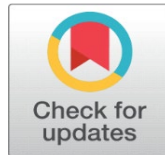


# THE SHELLFISH INDUSTRY IN INDONESIA: ECONOMIC SIGNIFICANCE, SUSTAINABILITY CHALLENGES AND COMMUNITY EMPOWERMENT

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## ABSTRACT

The main objectives of this study us to explore the shellfish industry in Indonesia, examining its economic significance, production trends, export potential, and challenges in sustainable practices. The study investigates key issues such as shellfish waste utilization and community empowerment, focusing on gender roles un communities. The research design involved a comprehensive literature review, analyzing relevant studies, reports, and data on shellfish production, processing and trade. Methodologically, the study assessed the ecological role of shellfish in marine ecosystems and its economic contribution to coastal livelihoods. The results indicate that the shellfish industry is an important component of the Indonesian economy but faces significant challenges, including inadequate infrastructure and limited market access. Furthermore, utilizing shellfish waste for value-added products shows great promise, while community empowerment, especially for women, is critical to strengthening the industry's resilience. The study concludes that processing techniques and infrastructure improvements are neede to ensure the industry's sustainability and competitiveness. Enhancement of gender-focused empowerment policies and programs is recommended to support long-term growth and ecological stability.

**Keywords:** Blood Shells, Sustainable Economic Development, Community Participation, Waste

## 1. INTRODUCTION

Indonesia is one of the major contributors to global aquaculture production and ranks second after China, with around 7% of total output. The waters around Indonesia are home to thousands of shellfish species, with green mussels, blood mussels, pearl oysters, clams, and oysters among those known to have high economic value [WWF-Indonesia \(2015\)](#). Although shellfish meat is commonly consumed, the remaining shells are often discarded despite their potential for economic reuse. Research conducted by [Murdinah \(2009\)](#) underlines the potential

of Indonesian shellfish, but optimal management is still limited. As global dietary trends shift from red meat to white meat (seafood), the Indonesian shellfish sector can be strategically positioned for greater global integration, especially given its natural catch base.

### 1.1. ECONOMIC IMPORTANCE OF SHELLFISH

The variety of shellfish eaten in Indonesia shows their cultural and economic importance. The blood cockle (*Anadara granulosa*) and the pearl oyster (*Crassostrea gigas*) are important due to their economic value and high demand. Sustainable harvesting of these species contributes to food security and provides livelihoods for local communities, especially in areas where shellfish farming is a significant economic activity. Therefore, understanding and sustainable management of mussel populations is essential to maintain their ecological and economic roles in coastal areas [Amali and Akib \(2023\)](#).

### 1.2. MUSSEL PRODUCTION AND CONSUMPTION

Green mussels (*Perna viridis*) contributed the most significant portion of production, 10,776.75 tons. In contrast, blood cockles (*Anadara granulosa*) contributed 1,370 tons. Total mussel production in that year reached 12,146.75 tons, indicating the importance of mussel cultivation, especially green mussels, in Indonesia's coastal fisheries sector [KKP \(2020\)](#). The dominance of green mussels in mussel production is likely due to several main factors, including the relatively short cultivation cycle, the species adaptability to diverse aquatic environments, and strong market demand. These characteristics make green mussels a suitable choice for small-scale coastal aquaculture operations.

### 1.3. DEVELOPMENT OF MUSSEL AND OTHER SHELLFISH PRODUCTS EXPORTS BY DESTINATION COUNTRY

According to data published by [Ekspor \(2020\)](#) Indonesia's shellfish commodity exports have increased in volume and overall export value. However, there have been fluctuations in several destination countries. The following is data on the development of Indonesian shellfish exports and similar products by destination country from January to December 2019 and 2020.

The volume of Indonesian shellfish and related commodities exports increased by 8.94%, from 12,046,927 kg in 2019 to 13,124,864 kg in 2020. This increase is also reflected in the FOB (Free on Board) value, which jumped by 62.13% from US\$ 6,522,223 to US\$ 10,574,870. This shows an increase in the selling price of Indonesian shellfish products in the international market despite a decrease in import volume from several destination countries. To strengthen exports, efforts must be made to diversify products, improve quality, and open access to new markets. This shellfish waste can have economic value if it is reused in handicrafts such as brooches, souvenirs, and decorative items [Abubakar et al. \(2021\)](#) stated that the use of shellfish waste for craft products can improve the skills and economy of coastal communities while empowering female fishermen by turning waste into products with economic value. The development of shellfish waste-based businesses still faces quite significant challenges and sales of products through online networks, and the absence of sophisticated marketing management that can have an impact on the sustainability of the shellfish business [Muhammadun and Al \(2022\)](#). One of the significant obstacles is the lack of access to financing to support

the working capital needs of small-scale fisheries. Therefore, it is necessary to introduce various innovative financing instruments that can be implemented to serve the financing needs of the small-scale fisheries sector that have not been met [Upare \(2024\)](#). This literature review aims to explore the shellfish industry in Indonesia by examining several important aspects: the ecological and economic significance of shellfish as a major fishery commodity, the use of shellfish waste to support creative economic initiatives, the role of community empowerment and gender involvement in the coastal shellfish industry, and challenges related to marketing, financing, and infrastructure development. Using a thorough examination of present scientific literature, this study seeks to offer a whole knowledge of the present state, possibilities, and limits of the shellfish sector in Indonesia.

## 2. METHODOLOGY

The data used in this study are the results of previous research, not direct observations. These data sources include primary scientific reports in articles or research journals related to the shellfish industry in Indonesia.

## 3. FINDINGS

An integrated analysis is provided regarding the ecological and economic significance of the shellfish industry in Indonesia. This analysis includes production and consumption trends, processing innovation, waste utilization, community empowerment, marketing, and financial and infrastructure challenges. Each aspect is examined to explain current conditions, identify potential opportunities, and address various important issues to encourage sustainable development in this industry.

### 3.1. RELATIVELY SHORT CULTIVATION CYCLE

Research conducted by [Sagita et al. \(2017\)](#) in Kuala Langsa, coastal waters of Aceh, showed that one type of shellfish, namely green mussels (*Perna viridis*), can reach harvest size in about six months. In longline cultivation with a density of 20 per sack, the mussels showed a specific growth rate (SGR) of 0.86% per day for length and 1.18% per day for weight, with a survival rate of 92.5%. These results highlight the efficiency of green mussel (*Perna viridis*) cultivation, especially for small-scale aquaculture businesses.

### 3.2. MARKET DEMAND

Research [Noor \(2015\)](#) in Pasaran Island, Bandar Lampung, highlighted the promising economic potential of green mussels (*Perna viridis*) for the aquaculture sector. The results showed that the local market demand for mussels keeps rising, along with low production costs and little technology needs, making mussels a feasible and appealing product in the coastal aquaculture industry. The findings also revealed that the cost of mussels was rather consistent, boosting the economic sustainability of local people living as fishermen.

### 3.3. SHELLFISH PROCESSING AND ADDED VALUE

The shellfish processing industry in Indonesia has significant potential to increase economic value because processed shellfish products are more expensive

than fresh shellfish. These processed products include canned and frozen shellfish and shellfish handicrafts.

- **Canned and Frozen Shellfish:** A study by [Gumilar et al. \(2021\)](#) analyzed the price index of processed fishery products in Bandung Regency, Indonesia, which showed that processed products such as fish floss and fish balls had a higher price index compared to fresh products, indicating an increase in economic value through processing.

### 3.4. UTILIZATION OF SHELL WASTE

The data found highlights the diversity of value-added products derived from shellfish waste, each offering ecological benefits and socio-economic potential. These waste-based products are increasingly recognized as part of the circular economy model, especially in coastal areas.

- **Handicrafts:** Items such as souvenirs, key chains, and decorative boxes are common among coastal communities. According to [Abubakar et al. \(2021\)](#) shellfish-based craft activities help reduce coastal waste and empower women in Ternate. Similarly, [Amali and Akib \(2023\)](#) reported that a training program in Kendari effectively encouraged local women to engage in small-scale shellfish craft businesses.
- **Functional Accessories:** Products such as eco-friendly bags, wallets, and tissue holders utilize shellfish pieces as a sustainable material. [Muttaqin et al. \(2023\)](#) emphasize the increasing consumer demand for household items with natural elements. Showing that with proper training, shellfish waste can be transformed into marketable goods, contributing to income diversification in coastal communities.
- **Jewelry:** Shell-based jewellery, such as rings, bracelets, and necklaces, is a highly aesthetic and culturally inspired use of waste. [Musapana and Amalia \(2020\)](#) Show how this craft can serve the tourism market and preserve traditional arts. [Ardiani et al. \(2024\)](#) Emphasize the importance of creative design and digital marketing to increase competitiveness.
- **Home Decor:** Shell waste is also used in decorative items such as vases, coasters, and wall panels. [Nastiti et al. \(2024\)](#) These products support sustainable design and are well-received in the environmentally conscious market. [Mahendra et al. \(2023\)](#) Highlight that shell waste has been utilized for handicrafts, such as wall decorations and interior design elements. By lowering marine waste and supporting a circular economy in Indonesia, this use helps with environmental sustainability and raises the economic worth of the commodity.

### 3.5. UTILIZATION OF SHELLFISH WASTE FOR OTHER INDUSTRIES

Several studies have shown that processed shellfish waste can be used as a raw material in several industrial sectors This aligns with the principles of a circular economy and offers new livelihood opportunities for coastal communities.

- **Calcium Carbonate and Organic Fertilizer Industry:** A report by [Dampang et al. \(2021\)](#) shows that mollusc shells contain about 98% calcium carbonate, which can be thermally converted (calcined) to calcium oxide (CaO) at temperatures above 700°C.

- **Construction Materials:** [Andika and Safarizki \(2019\)](#) evaluated the incorporation of crushed blood cockle shells into concrete mixes. The results showed that adding up to 10% shell powder by weight of cement significantly increased the compressive strength. Using shellfish waste helps socio-economic development and environmental sustainability, especially gender inclusive empowerment in shellfish producing zones.

### 3.6. COMMUNITY EMPOWERMENT AND GENDER ROLES

Empowerment programs targeting women in the shellfish industry who live in the coastal area help promote gender equality and improve economic resilience while contributing to sustainable livelihoods. Programs like those concentrating on shellfish crafts not only educate women but also help them broaden their product range, enhancing the quality and number of items made [Halimah et al. \(2023\)](#). Furthermore, [Yunus et al. \(2023\)](#) discovered that these programs enabled coastal women to become economically independent by equipping them with the knowledge and resources required to access new markets and raise their income possibilities. Offering digital tools and marketing assistance also enables women business owners to reach a larger customer base, empowering them more. By involving women in the shellfish value chain, these programs contribute to gender equality, promote community resilience, and preserve local traditions.

### 3.7. CHALLENGES IN MARKETING, FINANCE AND INFRASTRUCTURE

Though some structural limitations hinder its expansion, particularly for small-scale producers, the shellfish industry in Indonesia shows great promise. Poor infrastructure, insufficient financial literacy and limited marketing prospects restrict small enterprises capacity to expand and compete in the international market. These constraints require a multidimensional approach involving education, policy support, and infrastructure investment. Collaboration between the government, private sector, and local communities is expected to create a sustainable ecosystem, especially for the growth of the national shellfish industry [Table 1](#).

**Table 1**

Table 1 Challenges of the Shell Industry		
Constraint Type	Example	Source
Marketing	Limited to local shops	<a href="#">Harnani et al. (2023)</a>
Financial management	No financial records	<a href="#">Amali and Akib (2023)</a>
Infrastructure & tools	Insufficient capital, outdated equipment	<a href="#">Thannia (2022)</a>
Certification hurdles	Difficulty in obtaining halal certification	<a href="#">Noviani et al. (2020)</a>

[Table 1](#) outlines the systemic constraints faced by small-scale entrepreneurs in the coastal shellfish industry in Indonesia, highlighting how structural challenges are inherent in the current production and market systems. [Harnani et al. \(2023\)](#) Noted that limited marketing remains a significant constraint. Most producers rely heavily on traditional markets or local buyers without the capacity to penetrate regional or international markets. This is mainly due to limited access to digital marketing platforms and a lack of branding and product differentiation skills. [Tehuayo et al. \(2024\)](#) Micro and small businesses in coastal areas face several challenges in adopting digital marketing strategies, including limited digital literacy,



limited access to technology, and a lack of understanding of market intelligence. These limitations hinder their capacity to create value-added and market-oriented strategies. From a financial management standpoint, the lack of fundamental financial data, as noted by [Amali and Akib \(2023\)](#) greatly restricts prospects for company expansion. Financial literacy remains low, and many coastal community businesses operate informally without a business plan or reinvestment strategy. This reduces their creditworthiness and cuts them off from formal financial institutions. The Financial Services Authority ([OJK \(2022\)](#)) report found that less than 30% of coastal micro-enterprises have access to banking services or micro-loans, mainly due to documentation issues and a lack of knowledge about financial products. Furthermore, a financial literacy survey revealed that coastal communities have a financial literacy index of only 31.6%, far below the national average of 49.7%. This suggests that most business actors in the area do not understand the importance of cash flow records, budget planning, or profit and loss evaluations which hinders long-term planning and results in reactive responses to market changes. Infrastructure gaps also pose significant obstacles. As highlighted by [Thannia and Nadya \(2022\)](#) small-scale shellfish processors often operate with limited or outdated equipment, lack adequate refrigeration, and use substandard shellfish sorting and drying facilities. This is supported by research [Soebandriyo \(2015\)](#), which found that most micro and small-scale fisheries business actors in Rembang Regency face various challenges, including limited postharvest infrastructure, lack of capital, and a less-than-optimal marketing system. These problems are experienced mainly by micro and small business actors constrained by limited capital, hygiene standards, availability of raw materials, and market access. Obstacles related to certification are crucial to overcome in efforts to expand market access. [Noviani et al. \(2020\)](#) small business actors have difficulty obtaining halal certification due to high administrative costs and minimal technical support. This limits their participation in the value chain that targets Muslim consumers both domestically and abroad. Furthermore, the Strategic Plan Document of the Cooperatives and Small and Medium Enterprises Service of the Bangka Belitung Islands Province for 2023–2026 highlights various micro, small, and medium business empowerment programs, including improving product quality and standardization.

#### 4. DISCUSSIONS

Previous research results from various sources, including primary scientific reports in selected research articles or journals related to the shellfish industry in Indonesia, show that although the shellfish industry in Indonesia has significant economic potential, the industry faces certain constraints that limit its optimal growth. This sector is important to support the coastal economy, especially in creating jobs and increasing family income. With increasing demand in domestic and foreign markets, shellfish also contribute to local food security. Even with such significant economic promise, its actualization is still constrained by certain elements that must be handled to promote sustainable growth. Among the key challenges noted in the studies is the lack of processing and value addition for shellfish products. Many publications indicate that most shellfish produced in Indonesia are sold in fresh or simply processed form. This restricts the possibility of a larger market, particularly in fulfilling the needs of the worldwide market, which desires items with better quality and more complex processing. The lack of creativity in processed shellfish items reveals how underused the processing industry has been to boost product competitiveness. Improving more efficient and

environmentally friendly processing technologies is essential to offset this. Many small company operators in coastal areas have not used more sophisticated processing technologies, which might raise the added value of shellfish goods. It is thus crucial to give them more rigorous training so they may use current technologies to enhance the quality and variety of processed shellfish products. The government and business sector also have to cooperate to provide improved processing infrastructure, enabling more efficient, large-scale processing of products from major shellfish-producing areas.

Furthermore, among the topics frequently addressed in the studies examined is the use of shellfish waste. Though shellfish could be used as raw materials for fertilizers, construction, or craft items, their use in Indonesia remains somewhat restricted. Though it has significant economic value if handled correctly, several publications say this shell waste is often not used best. Creating an integrated waste processing system in the shellfish sector is one way to address this issue. Especially for individuals not directly engaged in shellfish farming, leftover shells can be turned into value-added items that could boost communal income. Building shell waste processing plants in coastal locations and training local populations on how to use this material more effectively can thus help to make this possible. Apart from these technical issues, there are structural and socio-economic limitations, including limited access to funds for small- and medium-scale shellfish business owners. Many small companies in this industry struggle to obtain the funds required to grow their operations, expand manufacturing capacity and embrace new technology. This situation is additionally aggravated by the absence of policy assistance emphasizing the growth of the shellfish sector. Policies that support local entrepreneurs more and simplify access to finance are required to help the shellfish sector forward, particularly for small enterprises largely owned by coastal communities.

Women's part in the shellfish industry is often ignored, which is well recorded in several publications. Though women play a significant role in postharvest and shellfish processing, they frequently lack sufficient access to training and funding, hence hindering their ability to shape the shellfish industry. Creating equal opportunity in this sector depends on community-based empowerment initiatives that include women in all facets of the industry, from manufacturing to marketing. Though the shellfish business in Indonesia has significant economic potential, specific challenges noted in this study must be handled right away if this sector is to grow as best as possible. Issues including socio-economic inequality in empowering coastal communities, particularly women, inadequate processing technology, less than ideal waste use, and limited access to finance call for a thorough and cooperative approach. The shellfish industry in Indonesia might be a sustainable sector and offer more economic advantages with combined efforts from the government, corporate sector and communities.

## **5. CONCLUSIONS**

The shellfish industry in Indonesia plays a significant role in the national economy and contributes significantly to exports and employment, especially in coastal areas. Shellfish can help to biodiversity and have great ecological importance. Still, the sustainability and infrastructure issues this sector struggles with have an impact on product quality and global competitiveness. Better management of shellfish waste can provide significant added value, primarily through its use as raw material for other industries that can also increase the economic value of a region. Empowering women in this sector through training and

capacity building also shows excellent potential to improve the welfare of coastal communities. Barriers to marketing, funding, and infrastructure that will allow this sector to survive are still to be addressed. Thus, important policy suggestions encourage creativity in shellfish processing and enhance distribution and marketing systems. Advancing the Indonesian shellfish industry will also require essential action by coastal communities, particularly in gender-based economic empowerment. A whole approach that includes appropriate stakeholders to preserve the ecosystem, enhance product quality, and maximize resource use would help this sector to be sustainable. This research is also expected to contribute to the development of science and can be the reference for the sustainability of references in this section. By summarizing and analyzing various previous research, This study provides a more detailed picture and facts about the actual conditions of the shellfish industry in Indonesia, such as the potential, challenges, and adaptive and sustainable management strategies. This study shows the need for further, more in-depth research based on field data on the effectiveness of community empowerment models, utilization of shellfish waste, and technological innovation in the processing and distributing shellfish products. For future development, it is recommended that location-based quantitative and qualitative research be conducted to test the findings of this literature review empirically.

### **CONFLICT OF INTERESTS**

None.

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None.

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