Logistics Cost Analysis in Fish Supply Chain in West Sumatra Using Activity-based Costing Method

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ABSTRACT

Pariaman is a city in West Sumatra that has many residents whose livelihoods are in the fisheries sector. Usaha Perikanan Mandiri Muaro Cinto (UPMMC) located in the Pariaman area is known to face challenges related to managing their logistics costs. This MSME has not been able to clearly identify the components of the logistics costs of the business they run so that business improvement strategies have not been formulated considering that key activities along the supply chain have not been mapped. Therefore, a logistics cost analysis was conducted for the UPMMC fish supply chain using the activity-based costing method. Several actors in the supply chain observed include suppliers, distributors, manufacturers/retailers, and customers. Based on the calculations carried out, it is known that the largest costs are in procurement activities, especially in fishing operations with a proportion of 33.15%. In addition, it is also known that shipping costs have a proportion of 32.93% or equivalent to IDR 2,143 per kg of tuna while packaging costs take a proportion of 19.98% of the total logistics costs.

1. INTRODUCTION

Pariaman is one of the cities located on the coast of West Sumatra Province, so it is not surprising that many residents make a living in the fisheries sector. Therefore, the fisheries business there has grown to be very competitive. To achieve maximum profit and ensure business sustainability, the right business strategy is needed. The fisheries business cannot stand alone, its success comes from the supply chain that supports it. There are many actors involved and working together in the fish supply chain. One aspect that is the main pulse of the supply chain is the flow of finance, besides of course the flow of goods and information (A. Szymonik, 2012) so that cost management along the supply chain is important to study. So far, people have not designed their business financing or if there is, it is not detailed, mainly due to limited human resources especially for small and micro-scale businesses. To achieve an impactful research level, we take the case of calculating the specific costs related to logistics activities at the Muaro Cinto Independent Fisheries Business (UPMMC), Pariaman. This is a unique challenge and opportunity that has the potential to be applied with modifications in similar Ministry of Micro, Small and Medium Enterprises (MSMEs) in the future.

In detail, this study is intended to analyze logistics costs so that the activities that play a role and are the main key in the supply chain of captured fish in the observed MSMEs can be identified. For this purpose, the Activity-based Costing (ABC) method (A. Almeida and J. Cunha, 2017), (T. L. Pohlen and B. J. La Londe, 1994) is used, the calculation of which is based on the identification and classification of business activities. One of the benefits associated with the use of activity-based costing is that the presentation of costs inherent in goods or services becomes more specific. This results in a more accurate measurement of product profitability, which helps in making the right strategic decisions about selling prices, product lines, markets, and business capital expenditures (C. M. Callahan et.al, 2009; A. Myrodia et.al, 2017; , I. Mahal and A. Hossain, 2015). In addition, the activity-

based costing system can also help entrepreneurs manage their competitive advantages, strengths, and weaknesses by measuring activity costs that relatively well represent the real aspects of operations in the field. This method can also improve the accuracy of financing and accuracy in cost details (L. Cannavacciuolo,2015; R. Cooper and R. S. Kaplan, 1992).

2. RESEARCH METHODOLOGY

The processed data in this study were obtained through interviews with the owner of the Muaro Cinto Independent Fishery Business in Pariaman, West Sumatra. In addition, there are supporting data used, namely the results of logistics cost analysis and information related to profit margins to assess the efficiency of the supply chain and become the basis for preparing future supply chain strategies. The calculation of logistics costs in the scope of the fish supply chain is carried out in several stages. First, collecting data on the flow of goods described in the fish supply chain structure in Pariaman, West Sumatra. Second, obtaining information on the costs for each resource used. Third, calculating the total expenditure for each activity carried out. Fourth, calculating the absolute costs incurred for each product shipped, as explained by N. Roztocki et.al,2014; R. S. Kaplan and S. R. Anderson,2007. As quoted by B. P. Nepal, 2015, the cost drivers of supply chain management services include labor and overhead costs associated with customer order management, purchasing, shipping costs, special packaging requirements, and profits for all these driver functions. The ideal approach to measuring these costs is to use activity-based costing. Furthermore, a comprehensive examination of income information is carried out with the aim of understanding the contribution of profits between actors in the organization of fish distribution activities, so that the productivity of its distribution can also be determined. The basis for the calculation used for the income examination is as follows (1), (2), and (3).

$$Mj_n = Ps_n - Pb_n \qquad \qquad (1)$$

Note:

Mj_n = Marketing profit (IDR/kg)
Ps_n = Selling price of fish at n^{th} tier in the fish supply chain
Pb_n = Purchase price of fish at the nth tier in the fish supply chain

$$Sm = \frac{Psm}{Pr} \ x \ 100\% \qquad \qquad (2)$$

Note:

Sm = Shared margin
Ps_n = Selling price at the nth tier in the fish supply chain
Pr = Customer price

$$pm = \frac{\pi n}{btn} \ x \ 100\% \qquad \qquad (3)$$

Note:

pm = Profit margin
π_n = Profit at the nth tier in the fish supply chain
bt_n = Costs at the nth tier in the fish supply chain

3. RESULTS AND DISCUSSION

The general fish supply chain in Pariaman is illustrated in Figure 1. Suppliers, distributors, manufacturers/retailers, and customers are the four tiers involved. Fisherman and boat owners, who usually operate as one unit, are the supply chain actors at the supplier level. Fisherman are employed by boat owners and receive salaries proportionally depending on the amount of catch. The main fish providers are fisherman while boat owners provide the equipment and tools needed to go to sea and fund fish netting operations.

There are three actors who act as distributors in the fish supply chain, namely small collectors, big collectors, and exporters. Small collectors are the main collectors who buy fish directly from fisherman but on a limited scale. Big collectors are parties who get fish from small collectors but also get fish directly from fisherman around their work area. Some big collectors send their fish to exporters or to inns and restaurants in various large urban communities. In addition, under certain conditions, big collectors can also sell to small collectors or send them to agents outside the area.

Before reaching the final buyer in the supply chain network, fish are generally sent to processing facilities such as restaurants or hotels in large cities. Final buyers can also buy fresh or frozen fish through market traders. Small traders (retailers) will make offers in limited quantities although sometimes they also make purchases in large quantities. Fish buyers in Pariaman consist of two groups, namely domestic/local buyers and foreign customers. Customers worldwide get fish from exporters, while domestic buyers generally get fish from restaurants, hotels, fish processing depots or from modern retailers or traditional markets.

The supply chain described above applies to marine catches in general, although not all types of fish go through the supply chain shown in Figure 1. In this study, the cost of tuna fish is calculated at its best catch condition. When the ship docks at the estuary, the fish will be taken to big collectors without going through small collectors first. Big collectors will send the fish to agents outside the city. Meanwhile, for the needs of residents, fish are usually supplied by small fisherman. So, the scope of this study is limited to the UPMMC unit which includes 2 tiers, namely first and second tier suppliers.
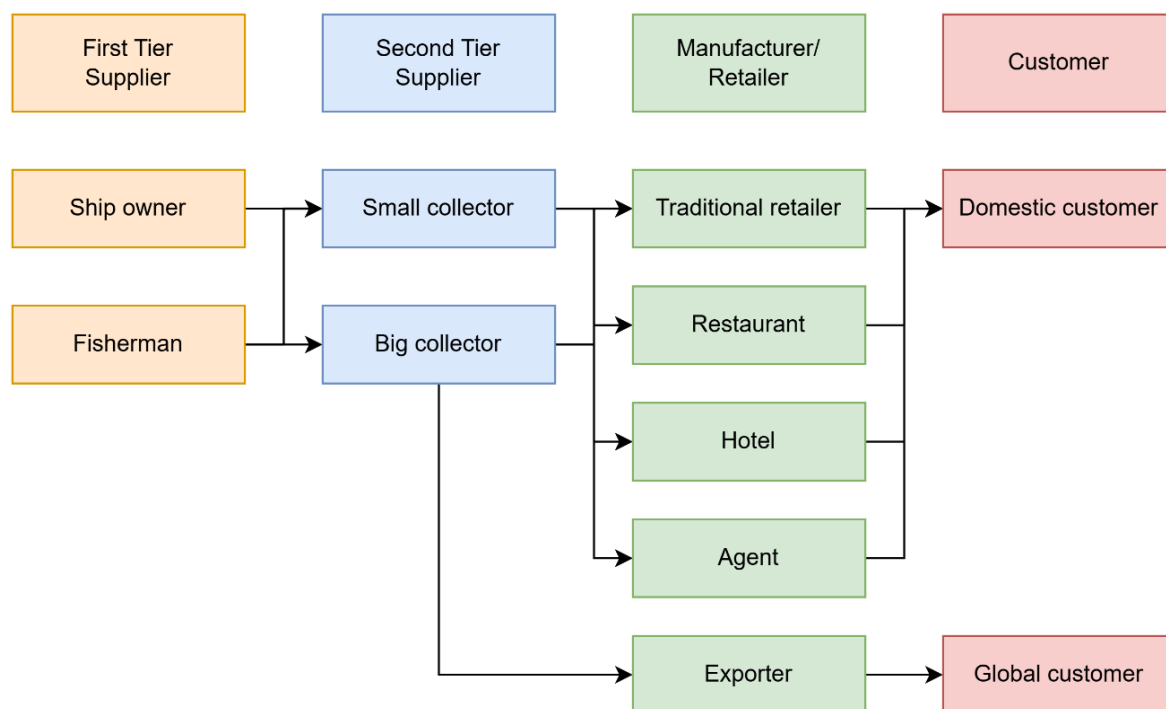
**Fig. 1.** Marine product supply chain scheme in Pariaman

The analysis of logistics costs in this study is limited to the supply chain involving ship owners, fisherman, and big collectors. In calculating costs, ship owners and fisherman are considered as one unit because fisherman are part of the Muaro Cinto organization. Basically, big collectors are also part of the Muaro Cinto organization, but because big collectors can also manage fish from other vessels, big collectors are determined as a separate tier. In addition to not being part of the Muaro Cinto organization, manufacturers and retailers are not considered because in this tier there is usually a value-added process consisting of various different activities depending on the processes that occur in it.

Tuna is one of the main fishery commodities in Pariaman. Unlike other marine products that are only obtained at certain times, tuna is usually available throughout the year. However, there is a significant increase in catches during certain periods. Tuna usually appears more when the moon is dark and decreases when the moon is bright, namely when the moon is 7-22 days old. Tuna also has a price that does not fluctuate too much, except when conditions are very rare or abundant. In its best condition, the average ship brings home a catch of 700 kg per day, thus, the logistics cost analysis is carried out according to the average price and average catch quantity during its best season.
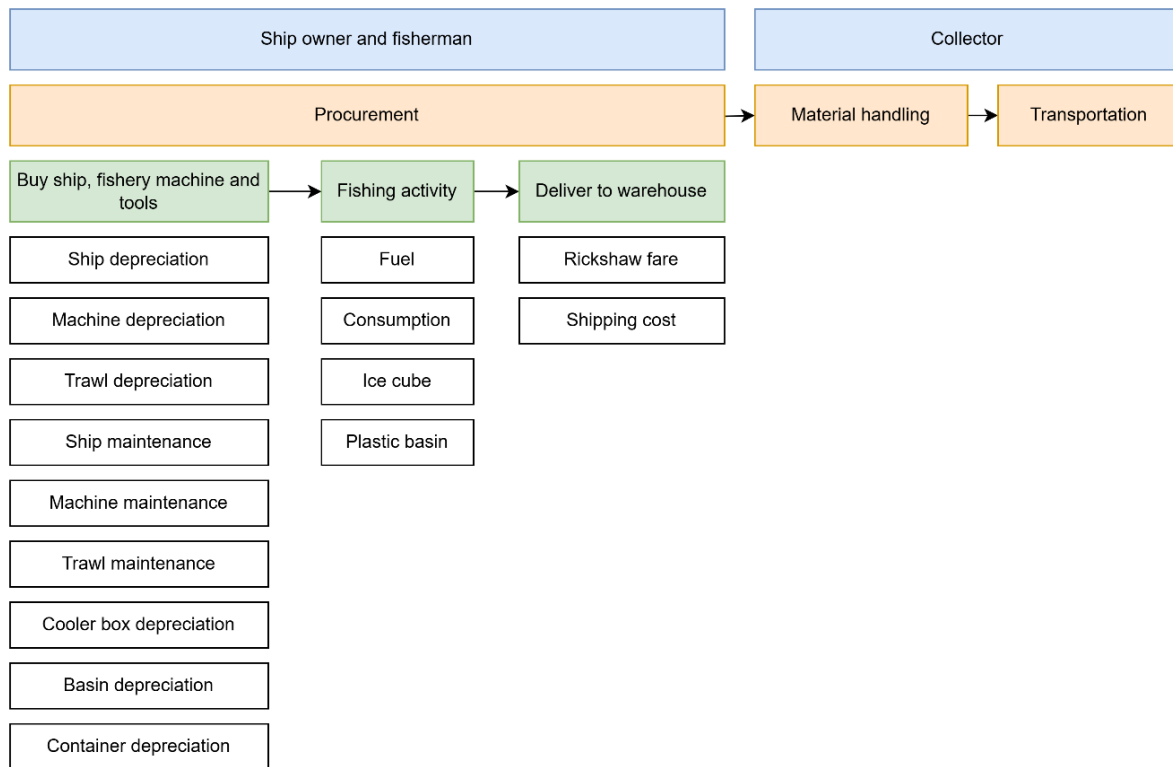
Fig. 2. Logistics activity scheme of Muaro Cinto Independent Fisheries Enterprise in Pariaman: Procurement

The logistics activity scheme of Muaro Cinto Independent Fisheries Business in Pariaman shown in Figure 2 and 3 include various stages and cost components required. Starting with the procurement of complete ships, engines, and fishing equipment, the activities that occur are preparing ships and equipment for fishing. The costs required in this process are ship depreciation costs, engine depreciation, fuel, and routine maintenance costs and the actors who play a role in this stage are ship owners and fisherman. Then, it is continued with fishing operations at sea including the operation of ships and fishing gear, involving fuel costs, supplies (food and drink), ice blocks for cooling fish, and plastic basins to hold the fish caught. After the catching process, the fish are transported to the warehouse for further processing, involving lifting wages. In the warehouse, the caught fish are treated and cooled so that the quality of the tuna is maintained. The costs required in this process are the depreciation costs of fiber boxes, ice blocks, and sea water as a cooler. Then it is continued with the fish sorting and weighing process, which involves the activity of sorting fish based on quality and size and weighing to determine weight. The costs required in this process are the depreciation costs of the packaging box, inner box plastic, and labor wages and the actors who play a role in this process are big collectors. The last step is shipping, the activities involved are transportation and the costs required are pick-up car rental, driver salary, fuel, travel costs and other costs. The actors who play a role in this process are big collectors.
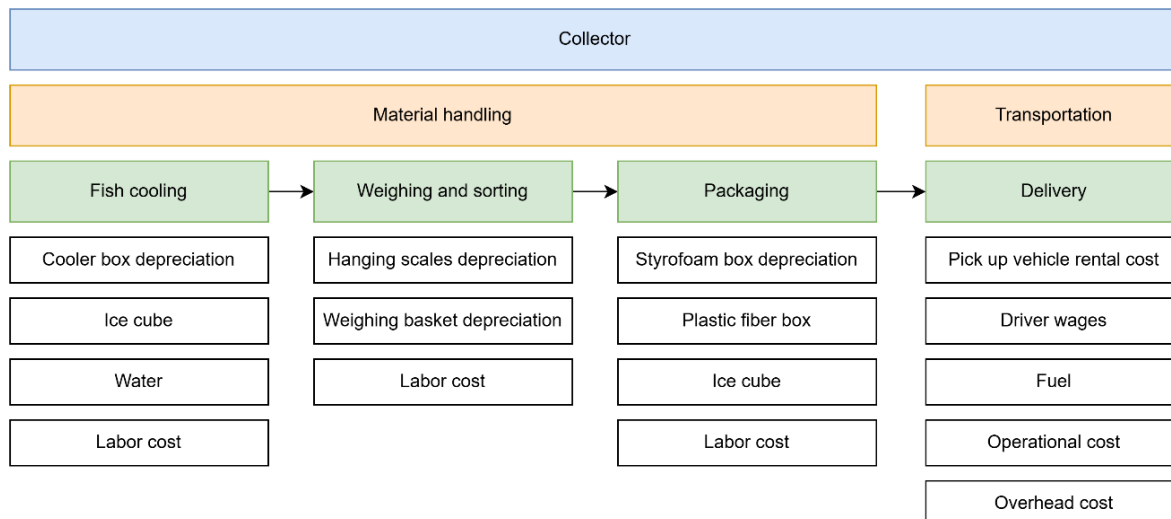
Fig. 3. Logistics activity scheme of Muaro Cinto Independent Fisheries Enterprise in Pariaman: Material handling and transportation

Logistics cost calculation is done by applying activity-based costing method. In the first stage, the main activities and their constituent activities are identified. For each activity, the resources involved will be identified (Table 1). The types of resources used in each skipjack tuna logistics activity can be seen in Figure 2 and 3. The costs incurred due to these resources are arranged based on their activities so that at the end of the calculation the amount of costs for each logistics activity can be known. Furthermore, the cost driver will be determined for each activity. The cost driver charges the activity cost from the cost pool to the cost object. The cost of an object may increase or decrease due to the cost driver. Table 2 shows the costs incurred for each supply chain activity based on the cost driver. This table is obtained by separating the total cost of the activity from the cost driver, resulting in the activity overhead cost per unit of cost driver, which is generally called the pool rate. Since there is only one type of goods, namely skipjack tuna, the total costs for activities and goods are consistently almost the same. To find out the cost of a cost object, if the result is the number of tuna (kg), then the total cost of goods is divided by the number of fish sent each day, as shown in Table 3.

Table 1.   Identify Resources for Each Activity

Main Activities	Detail Activities	Supply Chain Actors	Cost Drivers
Procurement	Procurement of ships, engines and fishing gear	Ship owners and fisherman	Intensity of use (times)
Procurement	Fishing operations	Ship owners and fisherman	Number of trips (times)
Procurement	Transportation to warehouse	Ship owner	Number of catches (basins)
Material handling	Fish care and cooling	Big collector	Treatment intensity (times)
Material handling	Sorting and weighing	Big collector	Fish handling intensity (times)
Material handling	Packaging	Big collector	Number of packages (boxes)
Transportation	Delivery	Big collector	Delivery intensity (times)

The largest cost is in procurement activities, especially in fishing operations with a proportion of 33.15%. This is because of the large costs incurred for one fishing trip. In one trip, a total cost of IDR 1,500,000 is needed. If charged to the cost object, which in this case is 700 kg of tuna in one trip, each kg of tuna is charged a cost of IDR 2,157. This cost will later be borne by the ship owner. Other cost activities that have a large proportion are shipping transportation costs and packaging costs. Shipping costs have a proportion of 32.93% or equivalent to IDR 2,143 per kg of tuna. This value is almost the same as the operational costs of fishing. The amount of transportation costs is influenced by the distance of the destination, which is quite far, namely to Bangkinang, Riau, which requires a

large travel cost for one shipment. Then the packaging cost takes a proportion of 19.98%. The packaging cost is quite large because a lot of materials are needed to pack one box of fish.

Table 2. Costs for Each Activity in The Supply Chain Based on Cost Drivers

Main Activities	Detail Activities	Resource	Ship Owners and Fisherman (IDR)	Big Collector (IDR)
Procurement	Procurement of ships, engines and fishing gear	Ship depreciation	16,438	-
		Machine depreciation	43,053	-
		Trawl depreciation	5,479	-
		Ship maintenance	4,11	-
		Machine maintenance	5,556	-
		Trawl maintenance	50,000	-
		Depreciation of cooler fiber box (120 kg)	438	-
		Basin depreciation	4,444	-
		Float depreciation	1,111	-
	Fishing operations	Fuel oil	1,200,000	-
		Provisions (food and drink)	150,000	-
		Ice cubes	40,000	-
		Plastic basin	120,000	-
	Transportation to warehouse	Rickshaw wages	5,000	-
		Lifting wages	5,000	-
Material handling	Fish care and cooling	Depreciation of cooler fiber box (500 kg)	-	1,644
		Depreciation of cooler fiber box (120 kg)	-	877
		Ice cubes	-	240,000
		Sea water	-	60,000
	Sorting and weighing	Depreciation of hanging scales	-	1,111
		Depreciation of weighing basket	-	833
	Packaging	Styrofoam box depreciation	-	1,000
		Duct tape	-	3,000
		Plastik fiber box	-	8,000
		Labor	-	20,000
		Ice cubes	-	20,000
Transportation	Delivery	Rent a pick-up car	-	500,000
		Driver salary	-	300,000
		Fuel oil	-	450,000
		Travel expenses (meals)	-	200,000
		Miscellaneous expense	-	50,000

Table 3.   Cost Proportion Details

Main activities	Detail Activities	Average Cost per kg of Tuna (IDR)		Total Logistics Cost/kg Tuna (IDR)	Proportion of Total Logistics Costs/kg of Tuna (%)
		Ship Owners and Fisherman	Big Collector		
Procurement	Procurement of ships, engines and fishing gear	187	-	18	2.87
Procurement	Fishing operations	2,157	-	2,157	33.15
Procurement	Transportation to warehouse	286	-	286	4.39
Total procurement cost		2,629	-	2,629	40.41
Material handling	Fish care and cooling	-	432	432	6.64
Material handling	Sorting and weighing	-	3	3	0.04
Material handling	Packing	-	1,300	1,300	19.98
Total biaya penanganan bahan		-	1,735	1,735	26.66
Transportasi	Delivery	-	2,143	2,143	32.93
Total transportation cost		-	2,143	2,143	32.93
Total logistics cost/kg Tuna		2,629	3,878	6,507	100.00

Boat owners and fisherman bear the total procurement cost of IDR 2,629/kg, while big collectors are responsible for the cost of handling materials of IDR 1,735/kg and transportation costs of IDR 2,143/kg. Overall, big collectors bear a larger proportion than boat owners and fisherman. Big collectors bear a total of 59.59% while boat owners and fisherman only bear a total of 40.41% of the total cost. This is because to manage relatively large quantities of tuna, big collectors must bear the cost of handling materials and transportation and require more labor. Value-added activities such as packaging are also factors that influence the amount of costs borne by big collectors and the largest storage costs.

Value Chain Analysis

In the activity-based management process, the ABC method acts as a source of information and focuses on important business operations, such as process efficiency and effectiveness. Therefore, this study uses activity-based cost analysis to calculate the value chain components listed in Table 4. The profit value obtained by the ship owner and fisherman is IDR 9,371. This profit will be divided into profits for the ship owner and the fishing team. The ship owner will get half of the net profit, which is IDR 4,685 per kg. While the rest will be divided by the number of fisherman + 1. Plus 1 here is the amount of costs incurred for charity. The number of fisherman who carry out fishing operations is 10 people, where each of them gets a profit of IDR 426 per kg.

The total marketing margin is the difference between the costs received by the buyer and the costs received by the producer Y. (Latumahina et.al,2021) Based on the calculation results, the total marketing margin from chain 1 to chain 2 is $Mj2 = Ps2 - Pb2$ = IDR 17,000 - IDR 12,000 = IDR 5,000, where this margin value is from big collectors. There is no marketing margin for ship owners and fisherman, indicating that they sell their catch at a price that is in accordance with the market price received by big collectors, without any additional profit from themselves in this marketing chain.

Shared margin indicates the income earned by each actor in the supply chain (P. Darcy D, 1012) from marketing activities without calculating the logistics costs incurred. Ship owners and fisherman as the first suppliers, get the largest share of marketing activities. This is because they do not purchase products (skipjack tuna), but produce and provide products. So based on the calculation results,

fisherman get $S_m = \frac{Ps_n}{P_r x 100}\% = $ IDR12,000 / IDR17,000 $\times$ 100% = 70.59% of the last selling price received by big collectors. This proves that fisherman have a strategic position in the supply chain because they control the main resource, namely skipjack tuna. The shared margin value reflects the power dynamics that occur in the skipjack tuna supply chain, where fisherman who act as controllers of the main resource have a significant advantage in gaining profits in this marketing activity.

Overall income (profit margin) is the proportion used for overall net income and is generated in the form of a percentage. In addition, the profit margin shows the difference in value between the profit and the total logistics costs or operational costs incurred (A. D. Eskatectona et.al, 2021). The largest total logistics costs are found in big collectors and the largest profits are found in ship owners. Ship owners and fisherman have a total profit margin of $pm = \frac{\pi_n}{bt_n} \times 100\% = \frac{12.000-2.629}{2.629} \times 100\% = 356,37\%$ of the total logistics costs used, much higher than the profit margin of big collectors who only $pm = \frac{\pi_n}{bt_n} \times 100\% = \frac{17.000-12.000-3.878}{3.878} \times 100\% = 28,94\%$. This is because the ship owners are not involved in marketing activities and only bear the costs for the procurement of ships, fishing gear, and fishing operations. The intensity of asset use, which is a type of long-term investment (R. Duncan and I. Temu ,1997)determines the activities of the constituents. Because ship owners and fisherman work together, they generate huge profits. Because ship owners and fisherman do not bear more costs than big collectors, the value chain becomes unbalanced.

Table 4. Profit Calculation

No.	Profit Details	Value Code (IDR/kg)	Marketing Margin (IDR)	Shared Margin (%)	Profit Margin (%)
1	Ship owners and fisherman		-	70.59	356.37
	a. Purchase price	-	-	-	-
	b. Total cost	2,629	-	-	-
	c. Selling price	12,000	-	-	-
2	Big collector		5,000	29.41	28.94
	a. Purchase price	12,000	-	-	-
	b. Total cost	3,878	-	-	-
	c. Selling price	17,000	-	-	-
	Total		5,000	100.00	

4. CONCLUSION

In general, the fishery supply chain in Pariaman consists of 4 tiers, namely suppliers, distributors, manufacturers/retailers, and customers. There are 3 actors who act as distributors in the tuna supply chain, namely small collectors, big collectors, and exporters. The calculation of logistics costs is carried out using the activity-based costing method. Based on the data obtained, three main cost components were found to play a major role in the supply chain, namely the cost of procuring ships, engines, fishing gear, fishing operations, and lifting fish to the warehouse with a total cost of IDR 2,629,000. Then there are the costs of handling materials in the form of fish care and cooling, sorting & weighing, and packaging with a total cost of IDR 1,735,000. And finally, there are transportation/shipping costs with a total of IDR 2,214,000.

The analysis of logistics costs in this study involved a limited tier including ship owners, fisherman, and big collectors. It is known that the largest costs are in procurement activities, especially in fishing operations with a proportion of 33.15%. Shipping costs have a proportion of 32.93% or equivalent to IDR 2,143 per kg of tuna. Then the packaging cost takes a proportion of 19.98%. Overall, big collectors bear a greater proportion of costs than ship owners and fisherman. Big collectors bear a total of 59.59% where ship owners and fisherman only bear a total of 40.41% of the

total costs. Due to the many risks borne by each actor, further research can be developed by considering the risk factors faced by actors in the fish supply chain in the Muaro Cinto area.

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