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Value-added analysis of tuna fish floss: A case study of IKM raja bawang in supporting food security

Sofya A. Rasyid[1]*
[1] *Agribusiness Study Program, Faculty of Agriculture, University of Muhammadiyah Palu, Palu, Central Sulawesi, 94118, Indonesia.*
*Correspondence: sofia_rasyid@ymail.com

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ABSTRACT
Background: Agroindustry is one of the strategic solutions in the development of fishery products, as it not only increases fishery yields but also contributes to improving income and strengthening the regional economy. Additionally, processing fish into value-added products, such as shredded tuna, can support food security through the diversification of processed products with longer shelf life and preserved nutritional value. This study aims to analyze the added value of processing tuna into shredded fish and its contribution to food security. **Method:** The research location was determined puIDRosive, based on the consideration that Raja Bawang IKM is one of the growing agro-industrial businesses producing shredded tuna in Palu City. Respondents were also selected puIDRosively through direct interviews with 1 leader/owner of Raja Bawang IKM, 1 deputy leader, and 4 employees. Thus, the total number of respondents was 6 people who had the competence to provide information related to the business and production of shredded fish. The data used in this study include both primary and secondary data. Value-added analysis was conducted using the Hayami method to determine output value, added value, profit, and labor contribution. **Findings:** The results show that the processing of tuna into shredded fish at Raja Bawang IKM generates an added value of IDR 40,163/kg with an added value ratio of 37.61%. The resulting profit reached IDR 16,163/kg with a profit rate of 40.24%. **Conclusion:** The findings indicate that processing tuna into shredded tuna not only provides economic benefits to business actors but also supports food security by supplying processed fish products with high nutritional value and longer shelf life. **Novelty/Originality of This Article:** It highlights the dual impact of value-added processing in enhancing business profitability and supporting local food security—an area that has received limited attention in prior studies, particularly in the context of micro-scale industries.

KEYWORDS: added value; agroindustry; food security; shredded tuna.

1. Introduction

The fisheries sector plays an important role in economic development, especially in developing countries with large coastal areas such as Indonesia. Fisheries not only contribute to food security, but are also a major source of income for coastal communities (FAO, 2021). As the largest archipelagic country in the world, Indonesia has fisheries potential which is very large, both in the capture fisheries and aquaculture sectors. However, the national fisheries industry still faces major challenges, such as the high rate of post-harvest loss and low utilization of the catch for value-added products (Agustina, 2014).

In recent decades, the processing of fishery products has become increasingly important in order to increase product added value, extend shelf life, and open up new market opportunities (OECD, 2019). The fisheries agroindustry is present as a solution in

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optimizing the use of catches, reducing waste, and increasing the competitiveness of products in the domestic and international markets (Hossain et al., 2021). One form of processing that is growing rapidly in the fisheries industry is shredded fish, especially shredded tuna. Shredded fish is a processed product based on fish meat that has been dried, in the form of fine fibers, and can be stored for a long time without experiencing a significant decrease in quality (Syamsu et al., 2018). This product has high economic value and is in increasing demand, both domestically and abroad. In addition to the economic aspect, processing fish into shredded fish also contributes to food security. Food security includes not only the availability of foodstuffs, but also supply stability, affordability, and people's access to high-value products (FAO, 2021). With a longer shelf life than fresh fish, shredded fish can be a more stable alternative source of protein, especially for areas that experience fluctuations in food supply due to weather factors or limited distribution infrastructure.

Tuna (*Thunnus* spp.) is one of the leading fishery commodities in Indonesia that has high economic value both in the form of fresh consumption and processed products (Najah et al., 2015). How many types of tuna are often used in the processing industry in Indonesia, including yellowfin tuna, bigeye tuna, and albakora (albacore tuna). The processing of tuna into shredded fish has several advantages over other processed products. Long shelf life - Shredded fish has a low moisture content, making it more resistant to spoilage than fresh fish or other processed products such as fish sausages or fish balls (Isnain et al., 2021). High nutritional content- Abin fish is rich in protein, omega-3 and essential fatty acids that are beneficial for body health (Syamsu et al., 2018). Relatively simple processing process- Compared to other fishery products such as canned fish or smoked fish, the process of making shredded fish is relatively easy and does not require large investment in processing technology (Rahman et al., 2020). Wide market opportunities- Shredded fish products are in great demand by consumers because they are practical, can be consumed directly, and have a variety of flavors that can be adjusted to market tastes (OECD, 2019)

However, despite having great potential, the tuna shredded industry in Indonesia still faces various challenges that need to be overcome in order to be able to develop more competitively in the global market. Some of the main challenges faced by this industry include: Price Fluctuations and Availability of Raw Materials (Ministry of Maritime Affairs and Fisheries, 2023), Limited Production technology (Isnain et al., 2021), product standardization and regulation (Suryahadi, 2024), and competition with similar products (OECD, 2019). In Indonesia, one of the areas that has great potential in the tuna processing industry is Palu City, Central Sulawesi. This city is known as one of the capture fisheries centers that has abundant tuna resources. One of the small and medium enteIDRrises (IKM) that is developing in the production of shredded tuna in this area is the Raja Bawang IKM. Raja Bawang IKM is an agroindustrial business that has been operating for several years and one of the production focuses is shredded fish. Despite having promising prospects, the industry faces several obstacles, such as limited capital, lack of product innovation, and instability in raw material prices.

By taking into account the challenges and opportunities that exist, the analysis of added value in this industry is important to understand the extent to which this business provides economic benefits as business actors and the workforce involved. In addition, this analysis can also reveal the contribution of the shredded fish industry to food security through the provision of stable, nutritious, and long-shelf processed fish products. Understanding the added value of processing tuna into shredded fish will provide insight for stakeholders regarding strategies to increase competitiveness and sustainability of this industry. Problem formulation, based on the above background, the main problems that need to be studied in this study are: How much added value is produced from processing tuna into shredded fish products at Raja Bawang IKM in Palu City? How does the processing of shredded tuna fish contribute to food security in the Palu City Area? Research objectives, in line with the formulation of the problem, this research aims to: Analyzing the amount of added value from processing tuna into shredded fish products at Raja Bawang IKM in Palu City. Examine the role of shredded fish processing in supporting food security through the diversification of processed fish products that are durable and nutritious.

2. Methods

2.1 Research time, place, and determination of respondents

The research site was carried out at the Raja Bawang Small and Medium Industry (IKM) located at Jalan Abdul Rahman Saleh, North Birobuli Village, South Palu District, Palu City in September-December 2024. The selection of the research location was carried out deliberately (puIDRosive) based on the consideration that the Raja Bawang IKM is one of the agro-industrial businesses that is developing in the production of shredded tuna in Palu City. The respondents of this study were also determined deliberately (puIDRosive) through direct interviews with 1 leader/owner of the Raja Bawang IKM, 1 deputy leader, and 4 employees. A total of 6 respondents were selected based on their competence in providing information related to business and comprehensive knowledge about fish shredded fish production activities.

2.2 Data collection

The data collected in this study is sourced from primary data and secondary data. Primary data is data obtained from respondents by conducting a survey by means of direct interviews using a list of questions (Questionare). The information collected includes aspects of production, raw material costs, labor, selling prices, and obstacles faced in business. Meanwhile, secondary data is obtained from various sources, such as scientific literature, government agency reports, and documents from related agencies, such as the Fisheries Service and the Cooperatives and MSMEs Service. This data is used to support and strengthen the analysis, including a broader picture of the shredded fish industry, market trends and policies that support the development of small and medium enteIDRrises in the fisheries secto

2.3 Data analysis

The analysis method used in this study is value-added analysis using the Hayami method which aims to determine the value of output, added value, profit, remuneration for labor and processing profit (Intyas et al., 2020), the rare steps of value-added analysis using the Hayami method include: calculating the output value; The output value is obtained from the production of shredded tuna in units of weight (kg) multiplied by the selling price. Calculate added value; Added value is calculated as the difference between the value of output and the cost of the main raw materials used in the production process. Calculating profits and remuneration for labor services; to find out how much labor contributes to the added value generated. Calculates the added value ratio (%); obtained by comparing the added value to the output value, which shows the percentage increase in value of the raw material after it has been processed into the final product. This method allows a comprehensive analysis of production efficiency, as well as helps in evaluating the extent to which small industries of Raja Bawang SMEs are able to provide economic benefits to the business actors and the workforce involved. In full, the formula of the Hayami method is presented in the following table: (Dzulmawan et al., 2019).

Table 1. Value-added analysis according to Hayami

No	Variabel	Calculated Value
1	Output, input, and prices	
	1. Output (Kg)	1
	2. Input (kg)	2
	3. Workforce (HOK)	3
	4. Conversion Factors	$(4) = \frac{(1)}{(2)}$
	5. Labor Coefficient (HOK/kg)	$(5) = \frac{(3)}{(2)}$

	6. Output Price (IDR)	6
	7. Direct Labor Wages (IDR/HOK)	7
2	Acceptance and advantages	
	8. Raw Material Price (IDR/kg)	8
	9. *Sumbangan* Input Other (IDR/kg)	9
	10. Output Value (IDR/kg)	$(10) = (4) \times (6)$
	11. (a) Added Value (IDR/kg)	$(11a) = (10) - (8) - (9)$
	(b) Added Value Ratio (%)	$(11b) = \frac{(11a)}{(10)} \times 100\%$
	12. (a) Labor Income (IDR/kg)	$(12a) = (5) \times (7)$
	(b) Labor Section (%)	$(12b) = \frac{(12a)}{(11a)} \times 100\%$
	13. (a) Profit (IDR/kg)	$(13a) = (11a) - (12a)$
	(b) Profit Rate (%)	$(13b) = \frac{(13a)}{(11a)} \times 100\%$
3	Reply to the owner's service of production factors	
	14. Margin (IDR/kg)	$(14) = (10) - (8)$
	(a) Labor Income (%)	$(14a) = \frac{(12)}{(14)} \times 100\%$
	(b) Other Donations (%)	$(14b) = \frac{(9)}{(14)} \times 100\%$
	(c) Business Owner's Profit (%)	$(14c) = \frac{(13a)}{(14)} \times 100\%$

(Hayami, 2022)

3. Result and Discussion

3.1 Agroindustry, food security, and added value

Agroindustry is a sector that utilizes agricultural and fishery products as raw materials to produce value-added products through processing, preservation, storage, packaging, and distribution processes (Rente, 2018). The development of the fisheries agroindustry not only increases the income of local communities but also contributes significantly to the national food security by providing affordable and high-quality protein sources. In addition, the agro-fisheries industry can reduce post-harvest losses and improve supply chain efficiency, so that ensuring stable food availability throughout the year (Wardana et al., 2024). Effective agro-industrial development can increase the number of workers , farmers' income, export volume, and foreign exchange, as well as expand the market share of agricultural and fishery products (East Kalimantan, 2016). By utilizing abundant natural resources, the fisheries agroindustry can produce high-quality processed products that meet international standards, thereby increasing the competitiveness of Indonesian products in the global market (Agustini et al., 2003).

3.2 Value added

Value added is the difference between the selling price of goods or services and the purchase price of raw materials and various supporting materials used to produce these goods (Rosita et al., 2018). Value added is the difference between the value of a company's output or the total revenue obtained from the sale of that output and the input costs of raw materials, components and services purchased to produce that output (Waknate et al., 2022).

3.3 Shredded fish

Shredded is a type of preserved food derived from meat (beef, buffalo, sea fish, freshwater fish) that is shredded in the form of fibers or separated from the fiber. Then it is added with spices and then fried. Shredded fish is one of the processed fishery products that has a long shelf life and high nutritional content. The relatively simple processing process and does not require large investments makes it a strategic choice in the development of

fisheries agro-industry (Firman et al., 2019). The processing of shredded fish is carried out by frying meat and spices using a lot of oil (deep frying). Deep frying is a frying process where the fried ingredients are all submerged in oil. In the deep frying process system, the temperature used is 170-200°C with a frying time of 5 minutes, the ratio of fried ingredients to oil is 1:2 (Dewi et al., 2011).

3.4 The process of processing tuna into shredded fish

The process of processing tuna into shredded fish goes through several stages that aim to produce high-quality shredded fish with a distinctive taste and longer durability. The process of making shredded fish begins with the selection of good raw materials, cleaning fish, cooking, processing spices, frying, to the final stage in the form of oil pressing, storage, packaging, and distribution of products to the market (Apriyanto, 2022) Dzulmawan et al., 2019) The stages of the process of making shredded fish at Raja Bawang IKM. Selection of raw materials: the main raw material used is fresh marlin tuna. Fish are obtained directly from fishermen to ensure freshness and quality of the meat. The selection of fresh fish is important because it will affect the taste and texture of the shredded fish produced. Cleaning: the fish that has been selected is then cleaned by removing the contents of the stomach, gills, and head. This process is carried out carefully so as not to damage the structure of the meat. After that, the fish is washed using running water for approximately 30 minutes to remove dirt and mucus that is still attached. After the initial wash, the fish is rinsed again to make sure it is completely clean before further processing. Once clean, the fish is cut into pieces to make it easier to process.

Steaming: the pieces of fish are steamed until cooked, with the aim of making it easier to separate the meat from the bones. Steaming also serves to reduce the moisture content in the fish and increase the shelf life of the final product. Once the fish is cooked, the meat is drained and refrigerated. Once cool enough, the fish is ground and shredded into fine flakes to make the mixing process easier with spices. The fish is steamed until cooked (to make it easier to pick up the meat and separate it from the bones). The steamed fish is then drained or cooled. After cooling, the fish is mashed and shredded until it becomes fine flakes. Seasoning: spices such as onion, garlic, coriander, ginger, and several other spices are mashed first to produce a distinctive taste. The mashed spices are then cooked with coconut milk until boiling. After that, the fish that has been stirred is mixed with the spices, then stirred until half dry to ensure that the spices penetrate perfectly into the fish meat. Frying pan: the fish meat that has been mixed with spices is then fried in hot oil for approximately 20 minutes until it turns brownish-yellow. This frying process is carried out in stages with an even stirring so that the shredded meat does not burn and can dry completely. After the frying process is complete, the shredded is removed from the pan and cooled.

Pressing (oil simmering): after frying, the shredded chicken still contains quite a lot of oil. Therefore, the shredded meat is put into a press (spinner) to remove the remaining oil. This pressing process aims to make shredded shredded meat crispier and more durable when stored. After the oil is completely drained, the shredded is removed and cooled again. After the shredded meat is cooled, put it first in an airtight container to keep the shredded meat crispy. Storage: the shredded shredded is placed in an airtight container. Storage in this container aims to maintain the crispiness of the shredded as well as prevent contamination from outside air that can affect the quality of the product. Good storage also plays a role in extending the shelf life of shredded fish. Packaging: after going through the storage stage, the shredded meat is ready to be packaged into aluminum foil plastic packaging with sizes of 100 grams and 200 grams. The use of aluminum foil packaging aims to maintain the quality of shredded meat so that it remains crispy, hygienic, and has a longer shelf life. The packaging is also labeled with information regarding the composition, production date, and expiration date.

Distribution: once packaged, the shredded tuna is ready to be distributed to various marketing channels. The distribution channel of Raja Bawang Palu SMEs is carried out in three ways. Direct distribution channels: shredded tuna products are directly distributed to

regular customers, such as supermarkets and mini markets. In this way, the product can be sold directly to consumers without intermediaries so that the price is more competitive. Semi-direct distribution channels: tuna shredded products are distributed to wholesalers as well as the bread and cake processing industry as complementary ingredients in the manufacture of various processed food products. Indirect distribution channels: products are purchased directly by consumers at the point of production. Consumers who usually buy directly at the factory include the surrounding community, regular customers, groups of guests from various agencies, and tourists who want to make shredded fish as a typical souvenir of Palu City. In general, the process of making shredded tuna at IKM Raja Bawang can be seen in the following picture:

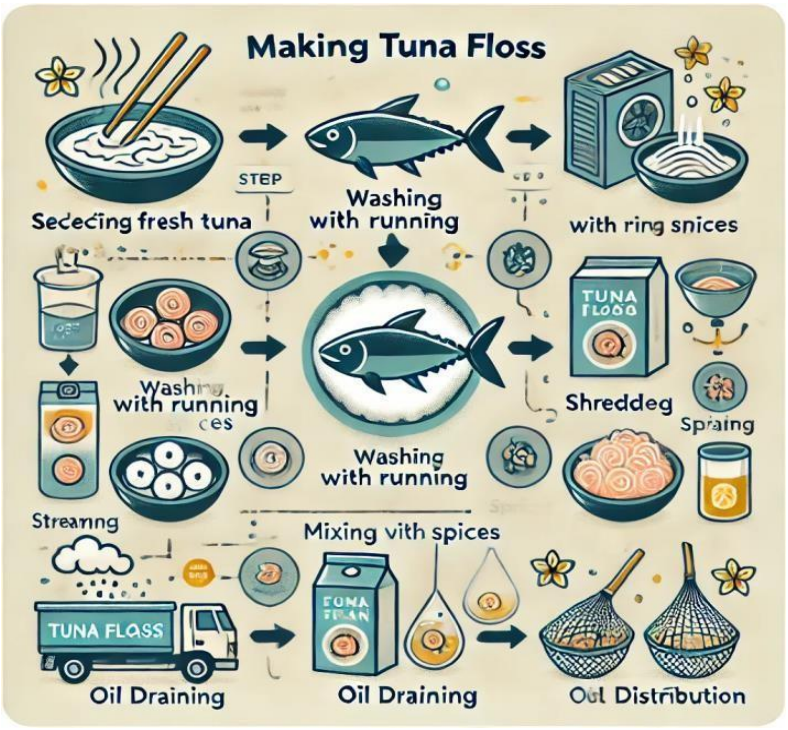

Fig 1. The process of making tuna shredded fish

3.5 Tuna shredded production system

In carrying out the fish shredded production system, there are several things that need to be known, including: the use of raw materials, the cost of supporting/auxiliary materials and the use of labor. Raw material usage: based on the results of research and direct interviews with respondents at the Raja Bawang IKM, it is known that the raw material for making shredded fish comes from the Tuna Marlin type of fish. The procurement of tuna raw materials in the processing of shredded fish is obtained from direct fishermen and other fish collectors. The process of purchasing raw materials is carried out by placing an order in advance by calling the fisherman, then the respondent immediately picks up the raw materials at the purchase location. The raw material payment system is paid directly in cash at the time of purchase at the raw material location. The purchase of raw materials is carried out four (4) times in one month. Each purchase of 50 Kg of tuna raw materials at a price of IDR 55,000/Kg. The raw materials that have been purchased are directly processed in a fresh state and are never stored in the refrigerator, because respondents always maintain the quality of the fish used as shredded fish. The tuna shredded product produced in one production is 17.8 Kg.

Cost of supporting materials: in the production process of shredded tuna at Raja Bawang IKM, the main raw material used is tuna, in addition to the main raw materials also require supporting/auxiliary materials such as spices, cooking oil, gas, and plastic packaging. Auxiliary materials are materials used to complete a product, but their use is

relatively small, or its use is very complicated to recognize the finished product (Indah N, 2023). The need for supporting materials/auxiliary tuna products in detail can be seen in Table 2.

Table 2. Cost of supporting materials for shredded tuna fish products IKM raja bawang

No	Description	Sum	Price (IDR)	Production Cost/ Process (IDR)
1	Cooking Oil (Liter)	12	14,000	168,000
2	Spices		250,000	250,000
3	Gas		33,000	33,000
4	Plastic Packaging 200 gr (lbr)	45	1,050	47,250
5	Plastic Packaging 100 gr (lbr)	88	950	83,600
	Sum		299,000	581,850

Based on Table 2. It can be seen that the total cost of supporting materials incurred in producing 50 kg of tuna raw materials is IDR 581,850. The cost of using the highest supporting ingredients in the use of spices is IDR 250,000. This is because Raja Bawang IKM in producing shredded products still maintains the best quality of shredded taste for its consumers. Labor usage: IKM Raja Bawang Palu in carrying out its business has 12 agro-industrial products. The main product is fried onions, but over time this company began to develop its business, namely by producing other snacks, including: various shredded onions, various chili sauces, various chips, various coffees, pastries, etc. The use of labor at Raja Bawang IKM in the process of making shredded tuna is needed to carry out various production activities such as washing, packing, crushing/shredding, mixing spices, frying, oil drizzling, storage, packing, and distribution. The total number of workers is 6 people. Labor wages are calculated per month (four times the production process) which is IDR 1,600,000/person so that the cost of labor wages incurred for one month with 6 people is IDR 9,600,000. The average wage per product is IDR 800,000/month, so the average wage per production is IDR 200,000. Production: raja Onion IKM produces shredded fish four times in one month. Each time production uses 50 kg of tuna raw materials. The tuna shredded products produced in one production are 17.8 Kg. Tuna shredded fish production activities are carried out regularly in each production time presented in Table 3 below.

Table 3. Production volume of shredded fish of raja bawang IKM in Palu City for one month

No	Production Process Period	Production Volume 100 gr (packaged)	200 gr (packaged)	Production Volume (Kg)
1	I	88	45	17.8
2	II	88	45	17.8
3	III	88	45	17.8
4	IV	88	45	17.8
Sum		352	180	71.2
Selling Price per package (IDR)		30,000	60,000	300,000
Production Value		1,056,0000	1,080,0000	21,360,000

Based on Table 3, it can be explained that the production of shredded fish produced for one month for a 100 gr package with a selling price of IDR 30,000 amounted to 352 packages with a production value of IDR 10,560,000, while for 200 gr packaging with a selling price of IDR 60,000 a total of 180 packages with a production value of IDR 10,800,000. The total production volume produced is 71.2 kg with a selling price @ IDR 300,000/kg resulting in a total production value of IDR 21,360,000.

3.6 Added value analysis

The value-added analysis in this study uses the Hayami method (Hayami, 2022). The activity of processing tuna into shredded fish is able to provide added value for Raja Bawang SMEs. In the analysis of added value, the amount of added value and the manager's profit

can be known. For more details on the analysis of the added value of shredded tuna in one production process, see Table 4.

Table 4. Analysis of the added value of tuna shredded tuna products IKM raja bawang per production process

No	Variabel	Calculated Value
1	Output, input, and prices	
	1. Output (Kg)	
	2. Input (kg)	50
	3. Workforce (HOK)	6
	4. Conversion Factors	0.35
	5. Labor Coefficient (HOK/kg)	0.12
	6. Output Price (IDR)	300,000
	7. Direct Labor Wages (IDR/HOK)	200,000
2	Acceptance and advantages	
	8. Raw Material Price (IDR/kg)	55,000
	9. *Sumbangan* Input Other (IDR/kg)	11,637
	10. Output Value (IDR/kg)	106,800
	11. (a) Added Value (IDR/kg)	40,163
	(b) Added Value Ratio (%)	37,606
	12. (a) Direct Labor Income (IDR/kg)	24000
	(b) Labor Share (%)	59.76
	13. (a) Profit (IDR/kg)	16,163
	(b) Profit Rate (%)	40.24
3	Reply to the owner's service of production factors	
	14. Margin (IDR/kg)	51,800
	(a) Labor Income (%)	46.33
	(b) Other Donations (%)	22.47
	(c) Business Owner's Profit (%)	31.20

Based on Table 4, it can be explained that added value is obtained from the tuna processing process (input) until it becomes a processed product (output), namely shredded fish. The input used is 50 kg resulting in an output of 17.8 kg/production process. So that the conversion factor obtained is 0.356. This conversion value shows that each processing of 1 kg of tuna will produce 0.356 kg of shredded fish. The conversion factor is a comparison between the use of the input and the output produced. This happens because the conversion factor is determined by the output. The more output obtained from the input, the greater the conversion factor obtained, because the greater the number of conversion factors obtained, the greater the added value created from a product. The labor coefficient is obtained from the ratio between the number of workers and the inputs processed. The results of the calculation obtained a labor coefficient of 0.120 HOK/kg, which means that each worker in 1 production process is able to process 0.120 kg of raw materials with an average labor wage of IDR 200,000. Meanwhile, the labor share is the ratio between labor rewards and added value which is also worth 66.37%. The average price of shredded fish products in marketing is IDR 300,000/kg. The average price of raw materials is IDR 55,000/kg. Other input contributions consist of supporting materials, namely; cooking oil, spices, gas, and plastic pacaging. In the process of processing shredded fish, another input contribution amounted to IDR 11,637/kg. Other input contributions are the total distribution of other input contributions by the amount of raw materials used. The output value is the multiplication of the conversion factor and the output price of IDR 106,800/kg of raw materials. The value of this product is influenced by the magnitude of the value of the conversion factor.

The added value of processing tuna into shredded fish obtained value amounting to IDR 40,163/kg of raw materials. This figure is the difference between the value of the product and the price of raw materials and other input contributions. The amount of product added value obtained is influenced by several factors, including the cost of other input donations in addition to the cost of raw materials. From the calculation of added value, the ratio of

added value is obtained by dividing the added value by the output value. The added value ratio is the percentage of added value to the output value. The ratio of added value in shredded fish is 37.61%. The income of the labor is directly the result of the multiplication of the labor coefficient and the average wage that. The value is IDR 24,000 production process. The share of labor is obtained from the division between direct labor income and added value multiplied by 100%, which is 59.76%. The profit obtained from the processing process of shredded fish amounted to IDR 16,163/kg of raw materials. This figure is obtained from the added value minus income to the workforce and the profit rate of 40.24%. Margin is the difference between the value of output and the price of raw materials. The margin value obtained was IDR 51,800/kg consisting of 46.33% direct labor income, 22.47% contribution from other inputs, and 31.20% profit from Raja Bawang IKM owners.

The findings of this study show that the processing of tuna into shredded fish at the Raja Bawang IKM provides a significant added value of IDR 40,163 per kilogram with an added value ratio of 37.61%, as well as a profit of IDR 16,163 per kilogram with a profit rate of 40.24%. This confirms that small and medium industries (SMEs) in the fisheries sector have promising economic potential, not only for business owners but also for the workforce involved in the production process. When compared to other studies, the study (Dzulmawan et al., 2019) found that the processing of shredded tuna in the Dzakiyah Permata Kendari household industry produced an added value of IDR 184,485 per kilogram, with an added value ratio of 89.8%, and a profit rate of 88.5%. This difference in added value can be caused by the scale of production, the efficiency of the processing process, and the cost structure applied in each industry. In addition, a study by (Ujung et al., 2016) which analyzed the business income of tuna fish in the Fishery Women Farmers Group in Makassar showed an annual income of IDR 254,284,600, or around IDR 254,284,600, or around IDR 21,190,383 per month. This shows that the fishery-based agro-industrial sector can be a significant source of income for small and medium-sized business groups. From a sustainability perspective, research by (Nurhayati et al., 2019) on the production of shredded catfish and meal with the principle of zero waste shows that a sustainability-based processing approach can increase added value and minimize waste. The implementation of similar technology in the processing of shredded tuna has the potential to increase production efficiency and environmental sustainability.

From the perspective of product diversification, research (Hamidi, 2016), regarding the agro-industry of shredded catfish in Riau reported that the added value obtained reached IDR 12,121.83 per kilogram with a profit margin of 91.84%. Although this figure is lower than shredded tuna in Kendari, this study shows that different types of fish have different added value potentials depending on the production process and the efficiency of using raw materials. As a comparison with non-fishery agro-industries, a study by (Ruauw, 2015) on the nutmeg candied industry in Bitung City found that the added value from processing nutmeg into sweets reached IDR 45,070 per kilogram, with an added value ratio of 95%. This shows that the agricultural product-based agro-industry sector also has a very high potential for added value, albeit with different cost structures and production processes. This also in line with research by (Kade Suliati et al., 2021) this study highlights that local food-based micro-businesses such as grilled corn can also provide added value for household business actors. Although the added value per unit may be lower than the shredded fish processing industry, the sector has the characteristics of a union in terms of lower initial capital, a simpler supply chain, and greater absoIDRtion of informal labor.

3.7 The contribution of tuna shredded fish processing to food security

The results of the study show that the processing of tuna into shredded fish makes a significant contribution to food security in the Palu City area through four main aspects. Food product diversification: the development of shredded fish not only adds to the variety of products in the local market, but also enriches food choices for the community. Food diversification is widely recognized as an important factor in achieving nutritional security and resistance to supply disruptions. Research (Abedin & Haque, 2021) reports that

increasing the variety of food products can reduce the risks associated with monoculture farming systems and dependence on limited food sources. Increased storage capacity: extending the shelf life of perishable food products is essential to reduce crop losses and ensure a stable food supply. Processing tuna into shredded fish has been proven to significantly extend the shelf life of products by reducing moisture content and inhibiting microbial growth. According to (Nurdiani et al., 2022) that processing with drying and heat treatment techniques can effectively extend the shelf life of fish products, thereby increasing food availability in certain periods.

Local economic empowerment: the formation of small and medium enteIDRrises (SMEs), such as Raja Bawang IKM, through the production of shredded tuna contributes greatly to the empowerment of the local economy. This form of added value not only creates jobs, but also encourages increased income and community development. A study conducted by (Ramdlaningrum et al., 2023), found that empowering micro, small and medium enteIDRrises (MSMEs) has a positive impact on household economic resilience and increasing access to better nutrition. Fisheries waste reduction: conversion of excess fish into high-value products such as shredded fish is a solution to overcome the problem of fishery waste. The utilization of fishery by-products not only reduces environmental pollution, but also creates additional sources of income. A study by (Mardiyana et al., 2022) highlights the need for a better waste management strategy in the fish processing MSME sector.

4. Conclusion

The results of this study answer the main question by showing that the processing of tuna into shredded fish at Raja Bawang IKM produces a significant added value, which is IDR 40,163 per kilogram with an added value ratio of 37.61%. The profit obtained reached IDR 16,163 per kilogram, with a profit rate of 40.24%. These findings confirm that the processing process is not only economical and profitable for business owners, but also contributes significant income to the workforce. Good labor efficiency and input conversion and processing factors play an important role in increasing added value, making this business competitive and sustainable. The processing of tuna into shredded fish contributes to food security in the city of Palu through four main aspects, namely: food diversification, increasing shelf life, empowering the local economy, and reducing fishery waste. This innovation supports food availability, community welfare, and environmental sustainability.

Increase in production scale; In order for a economic benefits and food security to be greater, business actors need to a increase the production capacity of shredded tuna through investment in modern equipment and improving the efficiency of the production process. Strengthening Marketing and Distribution; Digital marketing strategies as well as the expansion of distribution networks to a wider markets, including supermarkets and e-commerce, can increase competitiveness and product demand. Product Innovation and Diversification; The development of a shredded tuna variants with flavor, packaging, and nutritional fortification innovations can increase attractiveness and expand consumer segments. Policy and Partnership Support; Support from the government and the private sector in the form of training, access to capital, and policies that support MSMEs will accelerate the growth of the shredded fish industry. Optimization of waste utilization; To make it a more environmentally friendly, leftover products such as bones and fish heads can be processed into value-added products, such as fishmeal or animal feed.

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Biography of Author

Sofya A. Rasyid, Agribusiness Study Program, Faculty of Agriculture, Universitas Muhammadiyah Palu, Palu, Central Sulawesi, 94118, Indonesia.

- Email: sofia_rasyid@ymail.com
- ORCID: N/A
- Web of Science ResearcherID: N/A
- Scopus Author ID: N/A
- Homepage: N/A