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# Risk Management Strategies of Pig Farmers in Managing Production Challenges and Market Fluctuations

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A R T I C L E I N F O

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A B S T R A C T

Pig farming is an important part of the local economy in Samarinda, East Kalimantan, although it has a number of difficulties because of production, market volatility, and socio-ecological considerations. This study looks at the risk management techniques used by 150 pig producers at various farm sizes. From a quantitative perspective, the results show that just 10% of farmers use crop insurance, while 85% rely on personal resources to manage financial risks. 70% of farmers use diversification techniques, such raising fish or poultry, and 60% use biosecurity measures, like disinfection and immunization, to reduce production hazards. 50% of farmers enter into contracts with significant purchasers to stabilize prices as a way to control market risk.

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## INTRODUCTION

Pig farming in Samarinda, East Kalimantan, has significantly contributed to the local economy, particularly in providing animal protein and creating job opportunities for the community. According to data from the Central Statistics Agency (BPS) of Samarinda in 2023, the pig population in this region reached 12,345 heads, an increase of 6.8% compared to 2022, which recorded a population of 11,559 heads (BPS Samarinda, 2023). This trend indicates growth in the pig farming sector, involving small to medium-sized farmers. More than 75% of pig farms in Samarinda operate on a small scale, with an average ownership of 10 to 50 pigs per farm (Department of Livestock and Veterinary, 2024).

However, this sector faces substantial challenges in risk management, particularly in production, marketing, and socio-ecological aspects. From a production perspective, diseases such as hog cholera and respiratory diseases in pigs have become significant issues. Data from the Department of Livestock and Veterinary shows a 12% increase in the incidence of pig diseases in Samarinda in 2023 compared to the previous year, causing considerable economic losses (Department of Livestock and Veterinary, 2024). Additionally, the 15% increase in feed prices during the first quarter of 2024 posed a challenge for farmers. Dependence on feed made from imported raw materials creates instability in production costs, directly affecting the profit margins of small farmers (Mulyana & Sutrisno, 2023).

Marketing aspects also present a complex dynamic. The price of live pigs fluctuates between IDR 35,000 and IDR 45,000 per kilogram, influenced by seasonal demand such as during Christmas and New Year. However, outside of these seasons, prices tend to stagnate or even drop significantly (BPS Samarinda, 2023). Moreover, the social stigma against pork consumption in predominantly Muslim areas presents a challenge to market penetration. Diversifying pork-based products, such as sausages and processed products, has proven to be a strategy to add value and enhance product competitiveness (Tumiwa & Lumenta, 2023).

On the other hand, socio-ecological issues are a primary challenge faced by pig farming in Samarinda. Farm waste, both liquid and solid, often becomes a source of conflict between farmers and the surrounding community. Research has shown that more than 65% of pig farms in Samarinda are located near residential areas, increasing the risk of air and water pollution (Oktavia, 2024). Waste management technologies such as biogas and organic fertilizers have been applied by a small number of farmers, but adoption is still limited due to cost and technical knowledge factors. Social conflicts often stem from the community's perceptions of pig farming as contrary to local social and cultural norms (Siregar & Simanjuntak, 2023).

This study has explored the risk management strategies implemented by pig farmers in Samarinda to address these challenges. Strategies include implementing biosecurity measures to minimize disease risks, diversifying processed products to expand markets, and managing waste using environmentally friendly technologies to reduce social and environmental impacts. The findings indicate that the success of pig farming in Samarinda is not

only dependent on farmers' technical abilities but also on their adaptability to market and socio-ecological dynamics.

## LITERATURE REVIE

### *Risk Management in Agriculture: A Theoretical Overview*

Risk management in agriculture involves identifying, assessing, and mitigating risks that could adversely affect agricultural operations. The Risk Management Framework Theory (Harris et al., 2021) emphasizes that farmers need to develop strategic approaches, such as diversification, biosecurity, and insurance, to deal with both production and market risks. This framework suggests that effective risk management requires a proactive approach, including implementing preventive measures and preparing for unforeseen events, rather than simply reacting to challenges (Novickyté, 2019). In the context of pig farming, these strategies are crucial in addressing production challenges, including disease outbreaks, feed price fluctuations, and volatile market prices.

Several studies suggest that diversified risk management strategies, such as utilizing insurance for disease outbreaks and hedging against market fluctuations, can stabilize farm operations and reduce vulnerability to external shocks. A recent study by Mulyana & Sutrisno (2023) emphasized that diversified risk management practices are linked to improved financial resilience in Indonesian pig farmers.

### *Theory of Planned Behavior*

The Theory of Planned Behavior (TPB), proposed by Chen et al. (2024), is widely applied in understanding decision-making processes in agricultural practices. TPB suggests that individual behavior is influenced by attitudes, subjective norms, and perceived behavioral control. In risk management, this theory explains how farmers' perceptions of risks, attitudes toward specific management strategies, and external influences (such as peer recommendations) shape their decisions (Jilani et al., 2024).

In pig farming, TPB helps explain why some farmers adopt certain risk management strategies like biosecurity or market diversification (Ho et al., 2024). A positive attitude toward these practices, combined with strong support from social networks, can encourage their adoption. Recent studies, such as by Tumiwa & Lumenta (2023), indicate that farmers who perceive higher control over their farm operations are more likely to implement such strategies, especially when influenced by social networks and extension services.

### *The Resource-Based View (RBV)*

The Resource-Based View (RBV), introduced by Furr et al. (2021), focuses on leveraging internal resources to achieve competitive advantages. This theory is particularly relevant in agriculture, where resource availability, such as access to capital, infrastructure, and technology, influences risk management decisions (Gerhart et al., 2021). For pig farmers, having better resources—like access to modern disease control technology, capital for insurance, or improved feed options—can significantly reduce their exposure to production and market risks.

Recent studies, including research by Siregar & Simanjuntak (2023), argue that resource availability is a key factor in the adoption of risk management strategies. Farmers who can invest in advanced technologies or have better financial resources tend to implement more effective strategies that protect them from the volatility of both production and market environments.

### *Social Learning Theory*

According to Social Learning Theory (Amsari et al., 2024), individuals learn behaviors through observation, imitation, and the outcomes of others' actions. In pig farming, this theory explains how farmers adopt risk management practices by observing the success of their peers or learning from extension services. Social networks, including farmer associations and agricultural extension agents, are instrumental in disseminating knowledge about effective risk mitigation strategies.

Social learning plays a crucial role in pig farming, where farmers often model their behavior based on observed outcomes in their community. Oktavia (2024) highlights that peer influence and access to information networks significantly impact farmers' willingness to adopt innovative practices like disease control or market diversification, making them better equipped to handle risks.

## METHODOLOGY

This study investigates the risk management strategies employed by pig farmers in Samarinda, East Kalimantan, focusing on how they manage production challenges and market fluctuations. The research adopts a quantitative approach, utilizing descriptive and inferential statistical methods to analyze the factors influencing the adoption of these strategies and to evaluate their effectiveness.

### *Research Design*

The research utilizes a descriptive survey design, which is appropriate for understanding the current state of risk management practices among pig farmers. A structured questionnaire was developed to capture data on the various risk management strategies, the factors influencing their adoption, and the impact of these strategies on farm productivity and sustainability. The questionnaire was designed based on existing literature and relevant theoretical frameworks, including Risk Management Theory, the Theory of Planned Behavior (TPB), and the Resource-Based View (RBV). These frameworks allowed for an in-depth exploration of the various dimensions influencing risk management in the livestock sector.

### *Population and Sample*

The study targeted pig farmers in Samarinda, East Kalimantan, with the data collected from 150 respondents. The total population of pig farmers registered in Samarinda in 2024, according to the Department of Livestock and Veterinary, East Kalimantan, is approximately 500. Using a stratified random sampling method, farmers were categorized based on farm size (small, medium,

and large-scale operations), ensuring the sample was representative of the different farming scales. Stratified sampling was important to account for potential differences in resource availability, risk exposure, and management practices between smaller and larger farms.

Cochran's formula was used to determine the sample size, yielding 150 farmers. The sample was further divided proportionally, ensuring that each farm size was adequately represented. Data collection occurred through face-to-face surveys conducted by trained enumerators to ensure clarity and consistency in responses.

***Data Collection***

The data was collected using a structured questionnaire consisting of three main sections:

1. Demographic Information: This section captured data on the respondents' personal and farm characteristics, such as age, education level, farm size, income level, and access to resources (e.g., financial resources, technology, infrastructure).
2. Risk Management Strategies: This section assessed the types of risk management strategies employed by the farmers, including financial tools (e.g., insurance, savings), production strategies (e.g., diversification, biosecurity), and market strategies (e.g., price hedging, contract farming).
3. Factors Influencing Risk Management: This section explored the underlying factors affecting the adoption of risk management strategies, based on the Theory of Planned Behavior, such as attitudes, social norms, perceived behavioral control, and external factors like market conditions and government policies.

To ensure the reliability of the data collection instrument, a pre-test was conducted with 15 farmers to refine the questionnaire. The data collection took place over two months, from March to April 2024, with enumerators administering the questionnaires in person.

***Data Analysis***

The data was analyzed using both descriptive and inferential statistical methods to identify patterns, relationships, and factors influencing the adoption of risk management strategies.

Descriptive Statistics:

1. Frequencies and Percentages: These were used to describe the demographic characteristics of the respondents and to determine the prevalence of various risk management strategies.
2. Mean and Standard Deviation: These were used to assess the average level of adoption of specific risk management strategies and to understand the variability in strategy use among the farmers.

Factor Analysis: Exploratory Factor Analysis (EFA) was performed to reduce the dimensionality of the dataset and to identify the latent variables (factors) that explain the variation in risk management strategies. EFA allowed the grouping of variables into meaningful categories, such as financial risk

management, production-related risk management, and market-related risk management.

Multiple Regression Analysis: Multiple linear regression was employed to examine the relationship between independent variables (e.g., resource availability, farmer attitudes, market conditions) and the dependent variable, which is the adoption of risk management strategies. The regression equation used was as follows:

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \epsilon$$

Where:

1. Y is the dependent variable (adoption of risk management strategies).
2. $\beta_0$ is the intercept.
3. $\beta_1$, $\beta_2$, $\beta_3$, $\beta_4$ are the coefficients for the independent variables.
4. $X_1$ represents resource availability (e.g., financial resources, technology).
5. $X_2$ represents farmer attitudes (based on TPB, including perceptions of risk and control).
6. $X_3$ represents social networks (e.g., peer networks, access to extension services).
7. $X_4$ represents market conditions (e.g., price fluctuations, demand).
8. ε is the error term.

The regression model helped determine the extent to which each factor influenced the adoption of risk management strategies and identified the most significant predictors.

Reliability and Validity:

1. Reliability was assessed using Cronbach's Alpha, with a threshold of 0.70 deemed acceptable to confirm the consistency of the questionnaire items.
2. Validity was ensured through exploratory factor analysis (EFA), which validated the construct of risk management strategies and factors influencing adoption.

Ethical Considerations: Ethical approval for the study was obtained from the relevant ethics committee at the research institution. Informed consent was acquired from all participants, ensuring they were fully aware of the purpose of the research, the voluntary nature of participation, and the confidentiality of their responses. Data was anonymized to ensure privacy and ethical integrity throughout the research process.

## RESEARCH RESULT

The study investigated the risk management strategies employed by pig farmers in Samarinda, East Kalimantan, with a sample of 150 farmers from different production scales. Statistical analyses were performed, including descriptive statistics, exploratory factor analysis (EFA), and multiple regression analysis. The following outlines the detailed findings based on these analyses.

### *Demographic Characteristics of Respondents*

The demographic breakdown of the participants is shown in Table 1, reflecting the gender, age, experience, and farm size of the respondents. The majority of the respondents were male (70%) with an average age of 45 years,

indicating a workforce predominantly composed of middle-aged individuals. The average farming experience of the participants was 12 years, suggesting a well-established group of farmers with significant expertise. Regarding farm size, 60% were medium-scale farmers (200–500 pigs), while 30% were small-scale farmers (1–100 pigs), and 10% were large-scale farmers (more than 500 pigs).

Table 1. Demographic Characteristics of Respondents

| Characteristic | Frequency (%) | Average Value |
|---|---|---|
| Gender | | |
| Male | 70 | |
| Female | 30 | |
| Age (years) | | 45 |
| Farming Experience (years) | | 12 |
| Farm Size | | |
| Small-scale (1-100 pigs) | 30 | 50 pigs |
| Medium-scale (101-500 pigs) | 60 | 200 pigs |
| Large-scale (>500 pigs) | 10 | >500 pigs |

*Source: Primary data analysis (2024)*

***Risk Management Strategies Employed by Farmers***

The results of this study indicate that financial risk management is one of the primary strategies implemented by pig farmers in Samarinda. The majority of farmers (85%) rely on personal savings to cover unexpected costs. Only 10% of farmers have adopted agricultural insurance as a tool to mitigate financial risks. A small proportion, about 20%, rely on informal loans from family or friends as an alternative source of funds during financial crises. Table 2 shows the distribution of financial risk management strategies implemented by farmers.

Table 2. Financial Risk Management Strategies of Pig Farmers in Samarinda

| Financial Risk Management Strategy | Percentage of Farmers (%) |
|---|---|
| Personal Savings | 85% |
| Agricultural Insurance | 10% |
| Informal Loans | 20% |

*Source: Primary data analysis (2024)*

This finding aligns with previous research, which mentions that limited access to formal financial institutions leads farmers to depend more on informal funding sources (Setiawan et al., 2021).

***Production Risk Management***

In terms of managing production risks, particularly diseases that could affect livestock health, 70% of farmers practice business diversification. This diversification involves combining pig farming with other agricultural activities such as poultry, fish farming, or horticulture, which aims to reduce dependency on a single type of business. Table 3 shows the level of business diversification practiced by farmers in Samarinda.

Table 3. Business Diversification Practices by Pig Farmers in Samarinda

| Related Business Types | Percentage of Farmers (%) |
|---|---|
| Poultry Farming | 45% |
| Fish Farming | 25% |
| Horticulture | 15% |

*Source: Primary data analysis (2024)*

Additionally, 60% of farmers also apply strict biosecurity measures, including vaccination and routine disinfection of pigpens to prevent the spread of diseases like African Swine Fever (ASF). The implementation of biosecurity measures is consistent with Rahmawati and Putra's (2021) research, which highlighted that effective biosecurity can reduce the impact of disease outbreaks in pig farms.

***Market Risk Management***

Market risks related to price fluctuations in pig meat represent a major challenge for farmers. As many as 50% of farmers in Samarinda have entered into marketing contracts with large buyers to secure prices and ensure stable sales. Table 4 shows the number of farmers using marketing contracts as a strategy for market risk management.

Table 4. Market Risk Management Strategies through Marketing Contracts

| Market Risk Management Strategy | Percentage of Farmers (%) |
|---|---|
| Marketing Contracts with Large Buyers | 50% |
| Traditional Purchases | 50% |

*Source: Primary data analysis (2024)*

Additionally, 30% of farmers opt to join cooperatives, which have price stabilization mechanisms to address price volatility. This strategy provides benefits by reducing market uncertainty and offering farmers price certainty for their products.

***Factors Influencing the Adoption of Risk Management Strategies***

Table 5. Factors Influencing Adoption of Risk Management Strategies

| Predictor | Regression Coefficient (β) | p-value | Significance |
|---|---|---|---|
| Access to Financial Resources | 0.47 | 0.001 | Significant |
| Farmer Risk Perception | 0.35 | 0.004 | Significant |
| Social Network Support | 0.29 | 0.013 | Significant |
| Market Conditions | 0.38 | 0.001 | Significant |

*Source: Primary data analysis (2024)*

Access to Financial Resources was identified as the most significant predictor of adopting risk management strategies ($\beta = 0.47$, $p < 0.01$). Farmers with better access to financial resources were more likely to invest in formal insurance, adopt biosecurity measures, and diversify their production activities

(Setiawan et al., 2021). Farmer Risk Perception ($\beta = 0.35$, $p < 0.01$) also played a significant role in strategy adoption. Farmers who perceived higher risks from disease, market volatility, and natural disasters were more likely to implement risk-reduction measures (Siregar et al., 2021).

Social Network Support ($\beta = 0.29$, $p < 0.05$) was another influential factor, with strong networks encouraging knowledge-sharing and collective strategies like contract farming and price stabilization (Fauzi et al., 2021). Market Conditions ($\beta = 0.38$, $p < 0.01$) significantly influenced market-based strategies, particularly in volatile environments, supporting the findings by Fadli et al. (2020).

## DISCUSSION

The findings of this study indicate that pig farmers in Samarinda employ a diverse range of risk management strategies, with a primary focus on addressing financial and production risks. The most commonly used approach to managing financial risks is personal savings, which remains the preferred method despite the availability of more formal financial tools, such as insurance. This suggests a significant gap in the farmers' access to, and awareness of, formal financial instruments that could provide better protection against economic uncertainties. Previous research by Sari et al. (2020) and Setiawan et al. (2021) highlighted that the low adoption of financial tools like insurance could be attributed to limited understanding of their benefits, high premiums, and a lack of trust in insurance providers. These findings indicate a pressing need for policies that promote financial literacy, facilitate easier access to financial services, and offer tailored insurance products for farmers, particularly in the livestock sector.

The widespread use of diversification and biosecurity measures reflects a growing awareness among farmers about the importance of managing production risks. Diversification, in particular, allows farmers to spread risks across different types of production, reducing the dependency on a single source of income and buffering against potential losses from disease outbreaks or other disruptions. Biosecurity measures, on the other hand, play a crucial role in minimizing risks associated with animal diseases, such as African Swine Fever (ASF). ASF is a significant threat to pig farming, and the implementation of biosecurity protocols has proven effective in preventing its spread and minimizing production losses. These measures, including strict sanitation procedures, quarantine practices, and monitoring of pig movements, are aligned with recommendations from previous studies, such as those by Fadli et al. (2020), who noted that proactive health management can significantly reduce the impacts of disease outbreaks.

In the realm of market-related risks, strategies such as contract farming and cooperative price stabilization mechanisms have emerged as effective tools for managing price volatility and market uncertainties. Contract farming, as highlighted by Siregar et al. (2021), allows farmers to secure more predictable income streams by entering into agreements with buyers or processors, reducing their exposure to fluctuating market prices. Similarly, cooperative price stabilization mechanisms enable farmers to collectively bargain for better prices

and reduce the financial pressure caused by market fluctuations. These market-based strategies not only provide financial stability but also promote collective action among farmers, fostering a sense of solidarity and mutual support in managing shared risks. This finding supports the work of Fadli et al. (2020), who emphasized the role of cooperation in enhancing the resilience of smallholder farmers.

The regression analysis conducted in this study identified several key predictors of strategy adoption, which highlight the multifaceted nature of risk management in pig farming. The most significant predictors were access to financial resources, farmer risk perception, social network support, and market conditions. These factors underscore the importance of creating a supportive environment to enable the adoption of effective risk management strategies.
Access to financial resources ($\beta = 0.47$, $p < 0.01$) emerged as the most important predictor, suggesting that farmers with better financial access are more likely to adopt formal risk management tools. This finding is consistent with earlier studies by Setiawan et al. (2021), which noted that financial resources enable farmers to invest in insurance products and biosecurity measures that mitigate production risks. In addition, farmers who perceive higher risks from disease outbreaks, market volatility, and natural disasters are more likely to implement risk-reduction strategies ($\beta = 0.35$, $p < 0.01$). The higher the perceived risk, the more inclined farmers are to invest in measures that can safeguard their operations from potential threats. This highlights the importance of improving risk awareness and promoting risk perception management through extension services and training programs.

Social network support ($\beta = 0.29$, $p < 0.05$) also plays a significant role in facilitating the adoption of risk management strategies. Strong social networks provide farmers with the opportunity to share knowledge, exchange ideas, and collaborate on risk mitigation activities. This support system helps farmers access resources, information, and collective action, which are critical in navigating the uncertainties of the farming sector. Fauzi et al. (2021) supported this finding, emphasizing the role of social networks in fostering resilience and adaptive capacity among smallholder farmers.

Market conditions ($\beta = 0.38$, $p < 0.01$) significantly influenced market-based strategies. Farmers operating in volatile market environments are more likely to adopt risk management strategies that offer price stability, such as contract farming and price stabilization mechanisms. This supports the findings of Fadli et al. (2020), who highlighted the importance of market-oriented strategies in managing financial risks in the agricultural sector.

This study emphasizes the importance of a multifaceted approach to risk management in pig farming. It underscores the critical role of improving financial access and promoting financial literacy to enable farmers to utilize formal risk management tools, such as insurance. Additionally, fostering stronger social networks and providing market stability through policy interventions are key to enhancing the resilience of pig farmers in Samarinda. Strengthening the overall risk management environment by addressing these factors can ensure the sustainability and long-term success of pig farming in the

region. Moreover, this study advocates for policies that not only enhance financial access but also encourage farmers to adopt more diverse and comprehensive risk management strategies to cope with both production and market-related risks.

### *Social and Environmental Implications in Pig Farming Risk Management in Samarinda*

Pig farming in Samarinda, while providing essential economic benefits, also presents a range of social and environmental challenges that must be carefully considered to ensure the long-term sustainability of the sector. These challenges include societal stigma, community acceptance, and environmental concerns, all of which significantly influence the effectiveness and adoption of risk management strategies by farmers.

*Social Implications*

One of the primary social challenges faced by pig farmers in Samarinda is the stigma against pig farming. In many communities, pig farming is often viewed negatively due to cultural or religious factors, as well as concerns about hygiene and the perceived nuisance caused by pigs, such as odor and waste. This social stigma can result in restricted market access for pig farmers, as consumers may avoid purchasing pork products from perceived "undesirable" sources, thus affecting the profitability and sustainability of pig farming businesses (Fadli et al., 2020).

Moreover, social support networks are crucial for farmers to cope with risks and challenges. However, the stigma associated with pig farming may lead to isolation and a lack of cooperative support among farmers. This social marginalization could prevent farmers from fully benefiting from risk-sharing mechanisms, such as collective risk management strategies, community-based insurance, or price stabilization programs (Siregar et al., 2021).

To address these social implications, it is crucial to implement educational campaigns aimed at reducing stigma and increasing public awareness about the importance of pig farming for local economies and food security. Public education should emphasize the economic contributions of the pig farming sector, its role in providing livelihoods for many families, and the modern practices that farmers are adopting to address hygiene and disease management issues (Setiawan et al., 2021). Educational initiatives could involve collaboration with local religious leaders, community influencers, and agricultural extension services to help change negative perceptions.

Furthermore, community empowerment initiatives should focus on enhancing the involvement of pig farmers in decision-making processes, thus fostering a more inclusive and supportive community environment (Fauzi et al., 2021). Strengthening social ties and creating opportunities for farmers to collectively address their challenges will not only reduce the stigma surrounding pig farming but will also increase the overall resilience of the community in managing agricultural risks.

*Environmental Implications*

Another critical aspect of pig farming in Samarinda is its environmental impact. One of the primary concerns is waste management, as improper disposal of pig waste can lead to significant environmental pollution. This includes contamination of water sources, soil degradation, and the emission of greenhouse gases, particularly methane, which contributes to climate change (Widyastuti et al., 2020). Without proper waste management, pig farming can negatively affect surrounding ecosystems and the health of both humans and animals. The environmental consequences of inadequate waste management practices are particularly concerning in regions like Samarinda, where agricultural and rural activities are in close proximity to urban areas (Sari et al., 2020).

Given the importance of sustainable agricultural practices, it is vital that pig farmers adopt environmentally friendly waste management strategies. Techniques such as biogas production from pig manure, composting, and the use of organic fertilizers can significantly reduce environmental pollution and contribute to sustainable farming practices (Setiawan et al., 2021). Additionally, the implementation of closed-loop systems, where waste products are recycled and reused within the farming system, can create a more sustainable and eco-friendly model for pig farming. Such practices not only minimize environmental risks but also help farmers reduce input costs by turning waste into valuable resources, such as energy and organic fertilizer (Fadli et al., 2020).

Government policies and agricultural extension programs should prioritize educating farmers on eco-friendly waste management techniques and provide the necessary resources and infrastructure to facilitate their adoption. This could include offering subsidies or technical assistance for biogas plants or composting equipment, as well as incentives for farmers who implement waste-recycling systems. Public-private partnerships could also play a role in providing financial support and fostering innovation in sustainable waste management practices (Siregar et al., 2021).

Moreover, incorporating environmental sustainability into the risk management strategies of pig farming would benefit both farmers and the broader community by mitigating the long-term environmental risks associated with unsustainable farming practices. By adopting greener practices, pig farmers can improve their reputation within the community and increase consumer trust, leading to better market access and profitability (Sari et al., 2020).

*Linking Social and Environmental Efforts*

Addressing the social and environmental issues in pig farming is not only about improving the conditions of the farmers but also about creating a positive feedback loop that enhances the overall sustainability of the sector. By reducing the stigma associated with pig farming through education and community engagement, farmers will likely experience improved social acceptance, which in turn can lead to greater support for environmentally friendly initiatives. In turn, sustainable farming practices, such as waste recycling and biogas production, will help create a cleaner environment and improve the public image of pig farming.

The integration of social empowerment and environmental sustainability into the risk management framework is crucial for the long-term viability of pig farming in Samarinda. A balanced approach that considers both social and environmental dimensions will ensure that farmers are not only resilient to economic and production risks but are also equipped to tackle the social and environmental challenges they face.

In conclusion, pig farming in Samarinda presents both significant opportunities and challenges (Qamara et al., 2025). Efforts to address social stigma through educational campaigns and community empowerment, combined with the adoption of environmentally friendly waste management practices, are essential for the future sustainability of the industry. By creating a more supportive social environment and promoting eco-friendly practices, Samarinda can enhance the resilience of its pig farmers and contribute to the broader goal of sustainable agricultural development.

## CONCLUSIONS AND RECOMMENDATIONS

Pig farming in Samarinda remains an essential contributor to the local economy but is fraught with challenges, including disease outbreaks, fluctuating market prices, and socio-environmental issues. Farmers predominantly rely on personal savings as a financial risk management strategy, with minimal adoption of formal mechanisms such as insurance due to limited access and awareness. Production risks are effectively managed through biosecurity measures, including vaccination and disinfection, and diversification into other agricultural activities like poultry and fish farming. To address market risks, many farmers employ strategies such as contract farming and cooperative memberships, which stabilize prices and reduce uncertainties. Socio-ecological challenges, particularly waste management and community acceptance, remain pressing concerns that require immediate intervention. The study identifies access to financial resources, social networks, and farmers' risk perception as critical factors influencing the adoption of risk management strategies.

Several actions are recommended to enhance the sustainability of pig farming in Samarinda. First, policy interventions should focus on improving financial literacy among farmers and developing affordable insurance products tailored to their needs. Subsidies or incentives for adopting advanced biosecurity and waste management technologies, such as biogas and composting systems, should be prioritized. Second, cooperative systems and contract farming arrangements must be strengthened to stabilize prices and ensure reliable market access for farmers. Third, community engagement campaigns are essential to reduce social stigma and increase public understanding of the economic contributions of pig farming. Fourth, capacity-building programs must be introduced to train farmers in comprehensive risk management practices, including diversification and advanced production techniques. Finally, government support in fostering public-private partnerships could facilitate the adoption of innovative technologies and sustainable farming practices.

## ADVANCED RESEARCH

Future research should explore the economic feasibility and scalability of biogas and composting technologies for small-scale pig farms, considering their potential to address waste management issues while generating additional income streams. Studies examining the long-term impacts of social stigma on market access and farmer resilience are also necessary. Furthermore, the role of digital tools, such as farm management software, in improving risk management strategies warrants investigation. Comparative studies between different regions or farming scales could provide insights into best practices that are adaptable across contexts. Finally, evaluating the effectiveness of government policies and agricultural extension services in promoting innovative farming practices would help identify gaps and areas for improvement in the risk management framework.

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