Development of An Agricultural Equipment Circulation Data Management System for Organic Rice Large-Scale Farming Group

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Abstract*— This research aimed to develop and evaluate an information system for managing agricultural equipment loans to enhance the operational processes of the Taluk Klang Thung Organic Rice Farming Group in Tak Province, Thailand. The system development life cycle commenced with requirements elicitation through interviews to understand the group's existing operational workflows. System analysis and design were conducted using Data Flow Diagrams (DFDs), which identified six core processes. The data architecture was subsequently designed to establish relational integrity between tables governing the loan-return cycle and equipment inspection management. The system was implemented using the Django framework with an SQLite database for data persistence. To evaluate the system's efficacy and user acceptance, a satisfaction survey was administered to a sample of 30 group members. The results revealed a high level of overall user satisfaction, with a mean score (M) of 3.93 and a standard deviation (SD) of 0.48. Qualitative feedback indicated that the system was perceived as easy to use, fast, accurate, and effective for managing equipment loans, fostering user confidence. Furthermore, a theoretical validation was performed using Confirmatory Factor Analysis (CFA) to test the measurement model against the constructs of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). The analysis confirmed that all observed variables could significantly explain the latent variables of the theoretical models, with factor loadings ranging from 0.75 to 0.86, all of which substantially exceed the accepted threshold of ≥0.70. These findings demonstrate that the developed system is highly suitable for practical deployment and indicate a strong propensity for sustained user acceptance and utilization.

***Index Terms*— Circulation service system, Information system, Equipment management, Technology Acceptance Model**

I. INTRODUCTION

The Ascendance of Organic Agriculture in Thai National Strategy

In recent years, a global shift in consumer consciousness towards health, food safety, and environmental sustainability has catalyzed a significant and sustained increase in demand for organic agricultural products. This trend is not merely a market opportunity but represents a strategic response to the well-documented adverse effects of chemical-intensive agriculture, which include soil degradation, biodiversity loss, and public health concerns. Within this global context, the Royal Thai Government has formally elevated organic agriculture from a niche movement to a national strategic priority.

This policy shift is most clearly articulated in the 13th National Economic and Social Development Plan (2023–2027), which explicitly identifies organic agriculture as a key strategy for the nation's economic development. This plan, formulated by the Office of the National Economic and Social Development Council (NESDC), signals a high-level commitment to transforming Thailand's agricultural sector. The inclusion of organic farming in this foundational policy document indicates a calculated economic strategy. It reflects a move away from a reliance on the volume of bulk commodity exports and towards a value-based economic model that aims to increase the unit value, competitiveness, and profitability of agricultural products on the global stage.

Central to any discussion of Thai agriculture is rice. As the primary staple food for its population and a cornerstone of the national economy, rice is also one of Thailand's most significant export commodities. Consequently, the transition towards organic rice cultivation is of paramount importance, representing a critical sub-sector with the potential to drive this national strategic pivot. This paper aims to provide a multi-faceted analysis of the Thai organic rice sector, integrating national policy frameworks, economic data, detailed cultivation practices, and a synthesis of recent academic research on farmer success and certification models to illuminate the opportunities and challenges that lie ahead.

At its core organic rice is defined by a production system that completely abstains from synthetic chemical substances at every stage. This includes cultivation on land certified to be free of chemical residues and the use of high-quality, resilient seeds sourced from organic production systems. The process is not merely the absence of chemicals but a proactive, knowledge-intensive system of ecological management. A case study of a farmer certified under international standards by Wongnongwa, Bunjongsiri, and Kaeowan (2021) provides a detailed, practical methodology, which can be summarized in eight key steps.

Soil preparation, the process begins post harvest with natural fertilization. This often involves allowing livestock to graze on rice stubble, depositing manure, which is supplemented with compost and plowed into the soil to build fertility without synthetic inputs.

Seed Selection and preparation only high-quality seeds from certified organic sources are used. These seeds are selected for their resilience to local pests and environmental conditions.

Planting and sowing two primary methods are employed: transplanting seedlings (puk dam) and direct dry sowing (wan khao haeng), with the choice depending on water availability and labor.

Maintenance (weed and pest management) this is one of the most critical and labor intensive stages. Instead of herbicides and pesticides, farmers rely on an integrated system of manual weeding, applying mulch to suppress weed growth, and fostering a healthy ecosystem of natural predators (e.g., spiders, ladybugs) to control pests.

Harvesting, timing is crucial to ensure optimal grain quality. Harvesting is typically done when the grains have ripened but the stalks retain some moisture, a practice that improves milling outcomes.

Threshing, after harvesting, the rice grains are separated from the stalks. Equipment used for threshing must be thoroughly cleaned to prevent any cross contamination from conventionally farmed rice.

Drying, the harvested paddy is spread on clean surfaces and naturally sun dried to reduce its moisture content to a level suitable for storage and milling.

Post harvest handling and storage, this final stage is governed by a strict principle of segregation. Organic paddy must be stored separately from conventional rice. Critically, the milling process must use dedicated machinery that has not been used for conventional rice to guarantee purity and prevent contamination.

This meticulous, multi stage process underscores that organic farming is a holistic system requiring a deep understanding of ecological principles. The stringent requirement for dedicated infrastructure, such as separate milling equipment, highlights the fragility of the organic status and demonstrates that success depends not only on cultivation practices but also on the integrity of the entire value chain. This inherent need for a supportive ecosystem explains the vital role of farmer cooperatives and community networks in the sector's development.

Certification, knowledge transfer, and farmer success, a synthesis of recent research

The success of organic rice farming in Thailand is contingent upon a complex interplay of farmer capacity, community support, and robust certification systems. Recent academic research provides critical insights into these dynamics, revealing the factors that enable farmers to thrive and the structures that support them.

A study by Wongnongwa et al. (2021) on a farmer successfully certified under the stringent EU Regulation 834/07 and NOP-USDA Organic Standards offers a clear blueprint for accessing international markets. The research identified several key determinants of success, which can be divided into internal and external factors.

Internal factors include the farmer personal characteristics, such as diligence, patience, and integrity, a strong base of agricultural knowledge; and the indispensable support of family members who provide essential labor. External factors are equally critical and include supportive government policies that provide training and access to technology; strong farmer networks for knowledge sharing; and, most importantly, the central role of agricultural cooperatives, which provide market access, funding, and technical support.

While international certification is vital for export, its cost and complexity can be prohibitive for many smallholders. Research by Thongphong and Tharasuk (2024) on a community-based certification model in Songkhla province highlights an alternative path. Their findings emphasize the necessity of farmer knowledge, active participation in the verification process, and transparency to build trust among stakeholders. This model is a practical example of the Participatory Guarantee System (PGS).

PGS is a locally focused, low-cost quality assurance system built on the active participation of stakeholders, including farmers and consumers, and founded on principles of trust, social networking, and knowledge exchange. Rather than relying on an external third-party inspector, PGS groups conduct peer reviews and community verifications. This approach is particularly well-suited for smallholder farmers in Thailand for several reasons: it dramatically reduces certification costs, empowers farmers by giving them ownership of the process, and creates a powerful mechanism for peer-to-peer knowledge transfer, which is essential for mastering organic techniques. While PGS is highly effective for domestic markets, its primary limitation is that it often lacks the same level of recognition as third-party certification in international export markets.

II. RELATED WORK

A. Review Stage

A review of the literature reveals several research initiatives related to the development of information systems for equipment loan and return management. For instance, the study by Phurichan and La-iad-ong (2024) involved the development of an equipment loan and return system for scientific durable articles and equipment within the Biology Program, Faculty of Science, at Khon Kaen University. Implemented as a web application, the system was found to be beneficial for operational staff. The system helped to reduce work time and procedural steps, enabled data verification, and increased the convenience and speed of the equipment loan process for service providers.

The study by Phothong (2024) focused on the development of an information system for the loan and return of materials and durable equipment. The findings indicated that the system could effectively manage loan and return data, including the management of user information derived from these transactions. The system successfully categorized different types of materials and equipment according to user requirements and generated reports showing the remaining stock levels. A key feature of this system was its ability to facilitate the inspection of the condition of returned equipment, determining its readiness for subsequent use.

In a study by Buaroad et al. (2021), a web application was developed for the equipment loan and return system of the Physical education program at Muban Chombueng Rajabhat University. The research concluded that the application of technology to develop the system was appropriate and consistent with actual usage conditions, enabling more effective service provision to students. The system was capable of managing equipment loan and return data, reducing the time involved in the loan process, and decreasing the number of steps in the workflow. Furthermore, it allowed for data updates to verify the quantity of each type of equipment and to track items that had been borrowed.

To ensure that newly developed technology is accepted and aligns with the context of the target user group, the study by Zhang et al. (2024) investigated the acceptance of new agricultural technology among smallholder farmers in rural areas. Using the Unified Theory of Acceptance and Use of Technology (UTAUT) framework to analyze factors influencing the decision to adopt technology, the study found that Performance Expectancy and Effort Expectancy were significant variables that directly influenced the intention to use. Social Influence and Facilitating Conditions also played a secondary role. The research highlights the importance of designing technology that is both useful and uncomplicated to increase acceptance among rural farmers.

Similarly, McCormack et al. (2021) examined the factors affecting farmers' acceptance of an online system for managing Nutrient Management Plans (NMPs). The analysis confirmed that Perceived Usefulness and Perceived Ease of Use were the primary variables influencing the Behavioral Intention to Use among farmers. This research suggests that the design of online agricultural systems should emphasize ease of use and responsiveness to the actual needs of users to ensure sustained practical application.

The foundational studies from the Thai academic context provide a clear and consistent narrative regarding the impetus for and the perceived benefits of developing localized equipment loan systems. Each case represents a targeted intervention designed to solve specific, tangible operational problems at the departmental level.

The work of Phurichan and La-iad-ong (2024) at Khon Kaen University exemplifies this trend. By creating a web application for the Biology Program, the researchers addressed the direct needs of the administrative staff responsible for managing a specialized inventory of scientific equipment. The reported outcomes - reduced time, simplified procedures, and enhanced convenience are all metrics of administrative efficiency. The system's value was measured by its ability to streamline the workflow for the "service providers," demonstrating a clear focus on alleviating the operational burdens associated with manual tracking.

Similarly, the system developed by Phothong (2024) was designed to bring order and accountability to the management of materials and equipment. Its key functionalities, such as user data management, equipment categorization, and inventory reporting, are hallmarks of a system designed for control and oversight. The inclusion of a feature for assessing the post-return condition of equipment is particularly noteworthy, as it extends the system's function beyond simple tracking to asset lifecycle management, ensuring that equipment is not only returned but is also maintained in a state of readiness for future users. This points to a more sophisticated understanding of asset management, where the goal is to preserve the value and utility of the equipment over time.

The study by Buaroad et al. (2021) at Muban Chombueng Rajabhat University further reinforces this pattern. The development of a web application for the Physical Education program was deemed successful because it was appropriate and consistent with actual usage conditions. This suggests that the system was designed with a deep understanding of the specific workflows and user needs within that department. Like the other studies, its success was framed in terms of efficiency gains, reduced process time, fewer workflow steps, and improved tracking of equipment. The ability to provide more effective service to students is mentioned as a key outcome, but this appears to be a direct consequence of the improvements in administrative efficiency.

B. Final Stage

A critical examination of these three cases reveals a distinct pattern of internal, department level innovation. The systems were not developed as part of a university wide, centralized IT initiative but rather as bespoke solutions for specific academic units Biology, Physical Education, and a general materials management function. This suggests that the motivation for these projects arises from a bottom - up recognition of operational deficiencies. Individual departments, facing the daily friction of manual processes, are compelled to act as localized innovation hubs. This may be due to the absence of a suitable enterprise level solution, or because any existing central systems are too rigid or costly to be adapted to the unique needs of a particular department's inventory and user base. This highlights a potential gap in institutional IT strategy, where the lack of flexible, scalable, and centrally supported platforms necessitates a fragmented, department by department approach to solving a common administrative problem.

Furthermore, a deeper analysis of the stated objectives and success metrics across these studies points to the implicit primacy of operational efficiency over direct pedagogical enhancement. The value proposition of each system is articulated almost exclusively in administrative terms, time saved, steps reduced, data verified, and inventory tracked. While students are identified as beneficiaries of increased convenience, the core benefits are measured from the perspective of the administrator or service provider. There is a conspicuous absence of any discussion or measurement of how these systems might directly enhance research learning outcomes, facilitate novel pedagogical approaches, or support more ambitious research projects. For example, a system could be designed not just to manage assets but to actively support project-based learning by allowing researcher to reserve a complete kit of equipment for a specific assignment, or by integrating with a learning management system to link equipment availability to course schedules. The current focus, as reported, is on managing the assets as institutional property, rather than on maximizing their educational utility as tools for learning and discovery. This reveals a potential missed opportunity to frame and design such technological interventions as integral components of the academic and research infrastructure, rather than simply as administrative conveniences.

Taluk Klang Thung Organic Rice large scale farming group. Location Group 2, Taluk Klang Thung Sub-district, Mueang Tak District, Tak Province. The Taluk Klang Thung

Organic Rice large scale farming group is a collective of farmers dedicated to the cultivation and production of rice certified under the organic Thailand standard. The group collectively manages 405 rai of organic paddy fields.

Group members undertake the cultivation of organic rice annually, with the planting season commencing in June and the harvest taking place in November. A fundamental principle of their organic farming practice is the strict prohibition of chemical substances in all cultivation activities. This includes the mandated use of agricultural equipment designated solely for organic farming to prevent any chemical contamination of the produce.

Members of the agricultural cooperative share and rotate the use of farming equipment amongst themselves. however, a significant challenge arises from the concurrent planting schedules of the members, which complicates the planning and allocation of this shared agricultural machinery. To address this issue, the development of a formalized equipment borrowing and returning management system is proposed as a strategic approach to effectively sequence and manage equipment loans within the group.

A review of the relevant literature on asset management and lending systems indicates that implementing such a system for the Large-Scale Farming Project agricultural group would streamline the borrowing and returning process. This system would replace the traditional, manual method of record keeping in a physical logbook, which is often inefficient and prone to issues. For instance, the manual system is entirely dependent on a single record-keeper; if this individual is unavailable, equipment cannot be borrowed. Furthermore, the loss or damage of the logbook can result in a complete loss of borrowing records, making it impossible to track equipment or verify returns. Another critical drawback of the manual system is the inability to effectively monitor the operational status of returned equipment, which may be damaged and in need of maintenance or parts replacement.

Recognizing these inefficiencies, this research underscores the necessity of developing an information system to manage the lending of agricultural equipment. The proposed online system would also cater to the members readiness to adopt digital solutions. The primary benefits of implementing this agricultural equipment borrowing and returning system for the farmer group are multifaceted and focus on the following key areas.

Operational, efficiency the system is designed to reduce redundant steps and shorten the time required for the borrowing and returning process. This automation alleviates the administrative burden of manual documentation and tracking, allowing the equipment manager to allocate more time to other critical tasks related to equipment management.

Optimized, equipment management in systematically collecting real time usage data, the system provides a comprehensive overview of equipment utilization. This data enables the group to identify which pieces of equipment are in high demand and which are underutilized. Such insights are invaluable for strategic planning related to equipment procurement, scheduling preventive maintenance, and replacing obsolete machinery, thereby maximizing the utility of all assets.

Cost and loss reduction, a precise tracking mechanism significantly mitigates the risk of equipment loss. moreover, an automated notification feature ensures the timely return of all items, reducing the likelihood of damage from overuse or prolonged possession by a single user.

Enhanced user satisfaction and transparency, the system empowers members by allowing them to independently check the availability of equipment and make reservations online. This self-service capability fosters a more transparent and satisfactory user experience for all members of the cooperative.

The researcher recognizes the necessity of developing an information system for managing the borrowing and returning of agricultural equipment for the Taluk Klang Thung Large Scale Organic Rice farming group. This initiative aims to address the limitations inherent in the traditional, manual recording methods, which pose challenges in auditing, tracking, and allocating equipment. While the implementation of such a system is anticipated to enhance efficiency, reduce redundant processes, and promote transparency in management, its success is not solely contingent on its technical performance. User acceptance is an equally critical factor.

Therefore, this research adopts established technology acceptance frameworks to guide its evaluation. Specifically, it incorporates the Technology Acceptance Model (TAM), proposed by Davis (1989), which posits that the acceptance of a new technology is determined by two key beliefs, perceived usefulness and perceived ease of Use. These factors influence user attitudes toward and intentions to use the system.

Furthermore, the study considers the Unified Theory of Acceptance and Use of Technology (UTAUT), developed by Venkatesh et al. (2003). The UTAUT model extends TAM and other theories by identifying four principal determinants of user behavior: Performance Expectancy, Effort Expectancy, Social Influence, and Facilitating Conditions.

By employing these theoretical frameworks, the evaluation of the system will extend beyond mere software functionality. It will also capture the acceptance levels and attitudes of the farmers who are the end-users in a real world context. This holistic approach is crucial for ensuring the system's sustained adoption and its ability to deliver maximum benefits to the community (Davis, 1989; Venkatesh et al., 2003; Marangunić & Granić, 2015)

C. Research objectives

1. Develop a management system for the lending and returning of agricultural equipment.
2. Manage agricultural equipment, including monitoring the availability status of the equipment and tracking the lending and returning status.
3. Assess their user satisfaction with the system and to study the attitudes of users toward technology adoption.

III. METHODOLOGY

Scope of study area, this research was conducted with the large-scale organic rice farming group of Taluk Klang Thung, Village No. 2, Taluk Klang Thung Sub-district, Mueang Tak District, Tak Province.

Population and sample, the sample group consisted of 30 members from the Large-Scale Organic Rice farming group of Taluk Klang Thung.

Information system development principles, this research employed principles and theories of information system development for the analysis and design of the system, following the subsequent stages.

System analysis.

The researcher conducted a requirement analysis by examining data related to the processes of agricultural equipment usage within the study area. This included analyzing the existing equipment borrowing and returning procedures, the integration of equipment used with cultivation processes, the time required for each cultivation stage, and the coordination involved in borrowing and returning equipment. The collected data was then used to create a Data Flow Diagram (DFD) to map the flow of information and activities within the system.

System design.

An Entity-Relationship Diagram (ER-Diagram) was utilized to design the structure of the database for data storage.

Data structure validation.

The integrity and completeness of the data structure were verified using normalization principles to minimize data redundancy.

System development.

The system was developed using the Django Framework, a popular Python based web application framework. Django's object-oriented structure was chosen for its scalability and ease of future modifications. This framework allows for direct application of the design phase into development. For database management, SQLite was used due to its convenient integration with Python for data manipulation.

System testing.

The functionality of the information system was tested and verified against the design specifications outlined in the development framework. Testing was also conducted with the target user group of farmers, and the system was subsequently revised based on their feedback and suggestions.

User satisfaction and technology acceptance evaluation.

User satisfaction assessment.

User satisfaction with the system was evaluated using statistical methods. A 5-level rating scale was employed to measure satisfaction levels.

Technology acceptance study.

The user attitudes toward technology adoption were studied using a framework based on technology acceptance models. This involved assessing how perceived ease of use influences user attitudes and intentions to use the system.

Novel contributions of the research

The development of this agricultural equipment borrowing and returning management system has established a new approach for integrating computer theory with the practical operational processes of a large-scale farming cooperative.

This research extends the conventional framework of requirement analysis by integrating not only the procedural analysis of equipment borrowing and returning but also the management of rice cultivation activity data and the monitoring of real-world problems in agricultural plots. We have developed Data Flow Diagrams (DFDs) and Entity-Relationship (E-R) Diagrams that reflect both the resource management and production process management dimensions of agriculture. This approach systematically bridges the perspectives of information systems and agricultural practices.

1. New approach to database design for agricultural communities.

The database design was meticulously developed based on a comprehensive requirement-gathering process. It encompasses member data, borrowing-returning protocols, cultivation activities, and an analysis of practical field issues. The result is a specialized database tailored for community agriculture, designed to support an efficient borrowing and returning system for farming equipment. This system enables farmer groups to manage shareable equipment with high efficiency.

2. Methodology for evaluating and understanding user attitudes in a local agricultural context.

Assess technology acceptance, this study applies the Technology Acceptance Model (TAM) and concepts from the Unified Theory of Acceptance and Use of Technology (UTAUT) as analytical tools. Theoretical factors were translated into practical, context appropriate indicators for the target farmer group.

Key findings include.

1. Perceived usefulness/performance expectancy farmers perceived the system as a tool

that reduces time, minimizes errors, and increases transparency in equipment management.

2. Perceived ease of use/effort expectancy the system was designed to be user friendly,

even for individuals with limited technological skills.

3. Social influence group members played a significant role in collectively encouraging

and supporting the adoption of the system.

4. Facilitating conditions the availability of essential infrastructure, such as smartphones,

internet access, and a system administrator, was critical to the system's practical implementation and use.

1. Information system development results.

Following interviews concerning the operational procedures and activities of the Large-Scale Farming Project group, the gathered data was analyzed to determine the relationships between data and activities. This analysis informed the design of the data relationships for storage within a database management system. Subsequently, the information system was developed. The results of the system development are as follows.

Results of data and activity relationship analysis using a data flow diagram as shown in Figure 1, the Level 1 Data Flow Diagram (DFD) illustrates the system's data flow. The system requirements analysis revealed that, in addition to the need to borrow agricultural equipment, there was also a requirement to track the timeframe of each stage of the rice cultivation process. Therefore, the Level 1 DFD in Figure 1 depicts a total of six processes within the information system: master data management, member registration, equipment booking record management, problem-reporting record management, rice cultivation data logging, and report generation.

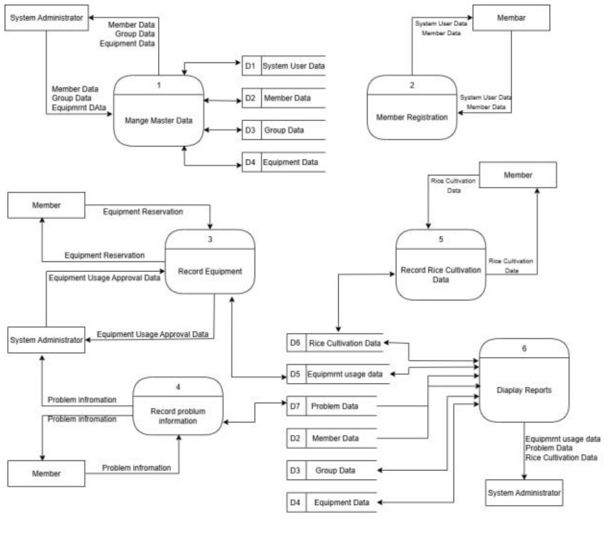

Figure 1. the Level 1 Data Flow Diagram (DFD)

System processes and functionalities

This article outlines the core processes of the information system, detailing the functionalities available to system administrators and members. The system is designed to manage rice cultivation activities, from resource allocation to data logging and reporting.

1. Foundational data management process

This process is administered by the system administrator and involves the management of fundamental system data. Key functions include overseeing user accounts, member information, member group configurations, and the inventory of available equipment.

2. Membership registration process

This process enables prospective members of a group to formally register and create an account within the information system, granting them access to its features and functionalities.

3. Equipment reservation process

This process allows members to submit requests for the use of agricultural equipment required for rice cultivation tasks. Following the submission of a request, a system administrator is responsible for reviewing and granting approval for equipment use.

4. Problem Reporting Process

This function facilitates the documentation of issues encountered by members. It allows users to record problems arising from the use of equipment, challenges within the rice cultivation process, or any other relevant issues pertaining to the group's agricultural activities.

5. Cultivation Data-logging Process

This process is designed for members to systematically record data related to their rice cultivation activities. Examples of data entries include, but are not limited to, information on plot plowing and rice seed sowing.

6. Reporting Process

This process provides the system administrator with the capability to generate comprehensive reports from the data stored within the information system. For instance, the administrator can produce reports detailing the cultivation data for each member or track the equipment borrowing history of all users.

1.2 Data Storage Design in the Database Management System

The data storage design is represented by the Entity Relationship Diagram (ERD), as shown in Figure 2.

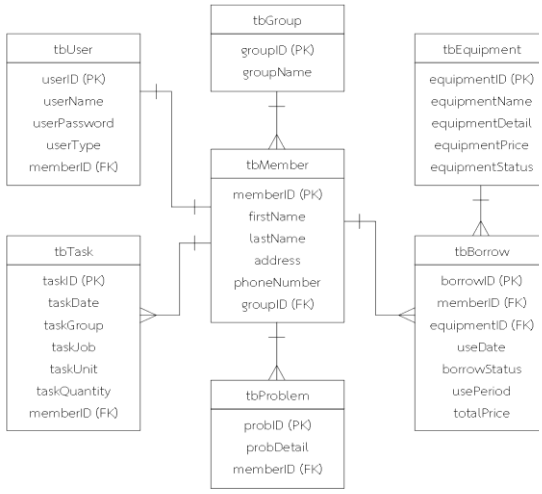

Figure 2. Diagram of data relationship

Figure 2 illustrates the relationships between the data stored within the database management system, which comprises seven distinct tables.

Database schema description

The system database is structured into seven primary tables, each serving a specific data storage function.

tbUser, this table stores the usernames and passwords for member authentication.

tbMember, this table contains the detailed profile information of each member.

tbGroup, this table is used to manage and store information about member groupings.

tbEquipment, this table holds detailed information about various agricultural equipment available for members to borrow.

tbBorrow, this table logs all transactions related to the borrowing of equipment by members.

tbTask, this table records data pertaining to the rice cultivation activities of the members.

tbProblem, this table serves as a repository for logging any issues or problems encountered. This includes, but is not

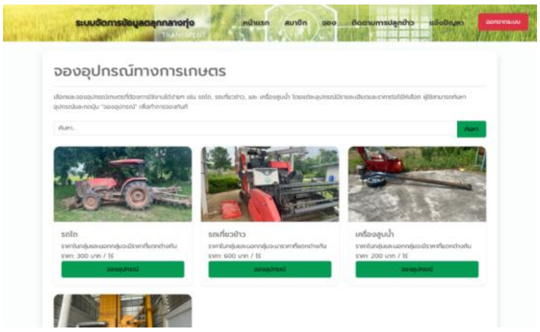

Figure 5. The user interface for agricultural equipment reservation.

limited to, problems arising from the use of agricultural equipment, such as damage to a tractor, as well as other related issues.

IV. RESULT

The development of the information system was based on an analysis of the relationships between data and processes, utilizing Data Flow Diagrams (DFDs). The data storage was designed for the database management system using an Entity-Relationship Diagram (ERD). Figure 3 shows the main interface of the system.

Figure 3. Show the main interface of the Agricultural Equipment Borrowing Returning Management System.

Administrator user role upon logging in as an administrator, a dedicated menu group for managing master data is available. The interface for this function is shown in Figure 4.

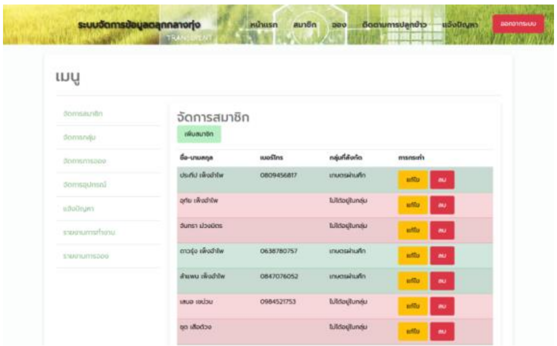

Figure 4. The administrator's interface for master data management.

The main functionalities of the system consist of three key components, agricultural equipment reservation, rice cultivation tracking, and problem reporting.

Agricultural equipment reservation function.

System users can reserve agricultural equipment, such as tractors and water pumps, for use in their own plots. The system displays information about the available equipment on the screen. After a member submits an equipment reservation request, the system administrator will review and approve the request. Figure 5 illustrates the user interface for the agricultural equipment reservation process.

Rice cultivation tracking function

System users can record data related to the rice cultivation process. The system categorizes this data into three main sections.

Soil Preparation, this section allows for the recording of the time frame and details corresponding to the soil preparation phase prior to planting.

Planting, this section is for recording the planting period, which is used to estimate the subsequent harvest time.

Weed and Impurity Removal, this section is for documenting the removal of weeds and other foreign matter from the rice paddies.

Figure 6 shows the user interface for recording soil preparation data. Figure 7 displays a summary of a member rice cultivation data.

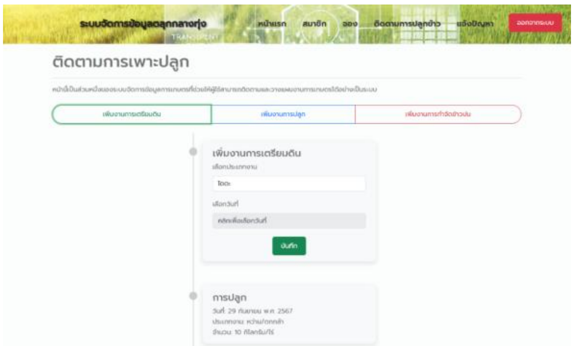

Figure 6. shows the user interface for recording soil preparation data.

Problem reporting function users can report issues encountered during the use of agricultural equipment or problems arising from the rice cultivation process and figure 8 shows the user interface for reporting some problem.

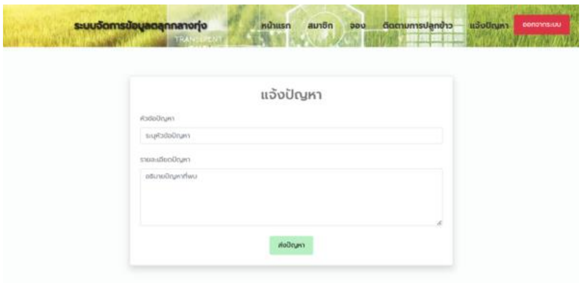

Figure 8. shows the user interface for reporting a problem.

Evaluation of satisfaction

The research employed a quantitative research method to assess satisfaction. Data was collected through a questionnaire utilizing a 5-point Likert scale, where respondents rated their level of agreement or satisfaction.

Satisfaction assessment of the information system usage.

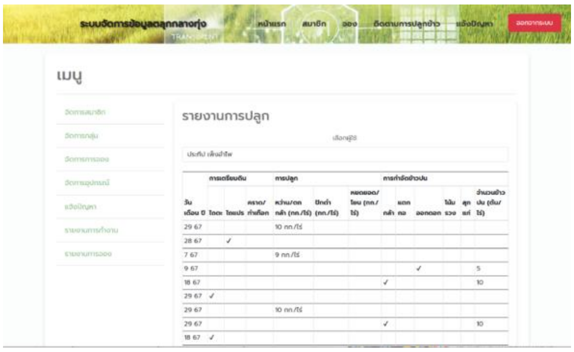

Figure 7. displays a summary of a member rice cultivation data.

Following the utilization of the information system by a sample group of 30 members from the Large-Scale Farming project, an assessment of their satisfaction with the system was conducted. The satisfaction survey employed a 5level Likert scale, with the following response options: "very high," "high," "moderate," "low," and "very low." The results of this satisfaction assessment were then summarized and analyzed using descriptive statistics, including the mean and standard deviation.

User satisfaction assessment of the information system.

Following the implementation and use of the information system, a user satisfaction evaluation was conducted. The sample group, comprising members of the designated population, assessed their satisfaction with the information system using a satisfaction survey. The results of this evaluation are presented in Table 1.

Table 1. User satisfaction assessment of the agricultural equipment lending returning management system.

The results of the satisfaction assessment for the agricultural equipment borrowing and returning information management system revealed that the overall satisfaction level of the sample group was high, with a mean score of 3.96 and a standard deviation of 0.48.

Sample group indicated a high level of satisfaction with the accuracy of the system's display and reporting functions, yielding a mean of 4.30 and a standard deviation of 0.69. The system's processing speed also received a high satisfaction rating, with a mean of 4.26 and a standard deviation of 0.44. Furthermore, the user-friendliness of the system and the ease of adding or updating information were both rated at a high level of satisfaction, with an identical mean of 4.10 and standard deviations of 0.41 and 0.60, respectively.

Satisfaction with the accuracy of user access control was also high, with a mean of 3.93 and a standard deviation of 0.68. Lastly, the clarity of the text displayed by the system was rated with a high level of satisfaction, showing a mean of 3.63 and a standard deviation of 0.55.

Descriptive analysis of user attitudes towards technology acceptance was conducted to evaluate the suitability of a data management system for borrowing and returning agricultural equipment among the Taluk Klang Thung Large-Scale Organic Rice Farming Group.

The evaluation, involving 30 users, revealed a positive overall assessment, with all aspects of the system rated as

Evaluation criteria	Mean	Standard Deviation	Evaluation result
1. System usability	4.10	0.41	High
2. System performance	4.26	0.44	High
3. Data management	4.10	0.60	High
4. Display clarity	3.63	0.55	High
5. Output accuracy	4.30	0.69	High
6. Access control integrity	3.93	0.68	High
7. Overall user satisfaction	3.96	0.48	High

"High".

The mean scores for each dimension were as follows.

Alignment with user needs	M=4.36	SD=0.59
Functional performance	M=4.27	SD=0.57
Ease of use	M=4.03	SD=0.51
Efficiency	M=4.05	SD=0.55
Data security	M=4.17	SD=0.59

Functional performance

Within the functional performance dimension, the highest-rated feature was the system ability to track rice cultivation activities (M=4.50,SD=0.56), reflecting the importance of accurate production data monitoring. Conversely, the indicators with the lowest scores were database connection speed (M=3.86,SD=0.62) and data access security (M=3.86,SD=0.62). Although these were the lowest scores, they were still within the High range, indicating continued user confidence in the system.

User satisfaction

Regarding user satisfaction, users found the system to be convenient to access (M=4.43,SD=0.62) and perceived that user permissions were appropriately controlled (M=4.43,SD=0.50). Furthermore, the authentication process required before use at each level received the highest score in this category (M=4.46,SD=0.56). This demonstrates that users place significant importance on the system's security measures in conjunction with its ease of use, these findings are presented in Table 2.

Table 2. Item loadings of observed variables for Technology Acceptance Constructs (TAM and UTAUT) among users of the management system for agricultural equipment loaning for the large-scale organic rice farming group.

Factor	TAM/UTAUT Factor	Factor Loading	Common Variance
The utilization of this system enhances the efficiency of agricultural equipment management	PU / Performance Expectancy	0.812	0.66
Reduce the time and complexity	PU	0.786	0.62
This system leads to fewer errors in the equipment lending and return procedure	PU	0.754	0.57
The system proves advantageous for the farmer cooperative	PU	0.832	0.69
The system has a gentle learning curve for users	PEOU / Effort Expectancy	0.845	0.71

The user interface and system text are clear and uncomplicated	PEOU	0.801	0.64
Users are able to operate the system fluently after a short period	PEOU	0.772	0.60
The attitude of users towards this system is positive	Attitude Toward Use	0.864	0.74
Users express a strong intention for continued use of the system	Behavioral Intention	0.853	0.73
Users express an intention to suggest this system to others	Behavioral Intention	0.825	0.68
Fellow members of the farmers group have an influence on the user decision to adopt the system	Social Influence	0.781	0.61
There is an expectation from key individuals (leaders) within the group that this system will be used	Social Influence	0.756	0.57
The necessary resources, like equipment and internet access, are sufficiently available to users	Facilitating Conditions	0.793	0.63
Users receive adequate support and assistance when using the system	Facilitating Conditions	0.802	0.65

Note: A factor loading of ≥ 0.70 is considered to have a strong correlation with the latent variable (Hair et al., 2019). The common variance, calculated as the square of the factor loading (Factor Loading2), represents the proportion of explained variance.

Based on the results of the Confirmatory Factor Analysis (CFA), as shown in the item loadings table, all observed variables distinctly explain the latent variables of the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT) model. The factor loadings ranged from 0.75 to 0.86, which exceeds the standard recommended value of ≥ 0.70. This indicates a strong consistency between the measurement items and their underlying theoretical constructs. each factor, including perceived usefulness, perceived ease of use, attitude toward using, behavioral intention, social influence, and facilitating conditions, demonstrated high common variance.

These findings reflect that the developed system aligns significantly with the user attitudes toward technology acceptance. It also confirms that the measurement instrument possesses both strong construct validity and a high degree of reliability, as illustrated in the structural model in Figure9.

The structural model diagram illustrates the relationships between variables derived from the Technology Acceptance Model (TAM) and the Unified Theory of Acceptance and Use of Technology (UTAUT). In this model, Facilitating Conditions (FC) and Social Influence (SI) are positioned as external independent variables that directly influence Behavioral Intention (BI). Additionally, FC affects Perceived Ease of Use (PEOU), which in turn influences both Perceived Usefulness (PU) and Attitude Toward Use (ATU). Meanwhile, PU has a direct impact on both ATU and BI, and ATU also affects BI.

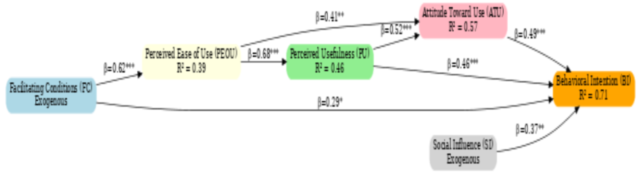

Figure 9. The structural model showing the relationships among variables based on TAM and UTAUT for the use of the agricultural equipment borrowing returning information management system.

The path coefficients (β) indicated on the arrows, such as PEOU → PU (β=0.68, $p < .001$), PU → ATU (β=0.52, $p < .001$), and ATU → BI (β=0.49, $p < .001$), demonstrate statistically significant relationships. The R-squared (R^2) values within the constructs PU (R^2=0.46), ATU (R^2=0.57), and BI (R^2=0.71) indicate that the independent variables can account for a high degree of variance in their respective dependent variables. These results suggest that the developed system is suitable for practical implementation and that users are likely to accept and continue using the system.

V. Conclusion

Based on the satisfaction assessment of the agricultural equipment borrowing and returning data management system for the Large-Scale Farming Group, it was found that users were satisfied with the overall system at a high level (mean = 3.96, standard deviation = 0.48). The system was found to be user-friendly, and adding or updating data within the system was straightforward. This aligns with the findings of Thanyarat Purichan and Bang-on La-i-ad-ong (2024), Athib Phothong (2024), and Somphatsorn Buaroad et al. (2021), which suggest that the ease of use of an information system positively affects user learning. When users can learn and operate a system easily, they are more likely to accept and willingly use it. Furthermore, the agricultural equipment borrowing and returning data management system provided clear display outputs and operated with speed and accuracy, consistent with the study by Athib Phothong (2024). A system that functions quickly and correctly fosters user confidence. Similarly, a system that displays information clearly on output devices enhances user ability to learn and understand its operation effectively.

The research findings reflect that the developed agricultural equipment borrowing and returning data management system can meet the needs of the farmer group across multiple dimensions, including accuracy, efficiency, convenience, and security, all of which were rated at a "high" level. This is consistent with the work of McCormack et al. (2021), which indicated that Perceived Usefulness and Perceived Ease of Use directly influence the intention to use a system. Although the system received a positive evaluation, it was noted that the database connection speed and data access security aspects had slightly lower average scores than other items. This suggests an opportunity for system improvement to enhance processing performance and strengthen security confidence. This discovery aligns with the Technology Acceptance Model (TAM), which posits that perceived usefulness and ease of use are primary drivers of acceptance, but concerns about access or speed may affect long-term attitudes and actual usage (Davis, 1989; Venkatesh et al., 2003). Therefore, emphasizing the system's ability to reduce procedural steps and increase transparency, while simultaneously improving performance and security, will help foster positive attitudes and increase farmers' intention to use the system in the future.

The development of the agricultural equipment borrowing and returning data management system for the large-scale farming group has met its established objectives. There is potential for further development to include data management for other group activities, such as managing organic rice trading data and analyzing organic rice production planning for the group. This would enhance data management efficiency across the entire supply chain of the Large-Scale Farming Group. Such enhancements would not only strengthen the group but also contribute to the expansion of organic rice production areas.

APPENDIX

This research received financial support from the Thailand Science Research and Innovation (TSRI), year 2024, for the project 'Enhancing the Capabilities of the Veteran Agricultural Community Enterprise in Taluk Klang Thung, Mueang Tak, Tak, through the Creative Economy Framework. Special thanks to Asst. Prof. Dr. Montean Rattanasiriwongwut, Faculty of Information Technology and Digital Innovation, for adding advanced statistical knowledge on user attitudes and behaviors with the system.

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ALL BIOS ARE REQUIRED

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