# Data and Geospatial Information Management Web Application for Enhancing the Competitiveness of Trang Pepper Large Agricultural Plot of Community Enterprise

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***Abstract*** **– Trang pepper, a crucial Geographical Indication (GI) product from Thailand's Trang Province, represents a significant new economic crop. The objectives were to develop a data and geospatial information management system for the large Trang pepper plots and evaluate the system. The study employed a mixed-methods approach, collecting qualitative data from five large-plot group leaders and quantitative data from 30 participants through purposive sampling. The developed system effectively tracks individual farmer plots with GPS coordinates for GI certification, recording essential metrics including planting area, pillar numbers, plant age, productivity, product grades, and pricing. The research demonstrates how technological integration in agricultural management can be practically implemented, providing a model for other GI products. The system improves traceability and transparency, fostering sustainable development of Trang's pepper industry and regional economic growth. The overall evaluation results found that the design and functionality were at a good level. The evaluation for ease of use or design of the interface for interaction between the system and the user is at a good level. The study revealed that successful technology adoption depends on users understanding the benefits of web applications and centralized data recording. User-friendly interface design was identified as key to encouraging system adoption.**

***Keywords*** **– Web application design, Trang pepper, geographical indication, agricultural information system**

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## 1. Introduction

Digital technology plays an important role in greatly increasing the potential of today's data management. Thailand's 13th National Economic and Social Development Plan (2022–2027) focuses on promoting the agricultural sector by emphasizing sustainable agriculture and providing farmers with increased income. Large-scale agriculture is one of the promotion policies with the goal of developing the grassroots economy which is the goal of developing the country towards prosperous and sustainable stability [1]. Therefore, information support systems play an important role in the development of Thailand's agricultural sector. It is used to support farmers' agricultural management decisions, which is a crucial tool for enhancing competitiveness in production planning and marketing [2].

"Trang Pepper" is the name given to young pepper or dried, granulated and ground pepper which is produced from a local pepper species called "Palian breed" that has a spicy taste, and a pungent smell, that is grown and processed in Trang province. It has a total cultivation area of 168,656 $m^2$ and has been registered as a Geographical Indication or GI from the Department of Intellectual Property. If it is black pepper, it will be sold at a price of 500 baht per kilogram. If it is ground pepper (white pepper), it will be sold for 1,200 baht per kilogram [3]. When compared with commonly consumed pepper, it is twice as expensive. Therefore, Trang pepper is considered an important economic crop of the province. In addition, upgrading the Trang pepper value chain is important and in line with the country's SDGs in terms of poverty reduction, creating food security and driving the community economy and sustainable management of natural resources [4].

Large-scale agriculture is one of the promotion policies with the goal of developing the grassroots economy. The principles and goals are joint management services, jointly selling products for market management and reducing production costs. These are the goals of developing the country towards stability, prosperity and sustainability by using the mechanism of leading the country towards becoming Thailand 4.0 [5]. However, operations of large plots or Trang pepper local enterprises face 'VUCA'. That is, a situation that occurs suddenly, such as the emergence of an epidemic in plants (volatility), uncertainty of production, lack of information to support decision making. Production data for marketing planning (uncertainty), the complexity of the technology used to collect data (complexity) and lack of reliable promotional information or important information that is useful for marketing promotion and is a point of attraction in the product (ambiguity). It can be seen that the important problems of managing large plots aside from disease outbreaks and the uncertainty of the yield are difficult to control.

There are problems in the operation of large plots and community enterprise groups and local enterprises of Trang pepper. The main problem is the problem of storing data for conversion management. This is because the information available in every government's agency is not current and is inconsistent. However, this information must be used to confirm the location of the plot because it is a GI product. Therefore, it cannot be used to make decisions immediately or in a timely manner. Moreover, the use of information technology is used to collect data to enhance decision making and used very little for competition. There is only use of social media to increase marketing channels.

It is not used for systematic data storage including analyzing data and reporting results to be used in timely decision-making to create a competitive advantage. Moreover, the challenge for designing a system for farmers to use is how to design the system to be user friendly and get farmers to accept the technology. This is a challenge to make the system successful in storing data to achieve its objectives and provide benefits as expected.

The research objectives were to develop a data and geospatial information management system for the large Trang pepper plots and evaluate the system. Therefore, the research team developed a web application for managing data and geospatial information of the large Trang pepper plot. In this research, there is the participation of users, including plot managers, Chairman of the Community Enterprise Group and pepper entrepreneurs in Trang Province. This web application will help store member-pepper conversion information systematically. It can show plot coordinates of members of large plots/enterprises, Trang pepper (Palian Pepper Specie), report on production volume, issue daily/monthly/yearly sales data reports which is separated according to the grade of each pepper/each enterprise group/large plot, and reports including all groups in the province. It can also display planting instructions for each period of the plot. Such reports can be used for planning and decision support for production planning and marketing plans according to the needs of Trang pepper. Importantly, Trang pepper is a GI crop of Trang Province and needs to be inspected. Registration and recording of produce can verify the origin of the produce.

The structure of this research is systematically organized into six main sections.

Section 1 introduction, followed by the Background Study - Section 2, which establishes the theoretical framework through an examination of Information System Design for Agriculture and Web Application Evaluation. The Method (Section 3) delineates the systematic approach through three phases: Context of Use Specification, System Requirement Analysis, and Web Application Design and Development. The Results (Section 4) and Discussion (Section 5) present the findings through System Requirements and Design, followed by System Evaluation. The study is circled with the Conclusion (Section 6).

## 2. Background Study

This study encompasses related topics including 2.1. Information System Design for Agriculture and 2.2. Web Application Evaluation, with the following details.

### *2.1. Information System Design for Agriculture*

Information system design for agriculture is important to support decision making, detailed statistics and trends and personalized insights to increase productivity. The main features of information systems include the convenience of retrieving information from users via the internet, statistical and other data presentation formats [6]. In addition, agricultural information systems have been developed for use in resource assessment and planning using knowledge-based combined with on-farm optimization modelling so that farmers can allocate the use of available resources to maximum benefit [7]. The development of information systems to support agricultural products with geographical indications (GIs) plays a crucial role in enhancing the value and sustainability of these products by leveraging geographic information system (GIS) technology. As emphasized in [8], the spatial dimension of registered GIs can be visualized using GIS, aiding consumer awareness and protecting local products. Furthermore, the European Commission's proposal to strengthen the European Union's GI system highlights the importance of improving the registration process and enforcement mechanisms [9]. Additionally, GI registration aids in the development of rural organizations by protecting product authenticity, promoting market differentiation, and increasing profits through the uniqueness of products linked to their geographical origin [10]. Therefore, the robust implementation of information systems can effectively support the promotion, protection, and sustainable development of agricultural products with geographical indications. There are various tools available for map imagery, however, Bing Maps plays a vital role in GI applications.

It serves as a source of high-resolution satellite imagery employed in creating reference datasets and monitoring changes in agricultural areas or urban regions [11].

This platform offers a diverse array of functionalities, such as displaying addresses, customizing map themes, geocoding, and route planning. Bing Maps further supports both 2D and 3D perspectives, with Silverlight technology enhancing the user experience through realistic visuals. Overall, Bing Maps excels as a comprehensive mapping solution with extensive data and diverse applications across various domains. To display coordinates on a map using Bing Maps, one can leverage the Bing Maps API to embed maps on webpages, customize their appearance, and execute queries using specific coordinates [12]. Notably, the fundamental functionalities of Bing Maps are available free of charge.

The acceptance of technology by farmers is also a critical issue in the design of information systems for agriculture. The Technology Acceptance Model (TAM) is a widely adopted framework for studying and understanding the factors influencing users' acceptance and adoption of new technologies. It is employed to inform the design of information systems' functionalities. TAM theoretical framework helps explain new technology usage and acceptance [13]. Developed by Fred Davis [16], it has been used to understand how people adopt and continue to use new technology. TAM's two primary factors: Perceived ease of use (PEOU) and perceived usefulness (PU) influence intention to use a technology (Figure 1). Perceived usefulness (PU) refers to perception of farmers of how IT improves agricultural outcomes and practices. Farmers adopt IT more if perceived as useful for productivity enhancement, costs reduction, decision-making improvement, and market information access [14], [15].

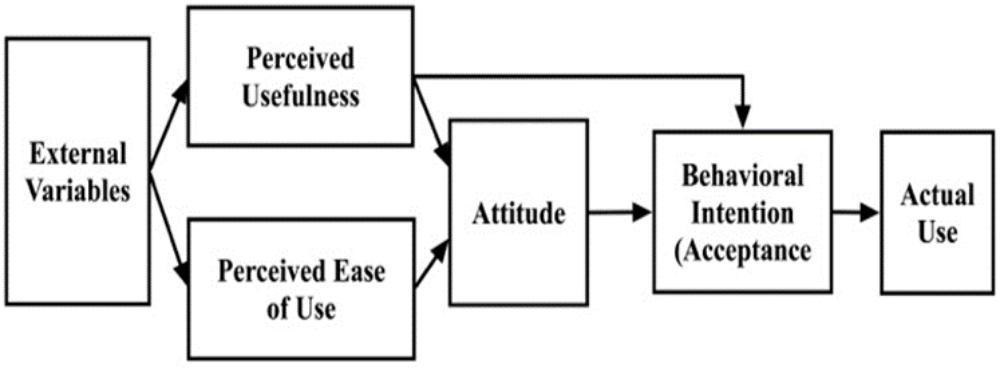


*Figure 1. Technology acceptance model (TAM) [16]*

Perceived ease of use (PEOU) relates to the perception of farmers of how IT is effortless to use. Farmers accept IT more if perceived as easy to operate and user-friendly.

Government support has a positive relationship with the adoption of smart farming and is the most significant influential factor driving farmers' acceptance of the system [17].

A study by [18] similarly found that Thai farmers expressed positive attitudes towards digital technology but faced with a low acceptance rate. Therefore, additional support is needed to increase technology skills and make technology use easier. This is consistent with a study by [19] which showed that when users find technology easy to use and perceive it as helpful, they are more likely to see benefits from using the technology.

The development of large-scale agricultural promotion systems in Thailand (https://co-farm.doae.go.th) aim to collect agricultural data on large plots, including crops, livestock, and fisheries, of the country that will show the number of large plots and total area in each province. However, from the preliminary interviews, it was found that the system was not able to meet the needs of the management of the large Trang pepper plot group for use in supporting decision making because it was only a system used to report the number of farmers participating in the large plot and the amount of area only. In addition to developing a system that can meet needs in designing the system, user persona must be taken into account in order to design a UI that is consistent with the user's characteristics [20].

From the economic survey Agricultural household society, crop year 2021/22, which was income-expense data from activities both in and outside of agriculture of farmers from May 2021 to April 2022, it was found that the average age of Thai farmers in 2022 is 55.1 years, divided into 55.3 years for males and 54.9 years for females [21]. In addition, from the study of "Setting a new foothold in the Thai Agricultural Sector in the Future" by the Thailand Development Research Institute (TDRI) in 2022 it is found that the average age of Thai farmers is 55 years. This shows that Thai farmers are getting older. From a survey of Trang pepper farmers, the average age is 61 years from a study by [22].

Factors that should be considered in designing a User Interface (UI) that is friendly to the elderly include:

1) User Interface design that emphasizes simplicity and sequence of brain processing, that are; reading from left to right, top to bottom in the same standard on every page; let the elderly use memory as little as possible; there is a web application navigator.

2) Using high-contrast colors, using large font sizes, and using Thai fonts with headings for easy reading. UI design elements should increase the size of text and numbers to improve readability; achieve high contrast between the background and text/icons by using a background shade with darker text and icons; scale the screen and adjust the size of the text and number buttons; simplify the interface by removing unnecessary elements and reducing clutter. The navigation should be clear and easy to use [23].

### *2.2. Web Application Evaluation*

The system evaluation approach evaluates usage to see if it meets its objectives and evaluates it according to the information technology success model [24] that states - The information system will be successful because of the quality of the information system, including:

1) Information such as up-to-date information e.g., the information is accurate.

2) System quality, such as the system's functionality is as intended and system reliability

3) Service quality such as system access e.g., the response is quick and uncomplicated.

In addition, it was evaluated according to HCI principles that consider various factors that affect the difficulty of use, such as the language used for communication, font size, background colour, icon size, and appropriate placement of system components [25].

UI design uses the 10 Usability Heuristics for UI Design by Jacob Nielsen [26], widely used to evaluate the design of the UI/UX or web application for usability [27]. The 10 principles include:

The system should display the status to the user in a timely manner.

The system should use easy-to-understand language using terminology that users are familiar with.

The user can exit the adverse situation and return to the initial state.

The design should be standardized so as not to confuse the user.

The design should focus on preventing data entry errors.

The system should help users remember how to use it.

The system should be easy to use, supporting both novice and experienced users.

The system should be easy to use, present only as much information as necessary, and fill in as little information as possible.

The system must display errors so that users can understand what type of problems can be encountered and how to fix them, and have a help document. In conclusion, Nielsen's principles [26] will help reduce usage problems that may occur.

## 3. Research Methodology

The development of this information system uses User-Centered Design software and application development that focuses on participation [28]. The research methods for developing a large-scale data management web application (Figure 2) can be divided into the following steps:

### *3.1. Specifying the Context of Use*

The population and sample in this research are community enterprises/large pepper plots in Trang Province. A purposive random sample was selected from those with operational results or still having active status from the database of the Department of Agricultural Extension. It was found that in Trang Province, there are large plots/community enterprises of the Trang pepper planting group that are still effective. Currently operating in 5 groups: Khao Wiset Pepper Community Enterprise, Lamor Local Pepper Group Community Enterprise, Raimontri Community Enterprise, Palian Pepper Promotion and Conservation Group, and the Palian District Pepper Farmers Group. And users at the super admin level are Provincial Agriculture and Provincial Commerce to be able to view reports from the system.

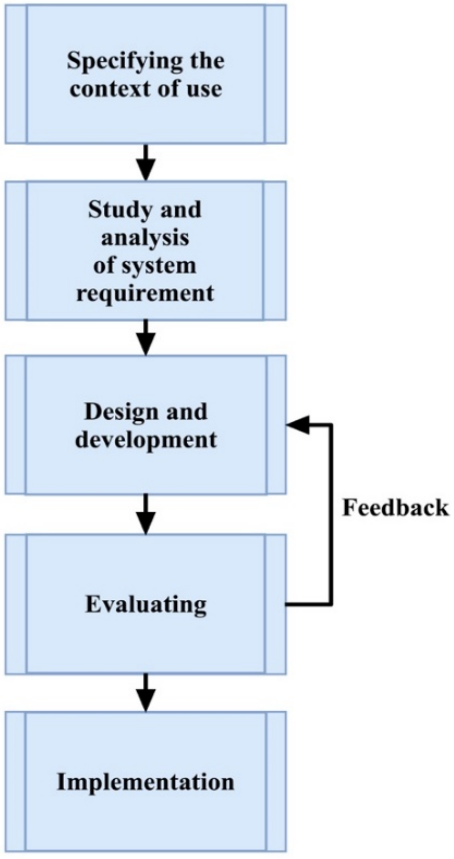


*Figure 2. Shows the process of developing web applications*

### *3.2. Study and Analysis of System Requirement*

The population and sample used in this research are five groups of large plots or community enterprises in Trang Province, Thailand.

Data were collected using in-depth interviews. The sample group was selected by purposive methods from large plot managers/chairmen of community enterprise groups/pepper entrepreneurs in Trang Province, totaling five large plot groups.

Then, the obtained data was analyzed to identify the main needs of farmers in data management.

The research tools were an interview form and a system evaluation form (developed according to reviews in section 2.2) which evaluated the consistency between the individual questions and the measurement objectives or measuring the accuracy of the questionnaire by three information technology experts. These tools have been approved by the Human Research Committee of Walailak University, Thailand number WUEC-22-014-01.

### *3.3. Web Application Design and Development*

The Web Application Design and Development process consists of the following details:

- Defining a User Persona

It is about the characteristics of the person who is the target user. This will help to understand the requirements of the target group better. It is used in user-centered design to determine how they would look and behave. This will affect the design of the system or software [29]. The process is comprised of qualitative research. The tool used is an interview form. Then, followed by the analysis of the form and function of similar needs of the obtained data to identify the needs of the target group. Finally, to create a design for the appropriate User Interface (UI).

- System Development

It is a database system for storing farmers' cultivation data using a relational database. Develop web applications (Coding) and test the functionality of various functions before testing the system with users.

- System Evaluation

In system evaluation purposive sampling was used from representatives of each group of farmers, totaling five people per group. This amount is appropriate to be able to measure the results of system use and save budget [30]. Then, to improve and modify the application according to the suggestions.

The evaluation tool is a system evaluation form, which has two parts:

1) Evaluation of functional design systems whether the operation of the system is as intended or not and whether the system has a quality system or not.

2) Evaluating the User Interface design section. The questions are closed-ended questions on a 5-level scale: Very little, a little, moderate, very much, and the most, and additional suggestions are open-ended questions. The analysis used mean and standard deviation.

- Implementation and transfer technology to the target group through workshops for farmer members in large plots/community enterprises, in all 5 target groups.

## 4. Results

The research findings comprise two main components: 4.1 System Requirements and Design and 4.2 System Evaluation.

### *4.1. System Requirements and Design*

From in-depth interviews with a sample group of chairmen of enterprises/large plots, between 7 February 2022 - 30 March 2022, the results of interviews in each group are summarized as shown in Table 1.

From interviews with users representing community enterprise groups/large plots, it was found that previously, there was only one group that had the storage of group information such as member information was in the form of records in books and the data was not available and not in time to decide.

From a literature review and research, it was found that an important factor in the adoption of this web application technology was the usefulness of the application being able to display information for decision making. Recording plot coordinates to use as preliminary information for registering farmers' GI and for verifying Trang pepper production in the group. To make farmers accept the technology and have a good attitude towards its use, the researcher designs a user interface that is easy to use and records data easily and without hassle. There must be a training workshop to convey how to use the system to farmers in the group.

Therefore, designing the functionality of the system includes the system can record the annual yield of farmers and can display the coordinates of farmers' plots.

*Table 1. Summary of in-depth interview results of the sample group*

| **Group name / number of members** | **Current problems and obstacles in group management** | **Member information storage and collection of product data** | **Needs/information necessary for group management in order to develop a web application for conversion management** |
|---|---|---|---|
| Khao Wiset Large Pepper Plot Community Enterprise (40 members) | There is a lack of knowledge about good and standard plot management. Some enterprises have not yet received GAP certification and use chemicals. In addition, there is no systematic household accounting and data collection. | Record the members' output in a notebook. | Systematic storage of data on both yield and GAP plot certification information for each farmer and plot coordinates to support being a GI product. |
| Raimontri Community Enterprise (10 members) | There is a lack of knowledge about processing pepper into products that meet market needs and marketing promotion. | There is no record of production. | There is a need for an online system, storing location data, planting areas for use in GI, GMP product certification, and production reports. |
| Lamo local pepper growing community enterprise group (40 members) | The group's operations include growing other pepper varieties along with growing Palian pepper varieties. Black pepper production is not graded and may be adulterated with other pepper varieties. The pepper plot has not yet been certified to GAP standards. There is no systematic household accounting and data storage. | There is no record of production. | There is a need for an online system, storing production data separated by grade of pepper and displaying the location of members' pepper plots for use in product certification, GI, GMP, and support from the government. |
| Palian District Pepper Growers Group (18 members) | Farmers have little access to technology, making it more difficult to expand distribution channels for their produce. There is also a lack of standard management, a lack of knowledge regarding plot management, cleanliness of produce and packaging. | There is no record of production. | There is a need for a system that can store member information as well as the annual production and sales of each farmer. |
| Community enterprise conserving local plant genetics (30 members) | The pepper plots are not yet certified for Good Agricultural Practices (GMP). There is no household accounting. Sales or income each year Lack of systematic data storage. | There is no record of production. | There is a need for a system that helps collect data that is easy to use and can view the production report each year. |

The system must be able to report information on farmers' pepper plots which includes personal information: planting area, number of stands (pillars) planted, age of pepper plants in each plot, productivity/year, grade of product sold, price sold, etc.

It must be able to report on a group overview where agents or managers of large plots can view various reports. At the provincial level or provincial agriculture or super admin, the reports on total production for all groups can be seen and the production trends for each year as well. The system requirements are shown in Figure 3.

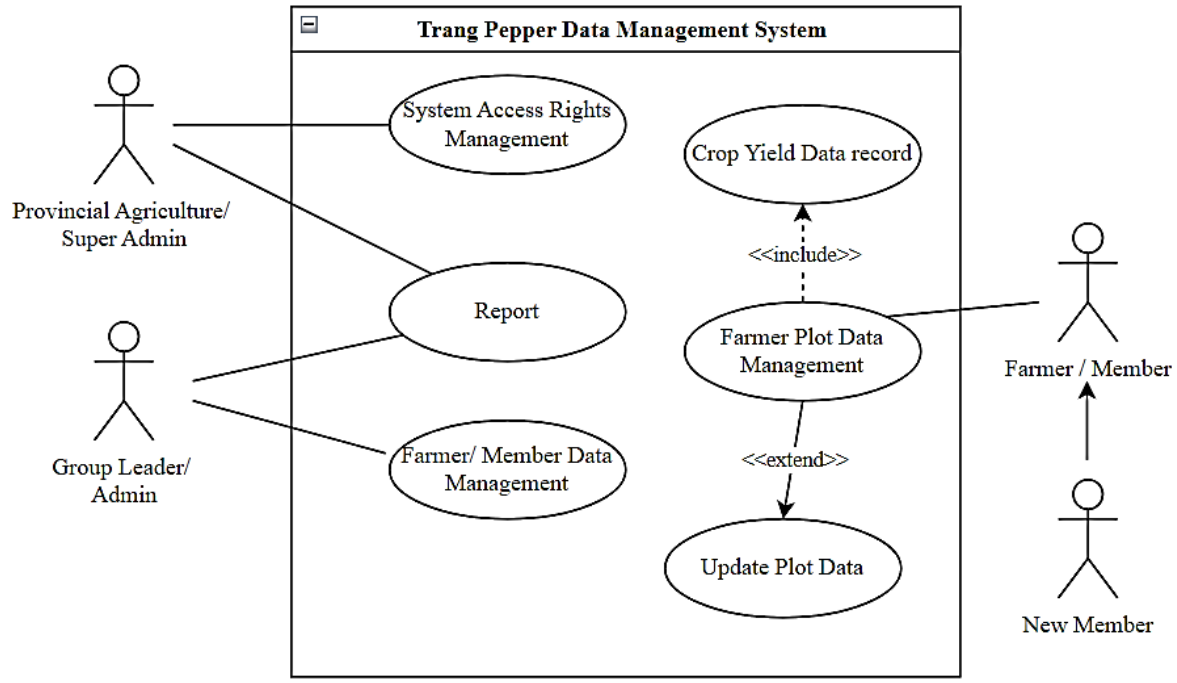


*Figure 3. Use case diagram of the system*

In the large-scale plot management system, each plot has assigned rights. Users are divided into 3 levels:

1) Member level or Trang pepper growers: Users at this level can login to use and record planting information, specify the plot coordinates, and to be able to manage their own pepper plots.

2) Large plot manager/community enterprise: Users at this level can view data and reports on large plots. which is designated as the admin of each group.

3) Provincial level administrators or super admins: Users at this level can view overall pepper production data for all 5 enterprise groups/large plots. The system has a data flow diagram as shown in Figure 4. The database design is a relational database with a total of five tables, consisting of group, Agriculturist, Cultivation, Plant, and Admin, as shown in Figure 5.

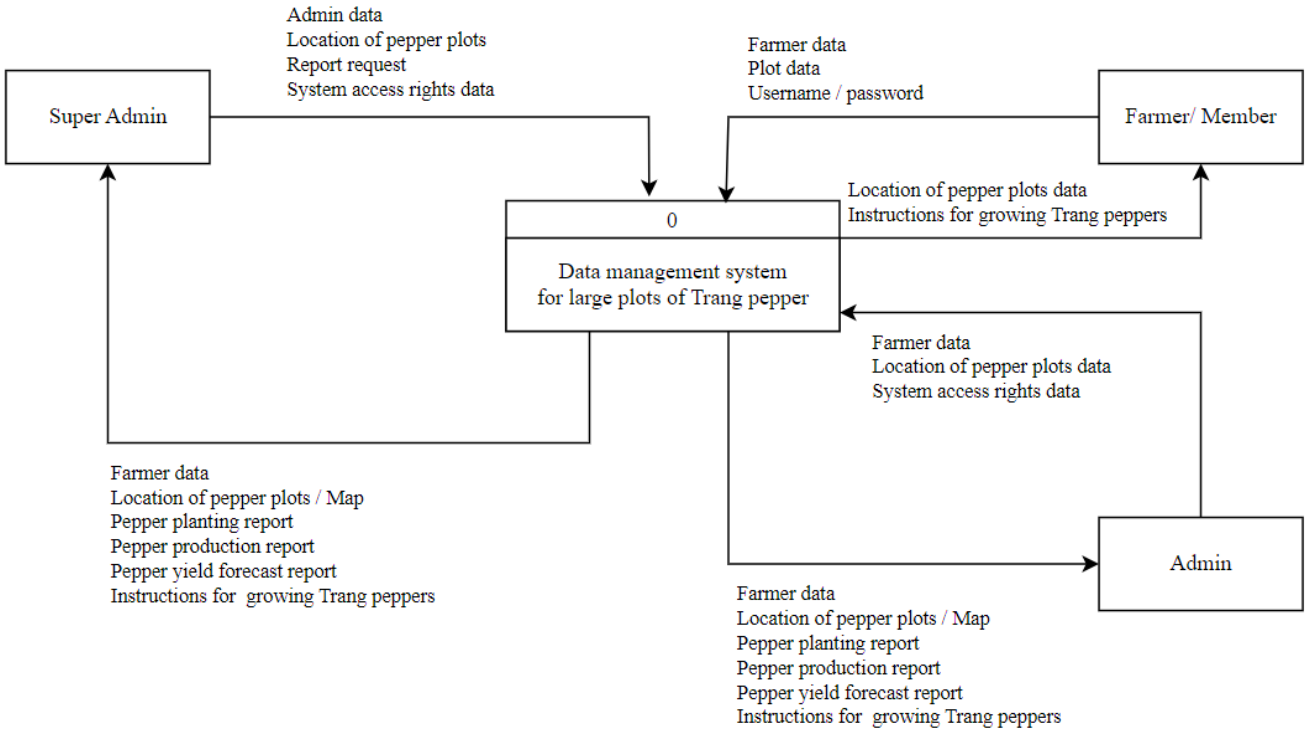


*Figure 4. The context diagram of the system*

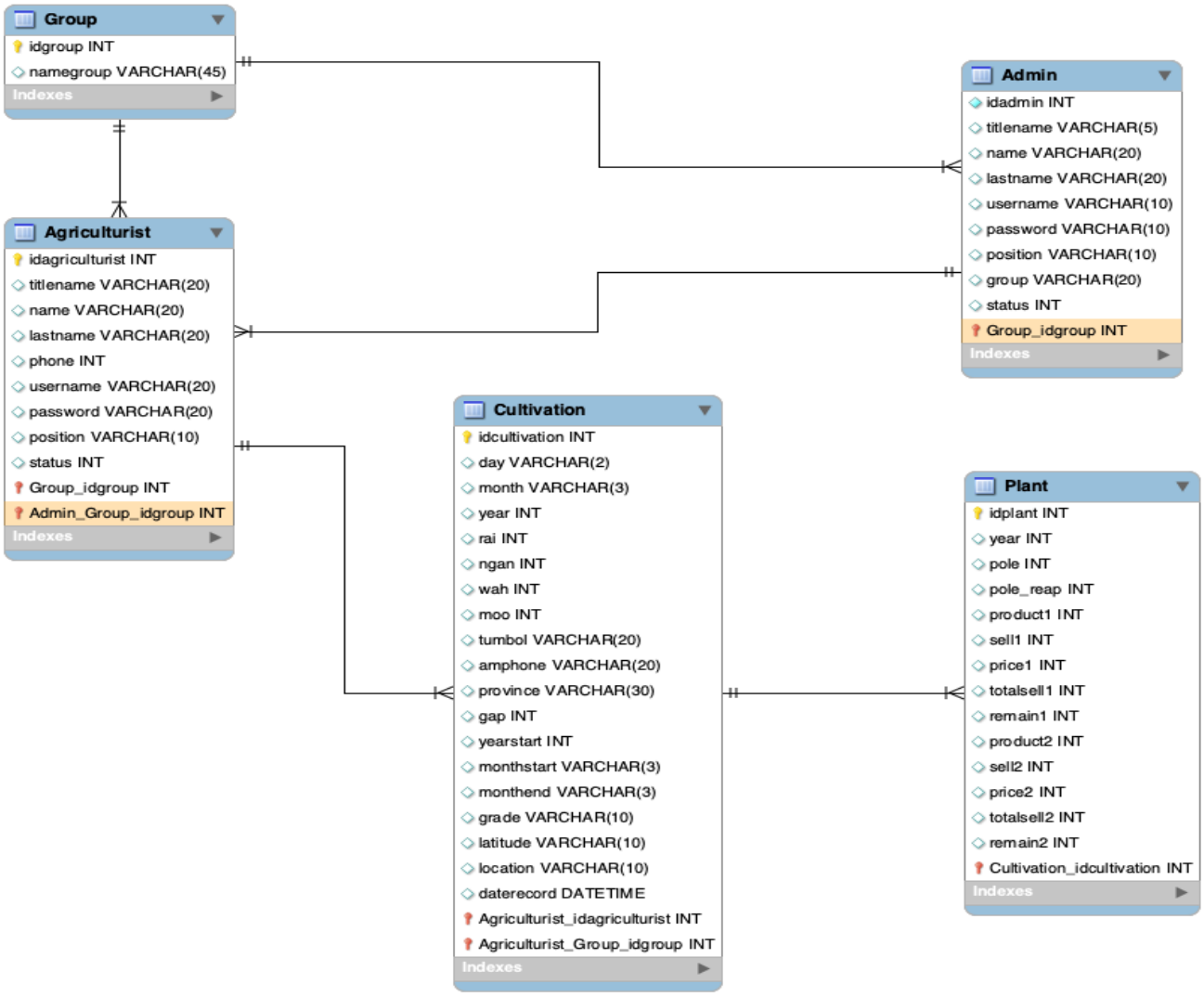


*Figure 5. The ER-diagram of the system*

Developing a plot management web application for individual farmers that can be run through a smartphone or computer through www.trang-pepper.com; the architecture of the system is client (Client) / Server (Server). Both the client and server use the Windows operating system, consisting of two main parts as follows: 1) The server service provider part has the Apache 2.2.29 program that acts as a web server and 2) Part of clients using the service. The system was developed using PHP language technology Version: 5.6.10 and the PHP MyAdmin 4.4.10 database management system to act as a database management program. Show the coordinates of farmers' pepper plots on the map by using the Bing Maps API key to connect to the Web Application.

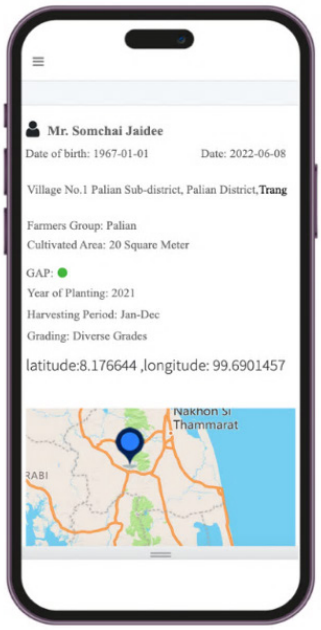


*Figure 6. Information and plot coordinates of farmers*

In addition, the UI design has been designed as a responsive design, where the display will change according to the size of the device being used and further designed to allow users to adjust the font size as desired to suit each user's vision. When logging into the system, it will be able to record pepper planting information, yield reports, and yield estimates. System can manage farmer/member information (Figure 6). Administrators/group leader can view member information in graphical and tabular reports and plot location (Figure 7). The administrator is able to edit member information. The system administrator can report pepper production quantity (grade A, B, or mixed grades) and compare the production each year.

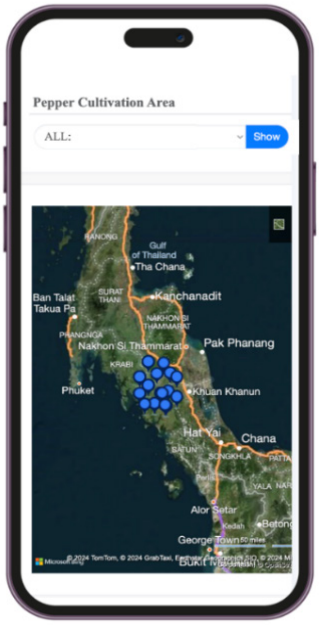


*Figure 7. The plot location*

### *4.2. System Evaluation*

System evaluation involves selecting a purposive sample by selecting information system development experts with at least 5 years of experience and representatives of farmer groups who use the system, 5 people per group. The overall evaluation results found that the design and functionality were at a good level ($\overline{x}$ =4.33, S.D.=0.58). The evaluation for ease of use or design of the interface for interaction between the system and the user is at a good level ($\overline{x}$=4.00, S.D.=1.00) as shown in Tables 2 and 3.

*Table 2. Results of the evaluation of the functional design system*

| Attribute | $\overline{x}$ | S.D. | Levels |
|---|---|---|---|
| 1. To be able to manage system usage rights appropriately | 4.67 | 0.58 | Highest |
| 2. To be able to update various information in the database. | 4.33 | 1.15 | High |
| 3. The system can present information correctly. | 4.67 | 0.58 | Highest |
| 4. The system can be used easily | 4.33 | 0.58 | High |
| 5. To be able to respond quickly to use | 4.00 | 0.00 | High |
| 6. The system's functionality can work as intended. | 4.33 | 0.58 | High |
| 7. The system is reliable. | 4.33 | 0.58 | High |
| 8. Satisfaction with overall system functions | 4.33 | 0.58 | High |

*Table 3. User interface design*

| Attribute | $\bar{x}$ | S.D. | Levels |
|---|---|---|---|
| 1. System menu suitability | 4.00 | 1.00 | High |
| 2. Appropriateness of font size | 4.33 | 0.58 | High |
| 3. Suitability of system colors | 4.33 | 0.58 | High |
| 4. Suitability of system symbols | 4.00 | 0.00 | High |
| 5. Appropriateness of the arrangement of system components | 4.00 | 1.00 | High |
| 6. Suitability for interaction with system users | 4.00 | 1.00 | High |
| 7. Overall satisfaction with the interaction | 4.00 | 1.00 | High |

The evaluation results found that farmers' acceptance and use of web applications for storing agricultural produce data is influenced by two main factors: 1) perceived usefulness and 2) perceived ease of use. This can be seen from the system evaluation results. The process of creating awareness of the importance and benefits of the system to farmers is through a process of analyzing system's needs and designing the system together with users to get a system that meets their needs and a workshop project to transfer technology. This is an important process in technology adoption. Training increases users' knowledge and skills and helps users feel confident in using information systems, including creating a good attitude in using information systems, and ICT infrastructure support from the government, such as access to the internet always, etc.

The discussion was presented according to the research objectives, which is to develop a data and geospatial information management system for the large Trang pepper plot and to evaluate the system as follows.

- The large Trang pepper plot data management system can be used to report results according to the set objectives. The system evaluation results are at a good level. It can raise the level of competitiveness for each large Trang pepper plot/community enterprise group to support decision making and production and marketing planning.

An important factor in getting farmers to accept technology is the perception that using the system is necessary and beneficial. The government sector must take part in promoting and supporting farmers to keep their information up to date in the system. It also points out the importance of data to be used as a database for receiving support and assistance from the government, such as in the case of plots damaged by disasters or promotion of product processing and marketing, especially in this case. Trang pepper has received GI certification, so the location of the plot has been recorded. Then, the resulting products will be verified and certified together with the Provincial Commerce Department to create a product verification system to promote sales. In addition, in the issue of system design, there should be representatives from those government sectors who participate in the design so that it can be useful to meet the needs of the super admin level.

- Evaluation of satisfaction with functionality is at a good level. As for the overall evaluation of satisfaction with the UI, it is also at a good level. Guidelines for designing a UI that is friendly to farmers, most of whom are elderly, include:

a) Use large, clear letters: Elderly people often have vision problems. Therefore, use large, clear letters, and use contrasting colors between the letters and the background. However, in this research, the letters are designed to be a responsive design, which the display will change according to the size of the equipment used by each farmer.

b) Use buttons and icons that are large and easy to see.

c) Use a simple and intuitive design. Enter as little information as necessary. There should be no complex or confusing buttons or inconsistency of icons' design.

d) The system has clear instructions for use. The ease of use will cause users of the system to have a good attitude and to accept the use of technology which is in line with the established research concepts.

e) Designed to have minimal typing of imported data. Data import should be designed to prevent data entry errors.

In conclusion, he development of Data and Geospatial Information Management Web Application for Enhancing the Competitiveness of Trang Pepper Large Agricultural Plot of Community Enterprise has achieved significant recognition. The project received Outstanding Awards in 2023 for its successful application of intellectual property, technology, innovation, and academic services to enhance production and service sector capabilities within the higher education institutional framework.

## 5. Discussion

The discussion is organized according to the two research objectives: Developing a data and geospatial information management system for the large Trang pepper plots and evaluating the system.

### *5.1. Development of the Data and Geospatial Information Management System*

The developed data management system successfully met its objectives, providing reports and insights critical for decision-making in production and marketing planning. The system evaluation results were rated at a good level, indicating its potential to enhance competitiveness for Trang pepper community enterprise groups. A crucial factor influencing farmers' acceptance of the technology is their perception of its necessity and benefits [16], [13].

Government involvement is vital in promoting the system and ensuring farmers keep their information updated. This aligns with findings emphasizing the role of government support in driving technology adoption in agriculture [14], [5]. For instance, data recorded in the system can serve as a critical database for disaster support, product processing, and marketing initiatives, particularly given Trang pepper's GI certification [10], [8]. Furthermore, integrating input from government representatives during system design could ensure the system aligns with super-admin-level requirements [24].

### *5.2. Evaluation of System Functionality and UI Design*

The functionality evaluation received positive ratings, with users expressing satisfaction with the user interface (UI). For elderly farmers, specific UI design principles were emphasized:

- Use of large, clear text: To address common vision issues, the design incorporated responsive fonts that adjust based on the device, consistent with research on text legibility in digital systems [25], [23].
- Visible buttons and icons: Larger, easily recognizable buttons improve usability, as seen in studies of digital interface design for senior users [22].
- Simplified, intuitive design: Reducing information complexity aligns with best practices in heuristic evaluations [26], [28].
- Clear instructions for use: User-friendly instructions foster positive attitudes toward technology, supporting previous findings on technology acceptance [18], [19].
- Minimizing data entry errors: Automated data input reduces user errors, enhancing the overall user experience [27].

The findings confirm that designing systems that are accessible and user-friendly for older farmers can promote technology acceptance and encourage regular use, ultimately supporting sustainable agricultural practices and GI certification initiatives.

## 6. Conclusion

The propensity for technological adoption among agricultural practitioners can be evaluated through their engagement in technology transfer initiatives implemented across five Trang pepper large agricultural enterprise community groups. The system evaluation and usage assessment, coupled with governmental initiatives promoting systematic data management among district-level agricultural operators, demonstrates a satisfactory level of implementation. This has resulted in enhanced awareness among farmers regarding the significance of system adoption and sustained utilization. The system can report the yield of each large plot group, the overall production, and the location of each plot. This serves as an essential tool for verifying the quantity and source of production. However, it cannot yet provide accurate yield predictions due to limited precision in the current implementation. Accurate predictions would require soil data, sensor integration, and machine learning capabilities. Subsequent investigations should examine the potential integration of advanced analytical methodologies, specifically predictive analytics and machine learning algorithms, into the existing framework. These sophisticated computational tools could yield substantial insights into various agricultural parameters, including pest infestation prediction and optimization of planting schedules based on weather and soil data. Future researchers interested in this topic should carefully consider these aspects to enhance the system's predictive capabilities.

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**References:**


[1]. Office of the National Economic and Social Development Council. (2022). *National Economic and Social Development Plan (2023-2027), 13*. Nesdc.go.th. Retrieved from: https://www.nesdc.go.th/nesdb_en/ewt_dl_link.php?nid=4500 [accessed: 19 May 2024].

[2]. Phoksawat, K., Mahmuddin, M., & Ta'a, A. (2019). Intercropping in Rubber Plantation Ontology for a Decision Support System. *Journal of Information Science Theory & Practice (JIStaP)*, *7*(4). Doi: 10.1633/JISTaP.2019.7.4.5

[3]. NBT Connext. (n.d.). *Palian pepper one of Trang's famous GIs.* Thai news. Retrieved from: https://thainews.prd.go.th/th/news/detail/TCATG220615154443008 [accessed: 25 May 2024].

[4]. Sawangwong, B., Jaidee, K., & Suksanga, M. (2023). The Community Economic Development Model to Sustainable Provincial Development: in Trang Province. *Journal of Public Administration and Social Management*, *5*(1), 12-27.

[5]. Kan, S. (2020). Operational development of large-scale agricultural extension system to implementation. *Baddhana Journal*, 7(2), 109–120.

[6]. Rajput, V., Chauhan, P., & Verma, M. P. (2023). Agri Solutions. *International Journal For Science Technology And Engineering*, *11*(6), 1187-1192. Doi: 10.22214/ijraset.2023.53811

[7]. Phoksawat, K., & Mahmuddin, M. (2016). Ontology-based knowledge and optimization model for decision support system to intercropping. *In 2016 International Computer Science and Engineering Conference (ICSEC)*, 1–6. Doi:10.1109/ICSEC.2016.7859927

[8]. Flinzberger, L., et al. (2022). Why geographical indications can support sustainable development in European agri-food landscapes. *Frontiers in Conservation Science*, *2*, 752377.

[9]. Wang, H., & Yu, X. (2023). Discussion on the Development Strategy of Digital Marketing of Agricultural Products from the Perspective of Long Tail Theory Take Agricultural Products with Geographical Indications as an Example. *BDEDM 2023: Proceedings of the 2nd International Conference on Big Data Economy and Digital Management.*

[10]. Choudhury, M. H., & Paul, S. K. (2022). Geographical Indication Registrations for Rural Enterprise Development. *Geographical Indication Protection in India: The Evolving Paradigm*, 75–104.

[11]. Lesiv, M., et al. (2018). Characterizing the Spatial and Temporal Availability of Very High Resolution Satellite Imagery for Monitoring Applications. *Earth System Science Data Discussions, 2018*, 1–24.

[12]. Sinani, A. (2013). *Learning Bing Maps API.* Packt Publishing Ltd.

[13]. Alshammari, S. H., & Rosli, M. S. (2020). A review of technology acceptance models and theories. *Innovative Teaching and Learning Journal (ITLJ)*, *4*(2), 12-22.

[14]. Nyagango, A. I., Sife, A. S., & Kazungu, I. (2023). Use of mobile phone technologies for accessing agricultural marketing information by grape smallholder farmers: a technological acceptance model (TAM) perspective. *Technological Sustainability*, *2*(3), 320-336. Doi: 10.1108/TECHS-01-2023-0002

[15]. Ambong, R. M. A., & Paulino, M. A. (2020). Analyzing rice farmers' intention to adopt modern rice technologies using technology acceptance model (TAM). *Asian Research Journal of Agriculture*, *13*(1), 21-30. Doi: 10.9734/arja/2020/v13i130094

[16]. Davis, F. D. (1989). Technology acceptance model: TAM. *Al-Suqri, MN, Al-Aufi, AS: Information Seeking Behavior and Technology Adoption,* 205–219.

[17]. Jaroenwanit, P., Phuensane, P., Sekhari, A., & Gay, C. (2023). Risk management in the adoption of smart farming technologies by rural farmers. *Uncertain Supply Chain Management*, 11(2), 533–546. Doi: 10.5267/j.uscm.2023.2.011

[18]. Sayruamyat, S., & Nadee, W. (2019). Acceptance and readiness of Thai farmers toward digital technology. *Smart Trends in Computing and Communications: Proceedings of SmartCom 2019,* 75-82. Doi: 10.1007/978-981-15-0077-0_8.

[19]. Tubtiang, A., & Pipatpanuvittaya, S. (2015). A study of factors that affect attitude toward deploying smart-farm technologies in Tanud subdistrict, Damnoen Saduak district in Ratchaburi province. *Journal of Food Science and Agricultural Technology (JFAT)*, *1*, 144-148.

[20]. Romi, I. M. (2012). Interface design factors impact on core affect. *Journal of Emerging Trends in Engineering and Applied Sciences*, *3*(2), 373-382.

[21]. Office of Agricultural Economics. (2022). *Survey of economic and social conditions of farmer households in 2022. Bangkok*. Oae.go.th. Retrieved from: https://www.oae.go.th/ [accessed: 22 May 2024].

[22]. Kamtab, P., & Wiriyanon, T. (2022). Design a Digital Multimodal User Interface for Senior Citizens. *Journal of Education Studies*, EDUCU5001005-13.

[23]. Polnigongit, W., Chanwimalueng, W., & Fitzgerald, S. (2023). The development of a fuzzy model and usability test of a recommended interface design for mobile phones for elderly users. *International Journal of Interactive Mobile Technologies*, *17*(2), 118-136.

[24]. DeLone, W. H., & McLean, E. R. (2003). The DeLone and McLean model of information systems success: a ten-year update. *Journal of management information systems*, *19*(4), 9-30.

[25]. Wang, X., et al. (2022). The influence of font size, contrast, and weight on text legibility for wearable devices. *International Conference on Human-Computer Interaction*, 124–136.

[26]. Nielsen, J. (1994). Enhancing the explanatory power of usability heuristics. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, 152–158.

[27]. Ramadhanti, N. T., Budiyanto, C. W., & Yuana, R. A. (2023). The use of heuristic evaluation on UI/UX design: A review to anticipate web app's usability. *AIP Conference Proceedings*, *2540*(1).

[28]. Lowdermilk, T. (2013). *User-centered design: a developer's guide to building user-friendly applications.* O'Reilly Media, Inc.

[29]. Karolita, D., et al. (2023). Use of personas in requirements engineering: A systematic mapping study. *Information and Software Technology*, *162*, 107264.

[30]. Jakob, N. (2000, March 18). *Why you only need to test with 5 users.* Nielsen Norman Group.