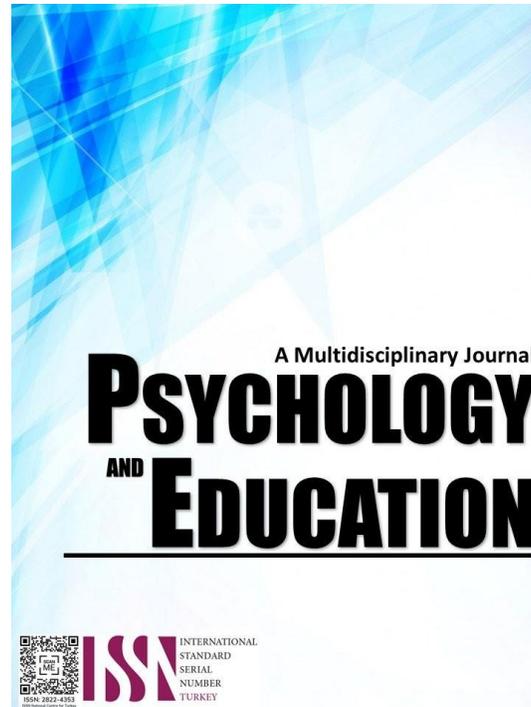


# PANAG ANI: A WEB-BASED RICE HARVESTER RENTALS AND RESERVATIONS OF TALUGTUG MUNICIPALITY



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## Panag Ani: A Web-Based Rice Harvester Rentals and Reservations of Talugtug Municipality

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### Abstract

This study developed and evaluated Panag Ani "A Web-Based Rice Harvester Rentals and Reservations of Talugtug Municipality" project would help answer the critical needs of rice farmers in the Philippines, particularly those from the Talugtug Municipality, as it concerns traditional manual reservation for rice harvesters. The goal of this capstone is to design a web-based digital platform that can easily rent and reserve rice harvesters to increase agricultural productivity and food security in the region. Using the Scrum framework for agile software development, the project went through stages such as planning, design, development, testing, and deployment, but always kept a user-centered approach. The system was evaluated using the standard of ISO 25010 based on properties of functionality, reliability, usability, efficiency, maintainability, portability, compatibility, and security. Furthermore, the Technology Acceptance Model were used in order to assess perceived usefulness, perceived ease of use, attitude towards using, and behavioral intention to use the system. Results show that Panag Ani received high marks in all assessment criteria, hence an overall mean score of 4.00, which were classified as "Very Good." Findings thus indicated that the system significantly increased the efficiency in making reservations on rice harvesters, reduced the number of scheduling conflicts, and is user-friendly even for non-technical persons. This project contributes to the modernization of agricultural practices in the Philippines and supports the Sustainable Development Goals (SDGs) through sustainable industrialization and innovation in the agricultural sector. Future recommendations included the expansion of the features of the system, such as online payment options and user engagement through SMS notifications. Overall, the Panag Ani system is a great step towards utilizing technology to support the agricultural community in Talugtug, Nueva Ecija.

**Keywords:** *Panag Ani, Web-based System, Rice Harvester Reservation, ISO 25010, Technology Acceptance Model (TAM)*

### Introduction

Rice is the second most important food crop globally in terms of area and production, with approximately 90% cultivated in Asia. Efficient harvesting practices are essential in preserving rice quality and reducing production costs. The advent of agricultural machinery has significantly transformed traditional farming, enhancing operational speed, accuracy, and reliability. In light of increasing digitization across sectors, integrating information and communication technologies into agriculture presents a valuable opportunity to improve productivity, coordination, and access to essential farming resources.

In the Philippine context, agriculture remains a key sector of the national economy despite a gradual decline in its contribution to gross domestic product (GDP) (Niccadies, 2018). Among agricultural commodities, rice is the most extensively cultivated and consumed staple, integral to the daily diet of Filipinos across all regions (Berkeley, 2017). The Philippines ranks as the eighth-largest rice producer in Southeast Asia, underscoring the crop's importance to food security and rural livelihoods (Global Yield Gap Atlas, 2018).

Nevertheless, the rice farming sector continues to encounter persistent structural and socio-economic challenges. These include an aging and declining farming population, diminishing agricultural land, rural-to-urban labor migration, and increasingly erratic weather patterns (Senate of the Philippines, 2016). In response, the Department of Agriculture has encouraged the adoption of mechanized technologies, particularly rice harvesters, to bolster productivity and address labor shortages (Ocampo, 2018). While these innovations are available, many farmers still rely on manual systems to reserve harvesting equipment, often resulting in inefficiencies such as scheduling conflicts, delays, and underutilization of machinery.

In alignment with the United Nations Sustainable Development Goals (SDGs), particularly SDG 2 (Zero Hunger) and SDG 9 (Industry, Innovation, and Infrastructure), the integration of digital systems in agricultural operations is critical for advancing food security and fostering sustainable industrial practices. Mechanization reduces post-harvest losses and increases operational efficiency. Digital platforms, such as reservation systems, further enhance the benefits of mechanization by ensuring optimized use and equitable access to farming technologies.

This study introduces Panag-Ani, a proposed digital rice harvester reservation system designed to support the inclusive and sustainable transformation of agricultural operations through innovation. The platform seeks to streamline the booking and allocation of harvesters, particularly among smallholder farmers, while promoting collaboration among key stakeholders, including government agencies, community organizations, and technology providers. In doing so, it also contributes to SDG 17 (Partnerships for the Goals), which emphasizes the importance of cross-sectoral cooperation in achieving sustainable development.

The objective of this study is to design and develop a digital rice harvester reservation system that addresses current inefficiencies in the scheduling and coordination of mechanized harvesting. Specifically, it seeks to: (1) minimize operational delays caused by manual reservations; (2) facilitate timely and equitable access to rice harvesters; (3) reduce scheduling overlaps; (4) enable secure data entry, editing, and storage functions; and (5) improve user accessibility through the integration of social media features. Through the implementation of this system, the study aims to enhance rice production efficiency, support smallholder farmers, and contribute to the broader goals of sustainable and inclusive agricultural development.

## Research Objectives

This study primarily aims to develop the Panag Ani: A web-based Rice Harvester Rentals and Reservations of Talugtug Municipality. Specifically, it aimed to:

1. Assess the developed website based on the ISO 25010 standard in terms of the following:
  - 1.1. functionality;
  - 1.2. reliability;
  - 1.3. usability;
  - 1.4. efficiency;
  - 1.5. maintainability;
  - 1.6. portability;
  - 1.7. compatibility; and
  - 1.8. security.
2. Evaluate the system based on the following construct of the Technology Acceptance Model (TAM):
  - 2.1. perceived usefulness;
  - 2.2. perceived ease of use;
  - 2.3. attitude towards use; and
  - 2.4. behavioral intention to use.

## Methodology

### Research Design

This investigation adopted a descriptive-developmental research framework, employing a quantitative methodology to examine stakeholder perspectives and evaluate the operational efficacy of the extant rice harvester rental process. Quantitative techniques facilitated the systematic acquisition and statistical interrogation of numerical data, enabling the identification of usage trends, operational deficiencies, and opportunities for enhancing reservation practices. As noted by Streefkerk et al. (2022), quantitative data collection methods, including structured questionnaires and field observations, are well-suited for empirical assessments, yielding dependable insights into user interactions and system performance. In this study, carefully constructed questionnaires with multiple-choice and closed-ended items were administered to key stakeholders—namely, agricultural practitioners, rental service providers, and municipal authorities—to collect pertinent data on harvester availability and operational effectiveness.

The formulation of the proposed digital reservation system for rice harvesters was governed by the System Development Life Cycle (SDLC), which provided a disciplined framework for system analysis, design, implementation, validation, and maintenance. To foster adaptability and iterative advancement, the Scrum methodology was incorporated into the development process. This agile approach supported continuous improvement through structured sprint cycles, collaborative appraisals, and the integration of stakeholder feedback, thereby promoting a system design attuned to user needs and operational realities.

### Respondents

The study engaged a total of 50 purposively selected respondents, classified into two primary groups: IT professionals and end-users. This classification was intended to ensure a balanced evaluation of the system's technical performance and practical usability.

The IT professional group, comprising 40% ( $n = 20$ ) of the total respondents, included 10 IT instructors and 10 IT practitioners. Their involvement was critical in assessing the system based on software quality standards, given their technical background and expertise.

The remaining 60% ( $n = 30$ ) consisted of end-users who are directly involved in agricultural operations and local governance. This group included 20 farmers, 5 rental service providers or reaper owners, and 5 municipal officials from Talugtug, Nueva Ecija. Their participation provided essential insights into the system's relevance, ease of use, and functionality in the context of actual farming and administrative processes.

### Instrument

Two distinct instruments were utilized to evaluate the development and prospective adoption of the Rice Harvester Reservation System. The first instrument was derived from the ISO/IEC 25010 software quality framework, as delineated by Vainshtein and Almog (2017). This standard provides a systematic methodology for assessing software quality across eight dimensions: functional suitability,

reliability, usability, performance efficiency, maintainability, portability, compatibility, and security. The ISO/IEC 25010 framework was selected for its comprehensive coverage, which ensures alignment with user requirements and industry benchmarks while fostering iterative refinement in system design.

The ISO/IEC 25010-derived questionnaire evaluated each of the eight quality dimensions. Participants rated these attributes using a five-point Likert scale, with response categories defined as follows: Outstanding (5), Commendable (4), Satisfactory (3), Marginal (2), and Inadequate (1). Ratings were informed by participants' direct interaction with the system's functionalities.

The second instrument was grounded in the Technology Acceptance Model (TAM), as conceptualized by Davis (1989) and extended by Turner et al. (2008). TAM was employed to gauge the potential for system adoption by examining four core constructs: perceived utility, operational simplicity, disposition toward use, and intent to adopt. These constructs were assessed through questionnaire items rated on the same five-point Likert scale: Outstanding (5), Commendable (4), Satisfactory (3), Marginal (2), and Inadequate (1).

To ensure content validity, both questionnaires underwent scrutiny by specialists in software engineering, agricultural technology, and research methodology. A preliminary trial was conducted to verify the clarity and pertinence of the questionnaire items. Instrument reliability was established using Cronbach's alpha, confirming the consistency and internal coherence of participant responses.

The questionnaires were administered in person to a diverse cohort comprising information technology experts, agricultural practitioners, reaper proprietors, and local governance officials. This face-to-face approach was selected to facilitate clear communication, address respondent queries, and enhance participation rates. The average duration for completing the survey ranged from 15 to 20 minutes.

### Procedure

The study proceeded in two phases: system development and evaluation. During development, the research team employed the Scrum methodology, embedded within the System Development Life Cycle (SDLC), to direct the iterative design, coding, and testing of the Panag-Ani system, a web platform for rice harvester rental and scheduling.

In the evaluation phase, a carefully chosen group—including information technology experts, farmers, reaper owners, and barangay officials—assessed the system. Each participant granted informed consent before engaging. A guided demonstration introduced the system's features, followed by hands-on exploration to ensure full understanding.

Data collection occurred in person using two rigorously developed instruments. The first, based on the ISO/IEC 25010 standard, evaluated software quality metrics such as functionality, efficiency, and usability. The second, drawn from the Technology Acceptance Model (TAM), examined perceived value, ease of operation, user sentiment, and adoption intent. Responses were safeguarded with strict confidentiality, stored securely, and analyzed quantitatively to inform system enhancements.

### Data Analysis

Data gathered from participants' evaluations of the Panag-Ani system were systematically analyzed using a predefined scoring framework. The arithmetic mean of the ratings provided by respondents served as the primary metric for assigning a qualitative assessment to the system's performance. Higher mean values indicated superior quality across evaluated attributes, whereas lower values highlighted aspects requiring further development.

Table 1 delineates the numerical thresholds, qualitative classifications, and corresponding interpretive descriptions employed to evaluate the system's performance.

Table 1. *Evaluation Framework*

<i>Numerical Rating</i>	<i>Qualitative Rating</i>	<i>Verbal Description</i>
4.20 – 5.00	Excellent	The system works perfectly and meets all quality standards.
3.40 – 4.19	Very Good	The system is reliable, meets most standards, and has minor issues that could be used for improvement.
2.60 – 3.39	Good	The system meets some standards but needs revisions to fix issues and improve performance.
1.80 – 2.59	Fair	The system misses key standards and needs major fixes to improve functionality and reliability.
1.00 – 1.79	Poor	The system fails basic standards and needs a full redesign to be reliable.

### Ethical Considerations

This investigation was executed with rigorous compliance to ethical research protocols, safeguarding the integrity, confidentiality, and autonomy of all participants. Prior to data acquisition, the objectives, methodologies, and scope of the study were transparently communicated to each participant. Written informed consent was secured, affirming that participation was voluntary and that individuals retained the right to withdraw at any stage without consequence.

To ensure privacy, all data were de-identified during collection, precluding the capture or disclosure of personally identifiable information. Responses gathered via surveys and interviews were stored in a secure, access-controlled environment and utilized

exclusively for scholarly analysis pertinent to the evaluation and refinement of the Panag-Ani system.

The research instruments—specifically, a tailored questionnaire grounded in the ISO/IEC 25010 software quality framework and an adapted Technology Acceptance Model (TAM)—were rigorously validated to uphold intellectual property rights and academic standards. The study design prioritized equitable representation, incorporating perspectives from diverse stakeholders, including agricultural practitioners, reaper proprietors, information technology specialists, and local governance officials, while mitigating bias through systematic sampling and analysis.

The research protocol underwent thorough scrutiny and received formal approval from the relevant institutional review board, ensuring alignment with both national and international ethical standards for studies involving human subjects.

## Results and Discussion

Figure 1. Presents the flow of the process in the development of the system. It covers the seven phases of the spiral mode.

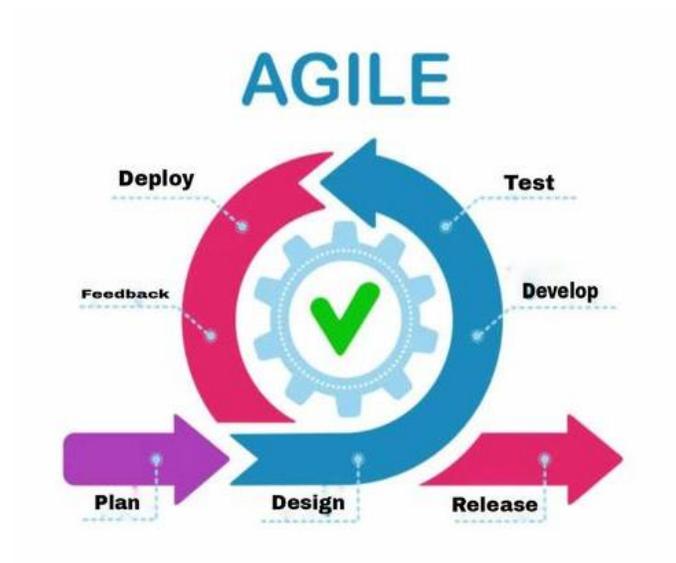


Figure 1. *The Agile Method*

### Plan

In this phase, the proponents conduct sprint planning begins in the Sprint by defining the projects that will be completed during it. The whole group will work together to create the finished plan. By tailoring the sprint planning process to the agricultural context, considering the unique challenges, and collaborating closely with stakeholders, developers can contribute to more efficient and effective practices (Schwaber and Sutherland, 2020).

### Design

In the design, the proponents design also known as the Daily Scrum, emerges as a vital ritual. The daily scrum is a routine activity that happens every day, ideally at an identical time each day to keep things simple. During the discussion, members of the team collaborate and link their tasks to the sprint goal (Jaising, Herranz, 2019). This essay explores the significance of daily stand-ups in the context of developing a Rice Harvester Reservation System, emphasizing their role in fostering communication, addressing challenges, and ensuring continuous progress. Daily stand-ups play a pivotal role in the agile development of a Rice Harvester Reservation System. By promoting collaboration, communication, and adaptability, these brief meetings serve as an essential for success. As the development team navigates the intricacies of agricultural technology, the daily stand-up becomes a cornerstone for addressing challenges, fostering a sense of shared responsibility, and ensuring that the Rice Harvester Reservation System evolves in tandem with the dynamic needs of the agricultural sector.

### Develop

In this phase the proponents develop within the agile development framework, particularly in the context of crafting a responsive and efficient Rice Harvester Reservation System. By delving into the reflective and improvement-focused aspects of Develop, we uncover how this practice becomes a cornerstone for continuous enhancement in agricultural technology. The agile principle of adaptability resonates strongly in the context of agricultural technology. The Develop becomes a metaphorical adjustment to seasonal changes, allowing the development team to adapt their practices based on the evolving landscape of requirements and challenges in building the Rice Harvester Reservation System, Develop provides an opportunity for everyone in the group to reflect. They can take a moment and reflect on the sprint, discuss what happened, analyze how they collaborated, identify areas for improvement, and then plan to implement

those changes in the next sprint (Westland, 2022).

### Test and Deploy

In this phase the In the agile development framework, Deployment is a pivotal event that marks the culmination of a Deploy cycle. Developers present the implemented features, improvements, and functionalities to stakeholders, providing a firsthand look at the progress achieved in enhancing reservation efficiency. The Sprint Review is a critical juncture in the agile development of a Rice Harvester Reservation System. It not only provides a tangible demonstration of progress but also facilitates collaboration, captures valuable stakeholder feedback, and drives continuous improvement. As the development team navigates the intricate landscape of agricultural technology, the Deploy becomes a compass, guiding them towards a more refined, efficient, and user-centric Rice Harvester Reservation System, The Deployment purpose is to examine the results and make recommendations for improvements in the future. The Team shows their work outcomes to the major customers and addresses development toward the product goal (Schwaber and Sutherland, 2020).

### Feedback

In this phase the proponents feedback comes from stakeholders, customers, and end-users throughout the development process. This feedback loop helps teams validate assumptions, identify areas for improvement, and ensure that the delivered features meet user needs and expectations. Feedback can be gathered through various channels such as user testing, demos, surveys, and direct communication.

### The Results On The Evaluation Made On The Technical Qualities Using ISO 25010 Of The System

Table 2 shows the evaluation of the Panag-Ani: A Web-Based Rice Harvester Rentals and Reservation System based on ISO standards

Table 2. ISO 25010 Evaluation Result

<i>Descriptors of ISO Standards</i>	<i>Mean</i>	<i>Verbal Description</i>
Functionality	4.00	Very Good
Reliability	3.80	Very Good
Usability	3.90	Very Good
Efficiency	4.00	Very Good
Maintainability	4.11	Very Good
Portability	4.21	Excellent
Compatibility	3.80	Very Good
Security	4.00	Very Good
General Grand Mean	3.98	Very Good

Legend: 4.20-5.00, Excellent; 3.40-4.19, Very Good; 2.60-3.39, Good; 1.80-2.59, Fair; 1.00-1.79, Poor

Table 2 presents the evaluation results of Panag-Ani: A Web-Based Rice Harvester Rentals and Reservation System using the ISO 25010 software quality model. The findings reveal that the system exhibits a high level of performance across multiple quality characteristics, with portability receiving the highest mean score of 4.21, categorized as Excellent. This indicates that the system can function effectively across diverse platforms with minimal configuration, highlighting its adaptability and broad usability.

Maintainability followed closely with a mean rating of 4.11 (Very Good), suggesting that the system is structured to allow efficient maintenance, updates, and modifications with reduced complexity. Functionality, rated at 4.07 (Very Good), reflects the system's effectiveness in delivering its intended features and meeting the users' requirements.

Both efficiency and security achieved a mean score of 4.00 (Very Good), which demonstrates that the system is capable of optimal resource utilization and adheres to strong data protection standards, ensuring safe and stable performance. The usability attribute received a mean score of 3.90 (Very Good), indicating that users generally found the system intuitive and accessible, although this area may benefit from refinements to further enhance the user experience.

Reliability and compatibility each received a mean score of 3.80, also interpreted as Very Good. These scores suggest the system performs dependably under normal conditions and can operate smoothly within varied technological environments. However, these areas may present opportunities for additional enhancement to strengthen performance consistency and system integration.

Overall, the general grand mean of 3.98 confirms that Panag-Ani adheres to a high standard of software quality. The system's strengths in portability and maintainability are particularly noteworthy, while incremental improvements in reliability and compatibility could further reinforce the system's effectiveness and user satisfaction.

### The results on the assessment made on Technology Acceptance Model of the System

Table 3 shows the evaluation of the Panag-Ani: A Web-Based Rice Harvester Rentals and Reservation System based on Technology Acceptance Model (TAM)

The evaluation based on the Technology Acceptance Model (TAM) indicates a high level of user acceptance for Panag-Ani: A Web-Based Rice Harvester Rental and Reservation System. Perceived Ease of Use received the highest mean score of 4.03, suggesting that users find the system intuitive and easy to navigate. Perceived Usefulness followed with a mean of 4.01, reflecting the system's practical

value in facilitating harvester reservations. The attributes Attitude Towards Use and Behavioral Intention to Use obtained mean scores of 3.95 and 3.93, respectively, indicating a generally positive disposition and strong intent among users to continue utilizing the system.

Table 3. TAM Evaluation Result

<i>Descriptors of Technology Acceptance Model</i>	<i>Mean</i>	<i>Verbal Description</i>
Perceived Usefulness	4.00	Very Good
Perceived Ease of Use	4.03	Very Good
Attitude Towards Use	4.00	Very Good
Behavioral Intention of Use	4.00	Very Good
General Grand Mean	4.01	Very Good

Legend: 4.20-5.00, Excellent; 3.40-4.19, Very Good; 2.60-3.39, Good; 1.80-2.59, Fair; 1.00-1.79, Poor

The evaluation based on the Technology Acceptance Model (TAM) indicates a high level of user acceptance for Panag-Ani: A Web-Based Rice Harvester Rental and Reservation System. Perceived Ease of Use received the highest mean score of 4.03, suggesting that users find the system intuitive and easy to navigate. Perceived Usefulness followed with a mean of 4.01, reflecting the system's practical value in facilitating harvester reservations. The attributes Attitude Towards Use and Behavioral Intention to Use obtained mean scores of 3.95 and 3.93, respectively, indicating a generally positive disposition and strong intent among users to continue utilizing the system.

The overall grand mean of 3.98 classifies the system as Very Good in terms of user acceptance. As emphasized by Sumak et al. (2020), high ease of use significantly contributes to user satisfaction and sustained engagement. These results affirm the system's effectiveness and usability, reinforcing its potential for broader adoption among stakeholders.

## Conclusions

The formulation and assessment of Panag-Ani, a web-based platform for rice harvester rental and scheduling, addressed critical deficiencies in the conventional manual reservation practices prevalent among Filipino farmers and harvester proprietors. Anchored in principles of sustainable development, the system aligns with Sustainable Development Goals 2 (Zero Hunger), 9 (Industry, Innovation, and Infrastructure), and 17 (Partnerships for the Goals), aiming to advance agricultural efficiency through technological innovation.

The study adopted a descriptive-developmental research framework, employing quantitative methods and adhering to the System Development Life Cycle (SDLC) integrated with the Scrum methodology. This approach ensured a disciplined and iterative process for system analysis, implementation, and refinement. Evaluation against the ISO/IEC 25010 software quality standard revealed commendable performance across multiple dimensions, with notable strengths in portability ( $M = 4.21$ ) and maintainability ( $M = 4.11$ ). The aggregate mean score of 3.98 indicates a high-caliber system, though opportunities for enhancement persist in reliability and compatibility.

User acceptance was substantiated through the Technology Acceptance Model (TAM), which assessed constructs such as operational simplicity ( $M = 4.03$ ) and perceived utility ( $M = 4.01$ ), both receiving elevated ratings. The overall mean of 3.98 reflects favorable stakeholder reception—encompassing information technology specialists, agricultural practitioners, reaper proprietors, and local governance officials—signaling their intent to sustain system usage.

In sum, Panag-Ani effectively mitigates technological barriers in agricultural machinery scheduling by delivering a dependable and accessible platform that streamlines reservation processes, fosters digital integration in rural farming communities, and promotes equitable innovation within the Philippine agricultural landscape. Its successful deployment establishes a foundation for expanding digital solutions in agriculture, offering a replicable model for community-driven technological advancements in the sector.

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