The Opportunity for Utilizing Low Economic Fish in the Fishing Port

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Abstract. The increasing population and rising living standards are expected to contribute to higher demand for animal-derived high-quality protein, primarily from fish. Capture fisheries have become a leading sector that supplies fish production for human consumption and fish processing industries. As the center of fish production from capture fisheries, the fishing port is vital to maintaining the supply and distribution of fish. The utilization of low-economic fish is generally consumed by local people and processed into salted fish. At the same time, it can become fresh material in the fish processing industry to increase its added value. The papers discuss the opportunity to utilize low-economic fish in fishing ports through the development fish processing industry based on fish production and each product's economic value. The potential amount of fish product was estimated based on application in the field and referred to previous research. The economic value is calculated based on market price. The production of low-economic fish in Karangantu reached 3,091 tons, with an average annual production of 2791 tons. The processing of low-economic fish into surimi, gelatin, and derivative products will increase the added value if it is only sold fresh for IDR 13.96 billion. The highest added value is obtained from fish meatballs at IDR 60.29 billion. The added value from surimi is IDR 46.89 billion. Low-economic fish processing can increase added value, create new jobs, and grow the fishery's economic activity at the fishing port.

Keywords: Added value · economic value · fish processing · low economic fish · utilization

1 Introduction

The world population in developing countries is predicted to grow by almost 35% in the next three decades [1]. This increasing population and rising living standards are expected to contribute to a higher demand for animal-derived high-quality protein, primarily from fish. Fish and other aquatic foods are high in protein and contain many essential micronutrients [2, 3]. Fish protein is highly digestible and rich in essential amino acids

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limited in other animal-sourced proteins, including methionine up to 6.5% and lysine up to 19.6%. This characteristic of its protein makes fish an exciting research object focusing on an economical, easy, and sustainable production to secure protein supply for the human diet in the future [4].

Capture fisheries and aquaculture provide 3 billion people with almost 20% of their average per capita animal protein intake [5]. The total dietary protein from fish can reach 60% or more in Indonesia [6]. Capture fisheries have become a leading sector that supplies fish production for human consumption and fish processing industries. As the center of fish production from capture fisheries, the fishing port is vital to maintaining the supply and distribution of fish to the consumer. Furthermore, the ports also prepare an area for the processing industry as part of a development strategy to increase landed fish's added value. Karangantu fishing port is a vital fish landing center in Banten Province that supplies fresh fish to various Indonesian regions. The commercial fish are distributed to Serang City, Jakarta, and Lampung. However, local people consume low-economic fish, which are processed into salted fish.

The low economic such as pony fish, croakers, threadfin bream, and sardinella processed salted fish has no significant added value to the community. It caused the processing industry in Karangantu fishing port to be still undeveloped. Simultaneously, low economic is highly potential to become fresh material in the fish processing industry to increase its added value [7]. Processing low economic into surimi as raw materials for various processed fish products (meatballs, nuggets, sausages, kamaboko) and gelatin is the appropriate choice to increase added value and product competitiveness based on market-oriented and market needs [8]. Surimi-based products are marketed in different forms (sticks, slices, crumbs, lobster tails) and are prevalent worldwide as convenient food [9].

Fish bones and fish skin are a by-product of surimi production. However, it can be processed into gelatin, which has high economic value and demand in Indonesia. Today the production of domestic gelatin cannot fulfill the necessities of national gelatin. Even the need for gelatin for Indonesia's industry is almost 90% from imports [10]. The gelatin from seawater fish skin had a relatively higher physicochemical characteristic than freshwater and can be used as a gelatin source for halal purposes [11]. Utilizing bone and fish skin into gelatin can be an alternative to generate safe, high-quality, and halal gelatin. It can also reduce Indonesia's industrial dependence on imported gelatin as a raw material in various products [12]. Furthermore, fish bones and skin for producing gelatin is a zero-waste production principle of fish processing to reduce environmental pollution [13].

The development of the fish processing industry in the fishing port area significantly affects local economic growth and social prosperity. This paper discusses the opportunities to utilize low-economic in fishing ports through the development of the fish processing industry based on the production of fish resources and each product's economic value. The growth and development of this business benefit the community and directly develop the fishery processing in the fishing port. Furthermore, it can create the center for low-economic fish utilization activities to build an integrated fisheries industrial area in the Karangantu fishing port.

Table 1. THE FORMULA FOR CALCULATING THE PROPORTION OF MINCED FISH AND PROCESSED PRODUCTS

No.	Criteria	Formula	Price (IDR)
1	Fresh fish (A)	Fish weight	3,000–5,000
2	Minced fish (B)	60% x A	15,000
3	Fish-bone and skin (C)	15% x A	As a waste
4	Fish head and guts (D)	20% x A	As a waste
5	Surimi (E)	80% x B	35,000–50,000
6	Gelatin	8% x C	180,000–250,000
7	Dried fish head and guts (F)	40% x D	As a waste
8	Fish meal	30% x F	15,000
9	Fish ball from minced fish	1.8 x B	20,000
10	Fish ball from surimi	1.8 x B	25,000

2 Method

The research was conducted from January to August 2020 in the Karangantu fishing port. For five years, the production data was collected from government offices, i.e., Karangantu fishing port, Fisheries and Marine Agency of Serang City, Fisheries and Marine Agency of Banten Province, and Ministry of Fisheries and Marine Affairs. The perspective of low economic fish utilization was achieved through in-depth interviews with Karangantu fishing port, the Head of Fisheries and Marine Agency, the Fishermen Association, society figures, and traditional fish processing actors. The potential amount of minced fish, surimi, gelatin, fish meal, and fish balls was estimated based on application in the field using fish meat bone separator and processing fish that's referred to [14–18], as presented in Table 1. The economic value of fish, minced fish, surimi, gelatin, fish meal, and fish balls is calculated based on Indonesia's market price in 2020.

3 Result and Discussion

3.1 The Production of Low Economic Fish

The dominant low-economic fish that landed in the Karangantu fishing port are pony fishes (*Leiognathus* sp.) and sardinella (*Sardinella fimbriata*). The highest production of both fish in 2019 reached 32.94% of total production [19]. The small number of low-economic fish consisted of goatfish (*Upeneus sulphureus*), rainbow sardine (*Dussumieria acuta*), lizard fishes (*Saurida tumbil*), threadfin bream (*Nemipterus* sp.), needlefish (*Tylosurus crocodilus*), croakers (*Pseudociena amoyensis*), dorab wolf herring (*Chirocentrus dorab*) and Indian halibut (*Isettodes irumei*). Fish production in Karangantu is obtained from the Karangantu fishing port and Fisheries Agency of Serang City. The fish production of the Karangantu fishing port is presented in Table 2, and the fish production at Karangantu (landed and not landed in the fishing port) is shown in Table 3.

Table 2. THE FISH PRODUCTION IN KARANGANTU FISHING PORT

Year	Total Fish Production (ton)	Low Economic Fish (ton)	Percentage (%)
2015	1,908	1,058	55
2016	2,031	997	49
2017	2,293	1,199	52
2018	2,420	1,007	42
2019	2,660	1,348	51

Table 3. THE FISH PRODUCTION IN KARANGANTU AREA

Year	Fish Production (ton)		Amount (ton)	Low Economic Fish (ton)
	At Fishing Port	Outside the Port		
2015	1,908	2,560	4,468	2,234
2016	2,031	2,965	4,996	2,498
2017	2,293	3,706	5,999	3,000
2018	2,420	3,841	6,261	3,131
2019	2,660	3,521	6,181	3,091
Average year^{-1}	2,262	3,319	5,581	2,791

The fish production at Karangantu fishing port during 2015–2019 continues to increase, and the amount of low economic fish range from 42–55%, as presented in Table 2. The production of low-economic fish is an average of 50% of the total fish production yearly. This amount is only fish landed in the fishing port. Meanwhile, fish caught in Banten Bay for industrial raw material did not land the fish at the port. These fishermen also sell their fish around the fishing port area. The trend of fish production continues to increase, and low economic fish, as presented in Table 3.

The low economic fish are fish with a low selling price due to low demand despite high production and fish of low quality [20]. Poor handling and the minimal use of ice in handling the catch also cause the quality of the fish to be less well preserved, which in turn causes decreasing the price or low price. The low economic fish are also the fish that are small in size and not according to market demand.

The low-economic fish are usually by-catch and discarded. Most of the by-catch, especially low-economic fish, are mostly thrown back into the sea (discarded) because there is no place to store also no time and energy to handle them. The by-catch and discarded fish are not added because they lack economic value when brought ashore. It is partly due to the absence of a processing industry that utilizes these types of fish to be processed into value-added products [7].

One of the crucial things in capturing fisheries is the presence of discard and by-catch. Unutilized fish is 27 million metric tons annually, or about 30% of total world

production. This figure is prominent enough for the size of fish production [21]. The by-catch can be processed into surimi [7].

Several research results indicate that the by-catch from various fishing gear operating in Banten Bay ranges from 25–74%. The by-catch from bottom gillnet of 71% [22], drift gillnet of 53% [23], single monofilament gillnet of 25% [24], the trap of 74% [25], and boat lift net of 36% [26]. From this description, it can be concluded that the availability of low-economic fish in Karangantu is relatively high. It is necessary to utilize the low economic fish to have a better selling value or added value than only being sold as fresh fish.

3.2 The Opportunity of Utilizing Low Economic Fish

The low-economic fish are dominated by demersal fish groups, which can be used as raw material for fish processing. Demersal fish production reached 41% of the total fish production [27]. This fish is white fish meat that has a better gel formation ability than red meat fish. Surimi production and fish processing can be carried out on a small industrial scale with simple equipment, making it suitable for development in fishery center areas with high fishery production, especially low-economic fish. All types of fish can be processed into surimi, but those chosen usually have a large amount of production and low economic value. Therefore, the use of low-cost fish to become surimi, initiated in the Karangantu fishing port area, is very appropriate.

Minced fish technology and surimi technology are possible to apply utilization on fish with low economic value. Processing low-economic fish activity into surimi, surimi-based product, and gelatin significantly affects the product's economic or added value. The highest added value is surimi, as shown in Table 4. The low-economic fish need to be processed into surimi and processed products because of its broad marketing reach; processed fish products are preferred by the public, and more varied types and processed products.

Table 4 shows the average price of low economic fish at the fishermen's level ranges from IDR 3,000–5,000 kg-1, while the fish collector is around IDR 5,000–7,000 kg-1. There is a price margin of IDR 2,000 kg-1. The revenue obtained by fishermen is IDR 13.96 billion. Meanwhile, if the fish is filled to produce minced fish with a selling price of IDR 15,000 kg-1, it will receive IDR 25.12 billion in revenue. It is a significant increase in economic value with a difference of IDR 11.16 billion. Meanwhile, if the minced fish is processed into surimi, the revenue is IDR 46.89 billion, generating a margin of IDR 32.93 billion.

One of the utilization of low-economic fish, which is abundant, is by making it into surimi. The raw materials used for making surimi are usually raw materials with less economic value but are available in large quantities [8, 28]. Surimi can be made from various types of fish [29]. Multiple studies have shown that low-economic fish can be used as surimi, for example, threadfin bream [7, 30, 31]; croakers [7, 18]; purple-spotted, lizard fishes [7], and sea cat-fishes [32].

Surimi is the Japanese term for mashed or processed minced meat that has undergone several washing processes intended to remove water-soluble components such as protein, sarcoplasm, blood, and enzymes [29]. Surimi is a semi-finished product processed by pulverizing the fish meat, washing it with cold water to remove any less attractive

Table 4. THE ECONOMIC VALUE OF UTILIZING LOW-ECONOMIC FISH

Type of Product	Production (kg year^{-1})	Price (IDR kg^{-1})	Economic Value (IDR million)
Fresh fish	2,791,000	3,000–5,000	13,955
Minced fish	1,674,600	15,000	25,119
Fish skin and bone	418,650		
Fish head and guts	558,200		
Surimi	1,339,680	35,000	46,889
Gelatin	20,933	180,000	3,768
Dried fish head and guts	223,280		
Fish meal	66,984	15,000	1,005
Fish meatball (from minced fish)	3,014,280	20,000	60,286
Fish meatball (from surimi)	2,411,424	25,000	60,286

organoleptic properties, and separating the water. Surimi can be marketed frozen. Surimi is a semi-finished product that can be processed into various products, such as meatballs, sausages, and nuggets. Surimi is processed into kamaboko, chikuwa, and fish ham in Japan. Surimi can also produce surimi-based products such as shrimp and crab meat analog products [33].

The advantages of surimi are: (a) stable supply and facilitates the planning of processed products; (b) lower storage and transportation costs because they are only a fair share of the fish; (c) stable price because it can be stored for a long time; (d) the problem of waste disposal is smaller; and (e) saves labor because handling is more accessible [29, 34].

Surimi processing activities or the fish fillet industry usually produce processing waste in fish bones and skins. Bone and fish skin can be processed into gelatin, a protein derivative of collagen fibers in cartilage. The gelatin function is an emulsifier, a stabilizer in the emulsion system [13].

Surimi and gelatin are intermediate products sold directly to the market and further processed into various product variants with high economic value. High-quality surimi price around IDR 25,000 to 50,000 per kilogram, while gelatin price is IDR 180,000 to 270,000 per kilogram. Domestic gelatin production has not been able to meet national gelatin needs. Almost 90% of the need for gelatin for the industry in Indonesia comes from imports [10].

Waste generated from the fishery activities is still relatively high, around 20–30% of the total material produced. Fish production has reached 6.5 million tons annually; about 2 million tons are wasted as waste. The waste is not yet included due to production errors resulting in a material breakdown. Also, fish processing, where 30% of the body

of fish are the head, bones, and skin [35]. The existence of fish waste in processed fish scraps can cause problems because handling that had been left alone, rot, and stacked all harm the environment, so it is necessary to do countermeasures against the waste [31]. Fish skin and bones can be processed into gelatin. Fish heads and guts can be dried and processed into fish meals.

The utilization of bone and fish skin waste into gelatin is expected to increase its economic value, be a safe and halal alternative for gelatin raw materials, and reduce industry dependence in Indonesia on imported gelatin [12]. Also, fish bones and skins as raw materials for gelatin are a cleaner production of fish processing. Clean production is a processing concept to reduce environmental pollution [13].

Fish meal is one of the fish preservation products in the form dry than ground into flour. Material Fish meal standard is generally less economical fish, a by-catch and waste from fishery product processing in the form of heads, bones, livers, fins, offal, and tail to produce a fish meal (SNI 1996). Fish processing waste in heads and guts can generate an economic value of IDR 1.0 billion by processing it into fish meal, as presented in Table 4.

Fish meal is used in feed formulations with usage rates ranging from 15% in fish feed to 5% in poultry feed. If poultry feed production reaches 5 million tons per year and fish feed is 2 million tons, then at least 0.25–0.75 million tons of fish meal are needed annually. Of this need, 70% still must be imported from various countries such as Peru and Chile. According to BPS data, importing fish meal in Indonesia in 2000 is 87,275 tons with a U.S. $ 39,483 million value. If economic conditions improve, feed production is forecasted to increase to 5.75 million tons. Ironically, Indonesia is a maritime country that still imports 70% of raw materials [36].

National fish meal production needs to be directed to utilize waste material from the fish industry. The small-scale sector of fish meal processing and manufacture in Indonesia would be very appropriate, considering that the availability of trash fish raw materials and processed waste is relatively large [36].

Meatballs are a popular type of food in Indonesia, which is generally made from beef. However, meatballs made from fish are starting to be found on the market. The types of fish often used as raw materials are generally mackerel and tuna, which are pretty expensive [29], so low-economic fish processing can be a solution to reduce raw material costs while simultaneously utilizing low-economic fish, which has been very limited in processing.

Fish balls can be made from minced fish [37] and surimi [38]. Processing into processed and derivative products, such as fish meatballs, can provide much greater added value than only being sold as fresh fish. Processing fish into fish meatballs can provide the most significant economic value from minced fish and surimi, each amounting to 60.29 billion, as presented in Table 4.

As a maritime country, Indonesia has vast waters, but the fish consumption of the Indonesian people is still very concerning. One of them is caused by the lack of variation in fishery products in the form preferred by the community. One of the things that can be done is to diversify processed fish products.

Developing an integrated industrial area for low-economic fish processing into surimi, gelatin, and derivative products will increase added value. It also will increase

competitive advantage and comparative advantage, create new jobs, grow the center of fisheries economic activity, produce intermediate products, and the end product (final product) is quality and has a high marketing opportunity. It is in line with the principle of capture fisheries industrialization, which is carried out through technological transformation and social transformation to change the fishery resource utilization paradigm to improve fishing communities' welfare. The successful application of science and technology for processing surimi, gelatin, and derivative processed products at Karangantu will be a reference in determining national policies in managing fishery ports throughout Indonesia while prioritizing superior potential in each port.

4 Conclusion

The average production of low-economic fish in Karangantu reached 2,791 tonnes year^{-1}. The processing of low-economic fish can increase the economic value of the product. Fish processing can increase the revenue 2–4 times than just selling it as fresh fish. The highest added value is obtained from fish meatballs at IDR 60.29 billion.

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