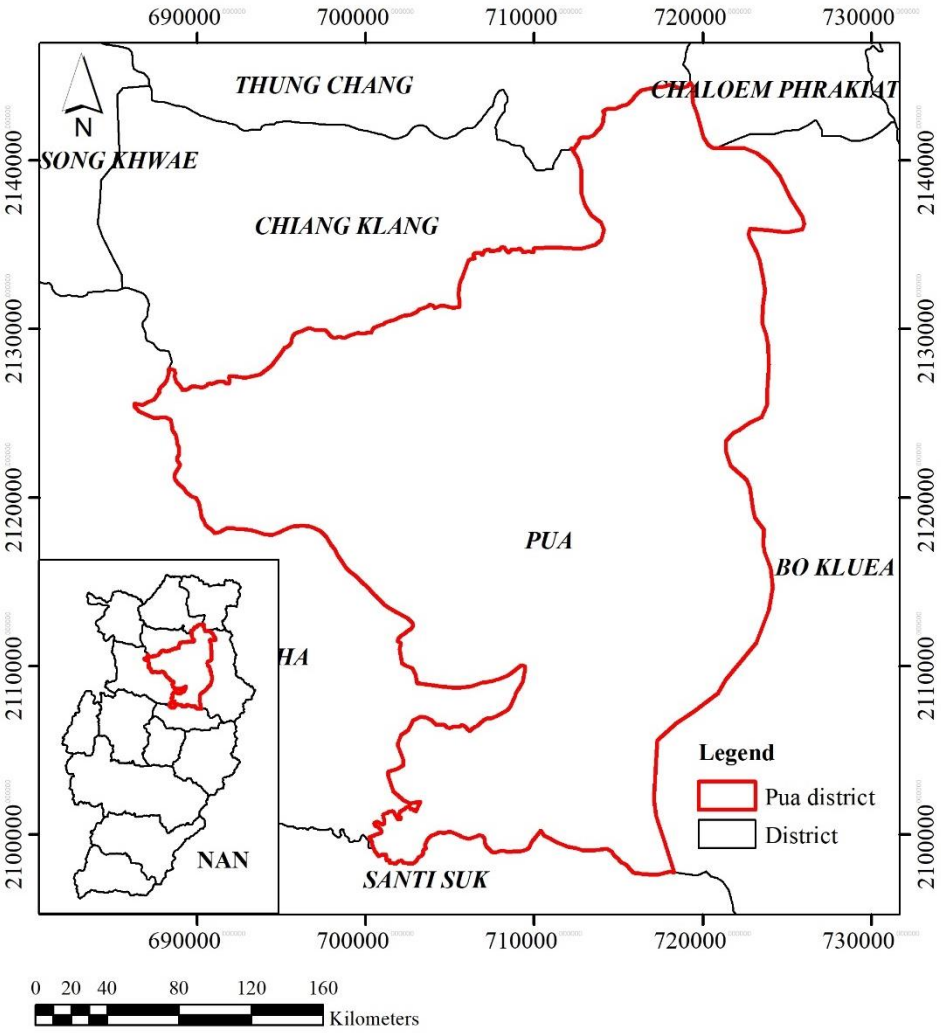


Figure 1. Study area, Pua district, Nan province.

2.2 Method

The ECS were developed by QGIS, Sumlime Text2, IntelXDK. The cloud server is data storage of the system. Administer office is checked data input – output and calculated results for each month of satellite image. Forecasting of the next month's yield calculations come out to be able to use a mobile phone to view the results of the geographic mapping of the cash crops of that area. You can also view the results of the next month's forecast.

2.2.1 *Data collection*

Collecting economic crop statistics each year information from Nan Provincial Agriculture and Cooperatives Office. They were randomly assigned to survey areas in each district to collect data from 9 types of farmers, namely, glutinous rice, longan, lychee, mango, sweet tamarind, coffee, tea, rambutan, and guava.

2.2.2 *Data analysis*

Firstly, admin section by managing information through web pages that can create, save, import or edit various data at any time. It works with databases that use cloud technology. Secondary, collect all data and the last display data in graphs or charts and documents (PDF

and MS Excel). Total year to date the relationship between the work of these 3 parts can be shown in figure 2.

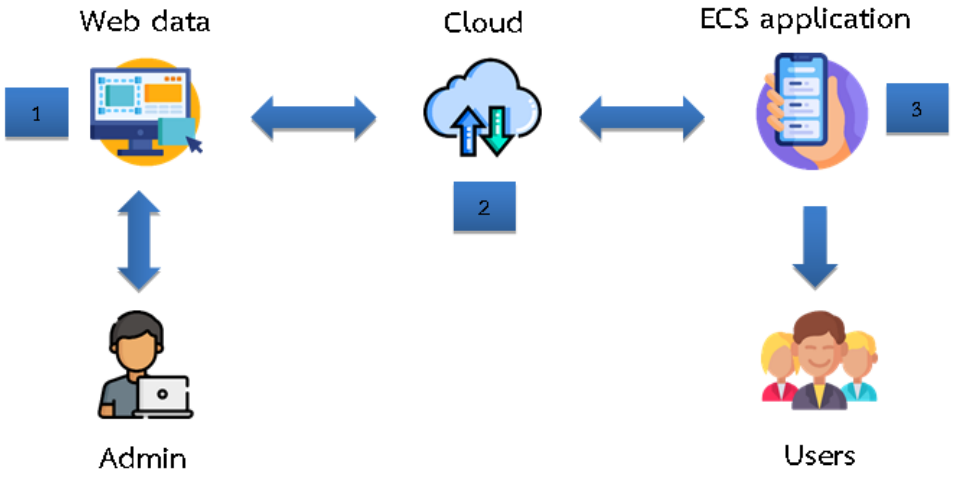


Figure 2. Overall ECS architecture.

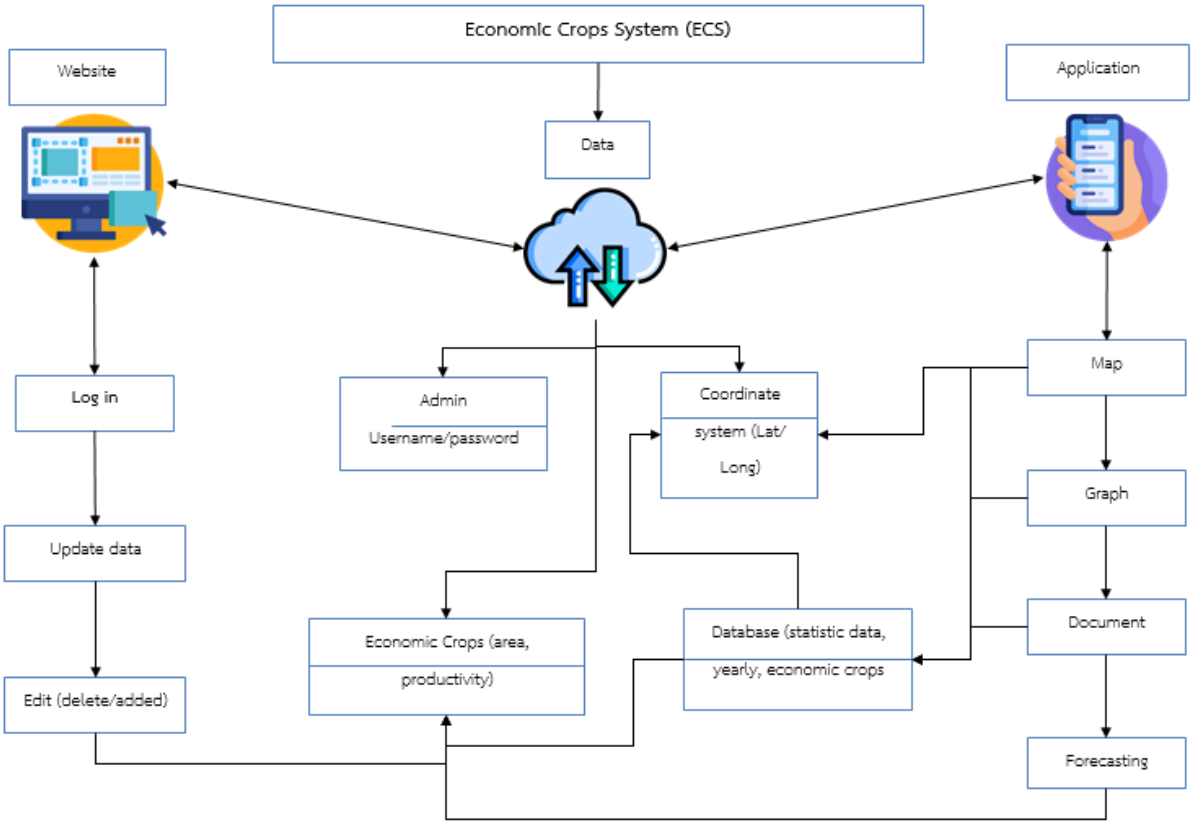


Figure 3. System design of ECS.

2.2.3 *System development*

This step was designed the system development including user interface (UI) and administrator.

1) User interface : 4 functions consist of (i) Map (ii) statistic data (iii) document data

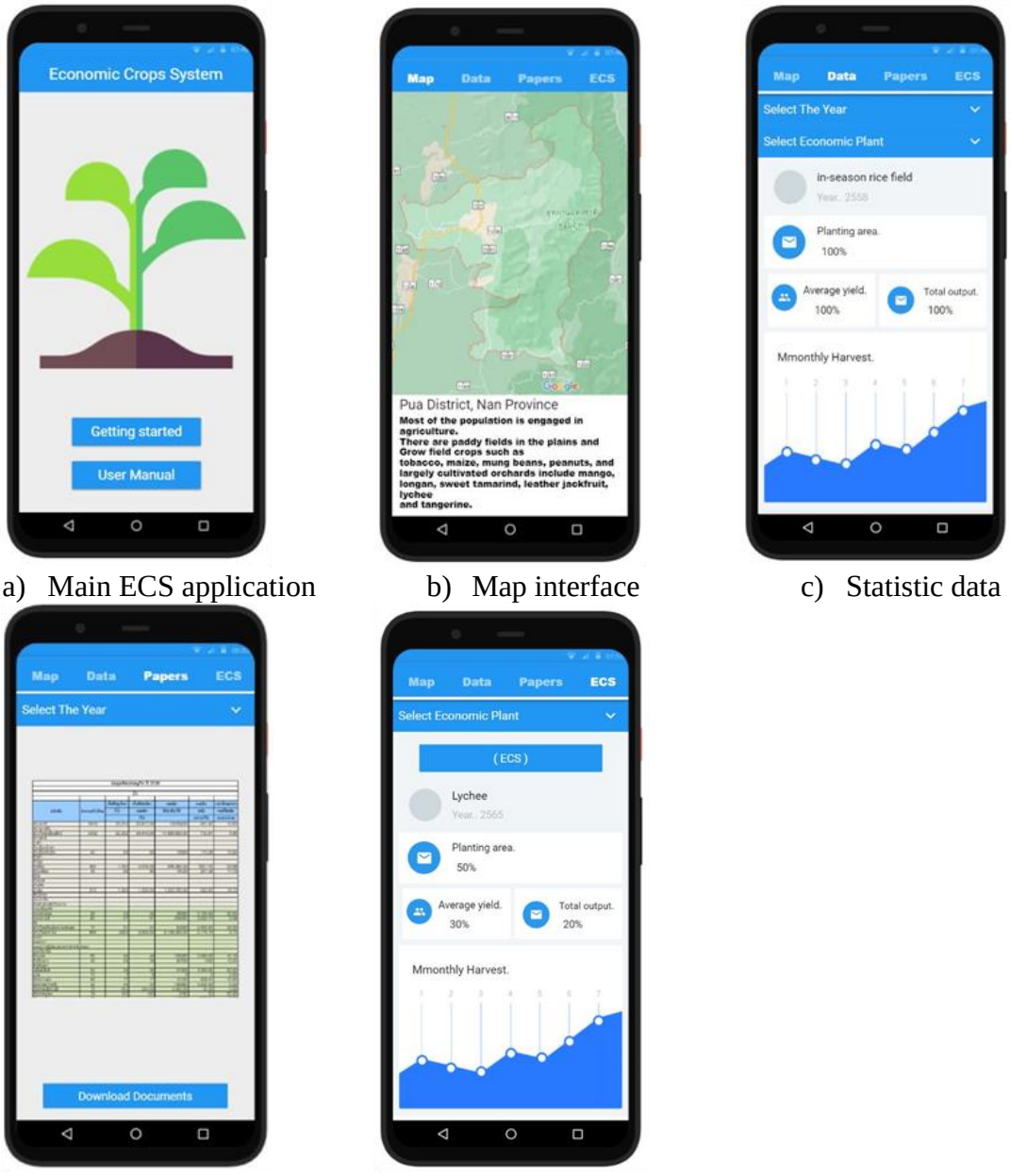
and (iv) forecasting

2) Administrator : updating, input data from MS Excel (coordinate system, crops data) and forecasting function.

3. RESULTS

3.1 Mobile Application : ECS application

Application of the mobile-side of the system was concentrated on the mobile GIS application. The function of predicting or predicting how much results will be achieved in the following year, where users have to select the crops they want to plant, then the application will display results individually. Year and calculate all the monthly cycles that the whole year will produce an estimation. Figure below shows some screenshots of the application.



a) Main ECS application b) Map interface c) Statistic data

d) Download document e) Forecasting page

Figure 4. Shown screenshots of the ECS application Pua district, Nan province.

The web interface for ECS is shown in Figure 5 to Figure 7. The agriculture office can visualize the reporting points of real time field survey that send data, and the can make use of that data for recording and analyzing purposes. For example, part of the economic crop prediction, fill in the numbers of the last year, such as 2016, etc. The system will calculate the results for the next year (Figure 5-7).

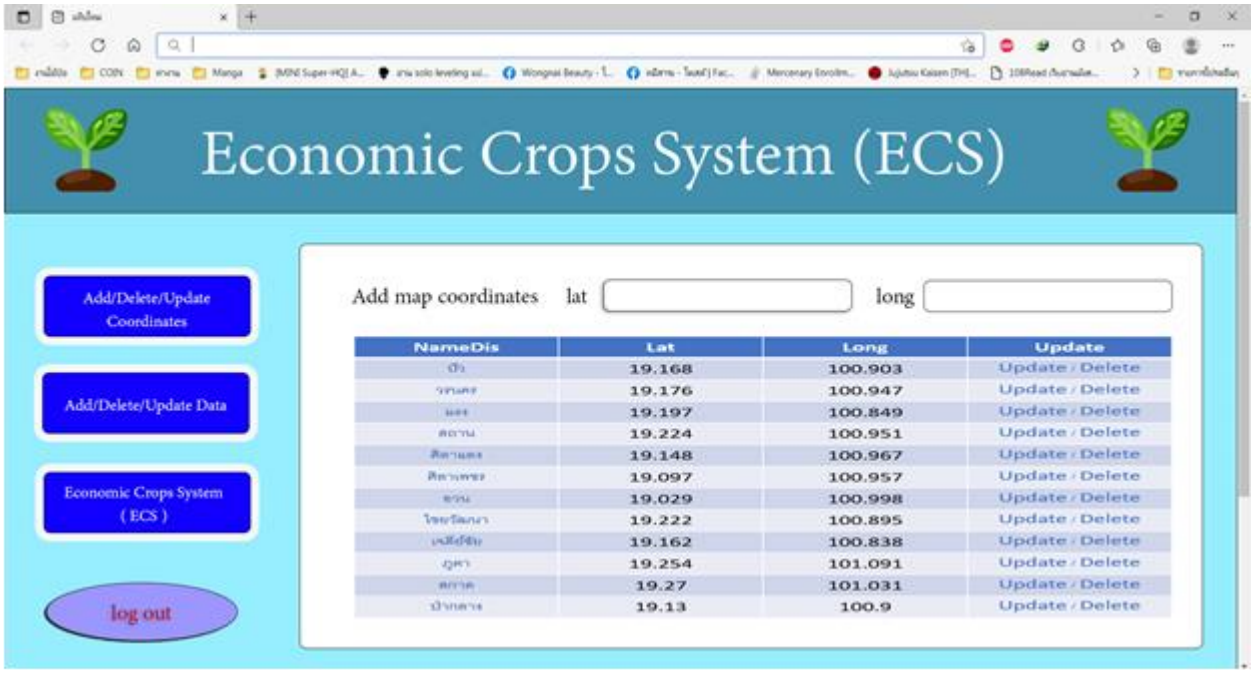


Figure 5. Coordinate web page.

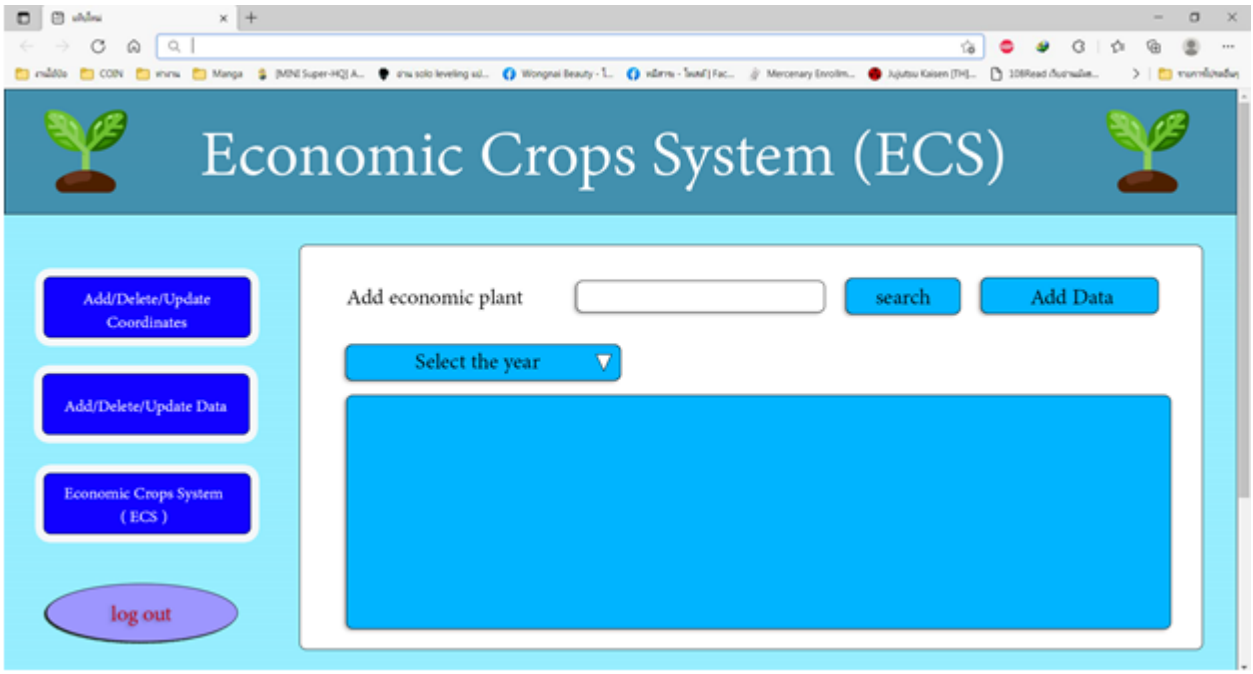


Figure 6. Date web page.

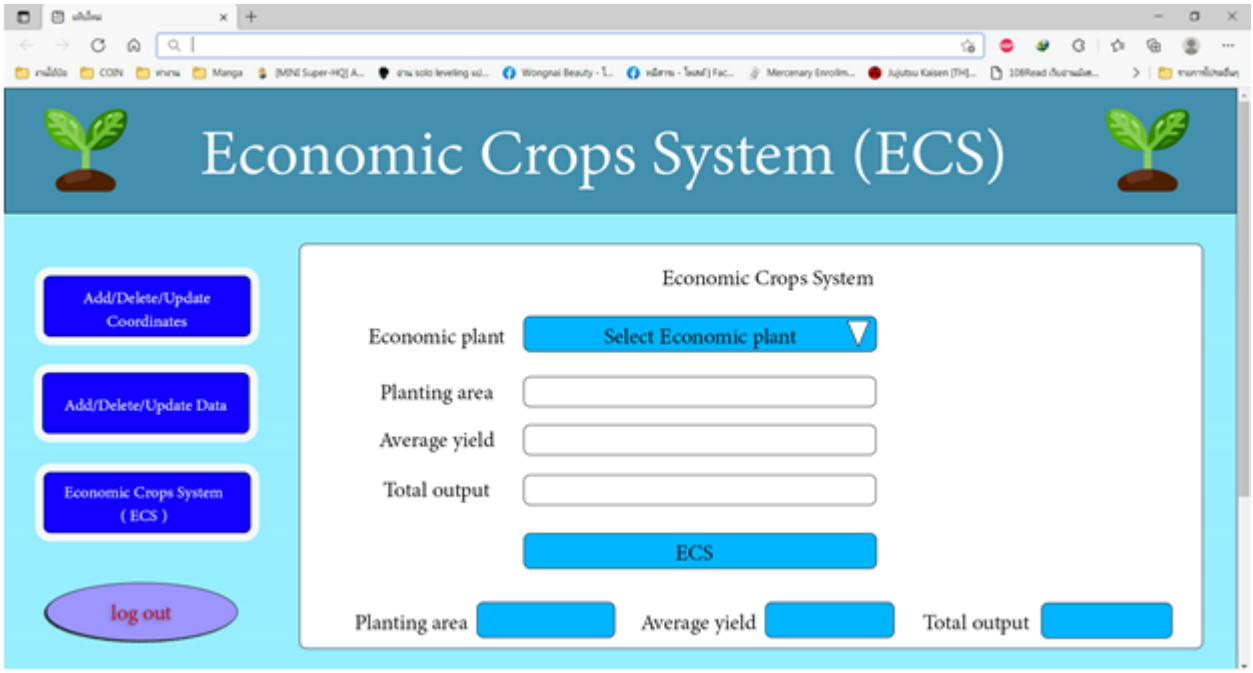


Figure 7. Forecasting web page.

4. CONCLUSION AND DISCUSSION

This research aims to develop a prototype of a system for predicting economic crops using artificial intelligence and GIS in Pua district. Nan province is a case study area for collecting data on economic crops. This system is designed to run primarily on applications, making it easy for users to browse and access information using information. In addition to updating the information through the web page administrator, the information will be stored on the cloud for ease of updating or editing. From the evaluation of the use of users from the system questionnaire in the form of averages in all 3 aspects of system design. The benefits of the system to use and the stability of the system is at a very good level, but if data can be collected in every area with more resolution, it should be expanded and surveyed to collect data at the village level in order to obtain complete information. more knowledge and further benefit to society. WebGIS is the integrated product of GIS and internet technologies; in WebGIS, the internet technologies are connected with GIS in order to take advantage of their special characteristics, such as easy usability, use of the GIS data such as input, adjustment, manipulation, analysis, and output of geographical information and to bring out related service on the internet (Miao & Yuan, 2013).

The system for predicting economic crops using artificial intelligence and GIS uses the area in Pua District. Nan Province is a case study area. There are research results from the assessment. It has been demonstrated to use for 2 groups of users who are personnel in the Phayao Provincial Agriculture Office. and interested individuals who were randomly selected from a total of 40 people assessed 3 aspects of competence from the user group at the satisfaction level. In terms of system design, it was at “very good” ($\bar{X}$ = 4.05, SD = 0.78). The benefits of the system to use were at “very good” ($\bar{X}$ = 4.08, SD = 0.77) and the system stability was at “Good” ($\bar{X}$ = 3.85, SD = 0.78) the overall mean of overall system satisfaction was at “very good” ($\bar{X}$ = 4.00, SD = 0.78).

The methodology is based on notions on general principles of Web GIS / Mobile GIS and has the potential for application for other economic crops of Thailand.

5. ACKNOWDGEMENT

This research is supported by School of Information and Communication Technology (ICT), University of Phayao, Thailand. Spatial thank would like to deliver to the Nan Provincial Agriculture and Cooperatives Office for supporting essential information.

6. REFERENCES

Buckeridge, D.L., Mason, R., Robertson, A., Frank, J., R. Glazier, R., and Purdon, L., 2002. Making health data maps: a case study of a community/university research collaboration. Soc. Sci Med. 55(7): 1189-206

Choosumrong, S., Raghavan, V., Jeefoo, P., and Vaddadi, N., 2016. Development of Service Oriented Web-GIS Platform for Monitoring and Evaluation using FOSS4G. International Journal of Geoinformatics, 12(3), 67-77.

Gavin, E., 2002. Geo-Information Supports Decision Making in Africa – An EIS-AFRICA position paper. Pretoria, South Africa: EISAFRICA. Retrieved from http://www.eis-africa.org/DOCS/A5-Engv7. pdf.

Jeefoo, P., 2020. A WebGIS Base Information System for Monitoring Wildfire Using Suomi-NPP (VIIRS) Satellite in Phare Province, Thailand. Naresuan University Journal: Science and Technology (NUJST), 28 (2), 62-71.

Kourgiala, N., and Karatzas, G., 2011. Flood management and a GIS modelling method to assess flood-hazard areas – a case study. Hydrological Sciences Journal, 56(2), 212-224.

Miao, F., and Yuan, Q., 2013. A WebGIS-Based Information System for Monitoring and Warning of Geological Disasters for Lanzhou City, China. Advances in Meteorology, 2013, 9. [http://dx.doi.org/10.1155/2013/769270]

Vakalis, D., Sarimveis, H., Kiranoudis, C. T., Alexandridis, A., and Bafas, G., 2004. A GIS based operational system for wildland fire crisis management II. System architecture and case studies. Applied Mathematical Modelling, 28(4), 411-425. [https://doi.org/10.1016/j.apm.2003.10.006]