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Production Risk Management for Local Rice Varieties in Tidal Lands: A Local Wisdom Approach in Barito Kuala Regency

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ABSTRACT

Local rice farming in the tidal lands of Barito Kuala Regency plays a strategic role in supporting regional food security. Still, it faces relatively high production risks due to tidal dynamics, soil acidity, and climate uncertainty. In these conditions, farmers have developed various local wisdom practices over generations as adaptation strategies to manage production uncertainty. This study aims to analyze the level of production risk of local rice field farming, measure expected production returns under risk conditions, identify local wisdom practices in risk management, and analyze the relationship between the level of adoption of local wisdom and production risk. The research was conducted in Barito Kuala Regency and involved 60 local rice farmers purposively selected. Data analysis was carried out quantitatively using production risk indicators in the form of average, variance, standard deviation, and Coefficient of Variation (CV), as well as expected return analysis, combined with qualitative analysis of farmers' local wisdom practices. The study found that local rice farming had a medium production risk, with a CV of 0.20 and an average production of 3,215 kg/ha. The expected return analysis indicates an expected production range of 3,780–3,850 kg/ha. Local wisdom practices, such as planting at times based on tidal cycles, using adaptive local varieties, traditional water management, and simultaneous planting, have been proven to help suppress production fluctuations. The high adoption of local wisdom correlates with lower production risk. This study concludes that local wisdom is an effective and sustainable mechanism for managing production risks in tidal land paddy rice farming.

KEYWORDS: production risk; local wisdom; paddy rice; tidal land; agricultural management.

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1. INTRODUCTION

Rice paddy farming in tidal land is one of the main pillars of food security and a source of livelihood for farmers in Barito Kuala Regency, South Kalimantan. This region has consistently become a major center of tidal rice production, contributing significantly to the province's total rice output. However, it faces relatively high yield fluctuations due to the biophysical characteristics of tidal swamp land, as reported by the Central Statistics Agency of Barito Kuala Regency [1]. The dynamics of water tides, soil acidity, and the potential for salinity intrusion make this land more prone to production uncertainty than technical irrigated rice fields [2,3]. Production risks in tidal paddy rice farming stem from complex interactions among climatic factors, water quality, sulfur-sulfate soil fertility, plant pest attacks, and limited management of production inputs [4,5]. Climate change magnifies production uncertainties by increasing flood frequency, irregular crop seasons, and rainfall anomalies, which directly affect crop stability [6,7]. The impact of production risks not only reduces productivity but also affects the income structure and food security of rice-farming households in tidal land areas [6].

Various empirical studies in South Kalimantan show that production risk is a real phenomenon faced by farmers in various agricultural commodities. Studies on large-scale chili and cayenne pepper farming show that, although financially viable, production fluctuations remain high due to weather factors, pest and disease attacks, and suboptimal input management [8,9]. The findings indicate that production risks are cross-commodity and are also relevant to strategic food crops such as rice, especially in marginal land ecosystems.

In Barito Kuala Regency, most paddy rice farmers still rely on local varieties that have been ecologically adapted to tidal land conditions. Local varieties such as Siam Mayang have adaptive advantages. However, the technical efficiency of rice farming with these local varieties still varies across farmers, indicating inefficiencies in input use and potential production risks that have not been optimally managed [10]. This condition confirms that adapting local varieties requires a more systematic risk-management strategy to improve production stability and efficiency.

On the other hand, formal risk management instruments such as Rice Farming Insurance (AUTP) still show relatively low adoption rates in swampy areas, which are influenced by farmers' perceptions, complexity of procedures, and low risk literacy [11]. This condition encourages farmers to rely more on informal strategies based on experience and inherited knowledge to address production uncertainties. This strategy manifests as local wisdom, such as determining planting time based on the tidal cycle, selecting local varieties tolerant of stress, and traditional water management that is adaptive to local environmental conditions [12,13].

However, risk management practices grounded in local wisdom are still rarely systematically studied and integrated into modern production risk analysis. Most agricultural risk research still emphasizes a quantitative approach, focusing on measuring yield variability and risk indicators without explicitly linking these to the social, cultural, and local knowledge dimensions of farmers [14,15]. In fact, integrating production risk analysis with local wisdom has the potential to yield a more contextual, adaptive, and sustainable risk management model for rice farmers in tidal fields.

Given these conditions, research on production risk management grounded in local wisdom in rice field farming of regional varieties in the tidal lands of Barito Kuala Regency is essential and relevant to carry out. This research is expected to fill a research gap by combining production risk analysis with farmers' local wisdom practices as endogenous adaptation strategies to production uncertainty, and to provide scientific contributions and policy recommendations for sustainable agricultural development in tidal land areas.

II. RESEARCH METHODS

A. Place and Time of Research

This research was carried out in Barito Kuala Regency, South Kalimantan Province, which is one of the leading centers of tidal rice farming, with local varieties that are adaptive to dynamic hydrological conditions [2,3]. The location selection was purposive, considering the characteristics of tidal agroecosystems with relatively high production risk and farmers' dependence on local knowledge in farming management [4,5]. The research was carried out during one paddy rice planting season, from April to November 2025, to capture variation in production risk across the entire cultivation cycle [14,16].

B. Sample Withdrawal Method

The sample extraction method used in this study is purposive sampling, with the criterion that respondents be local rice farmers actively cultivating tidal land and have at least 5 years of experience in rice farming [15,17]. This approach is used because the research focuses on production risk analysis and local wisdom, which requires respondents with adequate expertise and empirical knowledge [12,13]. The sample comprised 60 farmers, who were considered to have met the principle of sample adequacy for production risk analysis and farmer behavior analysis at the farm level [18,19].

The data used in this study include both primary and secondary data. Primary data were collected through structured interviews using questionnaires, field observations, and in-depth interviews to explore local wisdom practices in production risk management [20,21]. Secondary data is obtained from the Central Statistics Agency, related agencies, and relevant scientific publications to support the analysis and interpretation of research results.

C. Data Analysis

Data analysis was conducted quantitatively and qualitatively to provide a comprehensive picture of production risks and their management strategies. Production risk is analyzed using the classic statistical approach commonly used in agricultural risk studies to quantify uncertainty in farm-level production yields [22,23]. The leading indicators used include the average production value, variance, standard deviation, and the Coefficient of Variation (CV), which represents the magnitude of production fluctuations relative to the average value [18,19].

The average production is formulated as:

$$\bar{Y} = \frac{\sum_{i=1}^{n} Y_i}{n}$$

where $\bar{Y}$ is the average rice production (kg/ha), Y_i is the farmer's production, and n is the number of respondents [4.5].

$$\sigma^2 = \frac{\sum_{i=1}^{n} (Y_i - \bar{Y})^2}{n-1}$$

which describes the distribution of production to its average value [14,16], Furthermore, the standard deviation is obtained from the square root of the variance as follows:

$$\sigma = \sqrt{\sigma^2}$$

This shows the absolute deviation of farmers' production from the expected value [12,13].

The coefficient of variation (CV) is used as the main indicator of the level of production risk and is formulated as:

$$CV = \frac{\sigma}{\bar{Y}}$$

Larger CV values indicate a higher level of production risk, while smaller CV values indicate better production stability [15]. In general, agribusiness is categorized as low-risk if CV < 0.50 and high-risk if CV ≥ 0.50 [13,14].

Furthermore, the expected return analysis is used to describe the expected level of production output for farmers under conditions of uncertainty, thereby relating risk to potential yield [16]. This approach is relevant in the context of farmer decision-making in risky production environments, such as tidal land [17,24].

Expected production return is calculated by the formula:

$$E(Y) = \sum_{j=1}^{k} p_j Y_j$$

Where E(Y) is the expected production value, pj is the jth occurrence probability, and Yj is the production rate at the j condition [23]. This analysis is important for understanding the relationship between risk levels and expected outcomes in farmer decision-making in risky production environments, such as tidal lands [13,16].

The analysis of local wisdom was conducted qualitatively, using a descriptive approach to identify and classify farmers' local practices by production stage: pre-planting, planting, and post-planting [13,16]. Each local wisdom practice is analyzed based on its function in reducing risk exposure, reducing sensitivity to environmental disturbances, or increasing farmers' adaptation capacity [17,24].

To strengthen the qualitative analysis, the level of adoption of local wisdom was scored using the ordinal scale as follows:

$$S_i = \frac{\sum_{j=1}^{m} s_{ij}}{m}$$

Where Si is the ith farmer's local wisdom score, Sij is the jth practice score, and m is the number of practices identified [5,21]. The score was then associated with the level of production risk (CV) to see the pattern of the relationship between the application of local wisdom and the stability of agricultural production [25].

The final stage of analysis integrates the results of quantitative production risk analysis and qualitative local wisdom analysis to formulate a production risk management model grounded in local wisdom. This integration is carried out through a comparative approach among farmer groups based on the level of adoption of local wisdom and the level of production risk faced, so that a contextual and adaptive risk management pattern is developed for tidal land.

III. RESULTS AND DISCUSSION

A. Characteristics of Respondents and Rice Farmers of Local Varieties

The research respondents consisted of 60 local variety rice farmers who cultivated tidal land in Barito Kuala Regency. The average age of farmers is 47.8 years, with 18.6 years of farming experience, which shows the dominance of experienced farmers in tidal land rice management. This relatively long level of experience has implications for the accumulation of local knowledge in the face of production uncertainties arising from tidal dynamics and climate change.

The average cultivated land area is 0.74 ha per farmer, with local varieties such as Siam Mayang, Siam Karan Dukuh, Siam Rukut, Siam Mutiara, and Siam Sablas dominant. The selection of local varieties was made for their high adaptability to acidic, sulfate-rich soil conditions and to water-level fluctuations. However, their productivity is lower than that of new superior varieties. This condition shows that there is a trade-off between production stability and maximum yield potential, which is the primary consideration for farmers in a risky environment.

B. The Risk Level of Rice Farming Production

The results of the production risk analysis showed that local variety rice farming in the tidal land of Barito Kuala Regency was at a moderate risk level. This is reflected in the coefficient of variation (CV) of 0.20, indicating that production fluctuations are relatively controlled compared to the average. Quantitatively, the average rice production achieved by farmers is 3,215 kg/ha, with a variance of 412,860 kg^2/ha^2 and a standard deviation of 642.7 kg/ha. The sizable standard deviation indicates variation in results between seasons and fields, but it has not reached an extreme level of uncertainty.

Table 1. Indicators of Production Risk of Rice Farming

Indicator	Value
Average production (kg/ha)	3,215
Variance (kg^2/ha^2)	412,860
Standard deviation (kg/ha)	642.7
Coefficient of variation (CV)	0.20

The characteristics of tidal land naturally entail a high level of production risk due to fluctuations in water levels, salinity intrusion, and changes in soil acidity. However, the relatively low CV value in this study indicates that farmers have been able to suppress production volatility through long experience and local technological adjustments. Compared with conventional agricultural systems on suboptimal land, which often show CV above 0.30, this condition reflects an effective adaptation mechanism in the local variety paddy rice farming system.

Production risks are also influenced by climatic factors, particularly rainfall uncertainty and river water tidal dynamics. In seasons with prolonged high tides, the risk of inundation increases, potentially lowering yields. Conversely, in seasons with low tide and good drainage, production tends to be stable. Therefore, the variation in production, as reflected in the values of variance and standard deviation, is not solely due to natural factors but also reflects farmers' ability to manage these uncertainties

C. Expected Production Return under Risk Conditions

The analysis of expected production returns provides an overview of the expected value of rice production under risk conditions. The analysis showed that the expected production was 3,780–3,850 kg/ha, higher than the actual average of 3,215 kg/ha. This difference indicates that farmers have a rational expectation of the maximum yield potential achievable when environmental conditions and land management are optimal.

The relatively high expected return reflects farmers' optimism about the productivity of the local varieties they use. Local varieties of tidal land generally have adaptive advantages to inundation conditions, soil acidity, and tidal fluctuations. Thus, even though the average realized production is still below the expected value, farmers still maintain this farming system because the potential yield is considered economically feasible and relatively ecologically safe.

From a risk-management perspective, the difference between the expected return and the actual average production can be viewed as a risk premium that farmers must bear. The greater the production risk, the larger the gap between expected and realized results. However, the CV of only 0.20 indicates that the gap remains within farmers' tolerance limits. This explains why farmers continue to use local varieties and traditional technologies, because even though the results are not always optimal, production stability is maintained.

The high expected return also indicates that the tidal land rice farming system has the potential to increase production if risk management practices are strengthened, through the optimization of local wisdom and the integration of supporting technologies aligned with wetland characteristics.

D. Practice of Local Wisdom in Production Risk Management

The results of the qualitative analysis identified several main local wisdom practices used by farmers in dealing with production risks, namely:

- Determination of planting time based on the tidal cycle and the local seasonal calendar
  Planting timing based on tidal cycles and local seasonal calendars is the most fundamental local wisdom practice in production risk management in tidal lands. Farmers have observed the tidal and ebb patterns of river water, rainfall, wind direction, and specific ecological signs to determine when to start planting. This practice helps minimize the risk of excess inundation during the early vegetative phase and drought during the generative phase, both of which can significantly reduce yields. In the context of climate change, characterized by early-season uncertainty and increased extreme events, the local seasonal calendar is not static. However, it is constantly updated through farmers' collective experience. The adaptation shows that local knowledge is dynamic and responsive to environmental changes. The right planting time also contributes to synchronizing plant growth across an expanse, thereby reducing the risk of pest and disease attacks. Thus, this practice not only serves as a climate adaptation strategy, but also as a production risk management mechanism based on endogenous knowledge that is relatively inexpensive, easy to implement, and in accordance with the biophysical characteristics of tidal land.
- The use of local varieties tolerant of inundation and acidity
  The use of local rice varieties that are tolerant of inundation and soil acidity is a local wisdom strategy that plays an important role in reducing the risk of crop failure in tidal lands. Local varieties have generally undergone long-term natural and social selection, so they have better adaptive abilities to extreme environmental conditions, such as fluctuations in water levels, low soil pH, and high dissolved iron levels. Although the productivity of local varieties is often considered inferior to that of modern

varieties, farmers value yield stability and resilience to environmental stress as key advantages in the context of risk. The use of local varieties also reduces dependence on external inputs, such as chemical fertilizers and pesticides, whose availability is often uncertain. In addition, local varieties have substantial social and cultural value, thus encouraging their sustainable adoption. In the context of climate change, as inundation pressure and soil degradation increase, local varieties serve as a form of biological insurance, helping maintain the sustainability of production. These findings reinforce the view that the conservation and development of local varieties are integral to adaptation strategies and to production risk management based on local wisdom

- Traditional water management through microchannels
  Traditional water management through microchannels is a crucial local wisdom practice for controlling production risks arising from excess or insufficient water in tidal lands. Farmers manually build and maintain a network of small channels to regulate the flow of water in and out of rice fields according to the crop's growth phase. This system allows farmers to reduce the duration of inundation in the early stages of growth and to maintain soil moisture during long periods of low tide. The main advantage of traditional water management is its flexibility and adaptability to daily and seasonal hydrological conditions. In contrast to rigid, high-cost technical irrigation systems, microchannels are managed collectively through social agreements among farmers. This practice also reflects a local understanding of the relationship between water, soil, and plants, gained through long experience managing wetland ecosystems. In the context of climate change, when rainfall and tidal patterns are increasingly erratic, traditional water management systems have proven effective at mitigating production risks. Therefore, this practice can be seen as a relevant and sustainable form of endogenous adaptation.
- Experience-based pest control (simultaneous planting, mixed varieties)
  Pest control based on local experience, such as simultaneous planting and the use of mixed varieties, is a local wisdom strategy that helps reduce the risk of yield loss from plant pest attacks. Simultaneous planting is carried out to break the pest life cycle, especially rice-specific pests, by equalizing plant growth phases across a single expanse. This strategy reduces the risk of pests moving from old plants to young plants, thereby naturally lowering the intensity of attacks. Meanwhile, the use of mixed varieties creates genetic diversity within a single map, thereby increasing the system's resistance to pest and disease attacks. This practice reflects farmers' ecological understanding of the interactions between plants, pests, and the environment. In addition to being effective, this approach also reduces dependence on chemical pesticides, thereby reducing production costs and environmental risks. In the context of climate change, rising temperatures and humidity tend to accelerate pest development, making control strategies based on local wisdom increasingly relevant. These findings confirm that traditional pest control practices are not just habits, but part of an adaptive and sustainable production risk management system.

These practices have been applied for generations and have adapted to climate change and production pressures. These findings reinforce the argument that local knowledge is a relevant form of endogenous adaptation in at-risk agricultural systems. The dominance of farmers with a high adoption rate (62%) indicates that local wisdom remains the primary strategy for managing the risk of paddy rice production in tidal lands. This condition aligns with the low production risk (CV = 0.20) and the high expected production return (3,780–3,850 kg/ha), confirming the role of local wisdom as an effective and sustainable risk mitigation mechanism.

Table 2. Adoption Rate of Local Wisdom

Categories Adoption Rate	Percentage of Farmers (%)	Remarks
Height	62	Farmers consistently implement planting timing based on the local seasonal calendar, the use of tolerant local varieties, and traditional water management and other collective practices
Medium	27	Farmers apply some of the local wisdom practices, but begin to combine them with non-traditional technologies or customs
Low	11	Farmers rarely or inconsistently apply local wisdom, relying more on general practices without specific adjustments to the characteristics of tidal land

Farmers with a high rate of local wisdom adoption showed lower production CV values than other groups, indicating a significant role for local practices in reducing production risks.

E. The Relationship between Local Wisdom and Production Risk

The relationship between local wisdom and production risk is negative: the stronger the application of local wisdom, the lower the production risk farmers face. This is reflected in the relatively low CV value (0.20), even though farming is carried out in an ecologically high-risk environment. Local wisdom serves as a risk-mitigation mechanism, reducing the variability of outcomes.

The application of proper planting timing, the use of adaptive local varieties, and traditional water management collectively have been proven to reduce the likelihood of crop failure and extreme production fluctuations. Thus, local wisdom not only serves as cultural heritage but also as a rational economic strategy for dealing with production uncertainty.

This relationship also explains why the expected return on production is relatively high (3,780–3,850 kg/ha), even though the average actual production is still lower. Local wisdom provides farmers with confidence that the farming system they run has the potential for long-term success while maintaining production stability. Therefore, strengthening and preserving local wisdom is an important key in managing the risk of paddy rice production in the tidal lands of Barito Kuala Regency.

IV. CONCLUSION

This study concludes that local variety rice farming in the tidal land of Barito Kuala Regency faces a moderate level of production risk, as reflected in a coefficient of variation of 0.20 and an average production of 3,215 kg/ha. Although the farming environment is highly uncertain due to tidal dynamics and climatic factors, the application of local wisdom has been proven to suppress production fluctuations. The expected return analysis shows that farmers' expected production is 3,780–3,850 kg/ha, reflecting their rational optimism about the potential of local varieties. The high level of adoption of local wisdom, especially in the practice of planting timing, the use of adaptive varieties, and traditional water management, plays a significant role in maintaining yield stability and strengthening the resilience of farming to production risks.

Based on these findings, it is suggested that strengthening local wisdom be made an integral part of tidal land agricultural development policies and programs. Local governments and agricultural extension workers need to encourage the preservation and transfer of local knowledge through community-based mentoring, while integrating it with technological innovations that are compatible with wetland characteristics. In addition, further research is recommended to examine in more depth the quantitative relationship between the level of adoption of local wisdom and production risk indicators, as well as to evaluate the potential for increased productivity without compromising the stability and sustainability of paddy rice farming systems in tidal lands.

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