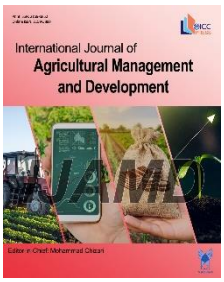

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Decision Making for Purchasing Certified Rice Seeds in Rainfed Paddy Fields

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Original Research

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Abstract

Certified seeds enhance rice yields, improve farmers' livelihoods, and strengthen food security. However, their use still requires improvement, particularly in rainfed paddy fields, which face challenges within the agricultural business system. This study investigates farmers' characteristics and perceptions regarding their decision-making processes when purchasing certified rice seeds. The research was conducted in Purworejo Regency in 2024 using a quantitative methodology. Data were collected through structured interviews with a questionnaire. The initial population was unknown; therefore, the sample size was determined following Cohen's (1992) approach. With seven research variables, a significance level of 5%, and an R^2 value of 0.50, the minimum required sample size was 137 individuals. Purposive sampling was used to select 137 farmers who manage rainfed paddy fields, cultivate rice, and have experience using certified rice seeds. Logistic regression analysis was employed to identify the primary factors influencing farmers' decisions to purchase certified rice seeds. The results indicated that socioeconomic conditions, including age and land area, significantly affect farmers' decisions. Efforts to increase rice production through the use of certified rice seeds in rainfed paddy fields should focus on younger farmers (≤44 years) with land that meets the economic scale (≥0.52 ha). Additionally, farmers' perceptions of seed attributes significantly influence their decisions to buy certified rice seeds, particularly regarding growth potential and harvesting age. To encourage farmers to purchase certified rice seeds from a technical perspective, it is essential to provide seeds with high growth potential and a short harvest age.

Keywords: Certified rice seeds; farmer characteristics; perceptions, purchase decisions; rainfed paddy fields

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INTRODUCTION

Rainfed paddy fields are essential for enhancing national food security, particularly given the conversion of irrigated paddy fields and the increasing risks posed by climate change (Hayashi et al., 2018). In Indonesia, rainfed paddy fields cover 1.4 million ha, with relatively low productivity ranging from 1.8 to 4.5 tons/ha. In Central Java, 272,364 ha of rainfed paddy fields yield 1.8 to 3.1 tons/ha and hold significant potential for improvement (Viandari et al., 2022). As part of its strategic food security policy, the Indonesian government aims to optimize low-productivity land, such as rainfed paddy fields. One reason for the low productivity of rainfed paddy fields is the limited use of certified rice seeds. In 2020, adoption reached only about 60%, while the national target for 2024 is 80% (Nuswardhani, 2019; Ministry of Agriculture, 2020).

Farmers' decisions to purchase certified seeds are closely linked to availability, accessibility, and utilization (McGuire & Sperling, 2016). In Indonesia, this concept is described by the term "7 rights," which include accuracy in type, quantity, quality, time, location, price, and service. Prior studies have highlighted factors influencing farmers' decisions regarding the use of certified rice seeds, including the availability of information and farmers' capabilities (Mardiharini et al., 2023), perceptions of risks and benefits of certified rice varieties (Baitia & Kurniyanto, 2024), and household socioeconomic conditions (Nasirudin et al., 2020). However, these studies were conducted in irrigated paddy fields or within the broader context of agriculture and have not explicitly addressed the behavior of farmers in rainfed paddy fields, who face greater risks due to climate variability and limited resources.

Research gap highlights the need for a comprehensive study on the socioeconomic factors and farmers' perceptions of seed attributes that influence their decisions to purchase certified seeds in rainfed paddy fields. This study aims to analyze how farmers in these fields make seed purchase decisions by weighing potential benefits and risks, using the Expected Utility Theory (EUT) approach. The novelty of this research lies in the unique application of EUT within the context of rainfed paddy fields and the integration of two key elements—socioeconomic conditions and perceptions of seed attributes—that have rarely been examined together. The study's results are expected to provide an empirical foundation for developing targeted strategies to enhance the adoption of certified seeds in rainfed paddy fields.

Theoretical framework

Certified rice seeds are crucial for enhancing productivity in rainfed paddy fields. They are produced and quality-controlled in accordance with operational standards, offering advantages in viability, genetic purity, growth capacity, and resistance to pests and diseases (Misra et al., 2023; Barteit, 2023). Their use has been shown to increase yields by 5–20% and provide yield stability under uncertain environmental conditions (Afzal et al., 2019; Nuruzzaman et al., 2023). Nevertheless, many farmers still rely on saved seeds or local markets, underscoring the need to better understand the dynamics behind the decision to purchase certified rice seeds.

A purchase decision is defined as the process of selecting among two or more alternatives, involving the evaluation of product attributes and expected outcomes (Song et al., 2021). The Expected Utility Theory (EUT) provides a relevant framework for analyzing farmer behavior under the risk-laden conditions of rainfed paddy fields. This theory posits that individuals choose the alternative offering the highest expected utility, not solely financial gain (Savchuk, 2022). Risk preference is therefore a significant determinant: risk-averse farmers tend to select certified seeds to minimize losses from crop uncertainty, while risk-neutral or risk-seeking farmers may opt for cheaper local seeds despite higher risks (Patil & Veettil, 2024).

To fully understand the decision to purchase certified seeds, it is essential to consider factors related to farmers' socioeconomic conditions, particularly individual and household characteristics that influence purchasing power and perceptions of technological innovations (Epriliyanti & Murti, 2021; Novotny et al., 2024). Socioeconomic conditions include age, job diversification, land ownership, and contributions to household income. Age is a key characteristic that reflects farmers' decision-making ability. Following World Health Organization (WHO) criteria, respondents are classified as young (≤44 years) or old (≥45 years).

Diversification of farming is an important livelihood strategy for small-scale farmers in low-income countries (Anang & Apedo, 2023). Farm size reflects a household's economic strength, access to inputs, economies of scale, and risk-bearing capacity (Jones-Garcia & Krishna, 2021). Farmers with larger landholdings generally have more financial resources, better access to credit, and greater influence over certified seed purchases (Lestari, 2023). The minimum land area necessary for achieving economies of scale is ≥0.52 ha (Susilowati & Maulana, 2020). Household income contributions from various sources are considered significant when they exceed 50% (Sakinah et al., 2021; Ellis et al., 2023; Arifin et al., 2021).
Based on the literature, this study proposes the following hypothesis:

H1: Farmers' socioeconomic conditions affect their decisions to purchase certified rice seeds.

The overall indicators of farmers' socioeconomic conditions used in this study are presented in Table 1.

In addition to socioeconomic conditions, farmers' perceptions of technological innovations also influence decision-making. Perception has been defined in several ways: as a psychological process obtained through the five senses and processed into positive or negative views that affect actions (Erin & Maharani, 2018); as the process of receiving, organizing, and interpreting stimuli to create understanding (Suyadi & Aisyah, 2021); and as the translation of stimuli into human senses (DiNuzzo et al., 2022). The outcomes of perception are reflected in responses and behavior (Kenyon & Sen, 2015).

Factors influencing perception can be internal—such as feelings, attitudes, desires or expectations, attention, learning, values, and needs—or external, including family background, information, and knowledge (Norawati et al., 2024).
Farmers' perceptions of seeds play a crucial role in the dissemination and adoption of certified rice seeds. Previous studies have highlighted multiple factors shaping farmers' perceptions, such as yield potential, selling price, demographic characteristics, seed quality, production costs, consumption preferences, access to technology, institutional programs, market factors, and environmental conditions (McGuire & Sperling, 2016; Ahmed et al., 2016; Louwaars & Manicad, 2022). This study defines perception as

Table 1. Socio-economic Condition of Farmer

Farmer characteristics	Criteria	Description	Source
Age (years)	≤44 ≥45	Youn Ol	WHO (2013)
Job diversification	Got Don't have	occupation Only as a	Iraoya & Isinika (2022); Sarker (2021)
Area	≥0.52 ha ≤0.51 ha	Economies of scale Non-economic scale area	Susilowati & Maulana (2012) Mahmud (2019)

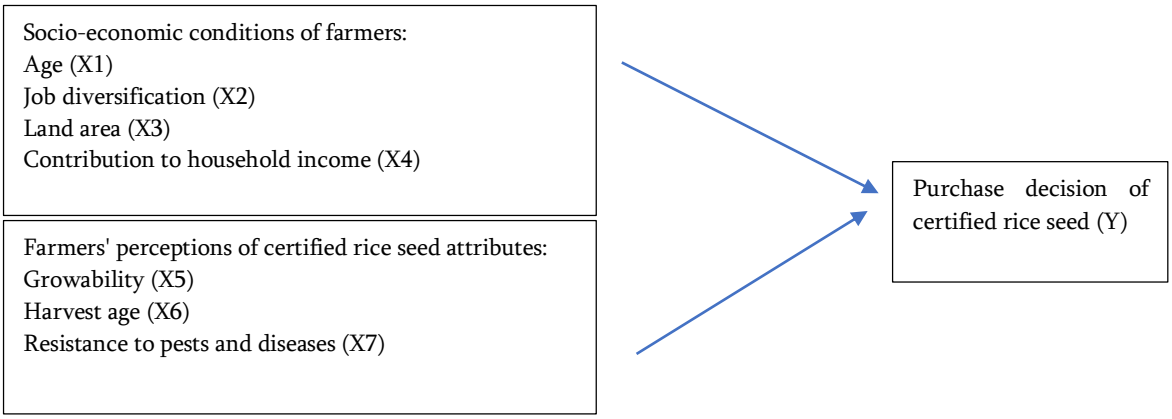

Figure 1. Research Model

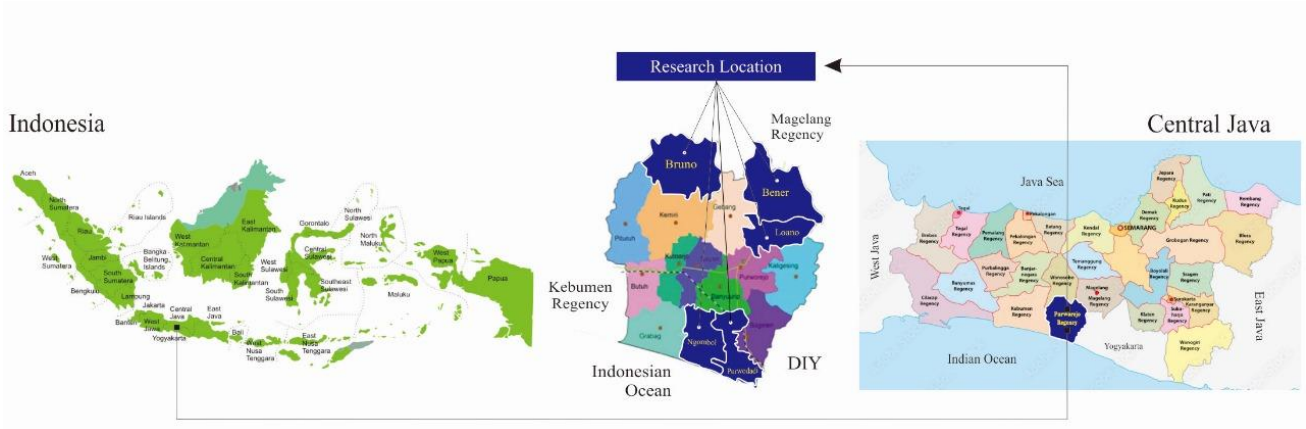

Figure 2. Map of the Research Location

farmers' responses during the sensing process, which may be positive or negative and directly influence decision-making. The seed attributes considered in this study include growth power, harvest age, and resistance to pests and diseases, based on the findings of Syamsiah et al. (2015), Andayani & Watiah (2016), and Epriliyanti & Murty (2021). Based on this literature, the study proposes the following hypothesis:

H2: Farmers' perceptions of seed attributes affect their decisions to purchase certified rice seeds.

The model built in this study is shown in Figure 1.

METHODOLOGY

Study area

The research was conducted in 2024 in rainfed paddy fields located in Purworejo District, Central Java, Indonesia, at 109°47′28″–110°8′20″ E and 7°32′–7°54′ S (Figure 2). Rainfed paddy fields hold significant potential to enhance rice production; however, certified rice seeds have not yet been optimally utilized. This site was selected to examine and address the specific challenges farmers encounter in improving production and household income, which in turn contributes to strengthening food security in Indonesia.

Collection and analysis

Data were collected through a survey using a structured questionnaire. The target population consisted of farmers who manage rainfed paddy fields, cultivate rice, and have experience using certified rice seeds. Five sub-districts with extensive rainfed paddy fields were selected as research sites. Initial information on eligible

farmers was obtained from Agricultural Extension Officers in each sub-district and further expanded using snowball sampling. The sample size was determined based on statistical power and effect size considerations, following Cohen (1992). With seven variables, a significance level of 5%, and an R^2 value of 0.50, the minimum required sample size was 137. Accordingly, this study involved 137 respondents representing the seven variables analyzed.

Data collected included farmers' socioeconomic conditions, perceptions of certified rice seed attributes, and purchasing decisions. Socioeconomic conditions covered age, job diversification, land size, and the contribution of rainfed paddy fields to household income. Farmers' perceptions focused on seed attributes, including growth power, harvest age, and resistance to pests and diseases (Table 2). Logistic regression analysis was employed to examine the influence of independent variables on the dependent variable, using SPSS 25 software.

RESULTS AND DISCUSSION

Decision-making for purchasing rice seeds

Seed systems in developing countries, including Indonesia, are classified into informal and formal systems. Together, these systems create a complementary seed ecosystem that meets the needs of smallholder farmers (Sperling & Almekinders, 2022).Farmers primarily obtain seeds through informal exchanges of their own harvest, though they also have access to seeds from the formal system (Coomes et al., 2015; Acevedo et al., 2020). Formal seed acquisition is often facilitated through government or private programs aimed at improving food security; however, most farmers purchase seeds through cash transactions from local markets or seed traders (Sperling & Almekinders, 2022).

Logistic regression analysis was employed to identify factors influencing farmers' decisions to purchase certified rice seeds. The model's goodness of fit was evaluated using the Hosmer–Lemeshow test, log-likelihood values, and pseudo R^2 statistics. The Hosmer–Lemeshow test assesses the overall logistic significance of the regression model.

The Hosmer–Lemeshow test yielded a chi-square value of 2.026 with a significance level of 0.980 (>0.05), indicating that the logistic regression model is appropriate and suitable for analysis. When only the constant is included, the log-likelihood value is 182.849; with the inclusion of independent variables, it decreases to 32.671, demonstrating that the variables improve the model's ability to distinguish between farmers who choose to purchase certified rice seeds and those who do not.

The Cox and Snell R^2 and Nagelkerke R^2 values are 0.666 and 0.904, respectively, indicating that the model explains 66.6% to 90.4% of the variation, with the remainder influenced by factors outside the model. Table 4 presents the logistic regression results. Independent variables with a Wald test p-value (Sig) < 0.05 have a significant partial effect on the dependent variable, while those with Sig > 0.05 do not.

Among farmer characteristics, age (X1) and land area (X3) have Wald Sig < 0.05, indicating a significant influence, whereas job diversification (X2) and income contribution from rainfed paddy fields (X4) have Sig > 0.05, showing no significant effect. Regarding farmers' perceptions of seed attributes, growth power (X5) and harvest age (X6) have Wald Sig < 0.05, significantly affecting decisions, whereas resistance to pests and diseases (X7) has Sig > 0.05, suggesting minimal impact on the choice to purchase certified rice seeds.

The influence of farmers' socioeconomic conditions on the decision to purchase rice seeds

Farmers' socioeconomic conditions significantly influence the decision to purchase certified rice seeds. Logistic regression results show that age (P = 0.018) and land area (P = 0.047) are particularly impactful at the 5% confidence level. The Exp(B) value (odds ratio) for age is 19.894 (95% CI: 1.665–237.771), indicating that age increases the likelihood of purchasing certified rice seeds by 19.894%. This aligns with Epriliyanti and Murti (2021), who reported that farmers' age affects seed purchase decisions. The Exp(B) value for land area is 29.263 (95% CI: 1.052–813.681), suggesting that larger landholdings increase the probability of purchasing certified rice seeds by 29.263%. Farmers with larger holdings tend to buy certified seeds due to greater economic incentives, better access to capital, and more visible benefits compared with smaller landholdings.

Among the respondents, 51.01% are classified as old farmers, while 48.99% are young. Older farmers generally have more farming experience and are more cautious in spending on certified seeds, whereas younger farmers are typically more receptive to innovations and new technologies (Nurlaela et al., 2021). To encourage adoption, especially among older farmers, the following strategies are recommended: i) conducting regular extension programs highlighting the benefits of certified rice seeds; ii) organizing field demonstrations across different growing seasons; and iii) providing training on effective cultivation using certified seeds. These approaches should be persuasive, as farmers generally aim to maximize profits by focusing on cost efficiency, product quality, attention to detail, and high yields (Wasono et al., 2024).

Most (92.70%) rainfed paddy fields (X3) are relatively small (≤0.51 ha). The limited size of these fields presents a major challenge to achieving agricultural efficiency and productivity. Small landholdings restrict farmers' ability to adopt modern agricultural technologies and innovations, including certified rice seeds. This situation often results from inheritance practices that divide land among family members, leading to land fragmentation a common feature of subsistence farming systems in many developing countries, where small plots are passed down through generations (Ndip et al., 2023).

Rainfed paddy fields have specific characteristics that demand high efficiency in input use, as they rely primarily on rainfall for irrigation.
This dependence can cause significant yield fluctuations due to climate variability and unpredictable rainfall patterns. In this context, certified rice seeds are crucial because they are developed and tested to possess superior qualities, including strong growth potential, resilience to environmental challenges, and higher yield potential than locally sourced seeds, thereby supporting increased rice production and food security (Qadir et al., 2024).

According to Article 1 of the Minister of Agrarian and Spatial Planning/Head of BPN Regulation No. 12/2019 on Land Consolidation, rainfed paddy fields that do not meet economies of scale need to be consolidated. When managed by professional institutions under corporate farming, land consolidation can provide farmers with training and support, enabling them to become more self-reliant in farming (Dalimunthe & Kurnia, 2018). Corporate-managed land consolidation has been shown to increase production and farm income (Ekowati et al., 2020).

Job diversification (X2) and income contributions from rainfed paddy fields (X4) do not significantly influence the decision to purchase certified rice seeds. While additional income from non-agricultural work can theoretically enhance purchasing power for certified seeds, in the context of rainfed paddy fields, such income is often allocated to household needs, children's education, and non-agricultural investments rather than agricultural inputs.

This aligns with Lindkvist and Ida (2019), who found that farmers with other jobs tend to focus less on maximizing agricultural yields and prefer cheaper or more readily available seeds.

Job diversification is practiced by 77.37% of farmers, reflecting that income from rainfed rice farming alone is insufficient to meet household needs. It also reflects the seasonal nature of farming, with free time available between planting and harvest periods. Off-farm work includes construction labor, small trading, and livestock enterprises (cattle, goats/sheep, and/or chickens). While job diversification can increase household income and potentially encourage the purchase of certified seeds, it may also reduce farmers' attention to farming activities, as off-farm jobs provide immediate daily income, whereas returns from rainfed paddy fields are realized only every 3–4 months per harvest season.

For most farmers (83.22%), income from rainfed paddy field rice farming contributes ≤51% to household income. This is consistent with Ghani, R.S., et al. (2023), who reported contributions ranging from 0.7% to 22.85%. The low income contribution (<51%) makes farmers more risk-averse, leading them to limit expenditures on certified rice seeds.

The influence of farmers' perceptions on the decision to purchase certified rice seeds

Farmers' perceptions of certified rice seed attributes significantly influence their decisions to purchase these seeds. Logistic regression results show that growth power (X5, P = 0.00) and harvest age (X6, $p < 0.01$) are significant at the 5% confidence level. The Exp(B) value for growth power is 38.624, indicating that a positive perception of growth power increases the likelihood of purchasing certified seeds by 38.624%. High germination rates ensure successful sprouting and optimal plant populations, directly affecting crop yields. The Exp(B) value for harvest age is 17.049, suggesting that perceptions of harvest age raise the probability of purchasing certified seeds by 17.049%.

Harvest age influences planting intensity and cropping patterns. Farmers generally prefer the Ciherang and IR 64 varieties because their short growing period (110–125 days) allows for two harvests in rainfed paddy fields. These findings align with Ardiansyah et al. (2022) and Rohmatul & Kurniyanto (2024), who report that farmers favor shorter harvest times due to reduced maintenance and lower risk, even though shorter plant age does not always correlate with higher productivity.

According to Ministerial Decree No. 335 of 2015, the minimum germination standard for rice seeds is 80%. In this study, 65.70% of farmers agreed or strongly agreed that certified seeds have high growth potential (Figure 3), highlighting germination as a critical factor. Poor growth power increases labor and seed requirements, a finding consistent with Murshid et al. (2019), who note that good germination allows farmers to better determine seed quantity.

Regarding harvest age, 71.5% of farmers agreed or strongly agreed with the suitability of certified seeds (Figure 3). Water availability is a major challenge in rainfed paddy fields, making short-duration crops preferable to mitigate drought risk during the dry season. This aligns with Viandari et al. (2022), indicating a preference for short-duration rice varieties to ensure sustainability. Recommended short-duration varieties (approximately 114 days) for rainfed paddy fields include Inpari 38 Rainfed, Inpari 39 Rainfed, and Inpari 41 Rainfed (Department of Agriculture and Food Security, Padang Pariaman Regency, 2024).

Resistance to pests and diseases (X7) does not significantly influence farmers' decisions to purchase certified rice seeds. Farmers tend to prioritize factors that directly impact yields and profits, while pest resistance is less immediately measurable. They often manage agricultural risks, including plant diseases, through other means, such as pesticides or control techniques. When a disease occurs sporadically or causes minimal damage, it is not considered a major factor in seed selection.

Moreover, farmers may prefer high-yielding varieties even if they are susceptible to diseases, provided the economic benefits outweigh potential losses (Michelson et al., 2023). Thus, while disease resistance is important, it does not significantly affect the decision to purchase certified rice seeds.

Table 2. Variables of Socio-Economic Conditions

Variables	Description
Age (X1)	≤44 years (young) = 1 ≥45 years (old). = 0
Job diversification X2)	Has a job outside of farming = 1 No work outside the farm =0
Area of rain-fed paddy fields (X3)	≥0.52 ha =1 ≤0.51 ha =0
Income contribution from rainfed paddy fields (X4)	≥50 % =1 ≤51 % =0
Perception of growth power (X5)	1 = strongly disagree 2= disagree 3= less agree 4= agree 5= strongly agree
Perception of harvest age (X6)	
Perception of pest and disease resistance (X7)	
Purchase of certified rice seeds (Y)	Buying = 1 No purchase = 0

Table 3. Fit of Logistic Regression Mod

Hosmer-Lemeshow			Model Statisics			
Chi-square	df	Sig	-2log likelihood only with constant	-2log likelihood only with predictors	Cox & Snell $R^{(2}$	Nagelkerke R^2
2.026	8	0.980	182.849	32.671	0.666	0.904

Table 4. Comprehensive Findings from Logistic Regression Analysis

Variables in the Equation								
							95% C.I. for EXP(B)	
		B	S.E.	Wald	df	Sig.	Exp(B)	Lower	Upper
Step 1[a]	X1	2.990	1.266	5.581	1	.018	19.894	1.665	237.771
	X2	.398	1.249	.102	1	.750	1.490	.129	17.237
	X3	3.376	1.697	3.960	1	.047	29.263	1.052	813.681
	X4	2.495	1.576	2.508	1	.113	12.125	.553	266.023
	X5	3.654	.979	13.927	1	.000	38.624	5.668	263.182
	X6	2.836	.841	11.369	1	.001	17.049	3.279	88.648
	X7	-.650	.939	.480	1	.488	.522	.083	3.286
	Constant	-29.380	7.751	14.366	1	.000	.000		

Table 5. Socio-Economic Conditions of Farmers in the Research Location

Variables	Criteria	Description	Number (%)
Age(year)	≤44 ≥45	Young Old	48.99 51.01
Side job	Got Don't have	Non-farmer occupation Only as a	77.37 22.63
Area of paddy fields	≥0.52 ha ≤0.51 ha	Economies of scale Non-economic scale area	06.30 92.70

Table 6. Socio-Economic Conditions of Farmers in the Research Location

Variables	Criteria	Description	Number (%)
Income contribution from paddy fields	≥50 %	The role of rainfed paddy fields is very important for household income sources	16.78
	≤51 %	The role of rainfed paddy fields is less important for household income sources	83.22

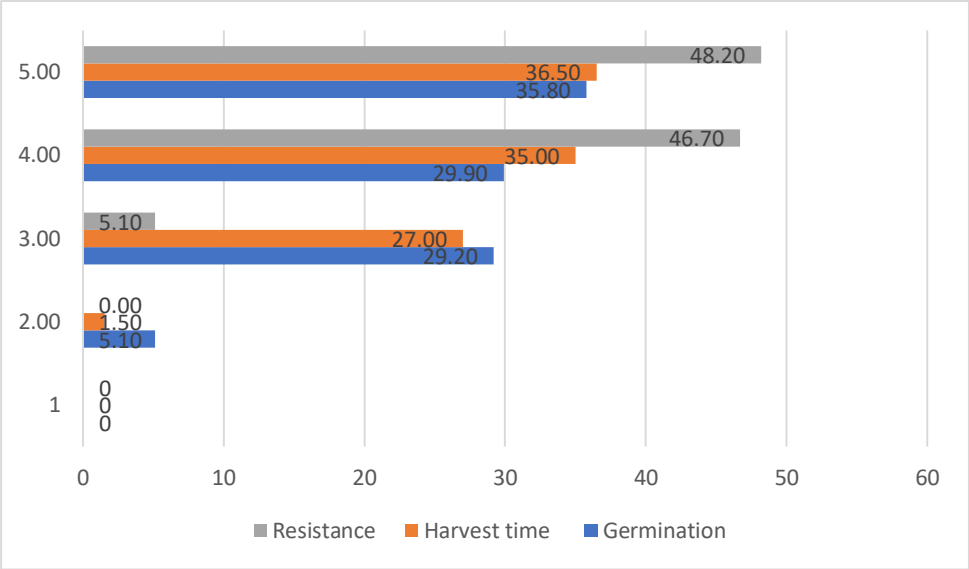

Figure 3. Farmers' Perceptions of Certified Rice Seed Attributes

CONCLUSIONS

Logistic regression analysis shows that farmers' characteristics, specifically age and land area, significantly influence the decision to purchase certified rice seeds. Younger farmers with larger rainfed paddy fields are more likely to buy certified seeds. In contrast, occupational diversification and the income contribution from rainfed paddy fields do not significantly affect this decision. Income from non-agricultural work is often directed toward household needs, children's education, or other investments rather than certified seeds. Low income contribution (<51%) makes farmers more risk-averse, leading them to reduce production costs by avoiding investments in certified seeds.

Perceptions of certified seed attributes that significantly influence purchasing decisions include growth power and harvest age. Higher growth power and shorter harvest age increase the likelihood of purchasing certified seeds. Although resistance to pests and diseases is important, it does not play a significant role, as farmers often manage agricultural risks, including diseases, through pesticides or other control techniques, reducing reliance on disease-resistant seeds.

POLICY IMPLICATIONS AND RECOMMENDATIONS

Younger farmers with larger landholdings are more receptive to innovations, making them key drivers of certified rice seed adoption in rainfed rice areas. Expanding the use of certified seeds can be achieved through a corporate farming approach professionally managed by younger farmers to achieve economies of scale and improve farming efficiency. Increased availability of certified seeds with shorter harvest periods and higher production potential is needed to replace existing varieties that have declined genetically in yield and pest resistance. Field demonstrations showcasing the benefits of certified seeds, including reduced pesticide use and lower long-term crop failure risk, can further encourage adoption.

Overall, the study's findings provide insights for policymakers to design inclusive and sustainable strategies for seed system resilience, supporting the Asta Cita of the President of the Republic of Indonesia. This is particularly relevant to the second goal, which emphasizes promoting food self-sufficiency by increasing productivity on less productive lands, such as rainfed paddy fields.

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Authors Contribution
Authors designed the research, collected and analyzed the data, and wrote the manuscript. All authors have read and approved the final version of the manuscript.

Availability of data and materials
The data that support the findings of this study are available from the corresponding author, upon reasonable request.

Conflict of interests
The authors declare that there are no financial, personal, or professional conflicts of interest that could have influenced the content or outcomes of this study.

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