Development of Agricultural Product Origin Inspection System for Supporting Agro-Tourism with Data Mining Techniques in Samut Prakan Province

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Received: October 29, 2024; Revi sed: November 20, 2024;
Accepted: December 17, 2024; Published Online: December 30, 2024

Abstract

This paper presents the innovative development of a source monitoring system for agricultural products that supports agricultural tourism using data mining techniques in the Samut Prakan Province using collaborative filtering. This method uses modeling techniques with clustering techniques and an Analytic Hierarchy Process (AHP). This method can create a database by adopting the approach of developing a knowledge base using the ontology method to propose knowledge in the form of groups of concepts and their relationships with each other within the scope of interest. This makes it possible to create a database that provides reasoning efficiently. This research is a combination of qualitative and quantitative research with the following objectives: (1) to study and collect data on the sources of agricultural products and agricultural tourism sites in Samut Prakan Province and (2) to develop a working model of the source inspection system of agricultural products for introducing agricultural tourism using data mining techniques. (3) To develop an application to support agricultural tourism by monitoring the sources of agricultural products in Samut Prakan Province. According to the research, (1) ontology can accurately and appropriately verify the sources of developed agricultural products to a large extent (4.16±0.46). (2) The system has a high level of efficiency (4.27±0.63). (3) Results of satisfaction assessment by users with a high level of satisfaction with the system. (4.25±0.65). However, the system of monitoring the source of agricultural products that supports agritourism with this developed data-mining technique can be used to meet the needs of users.

Keyword: Ontology, Agricultural Product Origin Inspection System, Recommendation System, Agro-Tourism

Introduction

Tourism is one of the industries that influence Thailand's economic system and is also an important engine to drive the economy. Owing to the COVID-19 pandemic, the number of tourists has continued to decline (Ministry of Tourism and Sports, Tourism and Sports Economics Division, 2020). However, in mid-2022, the global COVID-19 pandemic has tended to decrease, making the tourism atmosphere bustling. According to a study of tourism behavior, tourists tend to pay more attention to tourism in the area, such as natural attractions and tourist attractions, lifestyle, and cultural traditions (Tourism Authority of Thailand, 2023). In addition, data from the Department of Agricultural Promotion (2023) show that agricultural tourism and community tourism are increasingly popular forms of tourism among both Thai and foreign tourists. Therefore, the use of local natural resources to create value is a boost to the economy. Create a job Generate income for farmers and tourism entrepreneurs.

This area of Samut Prakan Province is home to Suvarnabhumi Airport, which is one of the main airports in Thailand. Data for January 2023 show that the average daily flight volume is 829 flights, and the average number of inbound and outbound passengers is 138,287 per day (Thai e-Finance News Agency 2023). Therefore, Samut Prakan Province is a city that tourists visit or use as a place to stop and relax before traveling to other places. Although Samut Prakan Province is an

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industrial city with many factories, it has a large area for farming and selling agricultural products. The country's famous agricultural products include Nam Dok Mai mangoes, pond gourami fish, fishing, and white shrimp farming. Nam Dok Mai's mango fruit in Thailand is a variety of mangoes commonly grown in the Bang Phli District, Samut Prakan Province. Nam Dok Mai' mango is a characteristic fruit that when ripe will have a sweet and delicious taste, with a unique aroma, it is a famous product of Samut Prakan province Thailand. These areas have developed into agricultural tourism sites according to the policies and plans of the Department of Agricultural Promotion to accommodate tourists who prefer ecotourism or nature tourism. According to the study, in the area of Samut Prakan Province, there is not enough information related to the investigation of the source of agricultural products that support agricultural tourism, and most of them are only in the form of websites or social media that provide information about tourist attractions. Searching for information on agricultural tourist attractions may not be convenient or fast. In addition to traveling to the location, there is still a lack of navigation systems and systems used to collect various opinions on tourism. Tourism information systems (Kronsirinut, Chonthisa, & Wiyuda, 2024) will be a convenient and effective communication channel. This allows users to receive fast and continuous services to create satisfaction among tourists.

General tourist attraction recommendation systems are divided into six methods (Burke, 2007): Content-based, Collaborative filtering, Demographic, Knowledge-based, Community-based, and Hybrid. This model and technique is divided into two groups (Breese, Heckerman, & Kadie, 1998): 1) Memory-based Techniques use the method of collecting information about tourists and tourist attractions they have visited and use it as a guide to make recommendations. It relies on statistical techniques to find a group of tourists (neighbors) with a similar travel history to the target tourists and to write appropriate recommendations. Similarly, tourist attraction information may be used by the target tourist, including neighbors who have already been there. All were analyzed for the similarity of the tourist attractions in the entire database with the tourist attractions that the target tourist wants to visit to offer the most suitable place recommendations to tourists. However, the challenge for Memory-based Techniques is the problem of sparsity and scalability caused by the insufficient amount of available data, making it impossible for systems based on Memory-based Techniques to recommend tourist attractions. and 2) Model-based techniques are model-based techniques use databases to create models. This model is intended to be used to predict tourist attractions for the target tourists. Zheng, Cao, Zheng, Xie, and Yang (2010) modelled the relationship between tourists. Javaheri (2011) proposed an arrangement of tourism routes using the Analytical Hierarchy Process (AHP) technique in conjunction with a GIS system. Various architectural styles along the route. This method allows the introduction of tourist attractions that meet the needs of tourists. It has also been found that the ontological method, which is one method that uses elements such as classes or concepts to deduce the meaning of things within a defined scope of knowledge. This allows the representation of knowledge through ontological methods to promote the exchange and sharing of knowledge as well as excellent reasoning skills. This can be used to help in the design of a database to effectively support the operation of the recommendation system.

In this paper, present a method for developing a system to monitor the sources of agricultural products that support agricultural tourism using data mining techniques in Samut Prakan Province. This study covered three districts: Bang Bo District, Bang Phli District, and Phra Samut Chedi District. This is an area of economic importance, tourism, and popular agricultural products. The Collaborative Filtering method uses a modeling technique based on the clustering technique and the Analytic Hierarchy Process (AHP). In addition, a database was prepared by applying the ontology method to develop a knowledge base. An effective reasoning database can be created to offer knowledge in the form of groups of concepts and their interrelationships within the scope of interest. The objectives of this research were as follows: 1) to study and collect data on the

sources of agricultural products and agricultural tourism sites in Samut Prakan Province. 2) To develop a working model of an agricultural product source monitoring system for introducing agricultural tourism using data mining techniques, and 3) to develop an agricultural tourism support application for monitoring the sources of agricultural products in Samut Prakan Province. The next section describes the research methodology, tools used, demographics, research results, and conclusions.

Methodology

This section describes how to conduct research, including the study and collection of data on the sources of agricultural products and attractions, development of system models, and development of applications.

1. Study of information on agricultural products and tourist attractions

1.1 Data collection from relevant agencies: The researcher collected data on the sources of agricultural products and agricultural tourism sites in Samut Prakan Province, including the Department of Agricultural Promotion, Phra Samut Chedi Chedi District Agriculture Office, Bang Bo District Agriculture Office, Bang Phli District Agriculture Office, Samut Prakan Provincial Agriculture Office, Samut Prakan Provincial Community Development Office, and Samut Prakan Provincial Tourism and Sports Office. As well as studying from the Basic Data Report and Information on Agriculture and Cooperatives of Samut Prakan Province for the year 2022 (Samut Prakan Provincial Agriculture Office, 2022).Report on the Implementation of the Agricultural Data Collection Project of Bang Krachao Sub-district (Bang Krachao Lovers Network, 2023). Visit agricultural tourism sites and agricultural product production areas. Stores that sell agricultural products and products to study and collect information.

1.2 Website Data Collection: This data collection includes information on agricultural tourism operators and agricultural production operators, and information on agricultural products in Bang Bo District, Bang Phli District, and Phra Samut Chedi District, Samut Prakan Province.

2. Development of the system working model

The development of a working model of this system uses the verification of the source of agricultural products for the introduction of agricultural tourism with data mining techniques. Start by studying the documents. Various related research papers were developed using the Collaborative filtering method. The method of developing a knowledge base using the ontology method is applied to propose knowledge in the form of groups of concepts and the relationships between them within the scope of interest, enabling the creation of a database with effective reasoning. This includes the use of rating scores and location technologies (GIS and Google Map Service) in conjunction with computer languages.

3. Application Development

Development of an application to support agricultural tourism for monitoring the source of agricultural products in Samut Prakan Province There are 7 steps to operate. as follows

3.1 Collect data for application development: Target groups were determined to collect demand data from a sample of entrepreneurs, distributors, and tourist operators. A total of 10 purposive sampling agents were selected from Bang Bo District, Bang Phli District, and Phra Samut Chedi District, Samut Prakan Province. Questionnaires were used to collect data on the following three aspects: system data, internal data management, and system application design. The results are analyzed to determine the mean and standard deviation and the results are used as a guide for the development of the system in the next stage.

3.2 Knowledge Base System: This system is based on ontology methods within the scope of the Source Monitoring System for Agricultural Products that Support Agricultural Tourism in Samut Prakan Province. This ontology method uses an accurate and appropriate assessment of agricultural ontology and tourism sites in the Samut Prakan Province. Experts should evaluate the accuracy and appropriateness of the ontology before using it as a guide to prepare the database used in the developed system.

3.3 System Analysis: This analysis defines the scope of the system accessibility of each group of users with a diagram of the system users and the relationship with the subsystems within the system (Use Case Diagram). This diagram shows the relationship between the data (ER-Diagram) and the flow chart design. To describe the process involved in the operation of the source monitoring system for agricultural products in Samut Prakan Province, which supports the development of agricultural tourism.

3.4 System Design: This User Interface design is used for each group of users, including the data acquisition section. Data processing and display. To be suitable for the right to access the system, convenient to use, and support the work of those involved. Interaction between users and computers is divided into two forms: web applications and mobile applications. The design is based on UX/UI design theories, based on the research of Joo, H. (2017).

3.5 Development of Inspection System: Verification of the source of agricultural products in Samut Prakan Province that supports agricultural tourism. The database program was MySQL version 8 and the web server was Apache version 2.2. The language used to develop the system is divided into two parts: the web application or backend language used for system development is PHP version 8.2, and the mobile application or front-end part is the React native version 0.71.

3.6 System Performance Test: This performance test uses a system performance assessment form to verify the source of agricultural products that support agricultural tourism using the developed data mining technique in Samut Prakan Province.This test covered four areas: functional requirement tests, functional tests, usability tests, and security tests.The confidence of the instrument was determined by IOC standards with five experts in research, measurement, and evaluation.The generated assessment was used to evaluate the performance of the system created by three experts.The Purposive Sampling method was used to include computer and information technology experts, knowledge base system preparation experts, and knowledge base system preparation experts. Spatial researchers and community leaders. The results were analyzed to determine the mean and standard deviation values, and the results were used as a guide to improve the efficiency of the system.

3.7 System User Satisfaction Assessment: This satisfaction assessment uses three user satisfaction assessments. The questions were divided into two aspects: the capability and application of the system. The quality of IOC assessment was determined by three experts in research, measurement, and evaluation. The satisfaction assessment form was conducted by three groups of users: 1) tourism service providers/agricultural product producers in the three target districts, namely Bang Bo District, Bang Phli District, and Phra Samut Chedi District, with a total of five people using a specific selection method (Purposive Sampling). The satisfaction assessment of the source inspection system of agricultural products that supports agricultural tourism in Samut Prakan Province by the owners of tourist attraction/agricultural product production sites. 2) Owners of shops selling agricultural products and agricultural products operating in the three targeted districts, namely Bang Bo District, Bang Phli District, and Phra Samut Chedi District, 10 shops. A purposive sampling method was used to study store owners' satisfaction with the developed system. Satisfaction assessment of the source inspection system of agricultural products that support agricultural tourism in Samut Prakan Province. by a shop or shop owner who sells agricultural products. and 3) 105 Thai tourists were collected from three locations in the following three districts: (1) Bang Bo District, namely, the Sufficiency Economy Learning Center. Ban Twibun Pikka-Luang Por Pan Yai Floating Market (2) Bang Phli District, Luk Phra Dabos Project Samut Prakan under the royal initiative, Wat Bang Phli Ancient Floating Market, Bang Pla Nawatwithi Community Enterprise and (3) Phra Samut Chedi District, including Ban Khun Samut Chin Muang Phra Waterfront Market by collecting data from 15 tourists from each source out of a total target of 105 tourists. A random Accidental Selection method was used to study the satisfaction of tourists with the developed system, and to use the results as a guide for system improvement.

Research Results

1. Results of the study and data collection

The results of the study and data collection from relevant government agencies revealed information on places related to agricultural activities, including agricultural tourism sites, shop information, and agricultural distribution sources (such as fresh markets). In Bang Bo District, Bang PhliDistrict, and Phra Samut Chedi District, Samut Prakan Province as shown in Table 1 and information on agricultural products/products found in Bang Bo District, Bang Phli District, and Phra Samut Chedi District, Samut Prakan Province as shown in Table 2.

2. Results of the development of the system working model

Results of the development of a working model of the agricultural product source monitoring system for introducing agricultural tourism using data mining techniques. The researcher used the data obtained from the study, collected the basic data in the system, and developed a working model of the source monitoring system for agricultural tourism using data mining techniques. The results show that the design of the working model of the agricultural product source monitoring system for introducing agricultural tourism with data mining tech-

Table 1 Number of places involved in agricultural activities

Ordinal Numbers	Location information	Districts in Samut Prakan Province (Number)			Total	Percentage
		Bang Bo,	Bang Phli,	Phra Samut Chedi		
1	Learning Center for Agricultural Production Optimization	2	1	1	4	0.69
2	Shops and Merchants	138	238	132	508	87.28
3	Agricultural Distribution Sources (Fresh Market and General Market)	20	20	4	44	7.56
4	Tourist attractions and agricultural tourism sites	7	5	9	21	3.61
5	Community enterprises that have been certified for product quality from Bureau of Industrial Product Standards	2	3	-	5	0.86
	Total	**169**	**267**	**146**	**582**	
	Percentage	**29.04**	**45.88**	**25.08**		**100**

Table 2 Summary of the number of agricultural products or products in Bang Bo District, Bang Phli District, and Phra Samut Chedi District

Product Type	Number of Products	Percentage
Vegetable Products	21	25.00
Medicinal Plant Products	18	21.43
Crop Products	15	17.86
Fishery Products (Freshwater Animals)	14	16.67
Livestock Products	6	7.14
Fishery Products (Coastal Aquatic Animals)	5	5.95

Table 2 (Continue)

Product Type	Number of Products	Percentage
Ornamental products	3	3.57
Agronomic Products	2	2.38
Total	**84**	**100.00**

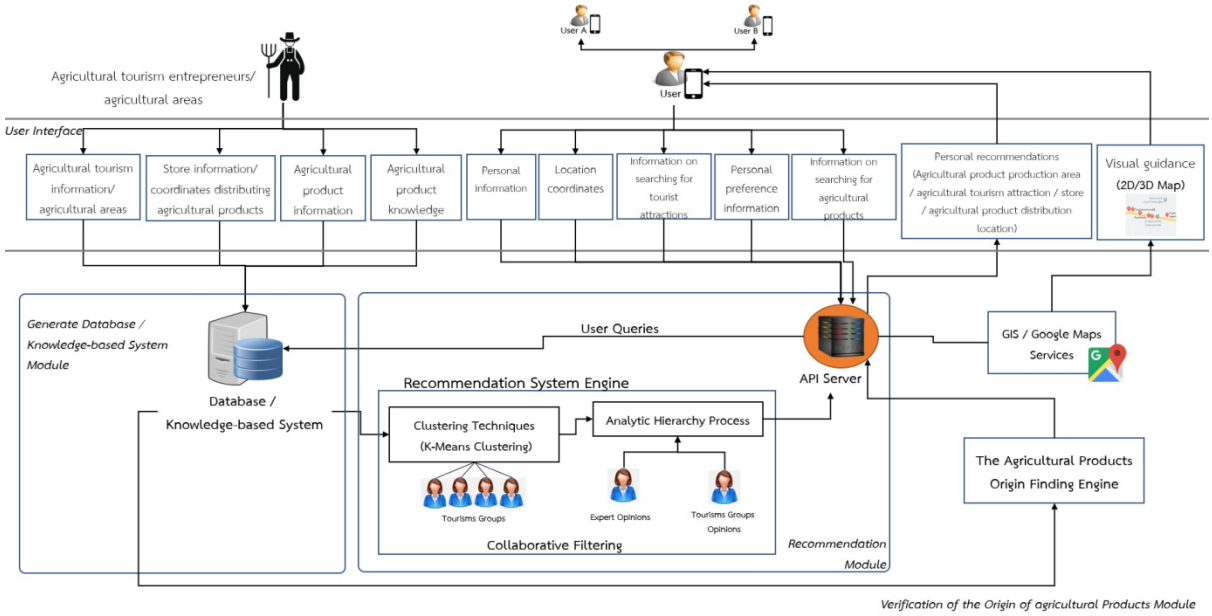

Figure 1. The working process of the source inspection system of agricultural products

niques can divide the operation of the system into four parts: creating a database/knowledge base system, part of the recommendation system function, part of the interaction with users, and monitoring of the source of agricultural products, as shown in Figure 1.

Figure 1 shows the working process of the source-monitoring system for agricultural products that supports agritourism. This work is divided into four parts, as follows:

Part 1: Generate Database/Knowledge-based System Module is the process of developing a data storage system by collecting data from two groups of related people: 1) information on tourism operators and agricultural product production area operators, including information on agricultural tourism sites/agricultural areas, information on shops/coordinates where agricultural tourism sites are distributed to shops, information on agricultural products, and knowledge of key raw materials that are developed into agricultural processing products from tourist sites in the research area. It is used in the source monitoring system for agricultural products that support agricultural tourism. It is then used to create a knowledge base using an ontology-based system to organize and transmit knowledge (organization and flow of knowledge).It promotes the sharing and exchange of knowledge by using it as a guide for designing and preparing a database used in the agricultural tourism guidance system and supporting the search for information related to agricultural tourism carried out through the system.

Part 2 Recommendation Module: The researcher developed a Recommendation System Engine using the collaborative filtering method with modeling techniques. Combining the synergy of clustering techniques and the Analytic Hierarchy Process (AHP) (Angskun&Angskun, 2014), the process is as follows.

1) Collect the data used to design and develop a tourist attraction ranking model. According to the data, tourist and expert information are included as follows:

1.1) Information of 100 tourists by a specific selection method obtained from tourists visiting tourist attractions in three districts: 1) Bang Bo District: Sufficiency Economy Learning Center Ban TwibunWingka-Luang Por Pan Floating Market, a total of 30 people. 2) Bang Phli District, Lukphradabos School Royal Projects, Wat Bang Phli Ancient Floating Market, with a total of 35 people; 3) Phra Samut Chedi District: Ban Khun Samut Chin Muang Phra Rim Market, with a total of 35 people.The details of collecting information related to agricultural tourism are as follows.

1.1.1) Tourist Basics

- Basic tourist characteristics include the following.

●Gender divided into male, female

●Age range divided into 18 – 28, 29 – 38, 39 – 49, 50 – 57 and 58 years and above.

●Income is divided into 15,000 – 25,000, 25,001 – 31,000, 31,001 – 34,000, 34,001 – 40,000 and 40,001 Baht or more.

●Occupational groups are divided into students, government officials, company Employees, private businesses, pension officials, trade, and others.

- Tourism characteristics data (based on most behavioral data) include the following:

●Traveling companions are divided into traveling alone, traveling to work,
Traveling with couples, friends, and family.

●Type of travel classified as private car Public transportation Tour buses and
others

●The nature of the demand for private agricultural tourism is classified as a stopover. Go for a day and night, and stay overnight.

●The daily budget is less than or equal to 1,000 Baht, 1,001 – 1,500 Baht, 1,501 – 2,000 Baht, and 2,000 Baht or more.

- Other tourists' information includes:

●Learning from tourism is classified as learning a lot. With the question "Do you like to learn how to do it and experiment with farming?" The possible answer is that they like it a lot, they want to try it, they like it, but they do not like it, and they do not like it.

●The diet experiments were classified into groups that were similar to the experiment. With the question "Do you often experiment with foods directly obtained from nature?" A possible answer is often, often, or not experimentally.

1.1.2) Tourists' opinions on the criteria used to consider tourist attractions included the main criteria and sub-criteria, as shown in Table 3.

Table 3 shows the details of the main criteria and sub-criteria, where F is the Factor showing the factors related to agricultural tourism that are set as criteria for tourists to consider. For example, F1 means that the main criterion 1 is tourist attractions, which consists of six sub-criteria: F1.1, community tourism attractions, and F1.2. Flea Market, F1.3 Floating Market, F1.4 Learning Resources, F1.5 Each tourist is required to comment on a comparison of each pair of sub-criteria related to tourist attractions. If you had to choose a tourist attraction, which criteria would you pay more attention to? Priority score values were compared between pairs. For the comparison of the priority scale, Shown in Table 4.

Similarly, comparing the importance of criteria starts by creating a matrix table showing all the main criteria and creating a matrix table of sub-criteria for all the main criteria. A comparison of the main criteria is shown in Table 5, and an example of a matrix comparing each pair of sub-criteria for the type of agritourism (F4) is shown in Table 6.

Table 3 Main criteria and sub-criteria used to determine tourist attractions

Main criteria	Sub-criteria
Attractions **(F1)**	Community Tourism Attractions **(F1.1),** Flea Market **(F1.2),** Floating Market **(F1.3),** Learning Resources **(F1.4),** Museums **(F1.5),** Gauge **(F1.6)**
Events **(F2)**	Demonstration **(F2.1),**Education **(F2.2),**Sales **(F2.3),** Business Intro **(F2.4)**
Agricultural Product Category **(F3)**	Agricultural Products **(F3.1),** Processed Products **(F3.2)**
Type of agritourism **(F4)**	Farming **(F4.1),**Fruit Gardening **(F4.2),** Flower Gardening **(F4.3),** Kitchen Gardening **(F4.4),** Herb Gardening **(F4.5),** Animal Husbandry **(F4.6)**
Food Component **(F5)**	Fruits **(F5.1),** Vegetables **(F5.2),** Sea Plants **(F5.3),** Livestock Farm (Pigs/Cows/Chickens) **(F5.4)**
Price **(F6)**	Little, Medium, Very
Location **(F7)**	Little, Medium, Very

Table 4 Comparative Emphasis Scale in Pairs (Revised from Vidhun Tansirikongkol, 1999)

Priority	Meaning	Explanation
1	Equally important	Both factors have the same objective impact.
3	More important than medium	Experience and analysis show that there is a moderate level of satisfaction in one factor over another.
5	Much more important.	Experience and analysis show that there is a greater degree of satisfaction in one factor than in another.
7	More important than most.	One factor clearly shows more satisfaction than the other.
9	More important than the maximum.	There is evidence of the highest level of satisfaction possible.
2, 4, 6, 8	It is a compromise score to reduce the gap between the level of feelings.	It is a semi-circular analysis. It cannot be explained in appropriate words.

Table 5 Example Matrix shows a comparison of the main criteria for each traveler.

Main criteria	Attractions (F1)	Events (F2)	Types of agricultural products (F3)	Types of agricultural tourism (F4)	Components of the diet (F5)	price (F6)	Location (F7)
Attractions (F1)	1	5	3	5	3	7	4
Events (F2)	1/5	1					
Agricultural Product Category (F3)	1/3		1				
Type of agritourism (F4)	1/5			1			

Table 5 (Continue)

Main criteria	Attrac-tions (F1)	Events (F2)	Types of agricultural products (F3)	Types of agricultural tourism (F4)	Compo-nents of the diet (F5)	price (F6)	Loca-tion (F7)
Food Component (F5)	1/3				1		
Price (F6)	1/7					1	
Location (F7)	1/4						1

Table 6 shows an example of a matrix comparing each pair of sub-criteria for the type of agritourism (F4).

Sub-criteria for the type of agricultural tourism (F4)	Farm (F4.1)	Orchard (F4.2)	Flower gardening (F4.3)	Kitchen gardening (F4.4)	Herb gardening (F4.5)	Animal husbandry (F4.6)
Farming (F4.1)	1	3	3	6	4	3
Orchard (F4.2)	1/3	1	5	4	3	2
Flower Gardening (F4.3)	1/3	1/5	1	1/5	3	5
Kitchen Gardening (F4.4)	1/6	1	5	1	1	1
Herb Gardening (F4.5)	1/4	1/3	1/3	1	1	1
Animal Husbandry (F4.6)	1/3	1/2	1/5	1	1	1

Table 5 presents an example of a comparison of the main criteria for each tourist. A diagonal has a magnitude of one because it compares the factor to itself. It shows that tourist attractions (F1) compared to tourist attractions (F1) have a magnitude value of 1. When comparing activities (F2) and tourist attractions (F1), it is a comparison in the inverted matrix table; therefore, the priority value is set as a compensation value equal to 1/5.

1.2) Information of 30 tourism experts in Bang Bo District, Bang Phli District, and Phra Samut Chedi District, Samut Prakan Province. A specific selection method was used to collect information on the top 20 tourist attractions in each district, totaling 60 rankings. The criteria for evaluating tourist attractions indicated by the Likert Scale are five levels: 5 is the highest, 4 is the highest, 3 is moderate, 2 is the least level, 1 is the least level, and 0 is no standard. An example of a tourist attraction rating based on the criteria for evaluating tourist attractions by experts is presented in Table 7.

Table 7 Example of Rating of Tourist Attractions according to the Evaluation Criteria for Tourist Attractions in Phra Samut Chedi District Samut Prakan Province by Experts

Tourist Attractions Phra Samut Chedi District	Evaluation criteria																
	F1				F2			F3		F4			F5			F6	F7
	F1.1	F1.2	F1.3	...	F2.1	F2.2	...	F3.1	F3.2	F4.1	F4.2	...	F5.1	F5.2	...		
Fort of Phra Jun Jomklao	3	2	0		0	5		3	5	0	2		0	5		0	4
Ban Sakhla Ancient Market	3	3	5		0	0		5	5	1	0		4	4		3	5
Khong Son Market	4	5	0		0	0		5	4	0	3		5	5		4	5
Ban Khun Samut Chin Community	5	3	0		4	5		5	3	0	4		5	3		3	4
Tadpole Fishing Pond Phishing Odd	5	0	0		5	5		5	3	0	0		0	0		5	5
:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:
Sea Butterfly Fort	3	4	0		0	4		0	3	0	0		4	4		0	4

Note: Details and explanations of factor (F) related to the F1 – F7 agricultural tourism evaluation criteria are presented in Table 3).

However,basic information about tourists and opinions on various factors according to the criteria set for choosing tourist attractions are received from tourists. The scores obtained by experts making tourist attraction assessments were used to develop tourist attraction ranking models for target tourists.

2) The development of a tourist attraction ranking model is done using grouping techniques and an analytical sequencing process is used together to create a model based on different preferences and conditions of different tourists. as follows

2.1) Clustering modeling using the K-Means Clustering method to find groups of tourists that are similar to the target tourists.This is combined with the analytical hierarchy process for the development of a tourist attraction ranking model. The K-Means Clustering method groups tourists into small groups, where each tourist is placed in a group that is close to him. The mean score of this group was the highest.For this study, Hartigan's rule method was chosen to determine the number of groups because it is the best method to determine the appropriate number of groups.For use in the K-Means Clustering technique (Chiang & Mirkin, 2010), the sum of the distance between each tourist and the center of the group of tourists was determined. This is shown in (1).

$$W_k = \sum_{j=1}^{k} \sum_{i \in G(j)} \left\| T_i, C_j \right\|^2 \qquad (1)$$

Where k is the number of groups, j is the group, so G(j) is the group j, where 1≤j≤k, and $\left\| T_i, C_j \right\|^2$ is the distance between each traveler, Ti, and the center point Cj of that group of travelers, and 1≤i≤N. where N is the total number of tourists. Similarly, the part of the Hartigan Index or H(k) calculation method for estimating the increase or decrease in groups in the K-Means Clustering process can be calculated as shown in Equation 2.

$$H(k) = \left(\frac{W(k)}{W(k+1)} - 1 \right) x\ (N - k - 1) \qquad (2)$$

Where H(k) is the Hartigan Index for the number of groups k, W(k) is the sum of the distances between each tourist and the midpoint of the group of tourists for the number of groups k, W(k+1) is the sum of the distances between each tourist and the center of the group for the number of groups k+1, N is the

total number of data points, and k is the number of groups. This study used the basic data of 100 tourists to create a grouping model and used the Hartigan Rule to determine the most suitable number of tourist groups. It was tested by experimenting with different values or numbers of groups. This stops segmentation when the Hartigan Index value is below 10. The results of the experiment are shown in Figure 2, and it is found that the number of groups with a Hartigan Index value below 10 as the first value is six. Once a total of six groups were formed, no more groups were formed. The optimal number of groups when using the K-Means Clustering technique was six.

2.2) Tourist attraction introduction with the Analytic Hierarchy Process or AHP is a method applied in the process of providing tourist attraction recommendations to tourists. This was based on the use of data from experienced tourists during the ranking process. This is because tourists have different travel behaviors and experiences. The Analytic Hierarchy Process divides big problems into sub-problems and hierarchies, which helps decision-makers to analyze problems systematically. Group comparisons into pairs were derived from the weight (priority) values for each element of the hierarchy. As a result, the capabilities of Analytic Hierarchy Process differ from those of other methods.

The elements of AHP used to solve the problem of prioritization of tourist attractions are detailed, including the goal being the priority of tourism; the main criterion is the criteria used to evaluate the seven tourist attractions. For example, the sub-criteria of the type of agricultural tourism (F4) consisted of rice farming (F4.1), fruit orchards (F4.2), flower gardening (F4.3), kitchen gardening (F4.4), herb gardening (F4.5), and animal husbandry (F4.6). The link between the goal and the main criterion shows a comparison of each pair of key criteria that represent the greater importance of each other in determining the priority of that key criterion. The priority of each criterion group was obtained by comparing the elements in each pair of hierarchies. The sum of the priorities in the primary criterion was equal to 1. This is used to prioritize attractions for each target tourist, as shown in Figure 3.

2.3) The modeling process with a combination of grouping techniques and Analytic Hierarchy Process consists of 4 steps as follows:

2.3.1) Grouping modeling to find groups of tourists with similar travel histories to the target tourists. This applies the resulting groups to the sequencing modeling process. The analysis was based on the total number of groups: six groups.

2.3.2) Calculate the priority of each tourist's criteria by determining the priority of the main criteria. This is done by comparing the criteria of each traveler, as listed in Table 5. After that, the obtained data are used to find the sum of each main criterion in the vertical table, which is shown in Table 8. Similarly, the numbers in each field are divided by the sum of each criterion according to the vertical table. Then, the sum in each row is calculated until finally, the priority of the criterion is calculated by dividing the sum of each row by the sum of the rows shown in Table 9.

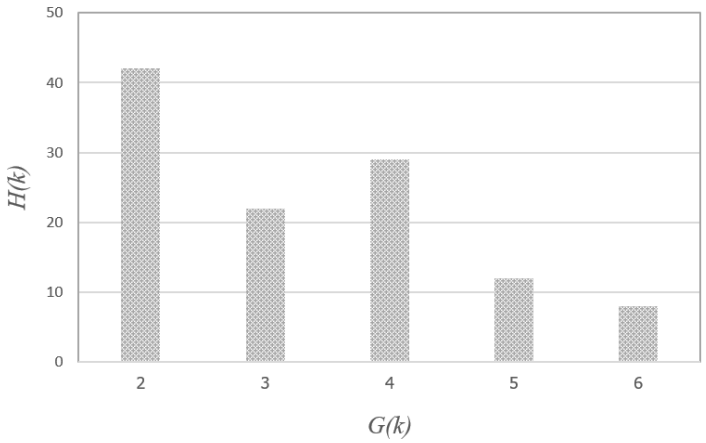

Figure 2. Finding the right number of groups of tourists using the Hartigan Rule

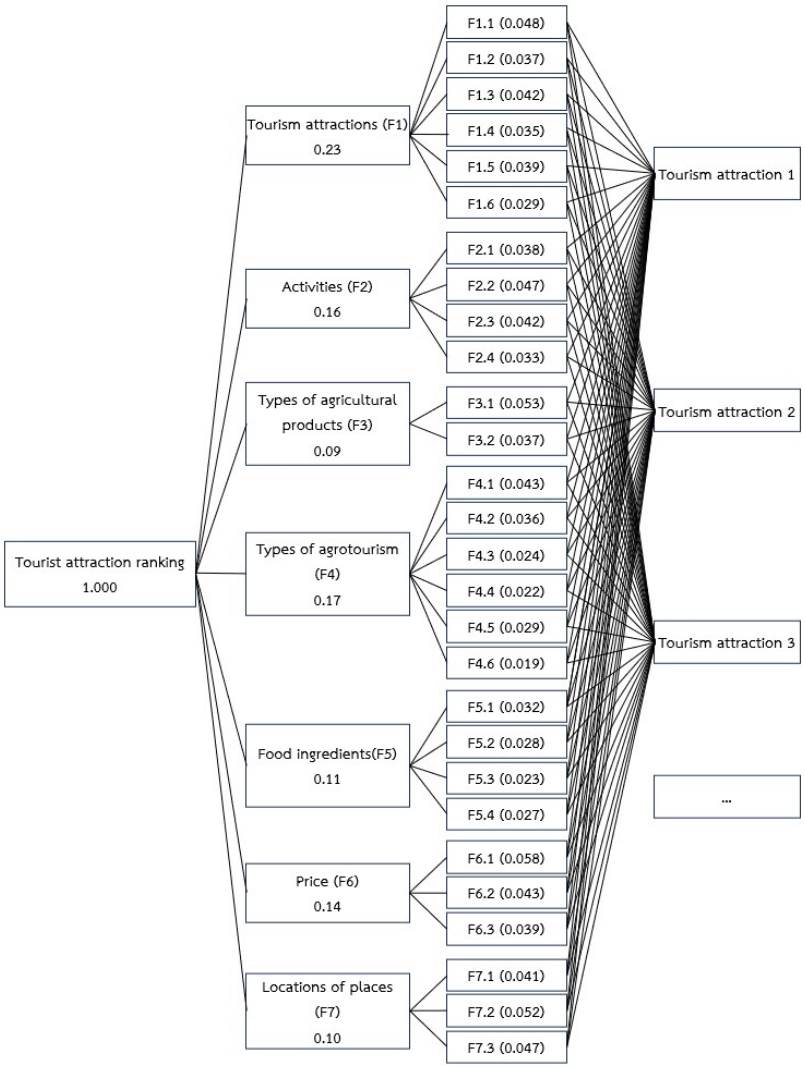

Figure 3. Analytic Hierarchy Process for this research

Table 8. Example of Summing of Each Main Criterion: Comparing the criteria for each tourist.

Main criteria	Attrac-tions (F1)	Events (F2)	Types of agricultural products (F3)	Types of agricultural tourism (F4)	Compo-nents of the diet (F5)	price (F6)	Location (F7)
Attractions (F1)	1	5	3	5	3	7	4
Events (F2)	1/5	1	2	1	1	1	1/5
Types of agricultural products (F3)	1/3	1/2	1	5	4	3	1
Types of agricultural tourism (F4)	1/5	1	1/5	1	1	1	1/4
Components of the diet (F5)	1/3	1	1/4	1	1	1/4	3
price (F6)	1/7	1	1/3	4	4	1	1
Location (F7)	1/4	5	1	4	1/3	1	1
Sum of each criterion	**2.46**	**14.50**	**7.78**	**21.00**	**14.23**	**14.25**	**10.45**

Table 9. Example Matrix shows a comparison of each pair of key criteria for each traveler.

Main criteria	Attractions (F1)	Events (F2)	Types of agricultural products (F3)	Types of agricultural tourism (F4)	Components of the diet (F5)	price (F6)	Location (F7)	Sum of all column	Priority of criteria
Attractions (F1)	1/2.46	5/14.50	3/7.78	5/21.00	3/14.23	7/14.25	4/10.45	2.46	**2.46/7 = 0.35**
Events (F2)	(1/5)/2.46	1/14.50	2/7.78	1/21.00	1/14.23	1/14.25	(1/5)/10.45	0.61	**0.61/7 = 0.09**
Types of agricultural products (F3)	(1/3)/2.46	(1/2)/14.50	1/7.78	5/21.00	4/14.23	3/14.25	1/10.45	1.12	**1.12/7 = 0.16**
Types of agricultural tourism (F4)	(1/5)/2.46	1/14.50	(1/5)/7.78	1/21.00	1/14.23	1/14.25	(1/4)/10.45	0.39	**0.39/7 = 0.05**
Components of the diet (F5)	(1/3)/ 2.46	1/14.50	(1/4)/ 7.78	1/21.00	1/14.23	(1/4)/ 14.25	3/10.45	0.66	**0.66/7 = 0.09**
price (F6)	(1/7)/2.46	1/14.50	(1/3)/7.78	4/21.00	4/14.23	1/14.25	1/10.45	0.81	**0.81/7 = 0.12**
Location (F7)	(1/4)/2.46	5/14.50	1/7.78	4/21.00	(1/3)/14.23	1/14.25	1/10.45	0.95	**0.95/7 = 0.14**
Sum of all rows	-	-	-	-	-	-	-	**7.00**	**1.00**

Table 10. An example Matrix shows a comparison of each sub-criterion pair of the Agritourism Type Criterion (F4).

Sub-criteria for the type of agritourism (F4)	farm (F4.1)	Orchard (F4.2)	Flower gardening (F4.3)	Kitchen gardening (F4.4)	Herb gardening (F4.5)	animal husbandry (F4.6)	Row sum	Priority of criteria
Farming (F4.1)	1/2.42	3/6.03	3/9.73	6/18.00	4/13.00	3/13.00	2.11	**2.11/6 = 0.35**
Orchard (F4.2)	(1/3)/2.42	1/6.03	5/9.73	4/18.00	3/13.00	2/13.00	1.34	**1.34/6 = 0.22**
Flower Gardening (F4.3)	(1/3)/2.42	(1/5)/6.03	1/9.73	(1/5)/18.00	3/13.00	5/13.00	0.87	**0.87/6 = 0.15**
Kitchen Gardening (F4.4)	(1/6)/2.42	1/6.03	5/9.73	1/18.00	1/13.00	1/13.00	0.81	**0.81/6 = 0.13**
Herb Gardening (F4.5)	(1/4)/2.42	(1/3)/6.03	(1/3)/9.73	1/18.00	1/13.00	1/13.00	0.41	**0.41/6 = 0.07**
Animal Husbandry (F4.6)	(1/3)2.42	(1/2)/6.03	(1/5)/9.73	1/18.00	1/13.00	1/13.00	0.46	**0.46/6 = 0.08**
Total	**2.42**	**6.03**	**14.50**	**13.20**	**13.00**	**13.00**	**6.00**	**1.00**

From the table, it can be concluded that there is a decision to choose a tourist destination. Tourist attraction criteria had the highest priority. This was followed by the production of agricultural products. Location, price, activity, food components, and type of agritourism, and then determine the priority of each tourist's sub-criteria. The process is the same as the main criteria listed in Table 10. Similarly, it prioritizes all 100 criteria collected from a total of 100 tourists. This is used to calculate the priority of the criteria in the next group. The example shown uses the sub-criteria comparison data from Table 6, which are further evaluated by one traveler.2.3.3) Determining the priority of the main criteria in each group is performed by searching for tourists belonging to the same group using the grouping model in step 2.3.1. Subsequently, the priority of the main criteria of all tourists in the same group is used to calculate the importance of the main criteria in that group with a median value, such as the priority of the main criteria of tourists in Group 1 shown in Table 11, and an example of determining the importance of the sub-criteria of agricultural tourism (F4) of Group 1 tourists is shown in Table 12.

Adjusting the priority of the primary criterion by multiplying the priority of the sub-criterion with the priority of the criterion is presented in Table 13.

Table 11. Prioritization of the main criteria of tourists in Group 1

Tourist Group 1	Priority of the main criteria							
	Attractions (F1)	Events (F2)	Types of agricultural products (F3)	Types of agricultural tourism (F4)	Components of the diet (F5)	price (F6)	Location (F7)	Total
The 3rd Tourist	0.35	0.09	0.16	0.05	0.09	0.12	0.14	1.00
The 10th Tourist	0.18	0.26	0.07	0.14	0.11	0.14	0.10	1.00
The 13th Tourist	0.22	0.19	0.08	0.16	0.12	0.10	0.13	1.00
The 21st Tourist	0.25	0.14	0.09	0.20	0.08	0.15	0.09	1.00
The 31st Tourist	0.17	0.15	0.11	0.22	0.15	0.13	0.07	1.00
Median	**0.22**	**0.15**	**0.09**	**0.16**	**0.11**	**0.13**	**0.10**	**0.96**
Priorities	**0.22/0.96= 0.23**	**0.15/0.96= 0.16**	**0.09/0.96= 0.09**	**0.16/0.96= 0.17**	**0.11/0.96= 0.11**	**0.13/0.96= 0.14**	**0.10/0.96= 0.10**	**1.00**

Table 12. Determination of the importance of the sub-criteria of agricultural tourism (F4) of group 1 tourists

Tourists Group 1	farm (F4.1)	Orchard (F4.2)	Flower gardening (F4.3)	Kitchen gardening (F4.4)	Herb gardening (F4.5)	animal husbandry (F4.6)	Total
The 3rd Tourist	0.35	0.22	0.15	0.13	0.07	0.08	1.00
The 10th Tourist	0.22	0.18	0.10	0.20	0.18	0.12	1.00
The 13th Tourist	0.20	0.24	0.08	0.22	0.17	0.09	1.00
The 21st Tourist	0.28	0.17	0.14	0.06	0.21	0.14	1.00
The 31st Tourist	0.26	0.24	0.16	0.11	0.12	0.11	1.00
Median	**0.26**	**0.22**	**0.14**	**0.13**	**0.17**	**0.11**	**1.03**
Priorities	**0.26/1.03= 0.25**	**0.22/1.03= 0.21**	**0.14/1.03= 0.14**	**0.13/1.03= 0.13**	**0.17/1.03= 0.17**	**0.11/1.03= 0.11**	**1.00**

Table 13. Example of priority adjustment of the type of agritourism sub-criterion (F4) of group 1 tourists

Agritourism Type Criteria (F4) (Priority Group 1)	Sub-criteria priority	The priority of the sub-criteria is updated according to the main criteria.
Farming (F4.1)	0.25x (0.17)	0.043
Orchard (F4.2)	0.21 x (0.17)	0.036
Flower Gardening (F4.3)	0.14 x (0.17)	0.024
Kitchen Gardening (F4.4)	0.13 x (0.17)	0.022
Herb Gardening (F4.5)	0.17 x (0.17)	0.029
Animal Husbandry (F4.6)	0.11 x (0.17)	0.019
Total	**1.00**	**0.17**

Table 14. Prioritization of Points in the Type of Agritourism (F4)

Score	Very most	Very	Moderate	Little	Least	Row sum	Points priority
very most	5/7.08	4/10.08	3/12.58	2/14.25	1/15.00	1.56	1.56/5 = **0.31**
very	(1/4)/7.08	5/10.08	4/12.58	3/14.25	2/15.00	1.20	1.20/5 = **0.24**
moderate	(1/3)/7.08	(1/4)/10.08	5/12.58	4/14.25	3/15.00	0.94	0.94/5 = **0.19**
little	(1/2)/7.08	(1/3)/10.08	(1/4)/12.58	5/14.25	4/15.00	0.74	0.74/5 = **0.15**
least	(1/1)/7.08	(1/2)/10.08	(1/3)/12.58	(1/4)/14.25	5/15.00	0.56	0.56/5 = **0.11**
Total	**7.08**	**10.08**	**12.58**	**14.25**	**15.00**	**5.00**	**1.00**

2.3.4) Ranking of tourist attractions according to expert evaluation criteria. All tourist attractions were provided with information to evaluate tourist attractions using five evaluation criteria, consisting of five having the criteria at the highest level, four having the criteria at a high level, three having the criteria at a moderate level, two having the criteria at a low level, one having the criteria at the least level, and zero having no criteria. According to the collection of the top 60 interesting tourism data points in the Bang Bo District. Bang Phli District and Phra Samut Chedi District, Samut Prakan Province according to the sub-criteria of the tourist attraction assessment set out in Table 7. The results of the comparison of the scores obtained and the priority of the scores obtained for all criteria are listed in Table 14. Therefore, it is necessary to determine the priority of both distributed and ideal scores. An example of prioritization across charts is presented in Table 15.

The calculation of the order of tourist attractions for individual tourists; for example, the target tourists are tourists in Group 1. Ban Sakhla Ancient Market, Khong Son Market, and the Ban Khun Samut Chin Community. The priority of the selected places can be determined by finding the sum of the priority values of all sub-criteria of group 1 tourists (Table 13). Multiply this by the priority of the points of the sub-criteria provided by the experts in those places (Table 7). For example, the results of the priority calculation were obtained for the first group of tourists working in orchards. It is equal to 0.036. The value in the score box provided by experts for the evaluation of the Ban Khun Samut Chin community as an orchard tourist attraction (score 4) was

Table 15. Prioritization Across Charts

Criteria for making an orchard	Distributed Priority (Weighted by 0.036*)	Ideal Priorities (Divided by the maximum value is 0.011)
very most (5)	0.31 x 0.036 = 0.011	**1.000**
Very (4)	0.24 x 0.036 = 0.009	**0.818**
Moderate (3)	0.19 x 0.036 = 0.007	**0.636**
Little (2)	0.15 x 0.036 = 0.005	**0.455**
Least (1)	0.11 x 0.036 = 0.004	**0.364**

* Priority of orchard criteria from Table 13

0.818. Similarly, do the same for all channels and multiply the points obtained from the expert's assessment by the scores of tourists in all channels. To determine the sum of each tourist attraction and compare and rank the results to recommend to the target tourists.

Part 3: The User Interface is the process of designing the interface between the user, the computer, and the smartphone. In this step, the interaction between the user and the computer is divided into two forms: the Web Application format used to manage data in the Admin area and the Mobile Application format used to collect data from agritourism operators/agricultural areas. It is used to introduce tourist attractions to tourists who want to travel to agricultural tourist attractions/areas. To check the source of agricultural products or to find out where agricultural products are sent for sale or produced as products for sale.

Part 4: Verification of the Origin of Agricultural Product Module.It is the process of developing the Agricultural Products Origin Finding Engine to work in accordance with the agricultural tourism destination and agricultural site recommendation systems.This procedure extracts data from agricultural sources/knowledge databases to provide personalized advice to tourists who want to check the sources of agricultural products. Determine where the source comes from agricultural tourism sites or agricultural areas.In addition, if tourists are in an agricultural tourist destination, they can check where the agricultural products are sent for sale or produced as products for sale.

3. Application Development Results

The development of an agricultural tourism support application for monitoring the source of agricultural products in Samut Prakan Province has been successful by dividing it into 7 steps as follows:

3.1 Results of data collection for application development with a questionnaire on the data requirements of the source monitoring system of agricultural products that support agricultural tourism using data mining techniques in Samut Prakan Province.The data collection results can be divided into three aspects: system data, internal data management, and system application design.The questionnaire was assessed for conformity according to the IOC standards by experts, with a value between 0.67 – 1.00. Ten people were recruited from Bang Phli District and Phra Samut Chedi District, Samut Prakan Province, by purposive sampling.

The results of the data demand survey showed that most of the participants wanted the system to display all information that was not different from the news/activities of tourist attractions, agricultural product information/agricultural products, agricultural tourism site information, agricultural shops/distribution sites, and agricultural knowledge information.In addition, agricultural tourism sites can be introduced to users and being able to check the sources of agricultural products. Similarly, information can be conveniently accessed with QR codes, as well as rating and viewing the results of comments on the location and viewing agricultural products/products in the same place.There is a location

link linked to the Navigation Map System (GPS) to help users get around. In addition, the system wants the system to have a display screen design in the manner of a mobile application type 2 (option in the questionnaire). Green-white tones, dark fonts, and light backgrounds. The menu is divided by category and images can be added from Pictures 4 to 6.The placement of the image depends on the appropriateness of the design on each page of the application, and it may or may not contain a video file, depending on its appropriateness.

3.2 The results of the preparation of the Knowledge-based System using the ontology-based system showed that the ontology investigated the source of agricultural products in Samut Prakan Province. There is a domain within the context of agricultural tourism destinations, agricultural product production areas, shops selling agricultural products, agricultural products, and products processed from agricultural products. This is illustrated in Figure 4.

Figure 4 shows the main concepts of ontology for monitoring the sources of agricultural products. The relationship between the concepts is that the Product Origin Inspection must have (has) product/product information must have (has) information on the place where agricultural products are produced (Attractions) must have (has) display of the location of the product/agricultural product information (Location), and there must be (has) operator who supervises the place where the agricultural product is produced.In the event that knowledge from local agriculture is disseminated and wants to publicize information on agricultural events in the area that are related to (Relate) places (Attractions) and (Relate) agricultural products/products (Products) in the area of Samut Prakan Province. In addition, products/products processed from agricultural products (proArgoProcess) are related to (Relate) products/products (products), and products/products processed from agricultural products (proArgoProcess) must have (has) ingredients of products or products from agricultural products. (proArgoProcessMix).Products/products are classified as (IS-a) mixtures of products or products from agricultural products. Introduction of an Agricultural Product Source Monitoring Ontology Developed for Computer and Information Technology Professionals. Local researcher owners of agricultural production sites in Samut Prakan Province and five owners of agricultural tourism sites in Samut Prakan Province were selected using a specific selection method. The accuracy and appropriateness of the developed ontology were examined and evaluated. It was found that, in general, experts considered that the ontology of monitoring the source of agricultural products was accurate and appropriate to a great extent. Therefore, the researcher used ontology as a guide to design and prepare a database used in the agricultural tourism guidance system. Support the search for information related to agricultural

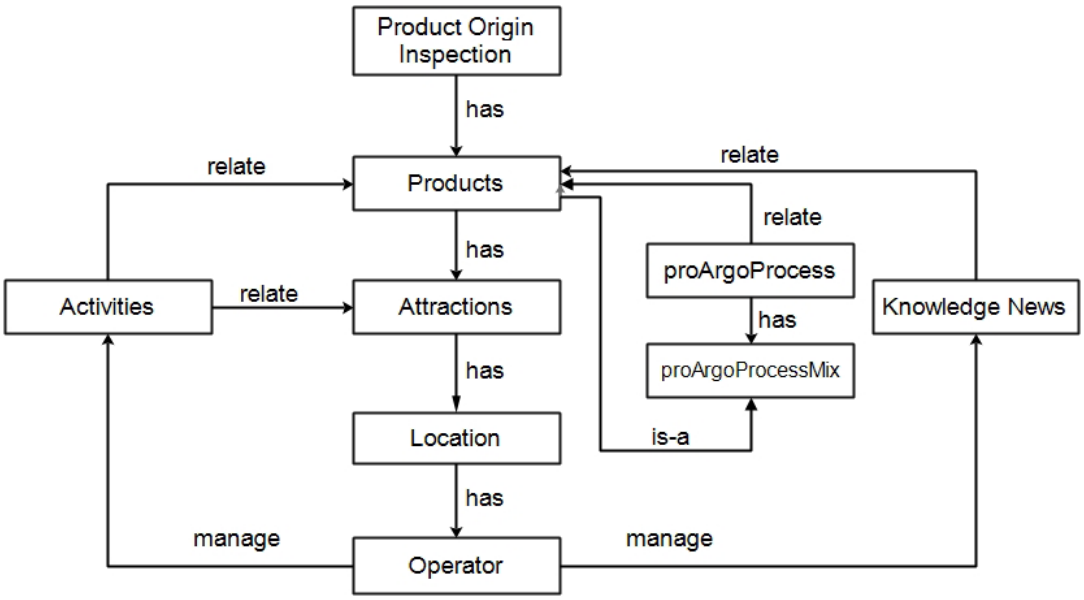

Figure 4. Main Concepts of Ontology of Investigating the Source of Agricultural Products

tourism through a system that is further developed.

3.3 Results of system analysis using all collected data, including problems and basic information on tourism and agriculture. Data requirements in the source monitoring system for agricultural products and knowledge base data using an ontology analysis system. The results of the analysis of the work process of system users and the relationship with the subsystem within the main system (Use Case Diagram) consisted of five related actors: administrators, tourists, shops, tourist attractions, and product production sites. It includes 11 functions and the results of the analysis and design of the database structure, as shown in Figure 5. Based on the concept of ontology, the source of agricultural products was verified with an ER-Diagram, consisting of a total of 31 data tables and more than 74 relationships, as shown in Figure 6.

In addition, an application process for providing information to the Agricultural Product Source Monitoring System operated by the owner of the facility or the owner of the agricultural product/product in Samut Prakan Province has been designed.To improve the understanding of the operation of the system, as shown in Figure 7.

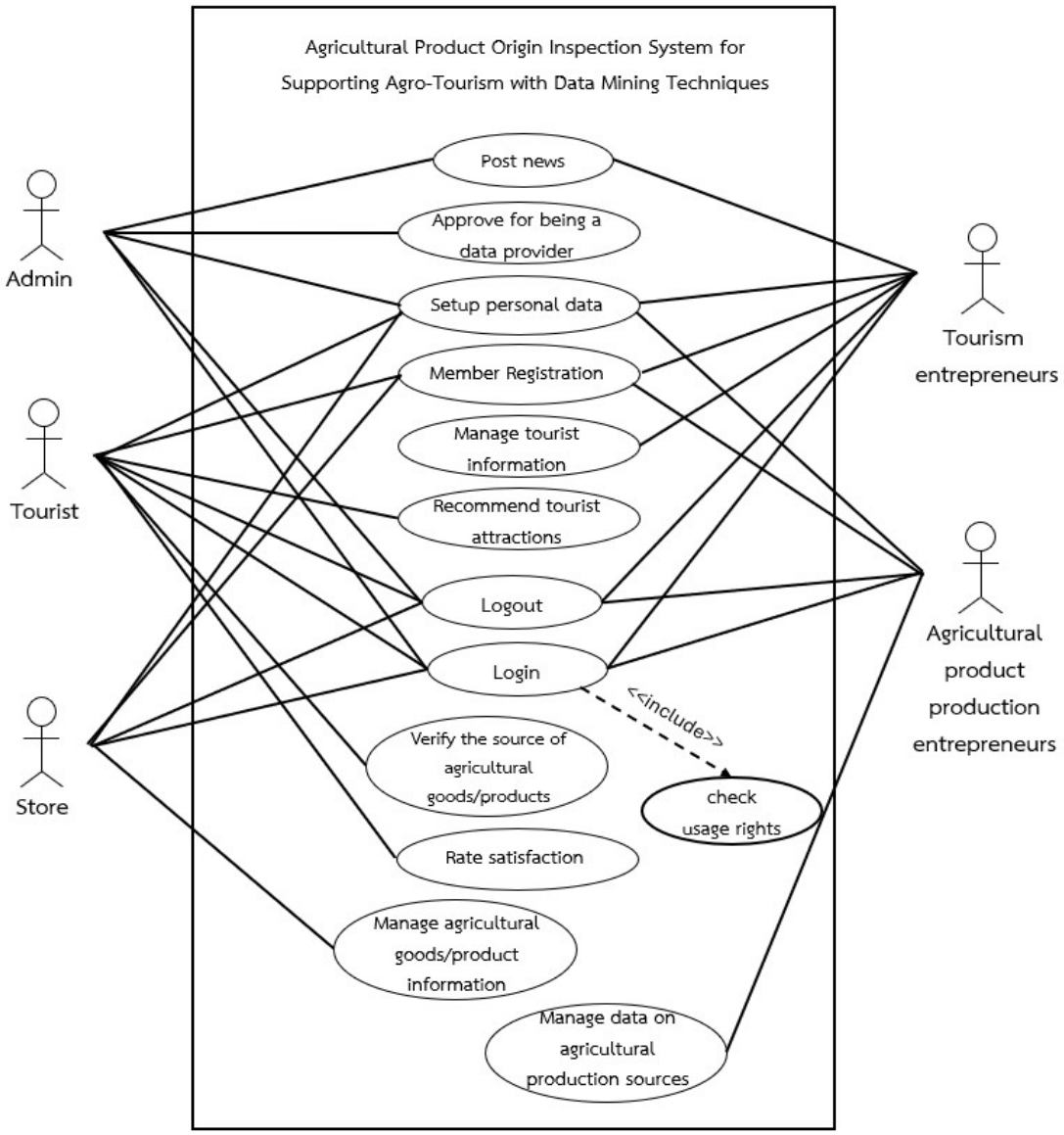

Figure 5. Use Case Diagram of the Agricultural Product Source Monitoring System for Agricultural Tourism Introduction

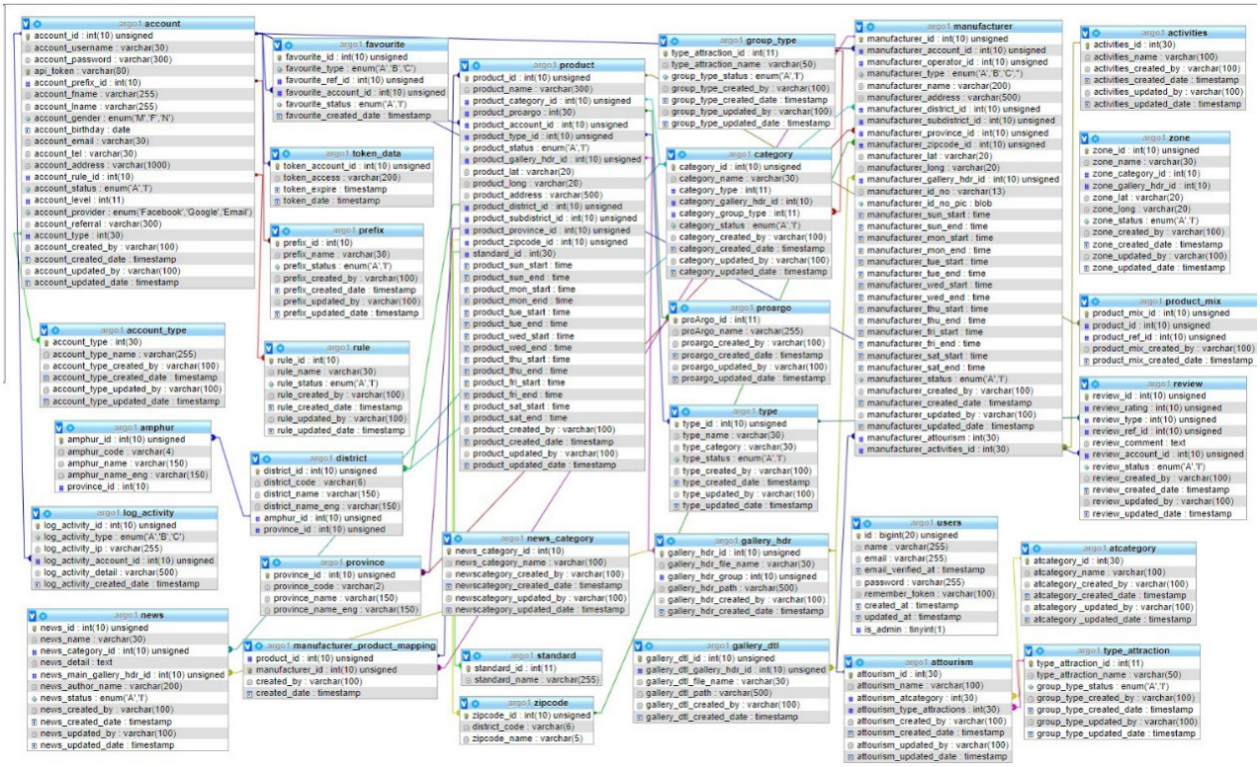

Figure 6. Structure and relationship of system data

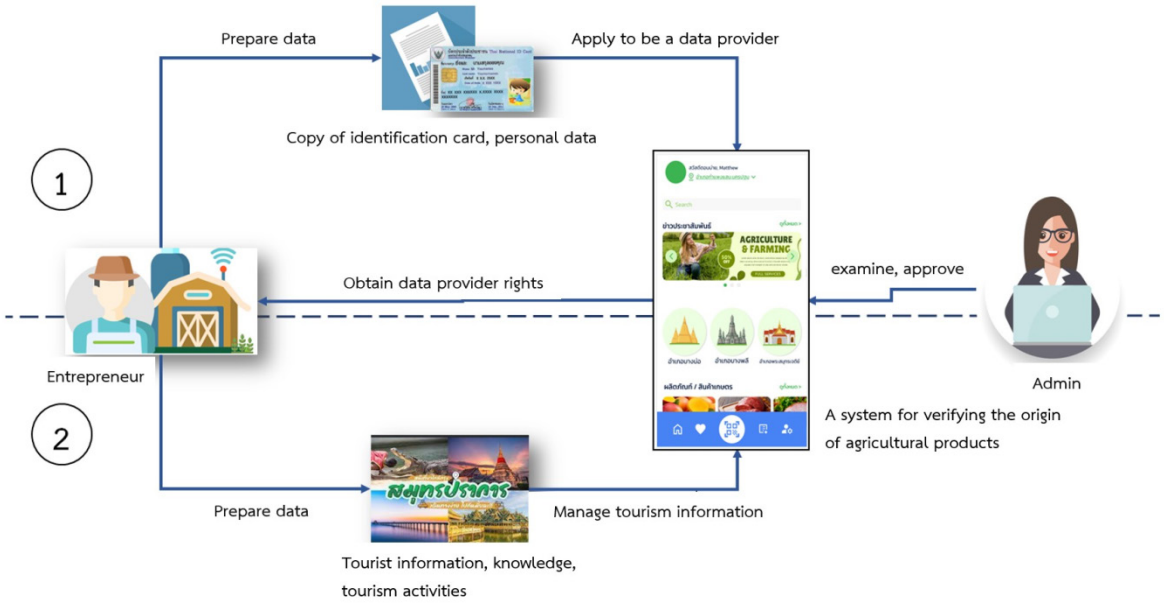

Figure 7. The process of applying to be a system informant

3.4 The results of system design results using design principles based on the UX/UI design theory studied by Joo, H. (2017). It is designed to be used as part of the back-end management of the system and forms a mobile application that can run on mobile devices, such as smartphones or tablets. In this study, the application was designed to operate on an Android operating system(Android).

3.5 Results of application development of the agricultural tourism support system for monitoring the source of agricultural products in Samut Prakan Province. The researcher divided the system users into five groups: tourists, tourist attraction providers, tourism operators, and tourists. The operators of agricultural product production sites, shops, and administrators are as follows.

1) *Tourists* can access general agricultural tourism information, but to access the application, they must apply the system.After that, fill in the user ID and password before accessing the application as a member, as shown in Figure 8 – 14.

Figure 8. Application homepage

Figure 9. Membership Registration Page

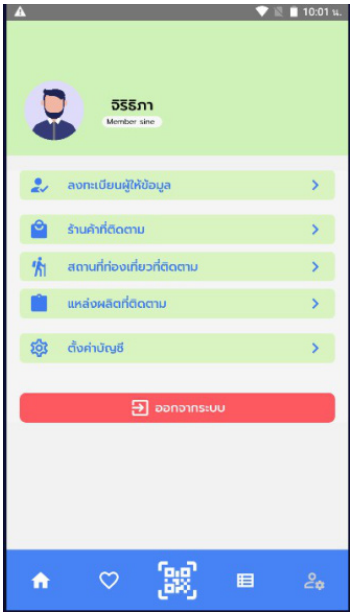

Figure 10. Tourist Profile Settings Page

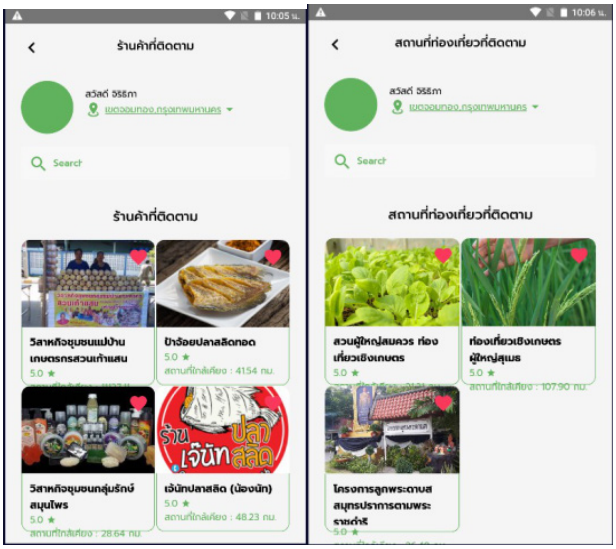

Figure 11. Shops and tourist attractions that tourists follow.

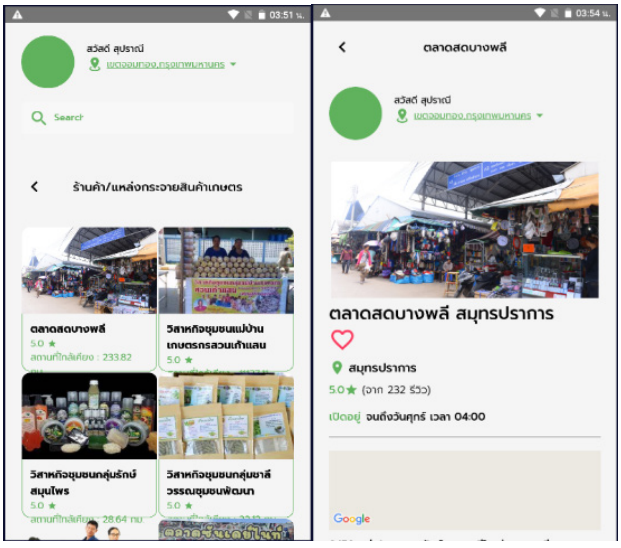

Figure 12. Detail page of shops and attractions that are tracked

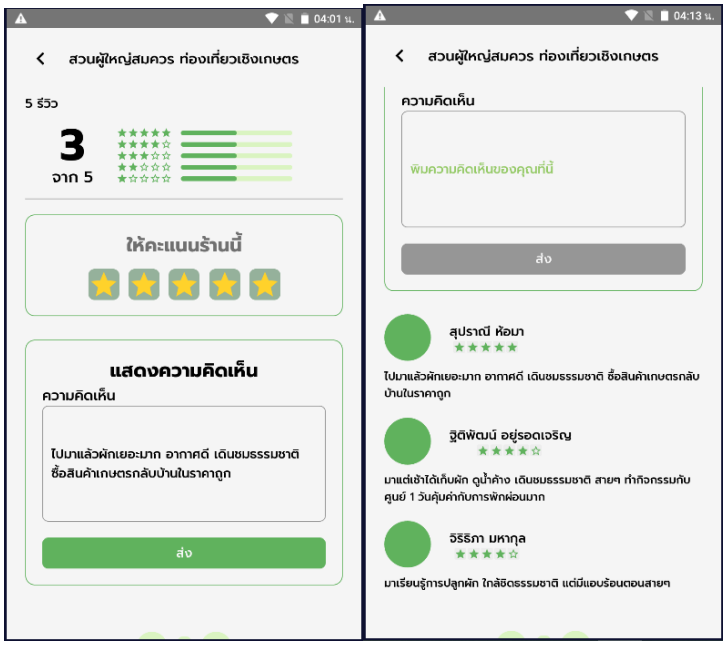

Figure 13. Satisfaction Rating and Comment Page

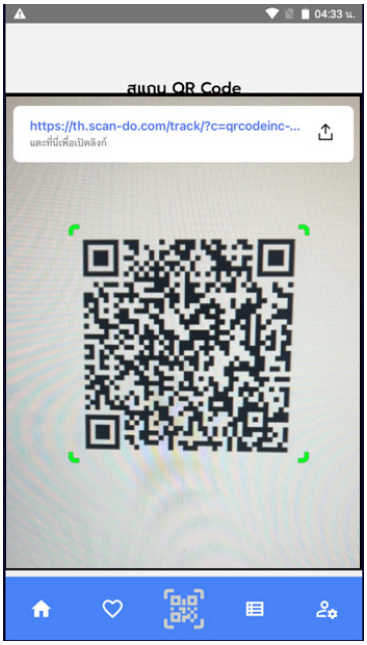

Figure 14. QR Code scan page to check the source of goods and products.

2) *Tourist attraction providers and product production site operators:* To access the application, the user must register to log into the system and register as an information provider. We can manage our storefront by setting up an account. Tourist attraction and product management are shown in Figures 15 –17.

Figure 15. Provider Setup Page

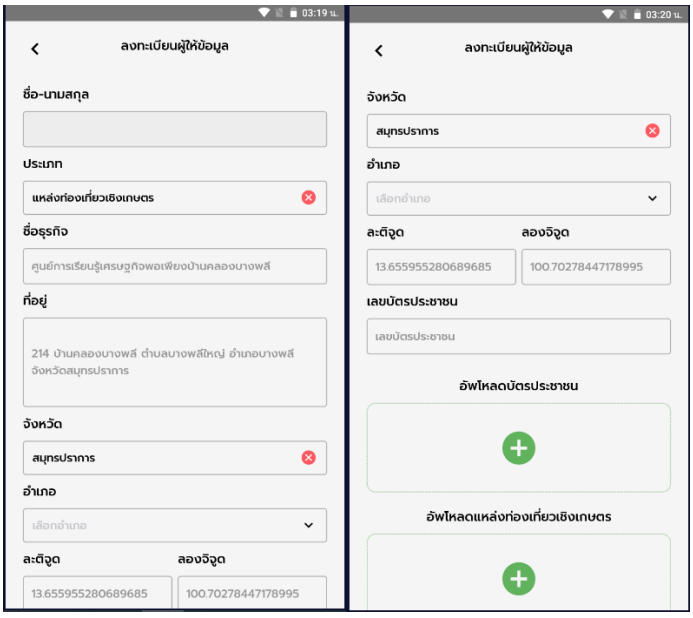

Figure 16. Contributor Registration Page

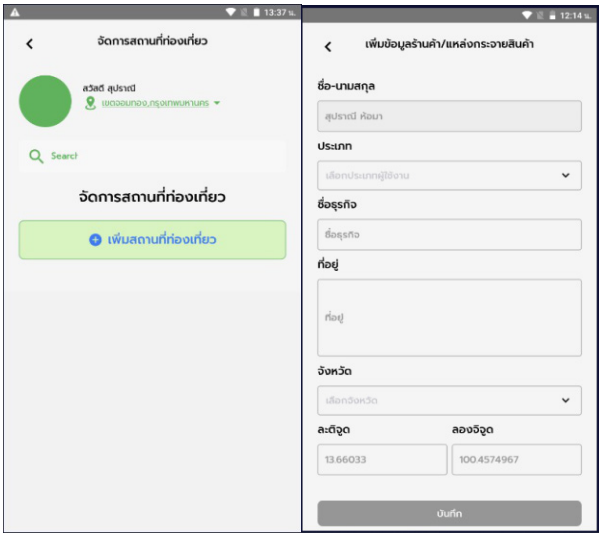

Figure 17. Page to add information on tourist attractions / agricultural product production sites

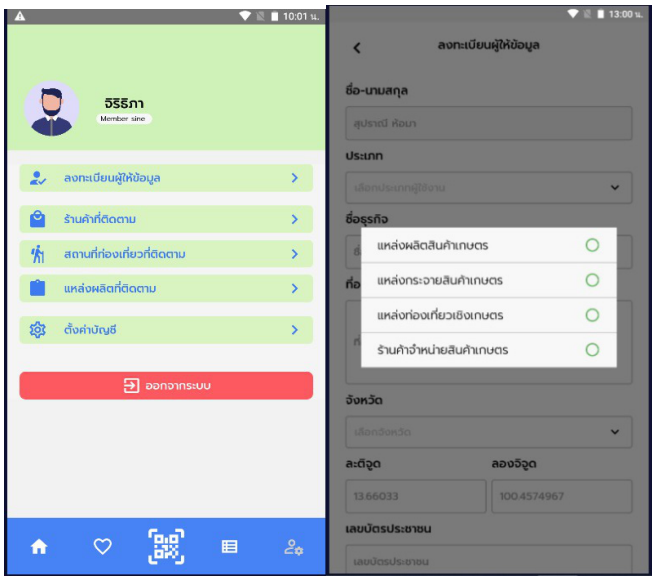

Figure 18. Registration page for store informants

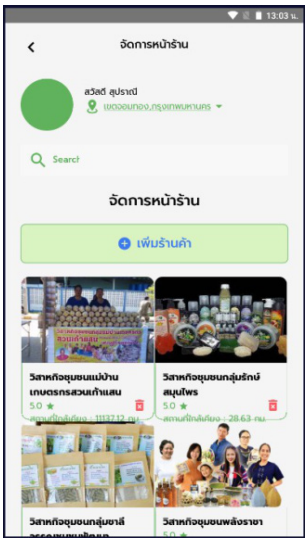

Figure 19. Shop page management page

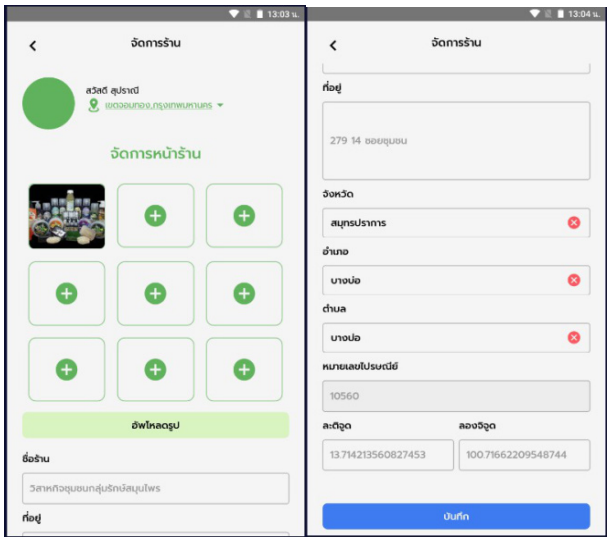

Figure 20. Store Information Management Page

3) *Merchants:* Access the application must register to access the system and register as an informant. Subsequently, specify the information required by the system and press confirm the preview data, as shown in Figures 18 – 20.

4) Administrators: must only confirm their administrator privileges to access the application. The administrator will be responsible for adding information about agricultural press releases. Tourism or others. In addition to managing the basic information of the system, an example is presented in Figures 21–22.

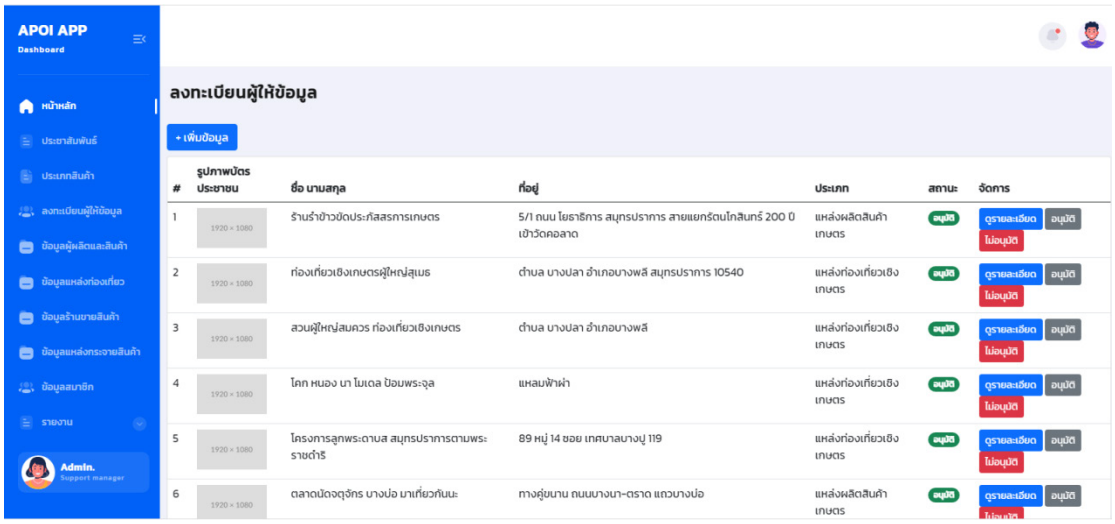

Figure 21. Registrant Information Management Page

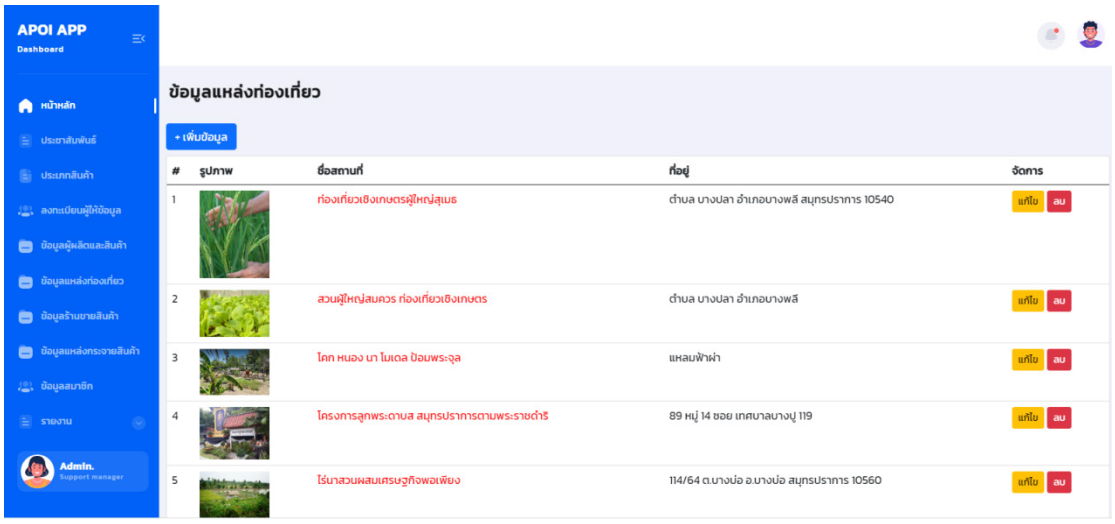

Figure 22. Agricultural Tourism Site Information

3.6 Results of the Performance Test of the Source Monitoring System of Agricultural Products Supporting Agricultural Tourism in Samut Prakan Province. The tutorial used a system-performance assessment. It is divided into four areas: system capabilities, accuracy of system operation, system usability, and system security. The questionnaire used to pass the conformity standard assessment by experts to determine the IOC value was between 0.67 – 1.00. The system performance evaluation form was given to five computer and information technology experts and spatial researchers in Samut Prakan Province. The evaluation of the performance of the system shows that the overall experts consider the system to be very effective (4.27±0.63), as shown in Table 16.

Table 16 Results of the overall evaluation of the performance of the system by experts

Assessment List	Mean	S.D.	Level of performance
System Capabilities	4.25	0.66	very
Accuracy of system operation	4.27	0.58	very
System Usage	4.34	0.66	very
System Security	4.20	0.65	very
Summary of the overall evaluation results	**4.27**	**0.63**	**very**

3.7 Results of three groups of system user satisfaction assessments: Three satisfaction assessments created for specific user satisfaction assessments, which have passed the IOC conformity standard assessment by experts, with a value between 0.67 – 1.00. The results of the user satisfaction assessments for each group are summarized in Table 17.

1) Results of satisfaction assessment by tourists using the statistics of Thai tourists visiting Samut Prakan Province. By 2023, there were 241,782 people (Ministry of Tourism and Sports, 2024). The sample size was determined according to the Taro Yamane table at a confidence level of 95% and margin of error of ±10% (Yamane, 1967). The sample size was 100, with the indicators of considering the results of satisfaction evaluation from the opinions of application users in various tourist attractions. The tool is a satisfaction assessment form that the researcher develops and evaluates. Experts in Research, Measurement, and Evaluation. The IOC value is between 0.67 and 1.00 and Cronbach's alpha coefficient value is 0.772, which is greater than 0.70 (Cronbach, 1970). This makes the tools developed by the researchers accurate and confident in accepting the results obtained to draw conclusions from the research. Satisfaction Assessment Results by Tourists The researcher collected data by collecting data from agricultural tourism sites and agricultural distribution sites in three districts, including seven locations: 1) Bang Bo District: Sufficiency Economy Learning Center, Ban Twibun, Peeka Floating Market, and Big Luang Phor Pan. 2) Bang Phli District: Luk Phra Dabos Project Samut Prakan under the royal initiative, Wat Bang Phli Ancient Floating Market, Bang Pla Nawatwithi Community Enterprise, and 3) Phra Samut Chedi District: Ban Khun Samut Chin Village, Muang Phra Riverside Market. Collect data from 15 tourists from each source using a random accidental selection method, that is, when walking to meet tourists in the tourist attractions mentioned above, who are ready to install the application. Therefore, a test and satisfaction assessment were conducted, and the results of collecting tourist data in tourist attractions were able to collect data from a total of 102 tourists, accounting for 97.14 percent. The results of the satisfaction assessment by tourists showed that tourists were satisfied with using the system at a high level (4.34±0.61).

2) The results of the user satisfaction assessment of the system consisted of owners of tourist attractions/agricultural product production sites who represented the people in the Bang Bo district. Bang Phli District and Phra Samut Chedi District, Samut Prakan Province A total of 5 people used a specific selection method and found that the owners of tourist attractions/agricultural production sites had a high level of satisfaction in using the system (4.26±0.62).

3) The system satisfaction assessment indicates that the shops are representative of the shops in the Bang Bo district. Bang Phli District and Phra Samut Chedi District, Samut Prakan Province 10 people. Using a specific selection method, it was found that store representatives were very satisfied with using the system (4.14±0.71).

Table 17. Results of System Usage Satisfaction Assessment

Assessment List	Mean	S.D.	Level of Satisfaction
Group 1: Tourists	**4.34**	**0.61**	**very**
System capabilities	4.29	0.60	very
System Usage	4.39	0.61	very
Group 2: Owners of tourist attractions/agricultural product production sites	**4.26**	**0.62**	**very**
System capabilities	4.24	0.66	very
System Usage	4.28	0.58	very
Group 3: Representatives of stores	**4.14**	**0.71**	**very**
System capabilities	4.15	0.66	very
System Usage	4.13	0.75	very
Summary of the overall sufficiency assessment results	**4.25**	**0.65**	**very**

Table 17. The results of the evaluation by the three groups of users showed that there was a high level of satisfaction in using the system (4.25±0.65). Therefore, it can be concluded that the system monitors the sources of agricultural products that support agricultural tourism using data-mining techniques. The developed method can be used in practice to meet the needs of relevant users.

Discussion

Development of an Agricultural Tourism Support System for Monitoring the Sources of Agricultural Products in Samut Prakan Province. In the form of a mobile application that supports the work of tourists and a web application that supports the work of the admin team. In addition, this study introduces agricultural tourism sites using the collaborative filtering method with a modeling technique that combines the synergy of clustering techniques with the K-mean algorithm. Determine the sum of the distance between each tourist and the center of the group of tourists and determine the number of groups according to Hartigan's rule by using the clustering method in conjunction with the Analytic Hierarchy Process. User satisfaction was very high(4.25±0.65). This is in line with the research of Nugraha, Suyoto, and Pranowo (2017), who conducted research on mobile application development for smart tourist guidance using the KNN algorithm, K-means, and collaborative filtering.In addition, the development of applications in the form of Mobile Applications also allows for the convenience of use for tourists to find tourist attractions or agricultural products they want. This is in line with the research of Hussein and Ahmed (2022), who conducted research on mobile applications for tourism: The case of Egypt presents a tourism model by introducing a new mobile application related to tourism in Egypt. This helps to support tourism and provides useful information to the Ministry of Tourism and software companies. Users can also conveniently and efficiently search for tourist attractions in Egypt. Similarly, the work of (Fongmanee, Chaikhamwang, Yaibuates, and Janthajirakowit, 2021; Rachman, Jauhari, Mukhlisin, Prastiti, Herawati, and Imamah, 2022).The application of the Analytic Hierarchy Process (AHP) in the system allows the developed system to generate recommendations regarding tourist attractions and agricultural production sites for tourists. This reduces the problem of sparsity and scalability caused by insufficient data and makes the system generate recommendations for tourists effectively. In line with the research of Wang 2021), research on the Ideological and Political Education Recommendation System Based

on AHP and Improved Collaborative Filtering Algorithm to solve problems in ideological and political education courses in universities. It is not adequately targeted and cannot be personalized by an ideological and political education recommendation system based on an analytical sequencing process(AHP). The collaborative filtration algorithms built are accurate and can work efficiently. However, the researcher adopted an ontology-based system as a guide to design and structure the database, enabling the creation of an ontology to verify the sources of agricultural products. It was used as a guide for the design and preparation of databases(Database). used in agricultural tourism guidance systems. Support the search for information related to agricultural tourism through an efficient system.The results of the evaluation of the performance of the system by experts show that the efficiency of the system is very high level (4.27±0.63). In line with the work of Prachayagringkai, Buranarach, and Wuttidittachotti (2023), research on the support system of self-assessment and gap analysis for new normal tourism standards was carried out by creating the Green National Park and New Normal National Park Ontology. It is used as a guide for database design and report preparation, as well as for the design of user interfaces of the developed system. According to the performance test of the system by experts, the system has a high level of efficiency (4.40±0.54). This makes it confident that the developed system can work and support agricultural tourism to monitor the sources of agricultural products in Samut Prakan Province.

Conclusion and Recommendations

Research and Development of a Source Monitoring System for Agricultural Products that Support Agricultural Tourism with Data Mining Techniques in Samut Prakan Province. Objectives (1) To study and collect information on the sources of agricultural products and agricultural tourism sites in the Samut Prakan Province. (2) To develop a working model for the source monitoring system of agricultural products for the introduction of agricultural tourism using data mining techniques. (3) To develop an application to support agricultural tourism for monitoring the sources of agricultural products in Samut Prakan Province. Development of an agro-tourism support system for monitoring the source of agricultural products in the form of a mobile application for users and a web application. For the backend admin team, the research process was divided into three stages: 1) The process of studying and collecting data on the source of agricultural products and tourist attractions was divided into collecting data from relevant agencies and collecting data by studying data from relevant websites. 2) The development of a functional model of the system is introduced by adopting a collaborative filtering method that uses modeling techniques. Clustering techniques and the Analytic Hierarchy Process (AHP) were used together.In addition, a database is prepared by applying the ontology method to propose knowledge in the form of groups of concepts and relationships with each other within the scope of interest, which will allow the creation of a database.and 3) Application development, a total of seven steps, including (1) data collection for application development. (2) Preparation of Knowledge-based System by Ontological Method. (3) System Analysis. (4) System design. (5) System development. (6) System performance testing. and (7) evaluation of system user satisfaction.There are a total of five groups of users involved in the system: tourists, tourist attraction providers, agricultural product manufacturers, store owners, and administrators who will be given access to different systems.The system has 12 main functions: Login, Press Release, Approve Contributors, Settings, Register Members, Manage Tourist Attraction Information, Recommend Tourist Attractions, Check the Source of Agricultural Products, Rate Satisfaction, Manage Product Information, Manage Product Source Information, and Log-out.Similarly, the ontology for monitoring the source of agricultural products consists of nine main concepts.Agricultural information includes the following: 1) a Product Origin Inspection class. 2) Product/Product Class. 3) Product/product class processed from agricultural products (ProArgoProcess). 4) Ingredient agricultural products (ProArgoProcessMix). 5) Attraction Class. 6) Activity class. 7) Location Class. 8) Knowledge News Class. and 9) type KnowledgeNews. Evaluation of the system with related assessments

showed that the quality of the questionnaire according to the IOC standard was between 0.67 – 1.00. 1) The results of the investigation and evaluation of the accuracy and appropriateness of the developed ontology show that experts consider the ontology of monitoring the source of agricultural products to a great extent (4.16±0.46). 2) The results of the performance test of the system by five computer and information technology experts and spatial researchers in Samut Prakan province showed that the experts considered the system to be very effective (4.27±0.63). 3) The results of the three groups of system user satisfaction assessments with three satisfaction assessments created for specific user satisfaction assessments, divided into 3.1) The results of the satisfaction assessment by 105 tourists showed that they could collect tourist data in tourist attractions, and a total of 102 tourists were able to collect data from tourists, accounting for 97.14% and the tourists were very satisfied with the use of the system (4.34±0.61). 3.2) Results of the System User Satisfaction Assessment by Owners of Tourist Attractions/Agricultural Products Producing Areas Representing the People in Bang Bo District, five people from Bang Phli District and Phra Samut Chedi District, Samut Prakan Province, and the owners of tourist attractions/agricultural product production sites were very satisfied with the use of the system (4.26±0.62). and 3.3) The results of the system satisfaction assessment consisted of shops representing shops in the Bang Bo District. Bang Phli District and Phra Samut Chedi District, Samut Prakan Province Quantity 10 People are satisfied with using the system to a high extent (4.14±0.71). Therefore, it can be concluded that the results of the satisfaction assessment by all three groups of users have a high level of satisfaction in using the system (4.25±0.65). It was also found that the system of monitoring the source of agricultural products that support agricultural tourism with the developed data mining technique can be applied practically to meet the needs of relevant users.

However, the development of a model to recommend tourist attractions to people in the future may further study the factors that influence the selection of tourist attractions. In order to be able to work efficiently, including ranking recommended tourist attractions so that the system can recommend tourist attractions more accurately. The process of categorizing tourist attractions and ranking formats may be improved by other methods to better meet the needs of tourists. Increase information on all types of tourist attractions to cover the Samut Prakan Province. Finally, adding a multimedia presentation to the tourist attraction introduction system so that tourists can visualize the tourist attractions creates tourist attractions.

Acknowledgments

The research team would like to thank Thonburi Rajabhat University for supporting the research funding and Samut Prakan Provincial Tourism and Sports Office. The Department of Agricultural Promotion, Samut Prakan Provincial Agriculture Office, Phra Samut Chedi District Agriculture Office, Bang Bo District Agriculture Office, Bang Phli District Agriculture Office, and Samut Prakan Provincial Community Development Office, as well as all users involved in the use test and provided data courtesy for this research.

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