Logistics Cost Structure Analysis for the Development of Supply Chain Strategies on Aquaculture Business

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Abstract
The cost of logistics is one of the most important factor in the aquaculture business. Each tier in the supply chain will affect the risk and profit margins earned by each business actors. The study was conducted to identify supply chain's tier in aquaculture business, analyzing the logistics' cost structure, calculating profit margins, and develop supply chain strategies. The study uses two stages of sampling, there are purposive sampling and snowball sampling. In-depth interviews were conducted to 79 respondents divided into two regions, namely Sleman region (distributed into 7 sub-regions), and Klaten region (3 sub-regions). The results showed aquaculture business which consists of 6 tiers: fish larvae producer, spreader, enlarger, wholesaler (collectors), retailer and consumer. The cost of logistics is the dominant activity procurement costs have on average 80.53% of the total cost. The profit margins for producers of fish larvae, spreaders, enlarger, and wholesalers vary from 0.4% - 57.9%. Supply chain strategy recommended for tier fish larvae producer is vertical integration, the tier spreader is recommended to apply vertical integration with the concept of few suppliers, the proposed strategy for tier enlarger is push-based strategy, and tier wholesaler is a pull-based strategy.

Keywords: Aquaculture, business, supply chain, profit margin, strategy

Introduction

During year 2010 - 2014, aquaculture production showed a positive trend with an increasing reach 23.74% per year on average. The positive performance for the value of aquaculture production also increases in the same period with an average increase of 16.12% per year. Meanwhile, the increasing in the production of aquaculture in freshwater which is accounted for 11% every year shows the potential growth for the community to develop the cultivation of freshwater fish. Based on the facts, more than 70% of freshwater fish production is absorbed by the domestic market in which Java Island is accounted for the larger due to the population density. Demand from Java Island will continue to grow because per capita consumption of fish in Java Island is still below per capita consumption outside Java Island. In addition, distribution of aquaculture product is different from the distribution of marine fisheries because aquaculture product requires special material handling to ensure that the fish is still alive during the delivery. There are several stakeholders involved in the supply chain of aquaculture business and each of them have different problem and challenge related to the operational and logistics activity in which contribute to the different risk faced by each tier. These different risks may cause the different profit margin in each tier. This study aims to analyze the cost structure along the supply chain, use value chain analysis approach toward the risk in each tier, and also develop supply chain strategy.

Methods

The study was conducted in the area around Yogyakarta province with the type of fish including tilapia, pomfret and catfish. The study used two stages of sampling which were purposive sampling and snowball sampling. Data collection was conducted through in-depth interview to each respondent. The respondents consist of 79 stakeholders divided into two regions, namely Sleman region which is distributed into 7 sub-regions including Ngemplak, Moyudan, Mlati, Berbah, Depok, Seyegan, and Kalasan, and Klaten region with 3 sub-regions including Tulung, Polanharjo and Karanganom. In-depth interviews were conducted to identify factors affecting cost structure and to identify logistics cost structure in each tier. Thus, the logistics cost analysis was then used to determine the profit margins earned by each tier. The results were then analyzed further using strategies in supply chain management.

Result and Discussion

The Supply Chain of Aquaculture for Freshwater Fish

The main stakeholders in supply chain of aquaculture consist of 6 tiers including fish larvae producer, spreader, enlarger, wholesaler (collectors), retailer and consumer. Figure 1 and 2 shows the supply chain of aquaculture in Sleman region and Klaten region.

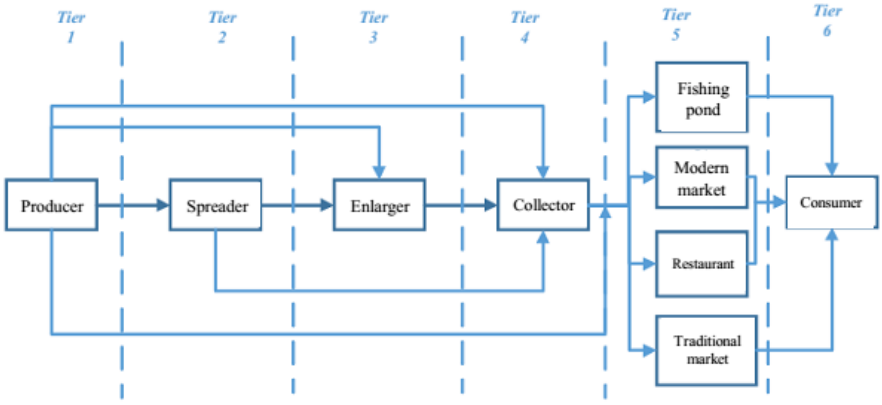


Figure 1 : The supply chain of aquaculture in Sleman region

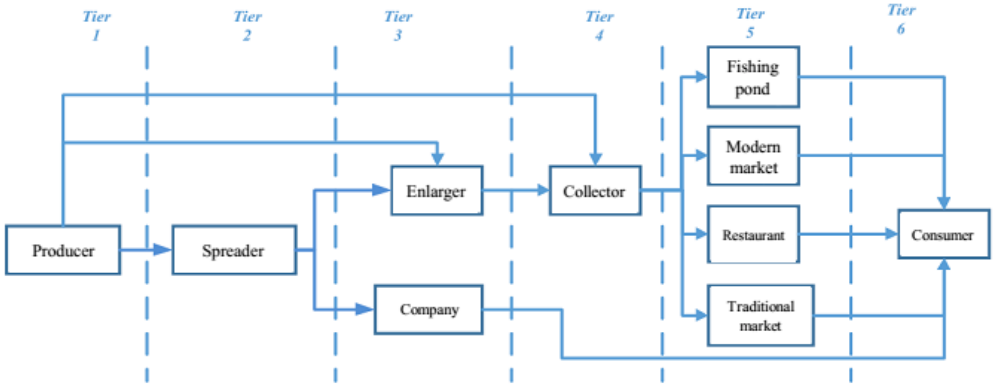


Figure 2 : The supply chain of aquaculture in Klaten region

Fish larvae producer has a role to produce good fish seed either in the form of larvae or egg. Fish seed is produced from fish spawning process in which requires special skills to pay attention on each parameter such as water temperature, fish condition, spawning time, and type of brood stock. Furthermore, spreader will continue to grow the larvae from spawning process. Based on the in-depth interview, the spreading activity is more often conducted in Sleman region than Klaten region. The third tier is enlarger who has a role to enlarge the fish into the size of consumption. The supply chain of aquaculture in both regions are slightly different because in the enlarger stage, there is one international company in Klaten who able to absorb almost the entire production of tilapia. On the other hand, the enlarger tier in Klaten is more superior because there are many enlargers in Klaten who focus and specialize themselves in fish enlargement process. Furthermore, wholesaler or collector buy the fish with ready-to-consume size and sell it to the retailer including fishing pond, modern market, restaurant and traditional market.

Analysis of Logistics Cost

Calculation of logistics costs in every activity can be used to determine which tier has a dominant proportion of cost against activity (Zeng & Rossetti, 2003; Pishvaee *et al.,* 2009; Guritno, *et al*., 2015). The logistics activity along the corn supply chain is divided into six activities including procurement, material handling, maintenance, transportation and communication. The analysis resulted in the proportion of logistics costs, component costs the most influence on their respective logistics activities and what activities can be controlled at every tier (Gumus & Guneri, 2007; Lailossa,

2005). Analysis of logistics cost for each type of fish should be calculated separately because each type of fish requires different kind of treatment. This study divide the analysis of logistics cost into five calculations which are logistics cost structure for tilapia in Sleman, catfish in Sleman, pomfret in Sleman, tilapia in Klaten and catfish in Klaten. All of those logistics cost analysis shows that procurement activity is accounted for the highest portion in the total logistics cost with the portion of 80.74%, 78.88%, 78.02%, 89.87% and 87.08% respectively. Procurement activity as the initial activity in this aquaculture business is very important because it will determine the successful of the rest activities in this business. Good initial activity leads to the good result and yield. In addition, the second highest cost is material handling with the portion of 13.03%, 12.90%, 15.51%, 6.90% and 4.35% respectively.

Table 1 : The average cost of each tier in the supply chain

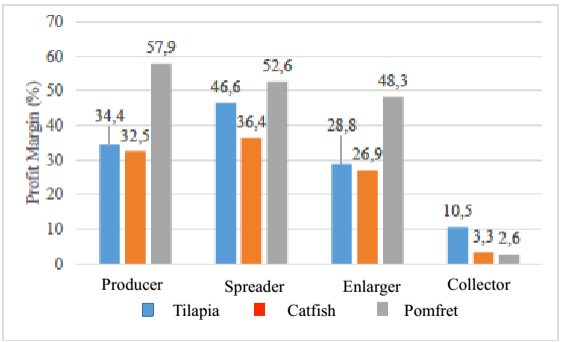
Tier		Average cost (Rp)				
		Sleman			Klaten	
		Tilapia	Catfish	Pomfret	Tilapia	Catfish
1	Fish larvae producer	1,689,840	1,586,231	814,293	2,108,287	1,579,705
2	Spreader	3,125,257	2,1752,608	1,904,916	3,319,142	3,074,659
3	Enlarger	9,260,889	8,255,578	2,307,718	34,734,465	8,848,981
4	Wholesaler/ collector	725,350	666,684	552,922	824,034	637,591

Note: 1 US$ = Rp 13,000.00

Table 1 shows the significant difference between the average cost of tilapia in Sleman and tilapia in Klaten. In the enlarger stage, the average cost in Klaten is almost four times than that of Sleman. This is because in Klaten has a typical pool with a heavy stocking rate that is much more than that of Sleman. The density of stocking numbers that can reach 150 fishes/m² at each pool may cause the increasing of volume of fishes being handled. Thus, it increases the feed cost.

Profit Margin Analysis

From the calculation of profit margin, different profit margin earned by each tier is occurred as shown in Figure 3 and 4. For aquaculture of tilapia and catfish, spreader earn for the highest profit margin among all tiers in both Sleman and Klaten, while wholesaler or collector earn for the smallest. On the other hand, fish larvae producer account for the second highest in Sleman, while enlarger is the second largest in Klaten.



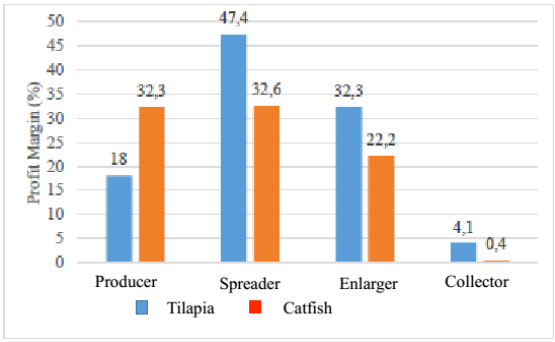


Figure 3 : Profit Margin of Each Tier in Sleman (left); Figure 4 : Profit Margin of Each Tier in Sleman (right)

Supply Chain Strategy for Aquaculture Business

The fish larvae producer should increase the quality of spawning process and encourage the use of feed alternative with the similar quality but with lower cost. In the long-term business, they should do vertical integration which can be potential in the future. As the second tier, spreader should enhance the ability to choose the good fish seed as well as choose the supplier who able to provide good quality of fish seed. So that, they only being supplied by few suppliers to maintain the quality. On the other hand, vertical integration with the fish larvae producer also may lead to the high availability of raw material. Next, enlarger should develop feed alternative as a side component of main feed with the lower cost and do the push-based strategy. They also should buy in the large quantity to the big organization or supplier in order to get lower price or discount. In addition, employing pull-based strategy, finding many suppliers to maintain the inventory and enhancing sales volume by increasing the number of store are the strategies that should be conducted by the wholesalers.

Conclusion

The results of the calculation of logistics cost structure shows that procurement and material handling are accounted for the highest portion. Therefore, the producer, spreader and enlarger should optimize their resources and improve the volume of yield. The fish larvae producer and spreader should do vertical integration as their supply chain strategy. For the supplier strategy, spreader should choose few suppliers to maintain the quality. Moreover, push based strategy should be chosen by enlarger, while collector should choose pull-based strategy.

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