



Strategy of Traditional Blood Cockle Farming in Limau Kapas District, Riau Province: A Value Chain and Governance Framework Analysis

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Abstract

Background: The traditional blood cockle farm in Limau Kapas District, Riau Province, Indonesia, has high economic potency, yet it still needs to be developed. While it has great potential, this sector faces a range of long-held challenges (particularly vague regulations that hinder legal-based businesses and repeated claims of land ownership from local fishermen who often steal fish from harvests).

Objective: To investigate the economic opportunities that can be achieved by adopting good governance and improving management capabilities.

Methods: The research was conducted using the qualitative method, with observation, interviews, and a literature review.

Results: The results suggest that improved governance can play a large role in alleviating these problems and increasing productivity. A collaborative effort between the government and the local community is key to developing a sustainable aquaculture ecosystem through education, favorable legislation, and access to capital for farmers. To gain those economic benefits of blood cockle aquaculture in the area, it is necessary to strengthen these aspects.

Conclusion: In conclusion, traditional blood cockle farming in the Limau Kapas District has great economic prospects but is hindered by governance gaps, regulatory ambiguity and limited access to finance. Sustainable and equitable aquaculture development is possible only through effective institutional collaboration between government, universities, and local communities.

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INTRODUCTION

The economic and ecological importance of blood cockles (*Anadara granosa*) farming is quite notable in Southeast Asia. In addition, aquaculture has encountered challenges such as a decrease in production rate and environmental problems (Xhakollari et al., 2023). Blood cockles are an essential food resource and income for coastal communities, particularly in Malaysia and Indonesia (Saffian et al., 2020; Yulinda et al., 2021). Indonesia Riau Province exports 450 tons per month, becoming the third eye parameter of the local economy. Guided by sustainable practices, traditional farms must ensure their activity in blood cockle farming for further sustainability as a crucial means of livelihood. Ensuring the balance between economic benefits and environmental stewardship is crucial to the grown of this aquaculture sector in future (Heimann & Delzeit, 2024; Mahary et al., 2023; Riza et al., 2021).

Blood cockles are a bivalve species commonly found in intertidal zones in Southeast Asia, and their sustainable farming is intertwined with the local ecosystem. Fundamental proper management strategies are vital to counterbalance the economic advantage while achieving conservation goals for areas poorly affected by overfishing and pollution (Paniagua & Rayamajhee, 2024). Negative allometric growth patterns have been reported for blood cockle populations, with males growing faster than females. Not surprisingly, concentrations of the pollutants NH₃ and heavy metals have been found to be high, which means that waste disposal regulations and habitat protection are strictly regulated. Based on information overfishing can be prevented by regulating the time and type of gear fishing activities (Miransa & Ferriols, 2023; Swastawati et al., 2022; Yona et al., 2020).

In some areas, traditional harvesting techniques may be preserved where they do not harm local ecosystems. A different facet to aquaculture can be used by focusing on conservation along with engaging local communities. The organic model of aquaculture for blood cockles with the supporting fisheries contributes to a better environment and improves local livelihoods. Traditional management strategies might work to an extent, but will need to change depending on contextual circumstances and locality demands. Modern aquaculture practices could be the answer to help improve sustainable farming of blood cockle (Mahary et al., 2023; Silva et al., 2020; Syahira et al., 2021).

In running a blood cockle cultivation business, cultivators often face the problem of cockle spat dying and being eaten by predatory snails. Furthermore, another problem is that there are no permits for the blood cockle cultivation business, so there is often blatant theft by various parties, resulting in a reduced catch (Permatasari & Ariadi, 2021). The absence of an official business license has caused conflicts between fishermen and cultivators. These parties claimed land ownership and installed bamboo poles in the blood cockle cultivation areas that did not follow established regulations or respect the designated fishermen's zones. As a result, fishermen pay more for operational costs because they cannot pass through the area, causing the fishing grounds to be pushed farther away. Therefore, there needs to be a regulation governing the management of blood cockle cultivation areas that refers to local wisdom values.

While there is an increasing literature on blood cockle management, much of the previous research has examined ecological and biological aspects, with few studies paying attention to the constraints related to integrated governance and value chain that affects business development at community level (Mahary et al., 2023; Yulinda et al., 2021). Finally, this study novelty is the simultaneous exploration of regulatory, financial and institutional barriers through an integrated governance and value chain framework using a field based qualitative approach in Limau Kapas District Rokan Hilir Regency Riau Province that previously had not been widely studied by literature review.

Blood cockles can be a lucrative enterprise, particularly in regions with strong local demand for the product. These pieces of advice describe the process to get started with marketing such as: researching the market, where to get products and materials from, how to maintain product quality and pricing competitively; promoting the product on social media outlets or platforms while establishing business alliances; delivering efficient customer service; monitoring changes in market/environment/customer needs and adapting. This research analyzed to plan this business, especially in a selection of an optimum location for development in the regional Limau Kapas District of Rokan Hilir Regency-Indonesia.

Based on the research background, the authors formulate the following problems:

1. What are the obstacles to the sustainable management of blood cockle cultivation from the perspectives of fisheries, the environment, marketing, and finance?
2. What internal and external factors affect community entrepreneurship in the blood cockle cultivation business?
3. How does the blood cockle cultivation business impact the income of traditional fishing communities in Limau Kapas District?

This research aimed to analyze and develop a strategy for developing a traditional blood cockle (*Anadara granosa*) farming business, with Limau Kapas District, Rokan Hilir Regency, Indonesia, as the research location. The expected benefit of this study is to gain insights into the marketing and finance aspects of sustainable blood cockle cultivation in Limau Kapas District,

Rokan Hilir Regency. Additionally, it aims to provide policy recommendations and empower entrepreneurial communities involved in the sustainable blood cockle business.

METHOD

Research Location

This research was conducted in the Limau Kapas District, Rokan Hilir Regency, Riau Province, approximately 300 kilometres from Pekanbaru, the capital city of Riau Province, as shown in Figure 1.

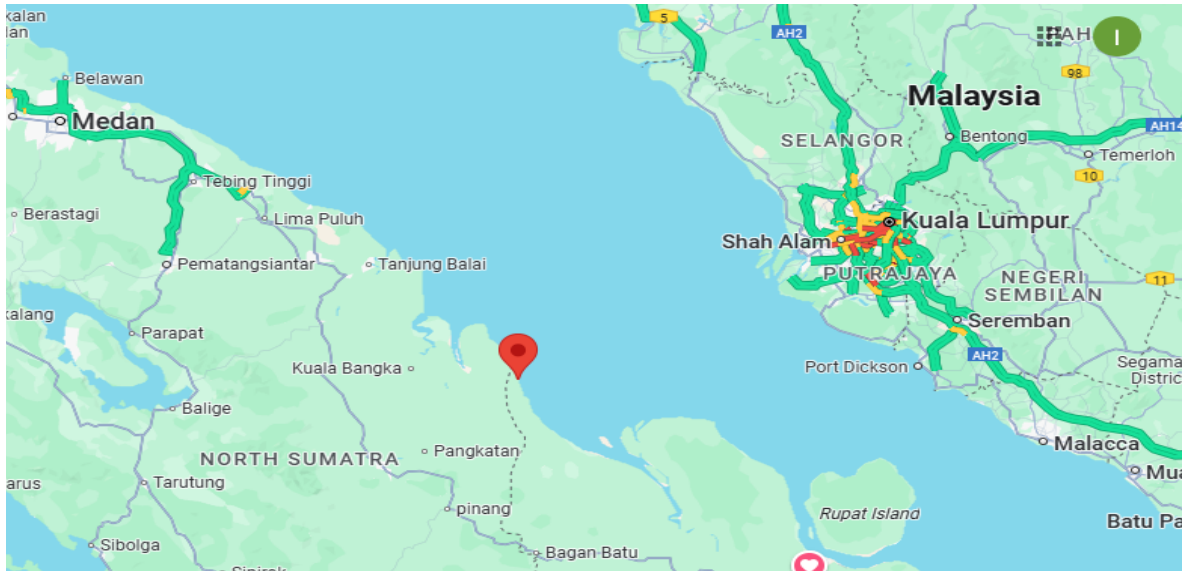


Figure 1. Map of the research location
Source: Google Maps (2025)

Material and Method

This study used the observation method, where observations were carried out directly in the field. The method of sampling respondents was the purposive sampling method, a deliberate sample collection technique applied to community members and fishermen in the observation area.

Data Collection Method

The data collection process in this study included both primary and secondary data. Primary data were collected through three methods: interviews, observations, and documentation. The primary data obtained through interviews served as the main source of information at the research site. These interviews were conducted orally with fishermen, either directly or indirectly. The data gathered covered several aspects, including marketing, financial, entrepreneurial, human resources, and financial accounting aspects.

Secondary data were collected through literature reviews, which involved referencing various sources and studying related literature, previous research, expert theories, and books related to the subject of study. The secondary data sources were drawn from prior research, journals, papers, and other materials relevant to the research problem.

Data Analysis

The data obtained from research activities were analyzed descriptively by interpreting and describing the condition of the subject and object of the research based on the data obtained.

Table 1. Characteristics of Research Informants

Informant Category	Number (n)	Selection Criteria	Role in Study
Blood Cockle Cultivators	18	Min. 3 years active cultivation in Limau	Primary informants on production, finance, and

Informant Category	Number (n)	Selection Criteria	Role in Study
Local Government Officials	6	Kapas Involved in fisheries or regional policy-making	market access Key informants on regulatory framework and institutional support
University Extension Officers	3	Directly engaged with fisheries community programs	Informants on technical development and capacity building
Collectors/Exporters	3	Min. 3 years trading blood cockles from Limau Kapas	Informants on market chain and pricing dynamics
TOTAL	30		
Data Collection Period	January–March 2025		
Analysis Method	Thematic Analysis		

RESULTS AND DISCUSSION

Results

Flowchart of the Coaching Process for Blood Cockle Farming

The development of traditional blood cockle cultivation groups in Limau Kapas District, Rokan Hilir Regency, Indonesia, involves many parties, including the Central Government of Indonesia, the Riau Provincial Government, the Rokan Hilir Regency Government, the Limau Kapas District Government, and the Village Government. In Figure 2, it is also shown that external parties include exporters, collectors, and universities. The Central Government plays a role in preparing regulations at the national level, the Provincial Government prepares regional regulations, and the regency, district, and village governments, along with universities, assist in the technical development of cultivation. Exporters and collectors contribute more to maintaining the quality of blood cockle commodities and their marketing. Internally, within the group, leadership is carried out by the group leader with the assistance of the secretary and treasurer. However, the relationship between the leader, secretary, and group members is not hierarchical, but rather relies on two-way communication with a spirit of togetherness and family among them, which can be seen in Figure 3.

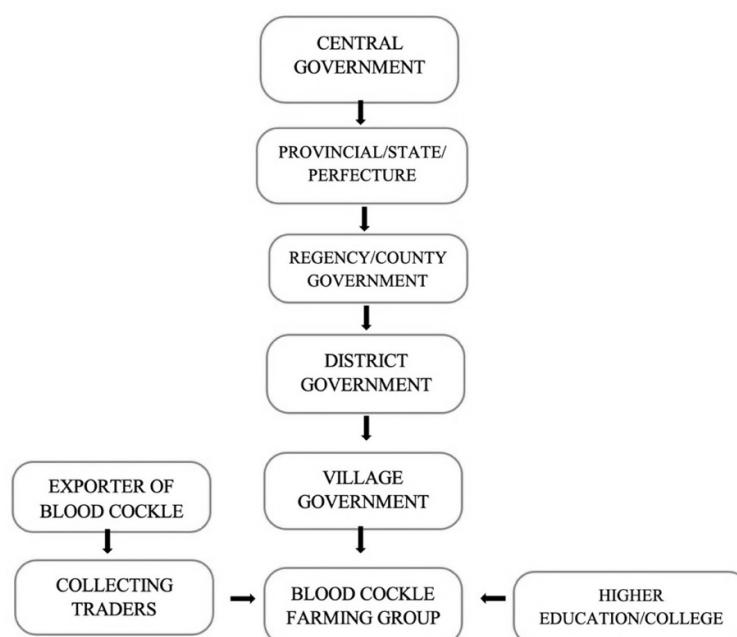


Figure 2. Flowchart of blood cockle cultivation group development in Limau Kapas district.

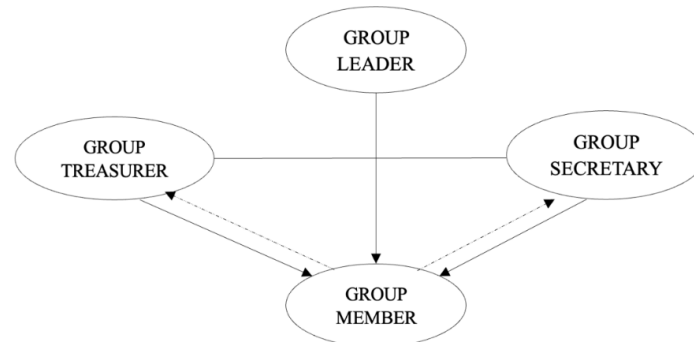


Figure 3. flowchart of coordination and guidance within the blood cockle farming group.

The local government also plans to make Limau Kapas District a center for blood cockle cultivation. In addition to providing direct economic benefits for fishermen, this area is also expected to increase the competitiveness of blood cockle commodities in the export market. The financial stability of blood cockle fishermen in Limau Kapas District, Rokan Hilir Regency, Riau, can be influenced by various factors, namely: economic factors such as income, operational costs, and market access, as well as social factors such as the level of education of fishermen, community support and cooperation among fishermen, and the number of family dependents, all of which also affect the consumption expenditure of fishermen's households (Miransa & Ferriols, 2023).

Financial Aspects

A. Economic Conditions of Blood Shell Fishermen in Limau Kapas District

The economic condition of blood cockle fishermen has shown great potential but still faces some challenges. This area has muddy coastal land suitable for blood cockle cultivation. Through the fisheries service, the local government provides support to this sector. Currently, the market demand for blood cockles is very high, with demand reaching 20 tons per day, while production only ranges from 5 to 10 tons per day. There are three types of blood cockle prices at the trader level: Small and Medium Size (SK) at Rp 8,000/kg, Petai Size at Rp 15,000/kg, and Jengkol Size at Rp 22,000–25,000/kg. This provides a considerable financial opportunity for fishermen. However, the limited provision of quality seeds is the main obstacle for fishermen. More modern seeding efforts continue to be pursued to achieve even better crop yields.

Another factor that also influences the economic condition is the ecological factor, such as resource availability. Judging from its natural resources, fluctuating blood cockle populations are caused by environmental factors or overfishing. Climate change, weather changes, or seasonal shifts significantly affect fishing activities and crop yields for fishermen. Additionally, diseases in shellfish can spread or be transmitted among blood cockles. In this case, fishing regulations government policies regarding fishing restrictions specifically intended to preserve resources do not yet exist. Subsidy support managed by the current government is in the form of seed assistance, amounting to 12 cans per person, with each can weighing 15 kg of seeds, totaling 180 kg per person. Access to credit and insurance, including special loans or insurance programs for fishermen, is currently unavailable. This is because fishermen must meet many requirements, so they can only borrow funds for production capital from collectors (Yulinda et al., 2021).

Technology factors also have an impact. Modern fishing equipment can increase catches, but it also requires significant investment. So far, the technology used is traditional technology, namely by hand. Access to information about the weather, market prices, and potential fishing locations, as well as government information, can be obtained from group coaches and then discussed with fellow fishermen. The last aspect is market environment factors. The price of blood cockles is influenced by local and regional demand. Since fishermen's income depends on the demand of collectors/agents, blood cockles of sufficient size must be harvested when ready, even in the absence of demand from collectors/agents. Competition among fishermen usually occurs at the time of seed purchase; there is often a scramble among fishermen because the available seeds are insufficient for the local area. This is because the existing seeds are exported abroad at very high prices, which is highly detrimental to local fishermen (Syahira et al., 2021).

From economic factors to environmental factors, there exists a conjunction between local government and society. This relationship cannot be separated because the regional government is the policymaker, while the fishing community is the object of policy implementation. The implementation of community-based administrative management must be in accordance with community needs and conditions. Local governments must be socially able to educate the public to better understand the environmental conditions where fishermen cultivate blood cockle (Riza et al., 2021).

At the ecological level, from the data obtained, the blood cockle resources caught are decreasing day by day. For this condition, the government should carry out top-down education, namely playing an active role so that blood cockle fishermen understand how to explore the potential of existing resources (Mahary et al., 2023). Because resources are decreasing day by day, efforts need to be made to cultivate them, namely by limiting fishing and selling blood cockles of a certain size. The local government has implemented a policy that limits the catch and sale of blood cockles to certain sizes, which is appropriate. However, a paradox occurs: the resources owned do not last as expected. The researchers' analysis shows that there has been massive exploitation of blood cockles and blood cockle seeds. Regulations implemented by local governments are not fully enforced (Yulinda et al., 2021).

At the level of competition between collectors or agents, the purchase price becomes a measure. From the results of interviews and field observations, there are often fights between fishermen because the available seeds are not sufficient for the local area, thus affecting the selling price. Fishermen's role is simply to produce blood cockles rather than thinking about how to explore the potential for sustainable business-oriented cultivation (Yulinda et al., 2020).

B. Challenges Faced by Fishermen

Different aspects that can affect the economic welfare and sustainability of blood cockle fishermen in Limau Kapas District, Rokan Hilir Regency, Riau include the difficulty they face in obtaining financial and credit services. Below are some of the main obstacles that fishermen often encounter: Lack of Financial Literacy: A low level understanding of financial products such as savings, loans and insurance causes fishing villages to be less able to take advantage of available financial services. Collateral and Administrative Requirements: Most fishermen neither possess nor need valuable or liquid assets. In the informal sector, administrative requirements such as land certificates and other documents are often a burden for the fishermen. Unstable income Fishermen income formula is highly dependent on each season and unsuitable weather, due to which financial institutions don't provide loans (high risk of default) Absence of Microfinance Institutions: This gap may be due to the limited presence or activity of microfinance institutions, which tend to be more flexible in their lending practices. Cooperatives and other savings and loan groups remain limited either in reach or capacity. Agents/Collectors Intermediaries: Many fishermen are unable to obtain formal financial institution loans and have become dependent on agents/collectors who provide loans, later being repaid through blood cockles sales. This can create a debt cycle that fishermen find difficult to get out of and aggravates the impact on the economic condition of fishermen. Also, smallholder fishermen find it challenging to access government credit facilities as the banks need to Know Your Customer (KYC) their clients and blood cockle fishermen do not usually possess any formal document. Subsidies or direct assistance tend to target specifically the provision of scheduled seeds (Yulinda et al., 2020).

C. Price Fluctuations and Environmental Changes on the Financial Condition of Blood Cockle Fishermen

In Limau Kapas District, blood cockle fishing is the dominant source of livelihood for the fishermen and various factors affect their income. Car price are mostly affected by supply and demand changes in the harvest season, production volume also domestic & international market. This also leads to blood cockle population declines, decreases in catches and hence income for fishermen due to environmental change (habitat destruction) and climate. Increased costs due to external factors such as trade policies, competition for global commodities and changes in fuel and transportation costs also impact operational expenses leading to higher costly fishing and distribution. And fishery management? If prices are high, profits are great and fishermen can

reinvest in their fishing businesses; if low, the fish is barely worth anything to help feed families or keep capital invested into a business.

Blood cockles are also impacted by environmental changes including overfishing, marine pollution, climate change, rising water temperatures and changing weather patterns. Declining catches are blamed on the declining shellfish population and as fishermen are forced to travel further afield, their operational costs have also risen. With respect to finances, fishermen have prices, and then there are lower catches. Operating costs, such as fuel, boat maintenance and fishing equipment keep increasing in scale, while inflation raises the cost of daily life. This volatility of income renders it hard for fishers to set aside funds or purchase new gear. KEY ISSUES Mitigation: Market access, inland market connectivity to get better prices, abstracting on the environment and training fishermen about sustainable fishing Marine pollution and illegal fishing activities need to be supervised strictly, and laws should be enforced (Li et al., 2023).

Referring to the respondents' opinion analysis, relevant research, and supporting theories, some recommendations are to improve the financial aspects of blood cockle aquaculture business in Limau Kapas District at Rokan Hilir Regency. This includes diversifying revenue sources through the processing of blood cockles by fishermen into products such as canned, frozen or dried blood cockles that would add value to the market. Marine tourism and ecotourism are also potential areas for growth that would provide income to communities and regions. Based on the opportunities in natural tourism and blood cockle culture, fishing tour or tours to blood cockles cultivation could bring some more income for fishermen who engaged in local tourism industry (Marafa, 2008).

Improving the productivity and sustainability of blood cockles cultivation requires skill and technology enhancement. This includes organizing training programs for fishermen to learn more effective ways of deepening the cultivation of blood cockle and also to assimilate technological advancements in order to increase harvests. For example, they can introduce new technology for monitoring water quality and modern methods of cultivation. Furthermore, fishermen can be trained to use more efficient processing technology in the production of processed blood cockles. Another key strategy is to provide access to broader markets. By partnering with buyers or distributors who are able to buy products in bulk, fishermen can access both local and national markets. Utilising and maximising digital platforms and social media can also help blood cockles and their derivative products to reach a wider range of consumers giving greater visibility whilst helping build the brand (Ribbers et al., 2022).

Access to financing and credit are key enablers of growth. Microcredit or low-interest loans help by giving fishermen the option to buy better equipment, improve farming practices and finance supplemental businesses. An extension of such opportunities would be in collaboration with local banks or financial institutions. In addition, training in financial management will make the fishermen themselves more aware of managing their income and expenses and saving and investing. Infrastructure improvements are also vital. Transport access and further improvement of port facilities will ease distribution blood cockle products. This might mean upgrading local ports, providing better transport options or expanding road access to link fishermen with markets. In addition, the availability of storage facilities such as cold storage for blood cockles can enhance product quality and prolong their half-life in the market (Saffian et al., 2020).

Sustainable management of natural resources is a priority. Fishermen should be informed about the conservation of blood cockles and eco-friendly sustainable farming. This includes responsible use of marine resources and minimizing damage to marine ecosystems. Local governments can aid in these efforts by instituting policies designed to preserve marine natural resources and safeguard the well-being of fishermen through closed seasons or catch quotas. Another crucial tactic is building coalitions and partnerships. Fishermen can benefit from forming groups or cooperatives, allowing them to pool resources for joint purchases of equipment, processing products and better marketing. So can collaboration with government agencies and NGOs that provide valuable support in the form of training, market access and funding (Dina et al., 2023).

Comprehensively blood cockle management integrated development program includes potential sites, market opportunities, and reasonable selling price. This should include management conflicts of fishermen especially land tenure, education of fisherman, suitable

regulation in the region, better access of financial support from investors specially banks. It can be especially important to put effective management strategies in place to ensure success. Because of this and the quickly evolving local, regional and global economies, traditional management practices are not going to cut it anymore. Fishermen need maximum support from local governments and technical guidance from higher education institutions to ensure success. while banks and regional governments can provide financial headroom and capital through university-based research development (Musawir et al., 2017).

This research answer questions related to fishermen conditions, the potential for blood cockle culture, income and relevant regulations. From a managerial perspective, fishermen who are part of business groups usually have no management knowledge, making it necessary to provide them with strong support. It requires local authority support in business management, private academic institutions for technical assistance and banking industry to back up the capital for the industry to thrive (Raptis et al., 2019).

In management theory, it is expected that the implementation of public management must be oriented towards cost efficiency and bureaucratic effectiveness. Webber stated that management will improve if an organisation implements good bureaucracy (Coudouel & Paternostro, 2005). In the 2000s, organizations still implemented lengthy bureaucratic processes to fulfill administrative requirements, but in the era of globalization, all conditions must shift from complicated and lengthy procedures to simpler ones. This means that the effectiveness of bureaucracy must be maintained. Based on the conditions depicted in Figure 2, the development structure for the blood cockle business group appears excessively long. This certainly does not accommodate the implementation of effective public management strategies to provide guidance to blood cockle business groups consisting of fishermen. An ineffective guidance structure will certainly result in biased interpretations of regulations and policies between central and regional governments operating under varying conditions. This means that efficiency will not be achieved if the bureaucracy is too long. The communication channel between the blood cockle cultivation business group and stakeholders will encounter barriers (interference) because the established channel is quite long. Long bureaucratic channels ultimately result in inefficiency.

Discussing management strategies for traditional blood cockle cultivation may seem contradictory. The cultivation of blood cockles is carried out using a traditional model, but the management must be modern. This remains relevant given the historical conditions of fishing communities that, as is well known, have long been established in these areas and whose skills were inherited from their parents (Webb, 1998).

Discussion

Sustainable blood cockle cultivation in the Limau Kapas District faces barriers of poor access to seeds of acceptable quality, weak regulatory oversight and exclusionary finance. While the natural potential for developing a commodity due to environmental conditions and strong market demand have great prospects, economic fluctuations, lack of awareness from producers regarding long-term stability, and some degree of unchecked ecological degradation limit this venture. Weak institutional governance resulting in exploitation is found to lead to resource depletion with overexploitation and inconsistent enforcement validating the earlier findings.

Theoretical underpinnings for these findings come from the common-pool resource (CPR) framework that suggests governance of shared resources requires clear property rights coupled with collective-choice arrangements and graduated sanctions for violators of rules. The absence of formal cultivation licenses in Limau Kapas District is a textbook example of the classic failure in commons governance, where vague rights breed overuse and conflict between groups. In addition, a value chain analysis lens shows clear asymmetries of power between collectors and cultivators that limit the economic agency of the latter. Such asymmetries need institutional remedies via formation of cooperatives, direct market linkages and access to formal financial services.

Internally, continuity is supported through traditional knowledge and group cohesion, but those same forces stifle innovation. At the external level, complex bureaucracy and little coordination of governments, universities, and collectors limits effectiveness in managing these

sector. This aligns with the argument that simplified, participational management makes policy more efficient and responsive.

The blood cockle is a farmed product that improves fishermen's income. However, the reduction in the economy is natural seasonally stable and controlled by market mechanisms. Therefore, Social entrepreneurship must address the integration of environmental education, microfinance and value-added product diversification contributing to sustainable development. This study highlights the importance of collaborative governance and continuous policy reform despite the temporal and quantitative gap in data. Long-term socioeconomic and ecological impacts should be measured in future studies to reinforce sustainability.

CONCLUSION

Blood cockle cultivation in the Limau Kapas District has great economic potential; however, there are several challenges that require further attention. Challenges faced by growers include vague regulations that have made it difficult to operate legally, as well as disputes over land with fishermen that frequently lead to theft of the harvest. Although demand for blood cockles is still high, price fluctuations and limited supply further complicate marketing. Hence, this business sustainability strategy should be focused on enhancing legal regulations and adopting better seeding technology. In addition, the government and the community need to work together toward building a better aquaculture ecosystem with sustainable industry, support regulations and increase the access of capital available for farmers through education.

Theoretically, these results contribute to an expanding literature on community-based aquaculture governance: The key structural challenges that inhibit sustainable blood cockle business development within coastal Indonesia are governance failure and value chain power asymmetries—demonstrating the continued operability of Ostrom's CPR framework in Southeast Asia's artisanal aquaculture contexts. From a practical perspective, the results indicate an immediate demand for simplified licensing mechanisms, possibly community cooperative institutions, and targeted microfinancing schemes based on the seasonal income of fishers. This study is subject to limitations inherent in cross-sectional qualitative studies with a narrow geographic scope limited to Limau Kapas District. Future research should adopt cross-sectional rather than only longitudinal mixed-methods approaches, and comparative analysis of multiple districts to examine the generalizability of these findings.

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AUTHOR CONTRIBUTION STATEMENT

Nyoto Nyoto designed the research, oversaw the methods and coordinated manuscript submission. I, Irwan Effendi and Aamir Gani assisted with data collection, analysis, and writing the manuscript. Evi Deliana helped with data collection and interpretation, and Emilda Firdaus contributed to insights in the analysis of data and research design. Hanafi Hussin provided theoretical input on sustainable aquaculture practices and contributed to the revision of the manuscript.

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