The Influence of Automated Harvest Robots in Japan on the Interest of TRPL IPB Students in Improving the Welfare of Agriculture

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Abstract

This study aims to examine the impact of Automated Harvesting Robots on agriculture in Japan and to investigate how the interest of TRPL IPB students in these technologies might influence agricultural innovation in Indonesia. The research evaluates how these robots have transformed agricultural practices in Japan by enhancing efficiency, reducing labour costs, and alleviating labour shortages. It also explores the potential for these advancements to stimulate agricultural innovation in Indonesia, facilitated by the engagement of TRPL IPB students. A mixed-methods approach was employed, combining an analysis of agricultural productivity and labour data from Japan with surveys and focus groups involving TRPL IPB students. This methodology comprehensively assesses the technological advancements and their implications for both Japanese and Indonesian agricultural sectors. Findings indicate that Automated Harvesting Robots have substantially improved efficiency and lowered labour costs in Japan while addressing labour shortages. These outcomes suggest that similar technologies could be beneficial if adopted in other regions. The high level of interest among TRPL IPB students reflects a readiness to integrate such innovations into Indonesian agriculture. Their feedback on the functionality of these robots offers valuable insights into their perceptions and potential barriers to technology adoption. The study highlights the critical role of technological exchange and student involvement in fostering agricultural innovation. However, limitations include potential cultural and infrastructural differences between Japan and Indonesia that may affect the direct applicability of these technologies. Future research should address these challenges and explore strategies to adapt and implement these innovations across diverse agricultural contexts effectively.

Keywords: Automated Harvest Robots, Japan, Technology, Agricultural

I. INTRODUCTION

Technological advancements have revolutionized various sectors, notably agriculture, where innovations like automated harvesting robots have become pivotal [1], [2]. Over the past decade, these robots have emerged as a significant technological breakthrough, transforming traditional agricultural practices by enhancing efficiency and productivity [3], [4]. Japan, recognized for its rapid technological progress, has been at the forefront of integrating automated harvesting robots into its agricultural sector, aiming to address labour shortages and optimize the harvesting process [5], [6]. Implementing these robots reflects a broader trend towards adopting intelligent technologies in agriculture, which is critical in addressing global food security challenges and improving crop management [7]. With their precise and efficient operations, automated harvesting robots represent a shift towards a more sustainable and productive agricultural model.

The deployment of automated harvesting robots in Japan has demonstrated substantial benefits, particularly in tasks requiring precision and speed, such as fruit and vegetable harvesting [8], [9], [10]. These robots have advanced sensors, artificial intelligence, and sophisticated mechanical systems to identify and harvest crops with minimal damage, reducing waste and maximizing yields [11]. The success of these robots in Japan has not only led to increased agricultural productivity but also provided a solution to the labour shortages that have long plagued the agricultural sector [12]. As a result, Japan's experience with automated harvesting robots serves as a model for other countries looking to enhance their agricultural practices through technology.

In Indonesia, there is growing interest in adopting modern agricultural technologies, including automated harvesting robots, particularly among students at Bogor Agricultural University (IPB) [13]. The Agricultural Engineering and Environmental Management (TRPL) Study Program at IPB is increasingly becoming a hub for students eager to explore and implement new technologies to improve agricultural welfare in the country [14]. This interest is fueled by the recognition that modern technology is essential for addressing the challenges faced by Indonesia's agricultural sector, such as labour shortages, inefficient practices, and low productivity [15]. As future leaders in agriculture, TRPL IPB students are keen to learn from international examples like Japan and apply similar innovations to enhance the sustainability and productivity of agriculture in Indonesia.

This study seeks to investigate the impact of Japan's use of automated harvesting robots on the interest of TRPL IPB students in advancing agricultural welfare in Indonesia [16]. By examining the students' knowledge and perception of this technology, the research aims to understand how exposure to successful implementations abroad influences their aspirations and plans for the future of agriculture in their own country [17]. The findings of this study are expected to provide valuable insights into how modern agricultural technologies can be integrated into the Indonesian context, potentially guiding future educational and policy efforts to support the adoption of such innovations.

Ultimately, understanding the influence of Japan's technological advancements on the interests and perspectives of TRPL IPB students is crucial for shaping the future of agriculture in Indonesia [18]. As the agricultural sector continues to evolve, driven by technological innovations, future professionals must be equipped with the knowledge and skills necessary to harness these advancements effectively [19]. This research highlights the importance of international technological transfer. It underscores the need for a proactive approach to integrating modern agricultural technologies to ensure the sustainability and welfare of agriculture in Indonesia [20]. Through strategic education and collaboration, Indonesia can replicate the successes seen in Japan, fostering a more resilient and prosperous agricultural sector.

II. METHOD

A. Research Design

This study employs a quantitative method involving various variables for analysis. The variables include both independent and dependent variables. The influence of Automated Harvest Robots in Japan serves as the independent variable, acting as a trigger for the dependent variable, which is the interest of TRPL IPB University students. Data was collected using a questionnaire that applies the Likert scale as a criterion for measuring data. The Likert scale is a rating method used to evaluate the perceptions, attitudes, or opinions of individuals or groups regarding an event [21].

The designed questionnaire uses positive questions to assess positive aspects, with a rating scale ranging from 5 to 1. These questions are crafted to provide a clear picture of students' perceptions and interests in automated harvesting robots in Japan. The questionnaire was administered to 30 respondents, who are students from the 58th, 59th, and 60th cohorts of the Software Engineering Technology (TRPL) program at the Vocational School of IPB University. Data collection was conducted on May 11, 2024, with the questionnaires distributed through the WhatsApp groups of each cohort. The results from this questionnaire will be used to analyze the extent to which automated harvesting robots in Japan influence the interest of TRPL IPB University students, as well as to evaluate their potential contribution to agricultural innovation in Indonesia. This research employs analytical methods which include:

1. Correlation Coefficient Test

This study utilizes the Pearson Product Moment correlation coefficient (PPM) test to evaluate the relationship between independent variables (X) and dependent variables (Y) in interval and ratio data 22]. The correlation coefficient (R) has a range of values between -1 and 1, depicting the strength of the relationship between the variables. Additionally, positive (+) or negative (-) values indicate the direction of the relationship. Table 1 illustrates the interpretation of the R-value.

Table 1 Interpretation of the Range of R-Values

Interval of Coefficients	Degree of Association
0,80 – 1,000	Very Strong
0,60 – 0,799	Strong
0,40 – 0,599	Moderate
0,20 – 0,399	Weak
0,00 – 0,199	Very Weak

2. Simple Linear Regression Test

Regression analysis can be employed to investigate the relationship between the dependent variable Y and the independent variable X. The main focus is to estimate Y's value based on X's existing value [23]. Simple linear regression analysis is a fundamental approach involving a single independent variable X. It aims to evaluate the extent of association and correlation between the dependent and independent variables [9]. The following is the formula of the model used:

$$\mathbf{Y = a + bX + \varepsilon}$$

3. Coefficient of Determination (R^2) Test and T-Test

The coefficient of determination (R^2) provides an overview of how well the model explains the variation in the response variable. It evaluates how much the independent variables influence the dependent variable [24]. The T-test evaluates the influence of the independent variable on the dependent variable. If the calculated T-value meets or exceeds the critical value from the T-distribution table, it indicates that the independent variable significantly affects the dependent variable [25].

B. The Relationship between Variables

There is a relationship between service quality, customer satisfaction, and loyalty. Adequate service quality can lead to customer satisfaction, subsequently enhancing the perception of service quality. When the received service meets or exceeds customer expectations, it is considered high quality and satisfying. Conversely, if customers perceive the service as inadequate or failing to meet expectations, it may be deemed low quality and unsatisfactory [26]. Therefore, users will feel satisfied if a system fails to achieve the expected effectiveness. However, when the system successfully meets expectations, it creates high user satisfaction. Satisfied users are more likely to continue using the system and provide positive feedback.

User satisfaction is closely related to service quality. High levels of user satisfaction indicate that the perceived quality of the service meets or exceeds expectations. To enhance user satisfaction, system designers must be able to deliver and implement high-quality services to their users as consumers. Figure 1 is an illustration of the relationship between these variables.

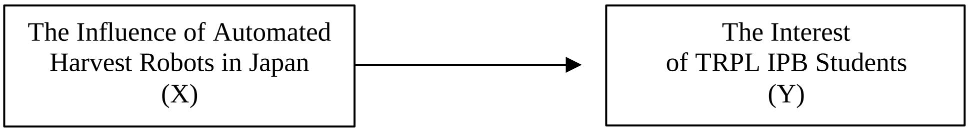

Figure 1 Research Conceptual Framework

When TRPL IPB University students see that Automated Harvesting Robots significantly improve agricultural productivity and efficiency, their interest in this technology will increase. This heightened interest can translate into a desire to learn more about these robots, leading to their implementation in Indonesian agriculture. As students become more satisfied with the performance and benefits of these robots, their willingness to engage with and promote this technology will grow.

III. RESULTS AND DISCUSSION

Based on the data obtained from the respondents, information on their characteristics is presented. These characteristics are classified by gender and type of respondent. Table 2 highlights the characteristics by gender, while Table 3 illustrates the characteristics by respondent type.

Table 2 Characteristics of Respondents by Gender

No	Gender	Number of Respondents	Percentage
1	Male	13	43%
2	Female	17	57%
	Total	**30**	**100%**

Source: Data processed from the questionnaire results

The data presents the gender distribution of a group of 30 respondents, highlighting the participation rates of males and females in the survey. Out of the total respondents, 13 individuals are male, constituting 43% of the sample. In contrast, 17 individuals are female, representing 57% of the total respondents. This indicates a more significant female representation in the survey, with women making up the majority of participants. The nearly balanced yet slightly skewed distribution suggests that the survey results may reflect perspectives that are more influenced by the female respondents. Indeed, this data provides a clear view of the gender composition, which could be essential for understanding the dynamics and potential biases within the survey outcomes.

Table 3 Characteristics of Respondents by Respondent Type

No	Respondent Type (Cohort)	Number of Respondents	Percentage
1	58	22	66%
2	59	5	15%
3	60	3	9%
	Total	**30**	**100%**

Source: Data processed from questionnaire results

The data in Table 3 outlines the characteristics of respondents by cohort type, illustrating the distribution of 30 participants across three different cohorts. The majority of respondents, 66% (22 individuals), belong to Cohort 58, indicating a strong representation from this group. Cohort 59 comprises 15% of the respondents, with 5 individuals participating. Cohort 60 is the smallest group, with only 3 respondents, making up 9% of the total. This distribution suggests that Cohort 58 had the highest level of engagement in the survey, significantly outweighing the participation rates of the other two cohorts. The data provides insight into the representation of each cohort in the survey, which may influence the overall findings based on the predominant input from Cohort 58.

This study involved 30 respondents, 13 men and 17 women. In the research related to automated harvest robots as a tool for Solving agricultural problems, to evaluate the relationship between the tool's effect and the interest of TRPL students, the analysis was carried out with statistical calculations using IBM SPSS Statistics 25.

Table 4 Validity Test Results

Indicator	RCalculated	RTable	α (5%)	Conclusion
P1	0.390	0,388	0,05	**Valid**
P2	0.776			
P3	0.420			
P4	0.533			
P5	0.522			
P6	0.716			
P7	0.599			
P8	0.737			
P9	0.729			

Source: Data processed from questionnaire results

Table 4 presents the validity test results for a set of indicators, showing the comparison between the calculated correlation coefficients (RCalculated) and the critical value from the table (RTable) at a 5% significance level ($\alpha = 0.05$). The critical RTable value is 0.388. For Indicator P1, the RCalculated value is 0.390, slightly above the RTable value, leading to the conclusion that this indicator is valid. Although the RTable value is not listed for the other indicators (P2 through P9), the implication is that their RCalculated values are compared against the same RTable value. All the RCalculated values for these indicators (ranging from 0.420 to 0.776) exceed the RTable threshold, suggesting that all these indicators are valid as well. This table confirms the reliability of the indicators used, as they all meet the validity criteria at the 5% significance level.

Table 5 shows the results of reliability testing, with a Cronbach's Alpha value of 0.783 for a set of 9 questions. This value indicates a solid level of internal consistency, suggesting that the questions are reliable in measuring the intended constructs. The Cronbach's Alpha above 0.7 confirms that the survey items are consistent and dependable for further analysis.

Table 5 Reliability Testing Results

Reliability Statistics	
Nilai Cronbach's Alpha	Questions
.783	9

Source: Data analyzed using SPSS

In this context, the Cronbach's Alpha value of 0.783 suggests a strong internal consistency among the 9 questions, meaning that they are likely to produce similar results under consistent conditions. This high level of reliability implies that the survey questions are well-constructed and dependable for capturing the intended information. The analysis, conducted using SPSS, further supports the validity of the survey, ensuring that the data collected can be used with confidence in subsequent analysis and interpretation.

The following analysis was conducted to show the effect of the tool (X) on student interest (Y) in the Automated Harvesting Robot Solving Agriculture Problems tool. The following are the results of data processing:

Table 6 Regression Calculation Results

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	2.214	0.883		2.507	0.019
	Influence (X)	0.300	0.216	0.258	1.388	0.177

Source: Data analyzed using SPSS

Based on Table 5, a regression equation is formed:

$$Y = a + Bx$$

$$Y = 2{,}214 + 0{,}300X$$

The coefficient of the regression equation above has a meaning: the regression coefficient value for the constant of 2.214 indicates that when the effectiveness variable of the tool influence is fixed or zero, student interest is expected to increase by 2.214 units. While the coefficient value of the tool influence variable is 0.300, each one-unit increase in the variable is associated with an increase in student interest of around 0.300 units, or equivalent to 30%.

Table 7 Analysis of the Coefficient of Determination

Model Summary				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.258[a]	.067	.032	.967

Source: Data analyzed using SPSS

In Table 6, the R-value is 0.258, which illustrates a reasonably strong correlation between the variable influence of the tool (X) and the student interest variable (Y) because it is in the range of 0.40 - 0.599. This analysis shows R2 of 0.067, which means that the variable influence of the tool (X) contributes 6.7% to the student interest variable (Y), while other variables influence 93.3%.

Table 8. T-Test Results

Independent Variable	T-Value	Significance
Influence of the tool (X)	1,388	0,177

Source: Data analyzed using SPSS

Based on Table 7, a Thitung of 1.388 was obtained, while the corresponding Ttabel value with a significance level of 0.05 and 28 degrees of freedom is 2.048. Since Thitung (1.388) < Ttabel (2.048), there is not enough evidence to reject the null hypothesis (H0) at the 0.05 level of significance. Therefore, it cannot be concluded that the influence of tools (X) significantly affects student interest (Y) at the 0.05 level of significance.

IV. Conclusion

From the results of the analysis and discussion, it was found that the correlation value (R) between tool influence and student interest was 0.258. The coefficient of determination (R2) showed 0.067, indicating that the regression model used can explain about 6.7% of the variation in tool influence. In comparison, the remaining 93.3% is influenced by other factors not included in the model. The equation Y = 2.214 + 0.300 X was formed through simple linear regression, with a constant value (a) of 2.214 and a coefficient value (b) of 0.300. The T-test results show rejection of the null hypothesis (H0) and acceptance of the alternative hypothesis (H1) because the value of Thitung (1.388) is greater than the value of T-table (2.048). Indeed, findings from the study indicate a strong relationship between the influence of the tool (X) on student interest (Y), which is supported by a positive correlation pattern. This illustrates that the adoption of Automated Harvesting Robot tool technology can have a significant impact on increasing students' interest in agriculture. This potential highlights the importance of technology implementation in creating student interest and engagement in the agricultural sector, which can contribute to increased prosperity and innovation in the agricultural industry.

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