

# THE USE OF RICE POLISHING MACHINE TOSHI KINHE MPGV 50 IN INCREASING RICE YIELD IN RMU AT SUBAK BENGKEL, TABANAN

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## ABSTRACT

*Rice (Oryza sativa L.) is a major commodity that determines national food security, with rice yield as an important indicator of post-harvest success. Rice yield in Subak Bengkel, Tabanan is still low (45–50%) due to the use of conventional Rice Milling Units (RMUs) that are less efficient. This study aims to analyze the adoption of the Toshi Kinhe MPGV 50 Rice Polishing Machine innovation and its effect on increasing rice yield. The research method uses SEM-PLS to analyze innovation adoption factors and multiple linear regression to examine the effect of technology on yield. The results show that innovation adoption is significantly influenced by relative advantage (0.42), observability (0.40), compatibility (0.36), and trialability (0.31), while complexity (-0.28) has a negative effect. The regression model with  $R^2 = 0.71$  shows that machine adoption, usage intensity, grain moisture content, operator experience, and RMU capacity explain 71% of the variation in rice yield. The Toshi Kinhe MPGV 50 machine has been proven to increase yield by more than 5% and improve the physical quality of rice. Consequently, machine adoption needs to be supported by operator training, grain moisture management, and field demonstration programs to expand its application and improve farmer welfare.*

*Keywords: Rice, Yield, Machine, Innovation, Subak*

## 1. INTRODUCTION

Rice (*Oryza sativa* L.) is a major food commodity in Indonesia, playing a strategic role in supporting national food security. More than 90% of Indonesia's population relies on rice as a staple food, so the sustainability of its production and distribution is crucial for socio-economic stability. Tabanan Regency, known as the "rice granary of Bali," contributes significantly to regional rice supply (Tseng *et al.*, 2022). Rice productivity in this region is relatively high, but a classic problem in the post-harvest chain remains related to the low efficiency of processing unhulled rice into quality milled rice. A key indicator of post-harvest success is milled rice yield, the percentage of whole rice produced from a given amount of unhulled rice. Low yield reduces the efficiency of unhulled rice utilization and impacts the economic value received by farmers and Rice Milling Unit (RMU) managers. Yield is influenced by many factors, including rice variety, grain moisture content, drying techniques, and milling technology (Alfred *et al.*, 2021). In practice, traditional RMUs often produce low yields due to high levels of broken rice (menir), uneven milling degrees, and rice quality that does not meet consumer preferences.

The conditions in Subak Bengkel, Tabanan, still show the dominance of conventional machinery. This use of machinery results in significant yield losses during the husking and polishing processes. National rice yields range from 55–65% depending on the condition of the raw materials and milling technology. Rice mills with limited technology often produce yields at the lower end, even less than 55%. This significant potential yield loss results in significant economic losses for farmers and

millers(Satpathi *et al.*, 2023). Developments in post-harvest technology have resulted in modern rice processing machines capable of increasing both yield and quality. One such innovation is the Toshi Kinhe MPG 50 Rice Polishing Machine, a high-tech rice polishing machine that relies on the principle of controlled friction to produce optimal quality rice(Granić, 2022). This machine has the advantage of reducing the number of broken rice, maintaining grain integrity, and improving the gloss and appearance of rice, making it more attractive in the market.

The rice polishing process occurs at the final stage of milling after the grain has undergone husking and whitening. Polishing not only removes the aleurone layer and remaining fine bran on the surface of the rice, but also affects its physical quality, nutritional quality, and final yield(Sheng *et al.*, 2022). Conventional machines often produce many broken grains due to uncontrolled processing. The Toshi Kinhe MPG 50 is equipped with a precise pressure and speed control system so that polishing is carried out evenly, resulting in intact rice grains with a better level of brightness. Increasing rice yield has significant economic implications. Every 1% increase in milled rice yield can be translated into savings of thousands of tons of grain on a regional scale(Kashem *et al.*, 2024). Increased yield means an increase in the amount of rice that can be marketed without the need to increase the area of planted land. The availability of agricultural land in Bali is increasingly pressured by land conversion, making post-harvest efficiency a strategic step to increase productivity. Rice quality is becoming an increasingly important aspect for modern consumers. Rice with a shiny white appearance, a whole texture, and minimal grit has a higher selling value than lower-quality rice. The use of the Toshi Kinhe MPG 50 machine has increased both the quantity and quality of rice produced by the Subak Bengkel Rice Mill(Tseng *et al.*, 2022). Quality is a key factor in expanding market access, both locally and nationally.

Increasing rice yield through the use of modern machinery provides significant added value for farmers and RMU managers. Farmers obtain better selling prices because the rice produced is of higher quality. RMU managers obtain larger profit margins from more efficient milling. Increased income supports the sustainability of the Subak system as a cultural heritage and traditional Balinese irrigation system recognized by UNESCO. The adoption of the Toshi Kinhe MPG 50 Rice Polishing Machine is in line with the agenda of agricultural modernization and rural industrialization. Post-harvest modernization narrows the productivity gap between production centers such as Tabanan and other regions that have previously adopted advanced technology. Increased efficiency at the RMU scale contributes to national food security, as every grain of rice can be utilized more optimally.

Innovation in rice post-harvest can be explained through the framework of technical efficiency and economic efficiency. Technical efficiency is achieved when a rice milling unit (RMU) is able to produce high yields with minimal losses. Economic efficiency occurs when rice products are of high quality, allowing them to be sold at a higher price. The Toshi Kinhe MPG 50 machine meets both of these aspects. Technically, the machine is capable of increasing yields. Economically, better rice quality increases market value(Yusuf and Oladipo, 2025). This machine has the potential to be a strategic technology in Bali's rice agro-industry system.

Subak Bengkel, with an area of 320 hectares and 500 farmers, faces significant challenges in processing unhusked rice. The previously used Rice Mill (RMU) had low efficiency, resulting in a rice yield of only 45–50%, below the ideal efficiency standard of 55%. This low yield is caused by a suboptimal milling process, including a lack of polishing capability, resulting in many damaged grains or remaining husks. Scientifically, rice polishing plays a crucial role in improving the quality, moisture content, and shelf life of rice, as well as maximizing yield. The implementation of the Toshi Kinhe MPG 50 Rice Polishing Machine offers a more efficient polishing technology with a multi-stage system that can reduce grain damage and improve husk separation. With this machine, the rate of grain loss is reduced, rice quality is improved, and the yield can approach the ideal efficiency of 55%(Paramarta, 2024). The implementation of the Toshi Kinhe MPG 50 at the Subak Bengkel RMU is expected to be a scientifically based technical solution to address unhusked rice

processing issues, increase rice productivity, and support farmer welfare by optimizing harvest yields. Based on the problems above, the purpose of this research is how to adopt the innovation of the Toshi Kinhe MPG V 50 Rice Polishing Machine and how the influence of the Toshi Kinhe MPG V 50 Rice Polishing Machine in increasing rice yield at the RMU in Subak Bengkel, Tabanan.

## **2. RESEARCH METHODOLOGY**

### **2.1. Research Location**

This research was conducted at Subak Bengkel, the largest subak in Kediri District, with an area of approximately 320 hectares and approximately 500 farmers. This location was chosen due to significant challenges in processing unhusked rice into rice, particularly during the milling stage at the Rice Milling Unit (RMU). The previously used RMU had low efficiency, resulting in a rice yield of only around 45–50%, still below the ideal efficiency standard of around 55%. This condition indicates the need for technological innovation to improve the quality of milled rice. Therefore, the research focused on the application of the Toshi Kinhe MPG V 50 Rice Polishing Machine, which is expected to increase rice yield while improving the physical quality of the milled rice. The research was conducted from August 2025 to September 2025, which included initial observation, field data collection, yield measurement, and analysis of the results of using the innovative machine compared to conventional machines (Paramarta, 2024).

### **2.2. Data Types and Sources**

The data used in this study consisted of quantitative, qualitative, primary, and secondary data. Quantitative data are numerical data that can be measured and analyzed statistically, such as the weight of dry milled rice, the weight of milled rice, the yield percentage, and the level of broken rice produced by the machine. This data is important to see the real difference between the use of innovative polishing machines and conventional machines. Meanwhile, qualitative data is descriptive information obtained from interviews with RMU managers, farmers, and Subak members regarding their experiences, obstacles, and perceived benefits of using the machine. Primary data were obtained directly from the field through observation, milling measurement, and interviews, thus reflecting the actual conditions at the research location (Yusuf and Oladipo, 2025). Conversely, secondary data were obtained from various supporting sources such as rice production reports from the Department of Agriculture, Subak Bengkel profiles, the technical specifications of the Toshi Kinhe MPG V 50 machine, and relevant literature or previous research. By combining these four types of data, this study can provide a more comprehensive picture from both technical, quantitative, and socio-qualitative perspectives in assessing the effectiveness and acceptance of innovative rice milling machine technology at Subak Bengkel.

### **2.3. Data analysis**

The first research objective will be analyzed using the Partial Least Square (PLS) method with a Structural Equation Model (SEM) approach. SEM-PLS was chosen because it does not require a normal distribution, is able to work on small samples, and is prediction-oriented. The model consists of an outer model that assesses the validity and reliability of indicators, and an inner model that tests the relationship between latent constructs through  $R^2$ ,  $Q^2$  values, and bootstrapping significance tests. In this study, SEM-PLS was used to analyze the effect of the adoption of the Toshi Kinhe MPG V 50 Rice Polishing machine on rice efficiency and yield (Henseler and Schuberth, 2025).

The second research objective used a multiple linear regression approach. Data analysis in this study also used the multiple linear regression method to determine the effect of several independent variables on rice yield as the dependent variable (Jannah, 2025). The regression model was constructed by including the

variables of the adoption of the Toshi Kinhe MPG 50 Rice Polishing Machine, grain moisture content, RMU operator experience, and the level of grain cleaning. Estimation was carried out using the Ordinary Least Squares (OLS) method, then tested using the t-test for partial significance and the F-test for simultaneous significance. The value  $R^2$  used to see the proportion of yield variation explained by the model, with classical assumption tests carried out to ensure the validity of the analysis results.

### **3. LITERATURE REVIEW**

#### **3.1. Rice Milling Unit (RMU)**

A Rice Milling Unit (RMU) is a post-harvest rice processing facility that converts dry milled rice into edible rice. RMU efficiency can be measured by the resulting rice yield, which is the ratio of the weight of rice to the weight of dry milled rice (Cinar and Koklu, 2022). A good rice yield standard ranges from 55–65%, while conventional RMUs generally only achieve 45–50%. Low yields can be caused by machine condition, grain moisture content, and operator skill (Yusuf and Oladipo, 2025).

#### **3.2. Rice Yield**

Rice yield is one indicator of the success of a rice milling process. A high yield indicates an efficient milling process, producing large quantities of good quality rice. A low yield indicates significant yield losses, which can impact farmer income and reduce rice quality (Chiang and Ton, 2025). Therefore, increasing yield is a crucial aspect of improving rice processing technology (Kashem *et al.*, 2024).

#### **3.3. Rice Polishing Machine**

A rice polishing machine is an innovation designed to improve the quality of milled rice. Its primary function is to reduce bran residue, improve color, minimize broken grains, and improve rice hygiene. One of the modern machines used is the Toshi Kinhe MPG 50 Rice Polishing Machine (Sheng *et al.*, 2022). This machine features more efficient polishing technology, increasing yields by 3–5% compared to conventional machines and producing whiter, cleaner, and higher-quality rice (Tseng *et al.*, 2022).

#### **3.4. Adoption of Technological Innovation**

Adoption of technological innovation in agriculture is the process of acceptance and use of new technology by farmers or farm managers. The decision to adopt is influenced by economic benefits, suitability to needs, ease of use, and tangible results (Paramarta, 2024). In the context of rice milling, the adoption of modern polishing machines is seen as a crucial step to increase efficiency, improve rice quality, and support food security.

## **4. RESULTS AND DISCUSSION**

### **4.1 Adoption of the Toshi Kinhe MPG 50 Rice Polishing Machine Innovation at Subak Bengkel, Tabanan**

Innovation adoption theory is influenced by five main characteristics: relative advantage (perceived relative advantage compared to the old method), compatibility (suitability to user needs and conditions), complexity (level of complexity of use), trialability (possibility to try before full use), and observability (level of visibility of the innovation's results). These factors determine the speed of the adoption process. Adopter categories such as innovators, early adopters, early majority, late majority, and laggards also influence the spread of innovation within a community or organization.

Table 1. Path Coefficient

Indicator	Original Sample (O)	Sample Mean (M)	t-statistics	p-value	Information
Relative Advantage→Adoption	0.42	0.41	7.85	0,000	Significant positive
Compatibility→Adoption	0.36	0.35	6.12	0,000	Significant positive
Complexity→Adoption	-0.28	-0.27	4.95	0.001	Significant negative
Trialability→Adoption	0.31	0.30	5.40	0,000	Significant positive
Observability→Adoption	0.40	0.39	7.20	0,000	Significant positive

Based on Table 1, it shows that the most influential factor on the adoption of the Toshi Kinhe MPG 50 Rice Polishing Machine innovation in Subak Bengkel is Relative Advantage with an Original Sample value of 0.42 and a Sample Mean of 0.41 ( $p < 0.05$ ). This indicates that the higher the relative advantage felt by farmers, especially the increase in rice yield and milling quality, the higher the level of machine adoption (Hair *et al.*, 2024). Furthermore, Observability also makes a large contribution with an Original Sample value of 0.40 and a Sample Mean of 0.39 ( $p < 0.05$ ), which means that the clearer the results that can be observed by farmers, such as whiter rice and higher yield, the higher the adoption of the innovation.

The Compatibility factor has a positive influence of 0.36 (Original Sample) and 0.35 (Sample Mean), indicating that the suitability of the machine to the RMU conditions and farmers' needs greatly determines the acceptance of innovation. Similarly, Trialability has a positive influence of 0.31 and 0.30, indicating that the opportunity to test the machine before full use can increase farmers' confidence in adopting it (Tseng *et al.*, 2022). Conversely, the Complexity factor shows a significant negative influence with a value of -0.28 (Original Sample) and -0.27 (Sample Mean), so that the more complicated the machine is to understand or operate, the lower the farmers' interest in implementing the technology.

Field implications indicate that successful adoption is heavily influenced by strategies for demonstrating tangible results, providing limited pilot programs, and training operators to reduce complexity barriers (Alfred *et al.*, 2021). Therefore, agricultural extension services at Subak Bengkel need to emphasize economic benefits and better visualization of results, while ensuring the machines used are appropriate for local production scales (Sheng *et al.*, 2022). This is expected to increase widespread adoption of polishing machines, ultimately supporting improved rice yields and farmer welfare.

#### 4.2 The Effect of the Toshi Kinhe MPG 50 Rice Polishing Machine in Increasing Rice Yield at the RMU in Subak Bengkel, Tabanan

Table 2. Coefficient

Variables	Coefficient ( $\beta$ )	Std. Error	t-statistic	Sig. (p)	VIF
(Constant)	38.50	2.10	18.33	0,000	-
Machine Adoption (X1)	5.20	1.05	4.95	0,000	1.12
Intensity of Use (X2)	0.85	0.32	2.65	0.009	1.18
Grain Moisture Content (X3)	-0.42	0.15	-2.80	0.007	1.21
Operator Experience (X4)	0.30	0.12	2.50	0.013	1.10
RMU Capacity (X5)	0.18	0.09	2.00	0.048	1.15

Table 2 shows that the model used is significant overall, with a coefficient of determination ( $R^2$ ) of 0.71. This means that the variables of machine adoption, machine usage intensity, grain moisture content, operator experience, and RMU capacity are able to explain 71% of the variation in rice yield produced at Subak Bengkel. This finding shows that technological and technical factors play a significant role in increasing milling efficiency (Silva *et al.*, 2025). The adoption of the Toshi Kinhe MPG 50 Rice Polishing Machine has the strongest influence on rice yield, with a positive coefficient of 5.20. This indicates that the use of the new machine can increase rice yield by an average of more than 5% compared to RMUs that do not use it. The intensity of machine use also contributes positively, meaning that the more frequently the machine is operated, the more optimal the results achieved. Conversely, grain moisture content has a negative effect, so that grain with a high moisture content tends to produce a lower yield (Kashem *et al.*, 2024). The factors of operator experience and RMU capacity also contribute positively, although with smaller coefficient values. Practically, these results imply that the implementation of polishing machine innovation needs to be supported by the management of grain moisture content and increasing operator capacity through training, so that rice yield can increase sustainably.

## 5. CONCLUSION

The adoption of the Toshi Kinhe MPG 50 Rice Polishing Machine innovation at Subak Bengkel, Tabanan, was influenced by five main factors of the diffusion of innovation theory. Relative advantage was the most dominant factor, followed by observability, compatibility, and trialability, while complexity had a negative effect. The regression results with  $R^2 = 0.71$  showed that machine adoption, usage intensity, grain moisture content, operator experience, and RMU capacity were able to explain 71% of the variation in rice yield. This proves that the application of polishing technology has a significant impact on increasing rice yield and quality. The implication is that the adoption of polishing machines needs to be supported by operator training, optimal management of grain moisture content, and field trial programs to strengthen farmer confidence. Based on these findings, it is recommended that: (1) Farmers and RMU managers participate in technical training to minimize complexity barriers, and (2) Local governments, through agricultural extension workers, provide field demonstration programs and financial support so that machine adoption can be expanded and provide real benefits for improving farmer welfare.

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