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RESEARCH ARTICLE

Communication Strategy in Supporting Adoption of Superior Rice Varieties: The Case of IPB 3S Rice Variety in Karawang, Indonesia

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ABSTRACT

Indonesia faces food security challenges owing to declining rice harvest areas, climate change, and dependence on rice imports. One proposed solution is the use of superior rice varieties, such as IPB 3S, which have the advantages of high productivity, saving fertilizer and water, and being resistant to pests and diseases. However, the adoption of this variety among farmers is still low because of marketing constraints, negative perceptions of rice quality, and limited access to seeds. This study aimed to formulate an innovation communication strategy that can accelerate the diffusion of the IPB 3S variety among farmers. This study employed a qualitative approach using the SWOT analysis method. Data were collected through in-depth interviews with stakeholders, focus group discussions (FGDs), and document analysis. The informants consisted of a variety of inventors, farmers, extension workers, middlemen, and related agencies. The results of the study indicate that IPB 3S has advantages in productivity and resource efficiency but faces obstacles in the form of low grain selling prices, negative perceptions of rice quality, and inadequate seed distribution. Effective communication strategies include increasing education through training and demfarms, strengthening seed distribution networks, promoting consumer confidence, and strategic partnerships with the government and farmer associations. This study emphasizes the importance of communication of innovation based on farmer needs and cross-stakeholder collaboration to overcome barriers to adoption. With an integrated strategy, the IPB 3S variety has great potential for increasing agricultural productivity and supporting national food security.

INTRODUCTION

Rice is a staple food in Indonesia, with a consumption rate of 114.6 kg per person per year, making it essential for daily nutrient absorption. Current demand for rice is 31.2 million tons, which is projected to grow as the population increases (Hibatullah *et al.* 2024). However, challenges such as a decrease in the area of rice harvest and the significant conversion of rice fields to non-harvest areas threaten food security. The area of rice harvest in 2024 is estimated to be around 10.05 million hectares, a decrease of 167.25 thousand hectares or 1.64 percent compared to the area of rice harvest in 2023 which was 10.21 million hectares (BPS 2024). In addition, low rice productivity and the threat of climate change are worsening. Climate change causes unpredictable weather patterns, increases the risk of crop failure, and worsens pest and plant disease. By 2024, Indonesia will have to import large amounts of rice to cover the shortfall in domestic production. The Central Statistics Agency (BPS) reported that Indonesia imported 3.48 million tons of rice from January to October

2024, with an import value of US$2.15 billion or equivalent to Rp34.19 trillion. Reliance on imports is a short-term solution to ensure food security and stabilize rice availability.

One long-term solution that is considered capable of overcoming this problem is to increase rice productivity using agricultural technology innovation. Advances in agricultural technology are essential to increase rice productivity and ensure food security (Naidu *et al.* 2024; Pasupuleti 2024). One promising innovation is the superior rice variety IPB 3S developed by Bogor Agricultural University (IPB University). The IPB 3S variety has various advantages, including high productivity, disease resistance, and rice quality, which suit the preferences of Indonesians (LKST-IPB 2019). This variety has obtained a decree since 2012 and has been introduced to the community through various programs, including demonstration farms (demfarms).

Demonstration of farming serves as an effective agricultural extension method by showcasing tangible results to rice farmers, thereby facilitating the adoption of modern technologies and practices. In East Java, Indonesia, technological modernization through demonstration farming has significantly improved the economic performance of rice farming. Farmers showed a high acceptance of new technologies that were compatible with local culture and norms (Mariyono dan Kuntariningsih 2024). In Tamil Nadu, India, the introduction of drought-tolerant rice varieties through field demonstrations resulted in a 7.75% increase in yield and additional income for farmers, motivating them to adopt new varieties (Ganapathy *et al.* 2024). In Madhya Pradesh, India, front-line demonstrations using improved production technologies led to a 23.80% increase in grain yield compared to traditional practices, highlighting the potential of demonstration farming to bridge the yield gap (Bisen *et al.* 2024). Despite its benefits, challenges, such as inadequate machinery and equipment for demonstration, can hamper the effectiveness of extension services. Addressing these issues is critical to the successful implementation of demonstration farming (Danjumah *et al.* 2024).

The IPB 3S demfarm program in 2015, implemented in Karawang Regency, West Java, Indonesia, gave very promising results. Karawang Regency, known as one of the national rice barns, was chosen as a strategic location for the implementation of this agricultural technology. The results of the demfarm showed that the IPB 3S variety had a higher productivity than the Ciherang rice variety commonly planted by local farmers. In addition, the IPB 3S variety showed good resistance to pests and diseases, as well as good adaptation to local environmental conditions.

However, despite the positive results of the IPB 3S demonstration farm, farmers did not adopt this variety in the following planting season. This raises a big question and indicates obstacles to the process of innovation diffusion. As explained by Rogers (2003), the diffusion of innovation is a process in which an idea, practice, or object that is considered new is accepted and adopted by individuals or certain social groups through communication channels in a social system. In the context of IPB 3S, the main obstacles in innovation diffusion include farmers' lack of understanding of the advantages of this variety, gaps in communication channels, and social, economic, and cultural challenges that influence farmers' adoption decisions,

Innovation communication is the process of disseminating information, ideas, or new technologies (innovations) to individuals, groups, or organizations to introduce, influence, or encourage innovation. Innovation communication is often used to explain how innovation spreads in society through various communication channels, both directly and indirectly. Research on agricultural technology innovation communication has been conducted widely in several countries. This is because the role of innovation communication is necessary, especially in agriculture, which is important in serving the increasing demand for food and jobs; thus, the adoption of new technologies becomes important (Dissanayake *et al.* 2022). Effective innovation communication depends on understanding the four pillars of the communication design logic: source, situation, intention, and impact. These elements help tailor messages to different stakeholders by considering their backgrounds and intentions, which can significantly affect their acceptance of and reaction to innovation results (Ludwig *et al.* 2024).

Innovation communication plays an important role in the innovation diffusion process (Guidolin & Manfredi 2023; Narożna dan Adamska 2024). Innovation diffusion is the process of spreading new ideas or technologies through certain communication channels over a certain period of time among members of a social system (Rogers 2003). The main purpose of innovation communication is to encourage behavioral change, namely the adoption of innovation by individuals or target groups (Kee

2017). The effectiveness of innovation communication is influenced by the quality of the information source, the message delivered, the communication channel used, and the characteristics of the recipient of the information (Pfeffermann dan Hülsmann 2011; Bruhn dan Ahlers 2013).

This study aimed to formulate an innovation communication strategy that can accelerate the diffusion of IPB 3S varieties among farmers. The approach used in this study involved a SWOT analysis. From the results of the SWOT analysis, an innovation communication strategy was formulated by considering the needs and characteristics of farmers as end users of the innovation.

MATERIALS AND METHODS

This study uses a qualitative approach because the main objective of this study is mostly exploratory, so it is very suitable for qualitative methods (Corbin dan Strauss 2014; Neuman 2014; Bloomberg dan Volpe 2018). Data collection was carried out for three months, from September to November 2024. The collected data consisted of primary and secondary data. Primary data were obtained through a series of in-depth interviews with stakeholders as key informants, namely, the inventor of the IPB 3S rice variety, IPB University as the copyright holder of the IPB 3S rice variety, farmers, heads of farmer groups, seed companies that produce IPB 3S rice seeds, Chairperson of the Indonesian Seed Bank and Agricultural Technology Association (AB2TI), Field Agricultural Extension Workers (PPL), Karawang Regency Agriculture Service, middlemen (buyers of rice harvests), rice milling companies, and owners of farmer kiosks (shops that sell agricultural production tools and facilities). Primary data were also obtained through closed-group discussions (FGD) with stakeholders. Secondary data were collected from various studies and documents related to IPB 3S, PPL notes, and documents reporting the results of the implementation of the demfarm.

In-depth interviews with stakeholders who were not FGD participants were conducted in several locations using interview guidelines that had been developed and created previously to guide the interview process. FDG participants were parties who were involved and actively participated when the IPB 3S demonstration farm was implemented. There were 20 FGD participants, consisting of farmers, PPL, middlemen, farmer kiosk owners, rice mill entrepreneurs, and representatives from the local Agriculture Service. Before the FGD, all participants were reminded of the IPB 3S rice demonstration farm implemented in 2015. This was intended so that participants could remember more comprehensively so that they could express their experiences correctly and honestly.

SWOT analysis is a strategic planning tool used to identify and evaluate the internal and external factors that may affect an organization, project, or business activity. This involves assessing four main components: Strengths, Weaknesses, Opportunities, and Threats. This method is widely used to formulate strategies by leveraging strengths, addressing weaknesses, exploiting opportunities, and mitigating threats (Dalton 2019; Kumar C.R. dan K.B. 2023). The SWOT analysis framework provides a structured approach for organizing and analyzing the data collected from stakeholders. The framework is designed to answer specific research questions related to the internal and external factors that influence IPB 3S innovation adoption decisions.

Qualitative data analysis is a systematic process for understanding and interpreting non-numerical data such as interviews, observations, or documents. This process consists of the following stages.

1. Familiarization: This stage involves going through the data in depth by listening to the recordings, reading the transcripts several times, and reviewing the observation notes and summaries. The goal was to gain a comprehensive understanding of the interviews before breaking them down into sections.

2. Identifying Thematic Framework: The activity carried out at this stage is to identify themes by writing memos in the margins of the text and capturing short phrases, ideas, or concepts that emerge from the data. This process helps develop categories and form descriptive statements based on the research questions.

3. Indexing: Data were filtered, highlighted, and sorted to extract relevant submissions and make comparisons within and across cases. This stage focuses on managing the data by cutting and pasting similar quotes together, leading to data reduction.

4. Charting and triangulation: The data extraction results were reorganized according to the thematic content. This process involved taking data from the original context of the discussion

participants and organizing it based on a previously developed thematic framework. In addition, triangulation was performed to compare data obtained from the literature, informants, and participants in group discussions. Triangulation in social research is the process of using multiple methods to collect data on the same phenomenon. The goal is to increase the accuracy, validity, and understanding of the results of the analysis (Elorza et al. 2022; Meydan & Akkaş 2024).

5. Mapping and Interpretation: The final stage involves interpreting the data by understanding each submission and identifying the relationships and connections between data points. Criteria are established, such as the words used, context, internal consistency, frequency, specificity, intensity of comments, and big ideas, to guide the interpretation process.

RESULTS

A description of the results is presented in three main sections. First, a description of the results related to the IPB 3S variety of rice according to the inventor, namely the rice research team from IPB University, as the person who developed and discovered this variety. This inventor was represented by Prof. Dr. Hajrial Aswidinnoor, M.Sc., as the head of the research team for this variety. The next section describes the results based on the experiences of farmers participating in the IPB 3S demfarm. The last section describes the results of the SWOT analysis.

About IPB 3S Variety and Claims from Inventor

The IPB 3S rice variety is included in the category of new type rice (PTB) or *new plant type of rice* (NPT), and is not a hybrid rice variety developed by the IPB University rice breeder research team. New type rice is a rice was first developed in 1989 by the International Rice Research Institute (IRRI). The establishment of PTB aims to increase rice productivity and production. The design of the PTB architecture was triggered by conditions in which the productivity of new superior rice varieties (VUB) from the green revolution (RH) era has been optimal and has tended to decline. This decline occurs because the genetic potential of RH-type architectural varieties has been saturated. Examples of RH rice varieties that are widely known in Indonesia are IR36, IR64, Ciherang, and recently various national rice varieties with the name Inpari (Aswidinnoor 2024) (Aswidinnoor 2024).

The development of PTB varieties is a mainstay of hope for increasing the productivity of rice fields and national rice production. The potential productivity of PTB, whose architecture is a combination of Indica and Javanica rice, has increased by 20-30 percent compared to RH architectural varieties. The characteristics of PTB variety architecture are as follows: (1) fewer tillers but all productive; (2) dense panicles (more than 200 grains of full grain/panicle); (3) upright, thick, and dark green leaves; (4) long flag leaves; and (5) sturdy stems and deep roots. This architecture is also accompanied by the characteristics that varieties generally must have, namely resistance to pests and diseases (Aswidinnoor 2024).

The first national PTB variety was the Fatmawati variety released in 2003. This variety was produced by rice breeders of the Research and Development Agency of the Ministry of Agriculture. This variety showed a higher yield potential than the RH type varieties. However, this variety did not develop in the community because it still had several shortcomings, namely difficult grain shedding, poor rice quality, and a fairly high percentage of empty grain on the panicle (Aswidinnoor 2024).

Since 1997, a research team from the Department of Agronomy and Horticulture, Faculty of Agriculture, IPB University, has conducted research activities on the development of PTB and has produced 13 superior PTB variety innovations. These varieties include tidal swamp land, irrigated and rainfed rice fields, and dry land (gogo). One of these varieties is IPB 3S, which has received recognition from the government as a superior PTB variety and was released in 2012 through the Decree (SK) of the Minister of Agriculture Number: 1112 / Kpts / SR, 120 / 3/2012. A description of the IPB 3S rice variety, based on SK, is presented in Table 1.

Table 1 Description of IPB 3S rice variety

No,	Item		Information
1	Origin of crossbreeding	:	IPB 6-d-10s-1-1-1/Fatmawati
2	Group	:	Cere
3	Age of the plant	:	± 112 days
4	Plant Height	:	± 118 cm

5	Productive Offspring	:	7-11 sticks
6	Plant shape	:	Upright
7	Lying down	:	Stand
8	Hair loss	:	Currently
9	Grain shape	:	Medium
10	Grain Color	:	Straw Yellow
11	Number of grains per malai	:	300-350 grains
12	The average yield	:	7.04 tonnes/ha GHG
13	Potential yield	:	11.23 tonnes/ha GHG
14	Weight 1000 grains	:	± 28.2 g
15	Rice texture	:	Pulen
16	Amylose content	:	± 21.6 %
* Disease resistance: - Resistant to Tungro, - somewhat resistant to blast race 033, - somewhat resistant to HDB race II * Planting recommendations: Irrigated and rain-fed land, 0 – 600 m above sea level			

Source: Decree of the Minister of Agriculture Number: 1112/Kpts/SR,120/3/2012

According to the inventor, the advantages of IPB 3S, in addition to high productivity and resistance to pests and diseases, also include several other advantages. First, the IPB 3S rice variety is a fertilizer-efficient PTB, so it is highly profitable nationally. At a time when fertilizer availability is limited and fertilizer prices have increased sharply, saving on fertilizer use, such as nitrogen, is expected to help national savings. Dense panicles accompanied by increased plant height in IPB 3S make it possible to reduce the dosage of nitrogen fertilizer used. The recommendation for IPB 3S fertilization in Karawang Regency is 150 kg urea per hectare. The dosage of nitrogen fertilizer for the IPB 3S variety was lower than that recommended by the Ministry of Agriculture for the Karawang Regency area (250 kg of urea per hectare).

The next advantage is water saving; the IPB 3S variety produces well under conditions of not too much water or macak-macak. The production performance is very good for rainfed land with limited water conditions. The last advantage of IPB 3S is that it can mitigate methane gas emissions. Rice cultivation in rice fields has been in the world spotlight as a source of methane gas emissions which are greenhouse gases and contribute to increasing global temperatures and climate change (Thakur dan Solanki 2022; Rosenbaum 2024; Sharma *et al.* 2024). If the flooding period in rice cultivation in irrigated rice fields can be reduced, then, in addition to saving irrigation water use, the IPB 3S variety is expected to contribute to reducing methane gas emissions.

Farmers' Perception of IPB 3S Variety

In 2015, the IPB 3S variety demonstration program was implemented in Karawang, involving 215 participating farmers from six groups. This program was designed to introduce and test the advantages of the IPB 3S variety at the field level while providing direct learning to farmers about appropriate cultivation technology. Through intensive mentoring by the Team from IPB University and the local PPL, farmers were given guidance on IPB 3S cultivation techniques, starting from land preparation, planting, and post-harvest. The implementation of this demonstration program not only aims to increase harvest yields but also provides space for farmers to share experiences and build perceptions of the IPB 3S variety. These perceptions cover various aspects that are explained below.

After the implementation of the IPB 3S demonstration farm in Karawang, farmers, as participants, had various experiences and perceptions of this variety. Productivity is one of these main concerns. Farmers compared the harvest of IPB 3S with that of other varieties that they typically plant. According to farmers, in general, they experienced an increase in harvest yields, and the productivity of IPB 3S was higher than that of the rice they usually plant.

The farmers’ statements regarding the higher productivity of IPB 3S are supported by the data presented in Table 2. The table shows the productivity of the IPB 3S variety planted by 34 farmers participating in the demfarm in 2015, and the Ciherang variety as a comparison in 2014. The production of the two varieties was compared during the same planting season, that is, the dry season. Based on Table 2, the highest productivity of IPB 3S participants in the demfarm reached 12.40 tons/ha of GKP, while the Ciherang variety was 9.20 tons/ha. The average productivity of the IPB 3S variety was 8.09 tons/ha, higher than the Ciherang variety at 6.34 tons/ha.

Table 2 Real production of IPB 3S demfarm participants in 2015 and Ciherang variety in 2014

No,	Participant Name (Initials)	Land Area (ha)	Dry Season Production - 2014 (Ciherang Variety)		Dry Season Production - 2015 (IPB 3S Variety)	
			Production (tons) of GKP	Productivity (tons/ha) GKP	Production (tons) of GKP	Productivity (tons/ha) GKP
1	KRN	2	12.70	6.35	16.40	8.20
2	NNG	2	12.70	6.35	16.50	8.25
3	ITA	0.5	3.10	6.20	4.30	8.60
4	NRD (1)	2	14,60	7,30	18,50	9,25
5	SLM	1	6,50	6,50	8,10	8,10
6	SDH	1	7,50	7,50	9,40	9,40
7	DRP	1	7,40	7,40	9,30	9,30
8	SRH	2	12,60	6,30	14,90	7,45
9	STG	1	6,90	6,90	8,50	8,50
10	SRP	1	7,10	7,10	8,64	8,64
11	UJA	1	5,50	5,50	7,70	7,70
12	ACH	2	12,40	6,20	16,50	8,25
13	TRM	1	4,80	4,80	5,20	5,20
14	WYD	2	10,60	5,30	15,50	7,75
15	RSM	2	10,90	5,45	14,80	7,40
16	KSM	1	6,20	6,20	8,50	8,50
17	ENC	2	12,40	6,20	14,70	7,35
18	YMP	2	12,40	6,20	15,90	7,95
19	DTM	2	12,40	6,20	14,90	7,45
20	JAY	2	12,50	6,25	15,30	7,65
21	SRD	2	10,90	5,45	14,60	7,30
22	DRM	1	6,10	6,10	8,20	8,20
23	KDR	1	6,20	6,20	8,10	8,10
24	NRD (2)	2	14,20	7,10	18,30	9,15
25	HDI	2	14,40	7,20	16,80	8,40
26	DDI	2	10,90	5,45	14,20	7,10
27	ENT	1	5,20	5,20	7,10	7,10
28	CRS	2	12,50	6,25	14,10	7,05
29	SDK	1	6,60	6,60	8,20	8,20
30	AWR	1,5	10,50	7,00	13,70	9,13
31	UDN	1	5,10	5,10	6,40	6,40
32	DSK	1	5,40	5,40	6,90	6,90
33	KSN	0.5	4.60	9.20	6.2	12.40
34	ASP	0.5	3.50	7.00	4.4	8.80
Max		**2.00**		**9.20**		**12.40**
Min		**0.50**		**4.80**		**5.20**
Avg		**1.44**		**6.34**		**8.09**

Source: Processed fromAswidinnoor (2024)

In terms of grain and rice quality, the farmers highlighted two aspects. First, it is difficult for the IPB 3S variety of rice to fall off, so the harvest is not optimal. Farmers perform the threshing process manually using the "digebot" method (local language). With this method, there is still a lot of rice left in the straw, between 15-20 percent. The straw that still leaves a lot of rice is fought over among residents who work as rice collectors from the harvest. In Karawang, residents who have this profession are called "Pengeprik". The fight over the remaining harvest among the pengepriks sometimes causes conflict between them. The second factor is related to the quality of the IPB 3S variety of rice, where there is a white chalk-like part on the rice grains. According to farmers, this shows that the quality of the IPB 3S variety is not as good as that of the Ciherang variety.

Resistance to pests and diseases is another factor that influences farmers' perceptions. They recorded experiences during the planting period related to the level of pest and disease attacks and compared the resistance of IPB 3S with the varieties they usually plant. Based on their experience as demfarm participants, the IPB 3S variety is more resistant to pest and disease attacks than local varieties or other rice varieties. In addition, the ability of IPB 3S to adapt to the environment, such as its tolerance to drought, is important.

In terms of plant management, farmers consider the IPB 3S cultivation technique no different from the varieties they usually planted before. This makes it easy for farmers to find no difficulties, from soil cultivation, sowing, and nursery, and fertilization to plant maintenance. The experience of following the suggested cultivation guide during the demfarm helped most farmers understand more efficient techniques,

Regarding the economic aspect, the results of the IPB 3S demfarm showed significant challenges, even though this variety had productivity advantages. Farmers participating in the demfarm stated that the IPB 3S harvest was indeed higher than the rice varieties they usually planted. However, this advantage has not fully provided a positive impact on their economic benefits, because the selling price of IPB 3S grain is lower than that of other varieties.

One of the main obstacles faced by farmers is the difficulty of marketing IPB 3S harvests. Many middlemen or grain buyers are reluctant to buy IPB 3S rice, and if they do buy it, they set a lower price. This is because of middlemen's concerns about the selling power of IPB 3S rice in the market. As a new variety, middlemen admit that they do not want to speculate on buying rice at a high price because they do not yet know the consumer preferences for IPB 3S rice. This uncertainty makes middlemen tend to choose varieties that already have a stable market, so farmers have difficulty getting decent prices.

This creates a dilemma for farmers who have tried to increase productivity through IPB 3S demfarm. Although the harvest has increased, the economic value they obtain is not comparable, because of the low selling price. This situation indicates the need for further intervention, both in the form of promoting IPB 3S rice to consumers and opening wider market access to support the sustainability of this variety cultivation in the future.

Low selling prices are one of the main obstacles to the sustainability of farmers’ adoption of the IPB 3S variety in Karawang. This economic factor appears to be the dominant factor in farmers' decisions to continue or abandon this variety after the demfarm program. Farmers admit that they are reluctant to replant IPB 3S even though their productivity is high due to the uncertainty of the selling price and the difficulty of marketing the harvest. This is exacerbated by the lack of trust of middlemen in the IPB 3S rice market, which causes the price of this variety of grains to be uncompetitive compared with other varieties that are already established in the market.

In addition, there is limited access to IPB 3S rice seeds. Some farmers are interested in replanting this variety after the demfarm program, but they have difficulty obtaining seeds. In local markets, farmers do not provide IPB 3S seeds, so they have no choice but to return to the varieties that are already available. This situation shows that, in addition to marketing challenges, seed availability is also an important factor influencing the sustainability of IPB 3S variety adoption in Karawang.

This combination of marketing constraints and limited access to seeds highlights the need for concerted effort to support farmers. Interventions, such as promoting varieties to consumers, opening wider market networks, and developing adequate seed distribution systems, are essential. Without solutions to these issues, the potential of the IPB 3S variety to increase agricultural productivity in Karawang cannot be optimally utilized.

SWOT Analysis

Table 3 SWOT analysis matrix

Internal **External**	**Strength (S)** 1. High productivity compared to other varieties 2. Save fertilizer, especially nitrogen 3. Save water 4. Resistant to pests and diseases 5. Good adaptation to dry environments 6. Potential for mitigating methane gas emissions 7. The texture of sticky rice with an amylose content of 21.6%.	**Weakness (W)** 1. The selling price of paddy is lower 2. Hard to fall out 3. Unavailability of seeds in local markets 4. The quality of rice is less in demand 5. Variety promotion is still limited 6. There is no adequate logistical support or seed distribution.
Opportunity (O) 1. Huge market potential for resource-efficient varieties 2. Support from national programs to increase rice productivity 3. Can be a climate change mitigation strategy 4. Farmers' interest in new varieties with high productivity 5. Market potential for development of rainfed or marginal land	**SO Strategy** 1. Increase promotion as a fertilizer and water efficient variety 2. Developing distribution networks to reach rainfed land markets 3. Involving the government in climate change mitigation programs with IPB 3S varieties	**WO Strategy** 1. Expanding seed access through an organized distribution system 2. Providing training for farmers to optimize harvesting techniques 3. Conducting campaigns to consumers to increase confidence in the quality of rice
Threat (T) 1. Tough competition from other established varieties, such as Ciherang 2. Market limitations due to middlemen's distrust of the selling power of IPB 3S 3. Consumer preferences who are not yet familiar with IPB 3S 4. Risk of changes in government policy regarding fertilizer or seed distribution	**ST Strategy** 1. Enhancing cooperation with government and farmer associations to encourage adoption of IPB 3S varieties 2. Forming partnerships with farmer cooperatives to overcome market constraints 3. Develop certification or quality labels to increase marketability	**WT Strategy** 1. Developing digital-based marketing strategies, such as e-commerce platforms to sell paddy/rice 2. Initiating incentive programs for farmers and middlemen as early adopters 3. Providing variety catalogs and educational brochures to increase farmer and buyer confidence.

Source: Author's compilation (2024)

DISCUSSION

The IPB 3S variety has major advantages in terms of productivity, efficiency of resource use, such as fertilizer and water, and resistance to pests and diseases. This makes it a potential solution for improving the resource efficiency in the agricultural sector. Modern breeding programs focus on developing rice varieties with a higher yield potential. For example, the International Rice Research Institute (IRRI) has developed cultivars capable of producing up to 10-11 tons/ha under favorable conditions (Zelensky dan Zelenskaya 2024).

The adaptation of IPB 3S to marginal environments, such as rainfed land, opens opportunities to expand cropping areas to non-irrigated areas. This adaptation is critical to improve food security and agricultural productivity in areas with limited water resources. Development and application of drought-tolerant rice varieties, effective soil-water management practices, and integrated nutrient management strategies are key to achieving this goal. In addition to being productive, these varieties are environmentally friendly, with the potential to mitigate greenhouse gas emissions. Modifications to traditional crop management, such as adjusting organic and fertilizer inputs, can significantly reduce greenhouse gas emissions from rice fields. Selecting appropriate rice cultivars and optimizing soil and irrigation strategies are essential to minimize emissions (Yadav *et al.* 2024). The use of short-duration rice varieties has been shown to conserve water and reduce methane and nitrous oxide emissions, although they may produce less than long-duration varieties (Kaur *et al.* 2024). The IPB 3S variety, with a plant age of approximately 112 days, is included in short-duration rice varieties.

However, the constraint faced was a low market acceptance. Lower selling prices of paddy and negative perceptions of rice quality are barriers to widespread adoption by farmers. Farmers' attitudes towards new seed varieties are influenced by their perceived economic benefits. Low selling price of rice will give negative perception towards new superior seed varieties (Ellyta *et al.* 2024). Limited access to seeds in local markets is a multifaceted issue that requires urgent attention to improve the distribution systems. Inefficiencies in formal and informal seed distribution systems are evident, with challenges such as lack of timely supply, price fluctuations, and limited access to certified seeds. Addressing these issues involves strengthening logistics, increasing promotion, and providing education to change market perceptions (Minwagaw & Ejigu 2021).

IPB 3S has a great opportunity to meet the need for resource-efficient varieties amid rising fertilizer prices and climate change challenges. Government policies that support increasing national food productivity form a strategic foundation for the development of these varieties. In addition, farmers' interest in new, more productive varieties can be utilized with the appropriate promotional strategy. This strategy should focus on increasing farmers' knowledge, improving access to resources, and utilizing effective communication channels. By understanding the determinants of adoption and adjusting strategies, stakeholders can significantly increase the uptake of high-yielding rice varieties. Fellow farmers, researchers, and extension agents are considered to be effective channels for communicating agricultural innovations. Demonstrations and radio broadcasts also play an important role in promoting improved rice varieties (Lamptey *et al.* 2024). Conducting variety demonstrations can effectively influence farmers' attitudes and skills, encouraging adoption by showcasing the benefits of new varieties in a real-world environment (Ganapathy *et al.* 2024).

A significant threat to the IPB 3S variety comes from competition with established varieties, such as Ciherang, which has the advantage of market stability and consumer preference. Farmers' dependence on middlemen who are reluctant to take risks with new varieties complicates the marketing of IPB 3S. The results of research conducted by Ikhwan et al. (2024) showed that adoption of improved rice varieties is influenced by factors such as price, taste, and productivity. Despite the potential for increased productivity and profitability, middlemen, as intermediaries, may be hesitant to support these new improved rice varieties due to uncertainty in market acceptance and consumer preferences. Another risk is inconsistent government policies, especially regarding fertilizer subsidies and seed distribution.

IPB 3S is considered to be in accordance with the national need for resource-efficient and climate-adaptive varieties. These advantages support the government's goal of increasing agricultural productivity sustainably. However, weaknesses in distribution and market acceptance must be addressed through strong promotional strategies to increase consumer confidence. Water and fertilizer-saving innovations and the potential for mitigating methane emissions indicate that IPB 3S supports modern agricultural technology but requires the development of a supportive market ecosystem.

Support from the government and institutions, such as IPB University, is essential to expand the adoption of this variety. Policies that support seed distribution, promotion, and partnership with farmer associations will accelerate the penetration of IPB 3S into the market.

Comprehensive strategic steps are required to increase the adoption and success of IPB 3S, comprehensive strategic steps are needed. First, market promotion and education must be increased by involving the government, farmer associations, and media to expand awareness and build trust in IPB 3S. This aims to change market perception, which has been less than supportive. Furthermore, strengthening logistics is a top priority by developing an integrated seed distribution system to guarantee its availability in the local market. Product diversification is also important, for example, by providing quality certification and attractive branding according to consumer preferences, so that the attractiveness of this variety in the market can increase. Finally, strategic partnerships with farmer cooperatives and middlemen must be formed to reduce marketing risks and expand distribution networks. These steps are expected to encourage IPB 3S penetration into the market and maximize its potential advantages.

The SWOT analysis shows that the IPB 3S variety has great potential to increase agricultural productivity and support environmental sustainability. However, its success is highly dependent on its ability to overcome marketing and distribution weaknesses and face market competition. The IPB 3S can become a leading innovation in the Indonesian agricultural sector.

CONCLUSION

Innovation communication strategies to accelerate the diffusion of IPB 3S varieties among farmers should focus on an integrated educational approach, strengthening distribution, and market promotion. Education through intensive training and mentoring is needed to improve farmers' understanding of the advantages of this variety, such as high productivity, efficient use of fertilizers and water, and resistance to pests and diseases. Demonstrations, as a means of direct communication, need to be strengthened to display real results that encourage technology adoption. Distribution is strengthened by ensuring the availability of seeds in local markets through organized networks involving farmer cooperatives and middlemen. Meanwhile, market promotion must include campaigns to increase consumer confidence in the quality of IPB 3S rice as well as incentives for farmers and middlemen as early adopters. Support from the government and institutions such as IPB University is essential to encourage policies that support seed distribution, promotion, and strategic partnerships with farmer associations so that obstacles such as low market acceptance and seed access can be overcome effectively.

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