FARMER PERSPECTIVES ON RICE-FISH FARMING INNOVATION AND RISK IN SUNGAI REBO VILLAGE, BANYUASIN REGENCY

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ABSTRACT

Rice-fish farming (*Mina Padi*) has been promoted as an integrated agribusiness strategy in tidal lowland areas. This study analyzed farmer characteristics, perceived innovation attributes, farming risks, and organizational experience in Sungai Rebo Village, Banyuasin Regency. A descriptive quantitative approach was applied using survey data from 100 rice farmers, analyzed through a Likert-scale index and boxplot visualization. Compatibility (mean = 3.86), trialability (3.82), and observability (3.87) cluster at higher Likert values, while relative advantage is perceived as moderate (3.69). Complexity displays the widest dispersion and the lowest mean score (3.18), indicating heterogeneous technical understanding among farmers. Perceived farming risks are dominated by economic and biological factors, particularly price fluctuation (3.94), low productivity (3.85), and pest and disease attacks (3.74). In contrast, flooding and dyke construction costs are consistently rated as very low risk (mean = 1.00). Organizational experience is generally moderate to high, with organizational status recording the highest mean (4.17), whereas information and technology utilization show greater variability (3.49 and 3.44). These findings indicate that farmers' evaluations of rice–fish farming are primarily influenced by perceived manageability, economic uncertainty, and organizational capacity rather than environmental constraints alone.

Keywords: Farmer perception; farming risk; innovation attributes; *mina padi*; organizational experience

INTRODUCTION

Indonesia is an agrarian country with extensive agricultural resources that include tidal lowland ecosystems influenced by periodic water level fluctuations from rivers and coastal systems (Zahra *et al*., 2024). These tidal lowlands are widely distributed across major islands and represent a strategic land resource for agricultural development and food production (Hatta *et al*., 2023). The total area of tidal lowlands in Indonesia is estimated to be around 8.92 million ha, consisting of approximately 7.56 million ha of mineral soil and 1.36 million ha of peat soil, with about 2.80 million ha currently used for rice farming (Zahra *et al*., 2024). Despite this large potential area, the productive utilisation of tidal lowlands remains constrained by biophysical limitations and socio-economic challenges. These constraints indicate that agricultural development in tidal lowlands requires not only technical interventions but also an understanding of farmer-related factors (Fahmid *et al*., 2022).

Tidal lowland areas in South Sumatra Province are considered suitable for rice-based farming systems due to their water availability and land characteristics (Ratmini *et al*., 2024). Banyuasin Regency is one of the largest tidal lowland agricultural regions in South Sumatra, with a substantial proportion of land allocated to rice farming activities (Pujawati *et al*., 2020). However, cropping intensity and productivity in this region remain relatively low compared to their potential due to limitations in farm management and institutional support (Pujawati *et al*., 2020). Previous studies have emphasised that increasing agricultural productivity in tidal lowlands depends on integrated farming systems that can improve land use efficiency and farm income stability (Masganti *et al*., 2020). These conditions position Banyuasin Regency as a relevant agribusiness landscape for examining farmer responses to agricultural innovation.

Rice farming continues to be the primary livelihood for rural households in tidal lowland areas where alternative income sources are limited (Antoni *et al*., 2021). Smallholder farmers in these areas face production risks related to climate variability, pest pressure, and market price fluctuations, which directly affect household income stability (Touch *et al*., 2024). Integrated rice-fish farming systems known as *mina padi* have been introduced as an alternative agribusiness strategy to diversify farm output and enhance income resilience (Goswami *et al.*, 2024). *Mina padi* combines rice cultivation and fish farming within the same paddy field, allowing farmers to obtain multiple outputs in a single production cycle (Fatimah *et al.*, 2020). This system has been shown to improve land productivity and reduce dependence on external chemical inputs in several Asian countries (Yassi *et al.*, 2023).

Despite its agronomic and economic advantages, the adoption of *mina padi* remains uneven across regions, including tidal lowland areas in South Sumatra (Tondang *et al.*, 2025). Empirical evidence suggests that limited adoption is often related to farmer perceptions rather than land suitability or technical feasibility (Arsil *et al.*, 2022). Farmers tend to evaluate agricultural innovations based on perceived benefits, compatibility with existing practices and perceived risks associated with production and management changes (Romadi *et al*., 2025). Risk perception plays a critical role in integrated farming systems that require adjustments in water management and production planning (Romadi *et al*., 2025). Organisational experience and access to farmer groups also influence how information about innovations is shared and interpreted among farmers (Wahyuni *et al.*, 2022).

Sungai Rebo Village in Banyuasin Regency is a rice-producing area with physical conditions that support the potential development of rice-fish farming systems. Although *Mina padi* has been introduced through local government programs, farmer participation and continuity remain limited in this village (Wahyuni *et al.*, 2022). Previous research indicates that early stage adoption contexts require a clear understanding of farmer characteristics, perceptions of innovation attributes, perceived risks and organisational experience to support effective agribusiness interventions (Rogers, 2003). Understanding these factors is essential for aligning agricultural innovation programs with local socio-economic conditions and farmer decision-making processes (Pawera *et al.*, 2024). Therefore, this study aims to identify farmer characteristics, perceptions of rice-fish innovation attributes, perceived farming risks and organisational experience in Sungai Rebo Village, Banyuasin Regency.

RESEARCH METHOD

This study was conducted in Sungai Rebo Village Banyuasin Regency, South Sumatra Province, Indonesia, from August to September 2025. The study area was purposively selected because it represents a tidal lowland rice farming area that has been designated as a pilot location for rice-fish farming development programs (Fyka *et al.*, 2024). Sungai Rebo Village reflects an agribusiness setting where rice farming dominates household livelihoods and integrated farming innovations have been introduced with varying levels of farmer engagement (Wahyuni *et al.*, 2022). The study applied a quantitative approach with a descriptive research design to document farmers' perceptions of rice-fish innovation attributes, perceived farming risks and organizational experience (Creswell, 2014). This design was selected because the research objective focused on identification and profiling rather than testing causal relationships among variables (Sugiyono, 2019). Descriptive quantitative methods are commonly used in agribusiness studies to support policy and extension planning in early-stage innovation contexts (Kothari, 2004).

The study population consisted of all active rice farmers in Sungai Rebo Village who were potential or previous participants in rice-fish farming programs (Indahsari *et al*., 2025). Based on farmer group administrative records, the population comprised 392 farmers who met the inclusion criteria. Simple random sampling was applied to ensure equal selection probability for each farmer (Sugiyono, 2019). The sample size was determined using the Slovin formula with a 10% margin of error as presented in Equation 1 (Slovin, 1960).

$$n = \frac{N}{1 + Ne^2} \tag{1}$$

where n is the sample size, N is the population size, and e is the margin of error set at 0.10 (Slovin, 1960). The calculation resulted in a minimum sample of approximately eighty respondents, which was increased to one hundred respondents to improve representativeness (Sugiyono, 2019).

Primary data were collected through face-to-face interviews using a structured questionnaire administered to selected farmers (Kothari, 2004). The questionnaire was designed to capture quantitative information on farmer characteristics, innovation perceptions, perceived risks, and organisational experience related to rice-fish farming systems (Rogers, 2003). Secondary data were obtained from government reports, statistical publications, scientific journals and institutional documents to support contextual interpretation of agribusiness conditions in the study area (Sugiyono, 2019).

The research instrument consisted of closed-ended questions measured using nominal ratio and Likert scale formats depending on the variable type (Likert, 1932). Farmer characteristics included age, education, landholding size, household size, income, gender and farming experience as core agribusiness attributes (Wahyuni *et al.*, 2022). Innovation attributes were measured based on relative advantage, compatibility, complexity, trialability and observability following diffusion of innovation theory (Rogers, 2003). Perceived farming risks included drought, flooding, pest and disease attacks, production instability, infrastructure costs and fish price fluctuation, reflecting uncertainty in tidal lowland agribusiness systems (Romadi *et al.*, 2025). Organisational experience was measured through indicators of membership duration, organisational role participation, access to information and ability to utilise technology within farmer groups (Nurfera *et al.*, 2020). A summary of variable indicators and measurement scales is presented in Table 1.

Table 1. Research variables, indicators and measurement scales

No.	Variable	Indicators	Scale
1	Farmer Characteristics	Age, Education, Gender, Farming Experience, Land Size, and Household Size.	Nominal Ratio
2	Innovation Attributes	Relative Advantage, Compatibility, Complexity, Trialability, and Observability.	Likert
3	Perceived Risk	Drought, Flooding, Pests Attacks, Production Instability, Infrastructure Cost, and Price Fluctuation.	Likert
4	Organizational Experience	Membership Duration, Role Participation, Information Access, and Technology Use.	Likert

Likert scale data were converted into perception indices to facilitate the interpretation of farmer responses (Likert, 1932). The perception index for each indicator was calculated using Equation 2 (Kothari, 2004).

$$I = \frac{\sum X_i}{n} \tag{2}$$

where *I* represents the perception index, X_i is the individual response score, and *n* is the number of respondents (Likert, 1932). The resulting index values were classified into ordinal categories ranging from very low to very high for innovation attributes and organisational experience and from very risky to not risky for perceived farming risk following standard agribusiness perception analysis procedures (Sugiyono, 2019).

RESULT AND DISCUSSION

Farmer Characteristics in Sungai Rebo Village

This section describes the socio-economic characteristics of rice farmers in Dusun III Talang Andong, Sungai Rebo Village, Banyuasin Regency. These characteristics provide the basic context for understanding farmers' perceptions of rice-fish innovation and perceived farming risks.

Age Distribution of Farmers

Farmer age is an important indicator of physical capacity and adaptive potential in agricultural decision-making.

Table 2. Age Distribution of Rice Farmers in Sungai Rebo Village

Age group (years)	Number of farmers	Percentage (%)
23–31	9	9.00
32–40	14	14.00
41–49	35	35.00
50–58	38	38.00
59–67	4	4.00
Total	100	100.00

Source: Processed Primary Data (2025)

The results show that most farmers fall within the productive age range of 23 to 58 years or 87% from all respondents (Table 2). This age structure suggests that farmers generally have sufficient physical ability and experience to manage rice farming activities (Mardiharini *et al.*, 2023). However, productive age does not automatically imply openness to innovation, as decision-making remains closely linked to risk perception and production stability (Patil & Veettil, 2024).

Education Level of Farmers

Education reflects farmers' capacity to access information and understand technological innovation.

Table 3. Education Level of Rice Farmers

Education level	Number of farmers	Percentage (%)
No formal education	8	8.00
Elementary school	46	46.00
Junior high school	35	35.00
Senior high school	11	11.00
Total	100	100.00

Source: Processed Primary Data (2025)

Most farmers have only completed elementary education (46%), indicating limited formal exposure to agricultural technology and management concepts (Table 3). This condition implies that farmers are more likely to rely on practical experience and peer observation (Asante *et al.*, 2024), rather than technical documentation, when evaluating innovations such as rice-fish farming.

Gender Composition of Farmers

Gender composition reflects the structure of labour and decision-making in rice farming households.

Table 4. Gender Composition of Rice Farmers

Gender	Number of Farmers	Percentage (%)
Male	83	83.00
Female	17	17.00
Total	100	100.00

Source: Processed Primary Data (2025)

Rice farming in Sungai Rebo Village is predominantly managed by male farmers (Table 4). This dominance indicates that most production and management decisions are controlled by men (83%), which has implications for the adoption of innovation, as access to land, capital, and farmer organisations is more commonly held by male farmers.

Farming Experience

Farming experience represents accumulated knowledge that shapes farmers' perceptions of innovation and risk (Table 5).

Table 5. Farming Experience of Rice Farmers

Farming Experience (years)	Number of Farmers	Percentage (%)
5–13	15	15.00
14–22	12	12.00
23–31	33	33.00
32–40	30	30.00
41–50	10	10.00
Total	100	100.00

Source: Processed Primary Data (2025)

Most farmers have more than 23 years of farming experience (73%), indicating strong practical knowledge of tidal lowland rice cultivation. Long experience allows farmers to critically evaluate new practices, but it may also reinforce preference for established methods and cautious attitudes toward innovations perceived as complex (Yamin *et al*., 2025).

Landholding Size

Landholding size determines production scale and farmers' tolerance for experimentation (Table 6).

Table 6. Landholding Size of Rice Farmers

Land Size (ha)	Number of Farmers	Percentage (%)
< 0.5	1	1.00
0.5–1.0	69	69.00
> 1.0	30	30.00
Total	100	100.00

Source: Processed Primary Data (2025)

The majority of farmers operate small to medium landholdings below 1 ha. This structure limits farmers' capacity to absorb production failure and encourages cautious decision-making (Xu *et al*., 2024), particularly toward innovations that require changes in land configuration or water management.

Household Dependents

Household dependents reflect economic pressure and livelihood responsibility.

Table 7. Number of Household Dependents

Number of dependents	Number of farmers	Percentage (%)
3	32	32.00
4	41	41.00
5	17	17.00
6	8	8.00
7	2	2.00
Total	100	100.00

Source: Processed Primary Data (2025)

Most farmers support three to four household members (Table 7), indicating moderate economic pressure. This condition encourages farmers to prioritise income stability and risk avoidance (Gulati *et al.*, 2024), which influences how innovations such as rice-fish farming are perceived.

Farmers' Perceptions of Rice-Fish Innovation Attributes

This section discusses farmers' perceptions of rice-fish farming innovation attributes in Sungai Rebo Village based on the distribution patterns (Figure 1). The boxplot visualisation captures not only average tendencies but also the spread, concentration, and variability of farmers' responses, allowing a more accurate representation of how farmers collectively evaluate rice-fish innovation before adoption.

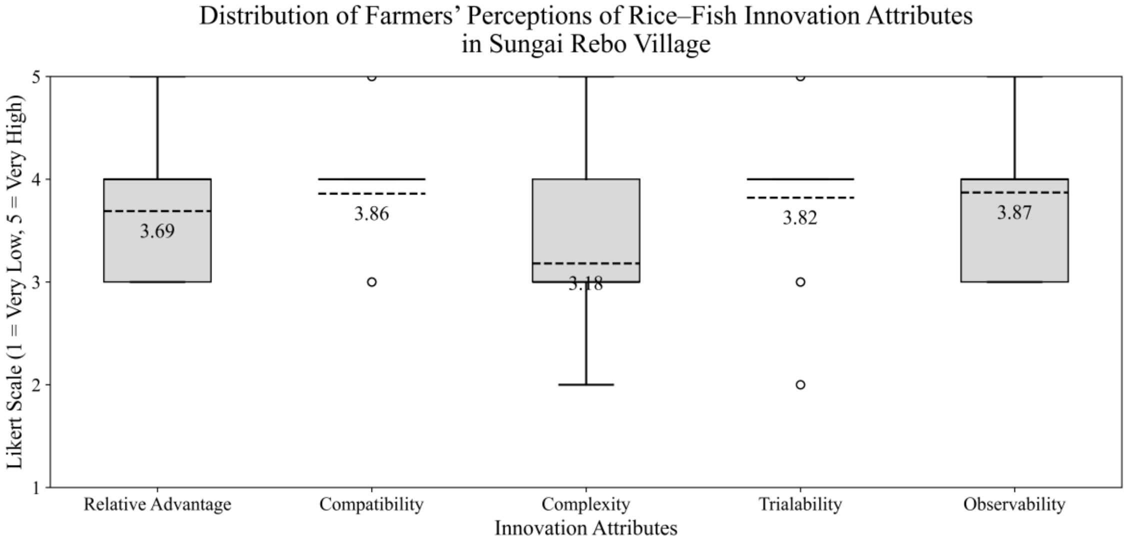

Figure 1. Boxplot Diagram of Farmers' Responses to Rice-Fish Innovation Attributes

Perceived Relative Advantage

The distribution of perceived relative advantage is concentrated between Likert scores 3 and 4, with a median located closer to 4 and a mean value of 3.69. This indicates that most farmers perceive rice-fish farming as offering benefits beyond conventional rice cultivation, although these benefits are not viewed as exceptionally high. The relatively narrow interquartile range suggests a shared understanding among farmers regarding the potential advantages of the innovation. At the same time, the absence of extremely low values indicates that very few farmers perceive rice-fish farming as disadvantageous. This pattern reflects cautious optimism, where perceived benefits exist but are evaluated against the need for production stability, which remains a dominant concern in tidal lowland rice farming systems.

Perceived Compatibility

Compatibility shows a high level of consensus among farmers, as indicated by a compact boxplot with a median near the upper quartile and a mean of 3.86. Most responses cluster around values 4 and 5, suggesting that rice-fish farming is widely perceived as consistent with existing rice farming practices, land conditions, and local norms. The limited dispersion indicates that compatibility is not a contested attribute among farmers in Sungai Rebo. This reflects the long-standing familiarity of farmers with water-based agricultural environments and reinforces the notion that social and ecological fit does not constitute a major barrier to rice–fish adoption in this village.

Perceived Complexity

Perceived complexity displays the widest distribution among all innovation attributes, with responses ranging from low to high values and a mean of 3.18. The median lies slightly above 3, indicating that, on average, farmers view rice-fish farming as moderately complex. The extended lower whisker and wider interquartile range reveal substantial variation in farmers' assessments. Some farmers perceive the system as manageable, while others associate it with increased difficulty, particularly related to water control, fish management, and coordination of farming activities. This heterogeneity suggests that complexity is experienced differently depending on farmers' skills, experience, and access to technical knowledge. As such, complexity represents the most critical cognitive constraint in farmers' evaluation of rice-fish innovation.

Perceived Trialability

Trialability exhibits a relatively high concentration of responses around Likert scores 4 and 5, with a mean of 3.82. The median lies close to 4, indicating that most farmers believe rice–fish farming can be tested on a limited scale before full adoption. However, the presence of lower outliers suggests that trialability is not uniformly accessible to all farmers. For some respondents, constraints such as land size, water infrastructure, or labour availability may limit opportunities for experimentation. Overall, the distribution indicates that trialability is perceived as a facilitating attribute, particularly important in reducing uncertainty among smallholder farmers who face high risk sensitivity.

Perceived Observability

Observability records the highest mean score (3.87) and a relatively narrow interquartile range, indicating strong agreement that the results of rice–fish farming are visible and easily recognized. The clustering of responses at higher values reflects the importance of visual evidence, such as fish harvest outcomes and field conditions, in shaping farmers' perceptions. This distribution suggests that farmer-to-farmer observation and informal learning play a significant role in the local diffusion of rice–fish innovation. High observability strengthens collective understanding and reduces information asymmetry, allowing farmers to evaluate outcomes without relying solely on external information sources.

The boxplot distributions demonstrate that farmers in Sungai Rebo generally perceive rice-fish farming as compatible, observable, and trialable, while viewing its relative advantage as moderate and its complexity as the main source of uncertainty (Kumara *et al.*, 2025). These perception patterns provide a clear representation of farmers' cognitive evaluation of rice–fish innovation, fulfilling the first research objective by identifying how innovation attributes are understood and assessed at the farmer level before adoption.

Farmers' Perceived Farming Risks in Rice-Fish Systems

The distribution of respondents' answers for each risk attribute is visualised using a boxplot (Figure 2), which allows interpretation of central tendency, response dispersion, and variability in farmers' perceptions.

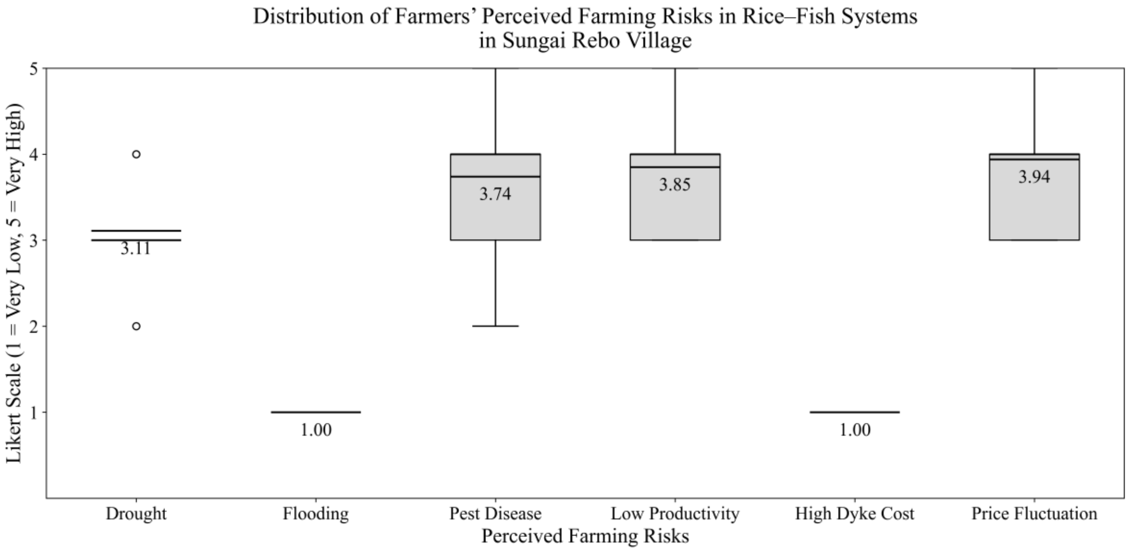

Figure 2. Boxplot Diagram of Perceived Farming Risk in Rice-Fish System

Drought Risk

The perceived risk of drought shows a moderate central tendency, with a mean value of 3.11. This indicates that farmers generally perceive drought as a moderate risk rather than a dominant constraint. The interquartile range is relatively narrow and concentrated around the mid-scale values, suggesting a certain level of agreement among respondents. Nevertheless, the presence of responses at both lower and higher scales reflects heterogeneity in drought exposure, which may be influenced by differences in field location, access to water sources, and seasonal conditions. Overall, drought is acknowledged but not considered the most critical risk in the rice-fish system.

Flooding Risk

Flooding exhibits the lowest mean value of 1.00 among all risk attributes. Responses are tightly clustered at the minimum Likert scale, indicating a strong and uniform perception that flooding poses minimal risk. The absence of dispersion suggests that flooding is not considered a significant threat to rice-fish farming in the study area. This perception is likely related to local agroecological conditions and existing field management practices that reduce vulnerability to flood events.

Pest and Disease Risk

Pest and disease risk is perceived as relatively high, with a mean value of 3.74. The boxplot shows a wider spread of responses compared to environmental risks, indicating variability in farmers' experiences with biological disturbances. This dispersion reflects differences in pest pressure, disease incidence, and management capacity. The high central tendency suggests that pest and disease issues represent a persistent challenge within the rice-fish system and require continuous attention from farmers.

Low Productivity Risk

Low productivity is perceived as a major risk, as indicated by a mean value of 3.85. Most responses are concentrated in the upper Likert scale, demonstrating strong agreement among farmers regarding the importance of this issue. Limited variability implies that concerns over productivity are widely shared, possibly reflecting uncertainties related to system management, input efficiency, or technical knowledge. This perception highlights productivity as a central factor influencing farmers' evaluation of the rice-fish system.

High Dyke Construction Cost Risk

The perceived risk associated with high dyke construction costs shows a very low mean value of 1.00. Responses are consistently clustered at the lowest scale, indicating that farmers do not regard construction costs as a significant barrier. This suggests that existing infrastructure, shared labour arrangements, or locally available materials effectively reduce the financial burden of dyke construction in the study area.

Price Fluctuation Risk

Price fluctuation represents the highest perceived risk, with a mean value of 3.94. Responses are predominantly concentrated at high Likert scale values, indicating strong concern among farmers regarding market instability. The relatively low dispersion suggests that price volatility is perceived as a common and unavoidable risk. This finding underscores the importance of external economic factors in shaping farmers' risk perceptions and decision-making related to rice-fish farming.

Risk Perception Patterns

Overall, the boxplot analysis reveals a clear hierarchy of perceived risks. Economic and biological risks, particularly price fluctuation, low productivity, and pest and disease pressures, are perceived as high and critical. In contrast, environmental and infrastructural risks such as flooding and dyke construction costs are perceived as low and manageable. Drought occupies an intermediate position, reflecting localised and situational impacts. These results demonstrate that farmers' risk perceptions in rice-fish systems are structured primarily around factors that directly affect income stability and production performance, rather than physical environmental constraints (Samaddar *et al.*, 2025). This pattern provides an important foundation for understanding farmers' decision-making and responses to innovation adoption in rice-fish farming systems.

Organizational Experience of Farmers

This subsection examines farmers' organizational experience as reflected by four indicators: membership duration, organisational status, information utilisation, and technology utilisation. The boxplot distributions provide insight into both central tendencies and variability of farmers' engagement within agricultural organisations in Sungai Rebo Village (Figure 3). Overall, the distributions indicate that farmers' organisational experience is predominantly situated within the moderate to high range of the Likert scale, suggesting a generally established level of organisational involvement and functional capacity, albeit with varying degrees across indicators.

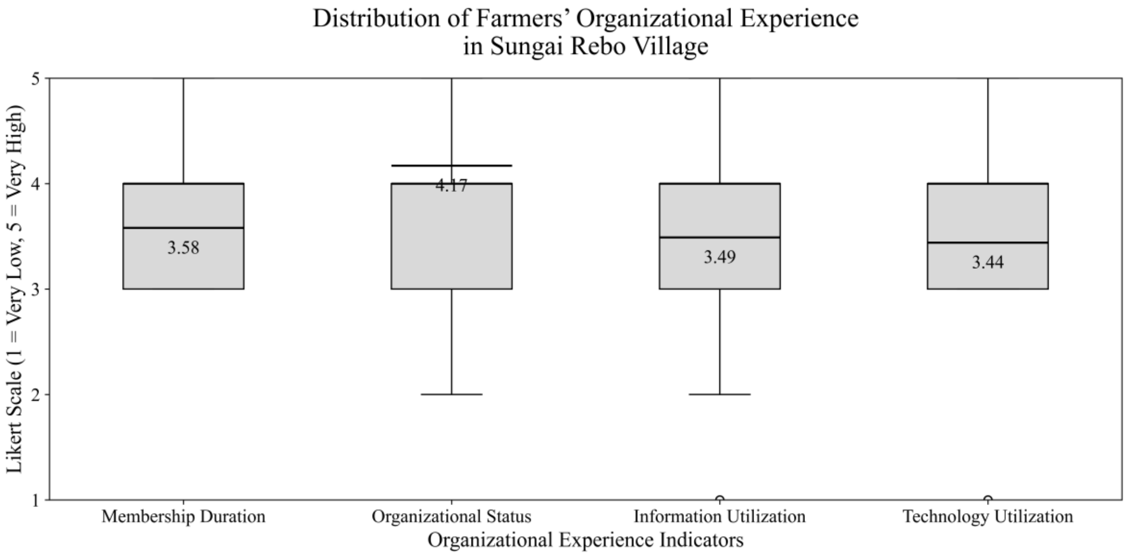

Figure 3. Boxplot Diagram of Farmers' Organizational Experience Indicator

Membership Duration

The distribution of membership duration is concentrated between Likert values 3 and 4, with a mean score of 3.58. The relatively narrow interquartile range indicates limited dispersion, implying that most farmers share comparable lengths of organisational membership. This pattern reflects a relatively homogeneous structure of organisational participation, where prolonged engagement is common but not extreme. Such consistency suggests stable organisational continuity, which may facilitate collective learning and routine coordination within farmer groups.

Organizational Status

Organisational status exhibits the highest mean value among the observed indicators, at 4.17, with the mean positioned near the upper quartile of the distribution. This indicates that a substantial proportion of farmers perceive themselves as holding active or influential roles within their organisations. The upward shift of the central tendency, relative to other indicators, suggests that organisational involvement extends beyond nominal membership. Farmers are not merely participants but are often engaged in decision-making, leadership roles, or operational responsibilities, highlighting the functional vitality of local farmer organisations.

Information Utilization

The distribution of information utilisation shows a mean score of 3.49, accompanied by a wider spread of values compared to membership-related indicators. While the majority of observations cluster around the mid to upper range, the presence of lower outliers indicates uneven capacity among farmers in accessing and applying agricultural information. This variability suggests that although information channels are generally accessible, differences persist in farmers' ability to interpret, evaluate, and operationalise information for farming decisions. Such heterogeneity reflects differing levels of exposure, experience, or support mechanisms within the organisational environment.

Technology Utilization

Technology utilisation presents a mean value of 3.44, with a distribution pattern similar to that of information utilisation. Most observations fall within the moderate range, while a small number of lower values indicate limited technological engagement among certain farmers. The dispersion of responses implies that technological adoption remains uneven. While basic technologies appear to be integrated into farming practices by many respondents, advanced or consistent use has not yet been uniformly achieved across the farmer population.

Taken together, the boxplot distributions illustrate that farmers in Sungai Rebo Village possess a moderately strong organisational foundation, characterised by sustained membership, active organisational roles, and functional, though uneven, capacities in information and technology utilisation. The contrast between high organisational status and more variable information and technology utilisation suggests that institutional participation does not automatically translate into uniform technical capability (Bai *et al*., 2024). This pattern underscores the importance of organisational structures not only as administrative entities but also as platforms for capacity building and knowledge diffusion within farming communities.

CONCLUSION AND SUGGESTION

The findings demonstrate that farmers in Sungai Rebo Village generally exhibit moderate to high perceptual readiness toward rice–fish farming systems, shaped by a combination of innovation attributes, perceived risks, and organisational experience. Innovation attributes are predominantly perceived as compatible, observable, and trialable, indicating that rice–fish farming is cognitively aligned with existing farming practices and local agroecological conditions. However, perceived complexity remains a salient constraint, reflecting heterogeneous technical understanding and management capacity among farmers. Risk perception patterns reveal that economic and biological risks, particularly price fluctuation, low productivity, and pest and disease pressure, are regarded as more critical than environmental and infrastructural risks. Organisational experience is characterised by relatively strong membership continuity and role participation, yet uneven capacities in information and technology utilisation persist. Taken together, these patterns indicate that farmers' evaluations of rice–fish farming are structured not by physical feasibility alone, but by perceived manageability, economic uncertainty, and differentiated organisational capacities within the farming community.

Based on the observed perception patterns, future development of rice–fish farming in tidal lowland areas should prioritize interventions that reduce perceived complexity and economic uncertainty rather than focusing solely on technical feasibility. Strengthening targeted extension strategies that emphasize practical management skills, adaptive water control, and integrated pest management is essential to address variability in farmers' technical confidence. Given the prominence of price fluctuation and productivity risks, policy support mechanisms such as market access facilitation, price information systems, and production risk mitigation instruments are recommended to enhance farmers' income stability. Furthermore, farmer organizations should be strengthened not only as administrative entities but as functional platforms for improving information utilization and technology adoption. Enhancing organizational learning processes and peer-based knowledge exchange can support more consistent interpretation and application of innovation-related information, thereby improving farmers' collective capacity to engage with rice–fish farming systems in a sustainable manner.

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