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Value Chain Analysis of Aquaponics Catfish Farming

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Abstract: *This research was aimed to perceive and analyze the relationship between fish farmers, value chain scheme, value and price margin, business feasibility, and strategy to strengthen the production of aquaponics catfish farming. This research employedqualitative and quantitative method (mix method analysis). The respondents of this research were fish farmers who were in charge in nursery stage, grow-out stage, and as collecting traders. The data were analyzed by using business profitability analysis, business feasibility analysis, and grand strategy matrix (GSM). The results of this study indicated that there were 3 maps of relationships between fish farmers; it included fish farmers in nursery stage, farming stage, and collecting stage. Based on thevalue chain scheme,there was a joint map between fish farmers with the addition of input and output capacity of each actor, as well as the flow of production activities from upstream to downstream. There were 12 forms of marketing flows which caused differentcatfish prices inTuban. It also contributed to the variousmargin prices and values. Business feasibility analysis of aquaponics catfish farming for short-term period indicated profitable activities, while the result for long-term period was considered feasible. The strategies to strengthen the production of aquaponics catfish farming consisted of divestment, integration, diversification and development. Furthermore, fish farmers are expected to optimize the production by adding input and seizing business opportunities from the maps and existing data.*

Keywords*: value chain, catfish, farming business, aquaponics, GSM, business development*

I. INTRODUCTION

Indonesia is one of the countries blessed by God's grace with various kinds of advantages such as potential nature and human resources. The high potential of Indonesia's natural resources provides business opportunities in the utilization of nature for the needs of human life such as catfish farming. Similarly, the high number of human resources is a high market potential to be developed in order to increase state revenues (Nurmalasari, 2017).

Value Chain Analysis aims to identify the low cost advantages or weaknesses occur along the value chain from raw materials to customer service activities, and helps managers to understand the company's position in the product's value chain to enhance competitive advantages. On this basis, the research is conducted to perceive and analyze (1) the relationship map between fish farmers, (2) value chain scheme, (3) price margin and value margin, (4) business feasibility, (5) strategies to strengthen the production.

II. LITERATURE REVIEW

Aquaculture in the narrow sense is the effort to keep the fish that previously lived wild in nature to be a pet fish. One of business activities of fishery aquaculture that often found in Indonesia is catfish farming with various kinds of cultivation technology (Rahardi, 2003). In the aquaculture sector, fishery cultivation activity is the second largest activity after fish catching. The current cultivation activity is highly encouraged in order to increase fishery productivity to meet the needs of fish consumption in large quantities. In addition, cultivation activity is intended to prevent fishery commodities from extinction.

The development of catfish business can be performed from fingerling size to consumption size that can be profitable in each segment. Besides for local consumption, catfish has begun to be exported due to considerable demand. Catfish is also one type of freshwater fish that has been cultivated commercially by Indonesian people especially in Java. Catfish cultivation business has increased after new species found, it is *dumbo* catfish (African sharptooth catfish). This increase occurs because *dumbo* catfish can be cultivated on

limited land and water source with high density and relatively low business capital; besides its cultivation techniques is easy to master and its marketing (fingerling and consumption level) is relatively cheap (Ari, 2013).

The technology used in aquaponics catfish farming is applied technology of saving land and water in aquaculture so it can serve as a model of urban fisheries and landscaping in residential complexes. Aquaponics is also a way of reducing water pollution caused by fish farming and it is also an alternative to reduce the amount of water used by fish farmers. Aquaponics continuously utilizes the water from fish farming to crops and vice versa. Besides being an alternative that can be applied as a solution to the limitations of water, aquaponics also gives additional income from crops. Aquaponics system in its process uses water from the fish pond, and thenit is recirculated through a pipe to which the plants will be grown. If the water remains in the tank, it will be toxic to fish. Nitrifying bacteria convert fish waste as nutrients that can be used for plants. Then this plant will serve as vegetation and break down the toxic substances into substances that are not harmful to fish. The oxygen supply in the water keeps the fish alive. Therefore, this is a mutually beneficial cycle. Generally, aquaponics utilizesa recirculation system by re-use the water that has been used in fish farming with biological and physical filters in the form of plants and its media (Akbar, 2003)

Value Chain Analysis (VCA) is an analysis that views a company as one part of the product value chain. The product value chain is an activity which begins from raw materials to after-sales handling. This value chain includes activities that occur because of the relationship with suppliers (Supplier Linkages) and consumers (Consumer Linkages). This is a separate activity but very dependent on one another (David, 2006). The term Value Chain describes how to view a company as an activity chain that converts input into valuable output for costumers. Value Chain Analysis seeks to understand how a business creates value for customers by examining the contribution of different activities in the business to that value. (Pearce & Robinson, 2008)

III. RESEARCH METHOD

This research was conducted in TubanRegency, East Java, Indonesia considering that the area had high potential and catfish production by 4,863.74 ton/year. This research combined qualitative and quantitative approach (mix method) which was conducted on different purposes. Qualitative approach was employed to perceive the relationship map between fish farmers, flow scheme, margin, and production strengthening. Meanwhile, quantitative approach was intended for financial analysis consisting of profitability analysis and business feasibility. The data were collected by conducting interview and in-depth discussion. The sample of this study was the representative of each business field, 1 sample from aquaponics catfish grow-out stage, 1 sample from nursery stage, 1 sample of collecting traders, and several people who provided input and received output, as well as related institutions.

The analytical method to answer the first and secondresearch objectives was qualitative analysis by using Miles and Huberman model on the value chain of the farming business. It included describing the primary and secondary activities and dividing it into two activities with the following steps: (1) mapping out the main and supporting actors, (2) identifying and mapping the key and supporting actors, (3) mapping geographic volume and flow, and services; (4) mapping the relationship between actors; (5) designingthe relationship map between actors, (6) designingproduction flow and value chain schemes. Then, all of the flows and descriptions of the above value chains were displayed in a figure and scheme.

Quantitative method was employed to answer the third objective of calculating the value of price margin and value margin. Meanwhile, calculating business feasibility value was done by analyzing the short term financial aspect (profitability analysis) and long term financial aspect (business feasibility by calculating the value of NPV, IRR and Net B / C).

The analysis used to determine the strategy of strengthening the production was by using GSM (Grand Strategy Matrix). It was done by analyzing the vertical and horizontal relationshipat each stage of each business field; there were five categories in primary activity consisting of (a) Input logistics, b) Operations, (c) Output logistics, (d) Marketing and selling, (c) Services. The supporting activities (secondary activities) included: (a) Purchasing, (c) technological development, (d) human resource management, (e) infra structure of the company.

IV. RESULTS AND DISCUSSION

4.1 Designing Relationship Map between Actors

In order to answer the first objective of the interrelationship between actors, the results of the previous identification weredescribed in this section.Value chain approach is a descriptive way that tries to see the interaction between the actors. One advantage of value chain analysis is that it considers the macro and micro aspects of production and exchange activities. Business-based analysis can provide new insight into the

strategies of the various actors.Based on numerous identifications, the conclusion of interrelationship between actors in the nursery business field can be seen in Figure 1.

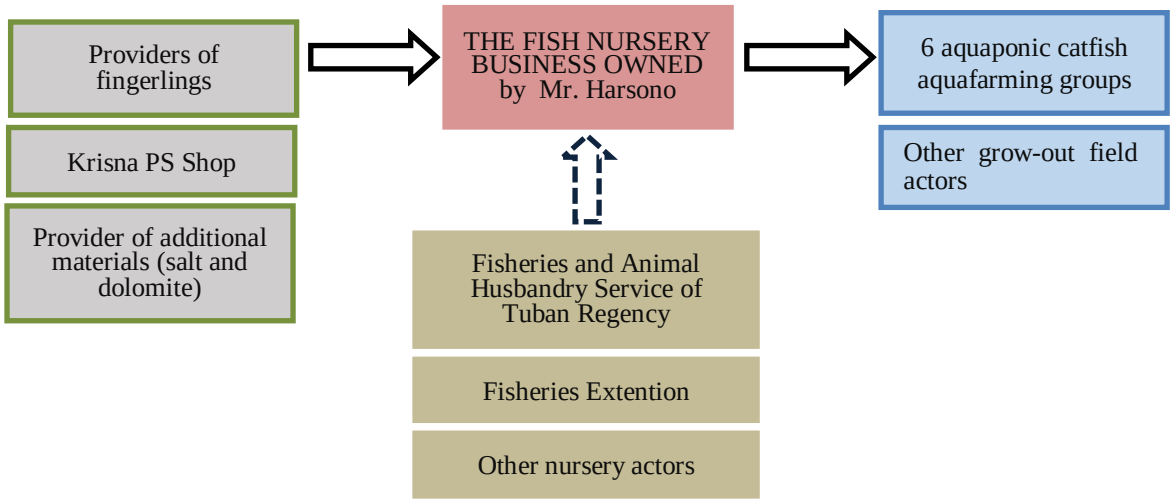

Figure 1. Relationship Map between Actors in Nursery Field

Based on the above figure, the relationship was divided into four actors. The first actor was input providers consisting of providers of fingerlings ordered from Pare, Krisna PS shop which provided feed, probiotics etc., building materials store which provided materials for pondbuilding, and another provider of salt, dolomite and molasses. Then, the second actor was the main actor who did the nursery process starting from the beginning to the end. The third actor was the related institution or agency; in this case there were three more actors as follows:(1) Fisheries and Animal Husbandry Service of Tuban Regency which run coordination and counselling for production process, (2) Other nursery actors who communicated the current price and exchanged information of unfulfilled demand, (3) Output recipient. In the fish nursery business owned by Mr. Harsono, almost all fingerlings were put into grow-out pond of aquaponics catfish, and the remaining catfish belonged to another grow-out pond. The result of this research shares the same idea with Julianto's research in 2015 which mentioned that every actor has certain kinds of relationship such as recipient, provider, or supervisor. Then, the relationship map between grow-out field actors can be seen in Figure 2.

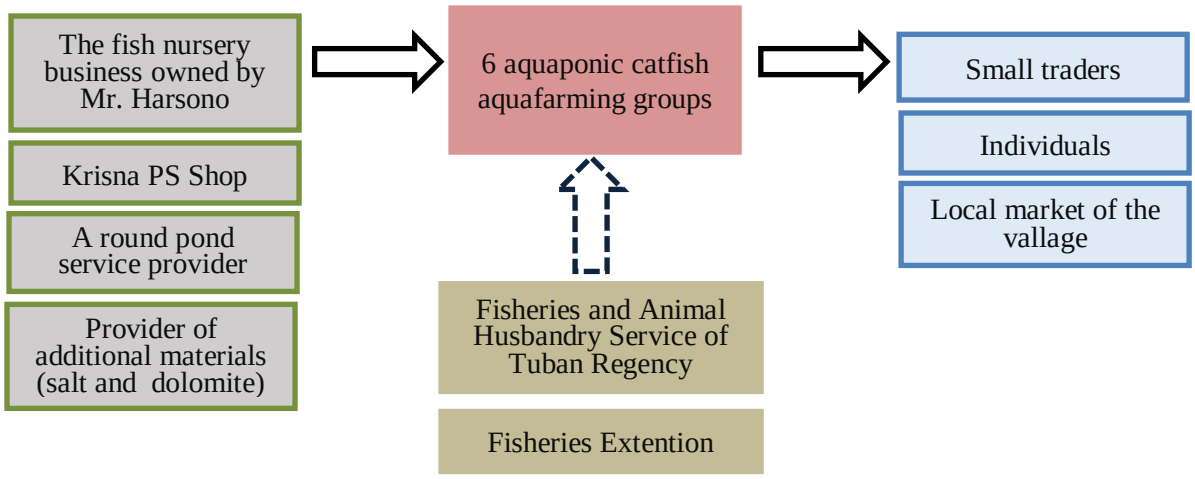

Figure 2. Relationship Map between Actors in Grow-out Field

Based on the above figure, the relationship was divided into four actors. The first actor was input providers consisting of ready-stocked fingerlings provider ordered from Mr. Harsono, Krisna PS shop which provided feed, probiotics etc., building materials store which provided materials for pondbuilding, and another provider of salt, dolomite and molasses. The second actor was the main actor consisting of 6 groups of aquaponics catfish farmers who performed the grow-out process from beginning to end. The third actor was the

related institution or agency namely the Fisheries and Animal Husbandry Service of Tuban Regency and fisheries counselor.

There was only slight difference from the map in Figure 1. In Figure 2, there was no link between the actors of catfish grow-out.Thus there was no adequate information. Then, the output recipient was the last actor. The first distributor of aquaponics catfish in grow-out field was collecting trader. However, only some of the collecting traders were willing to accept the catfish so that it became dependent. When the catfish products were not received by the collectors, it was sold to some neighbors within small scale. Figure 3 represents the relationship map between collecting traders.

Based on the above figure, the relationship was divided into four actors. The first actor was input providers consisting of groups of aquaponics catfish farmers, and other actors in grow-out field such as catfish seller, block ice seller, fish container seller, and car rent

Then the second actor was collecting trader. In Tuban, there were two kinds of collectors based on the goods quantity, small and big scale collector. The third actor was the related institution or institutions consisting of Fisheries and Animal Husbandry Service of Tuban Regency which run coordination and counselling for production process, farmer groups, and fisheries counselor who discussed and shared adequate information.

The last actor was the output recipient. All fish products were sold by the collecting traders in some markets in Tuban or other cities. Food sellers, processing industries, retailers, and final consumers bought the fish in the market. Based on the above identifications, the next step was to design a value chain flow scheme;the scheme described in detail the activities of the actors along with the flow, and output and input capacity.

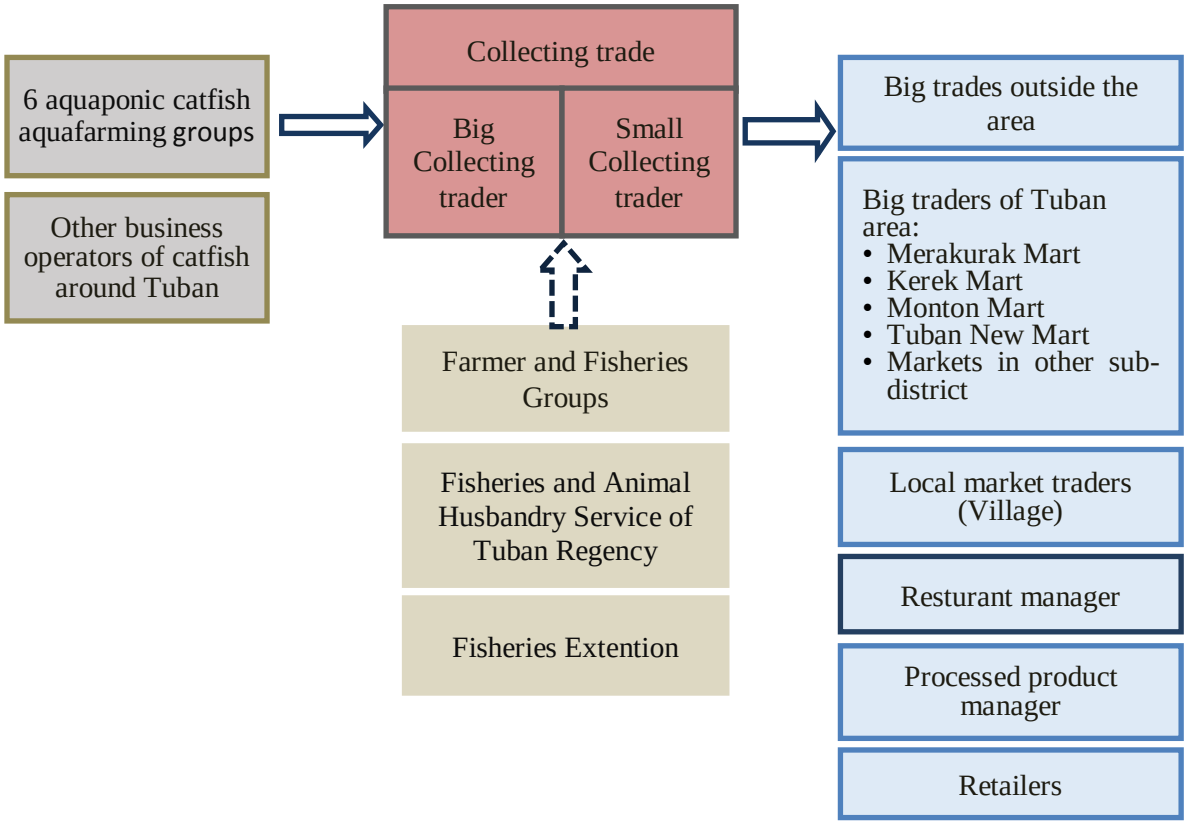

Figure 3. Relationship Map between Collecting Traders

4.2 Designing Chain Flow Scheme

In order to answer the second objective regarding the scheme and the value chain flows. The scheme and chain flow were presented. Based on the mapping result of actors, activities, volumes etc., the scheme and value chain flowof production activities in upstream and downstream as well its supporting actors could be designed. Thus the success of a business could be seen in general result not each business field. The scheme of value chain flow can be seen in Figure 4.

As seen in Figure 4, the scheme was divided into several actors consisting of main actors, input providers, output recipient, and related institution / agency as well as the flow of relationships and capacity of each actor. The main actors were nursery field business actor, grow-out field business actor, and collecting trader. This scheme was slightly more complex than the relationship map between actors. The value chain scheme tried to combine three relationship maps between actors in each field as well as the flow and capacity. The following section presented more detail explanation of the actors in the value chain flow scheme.

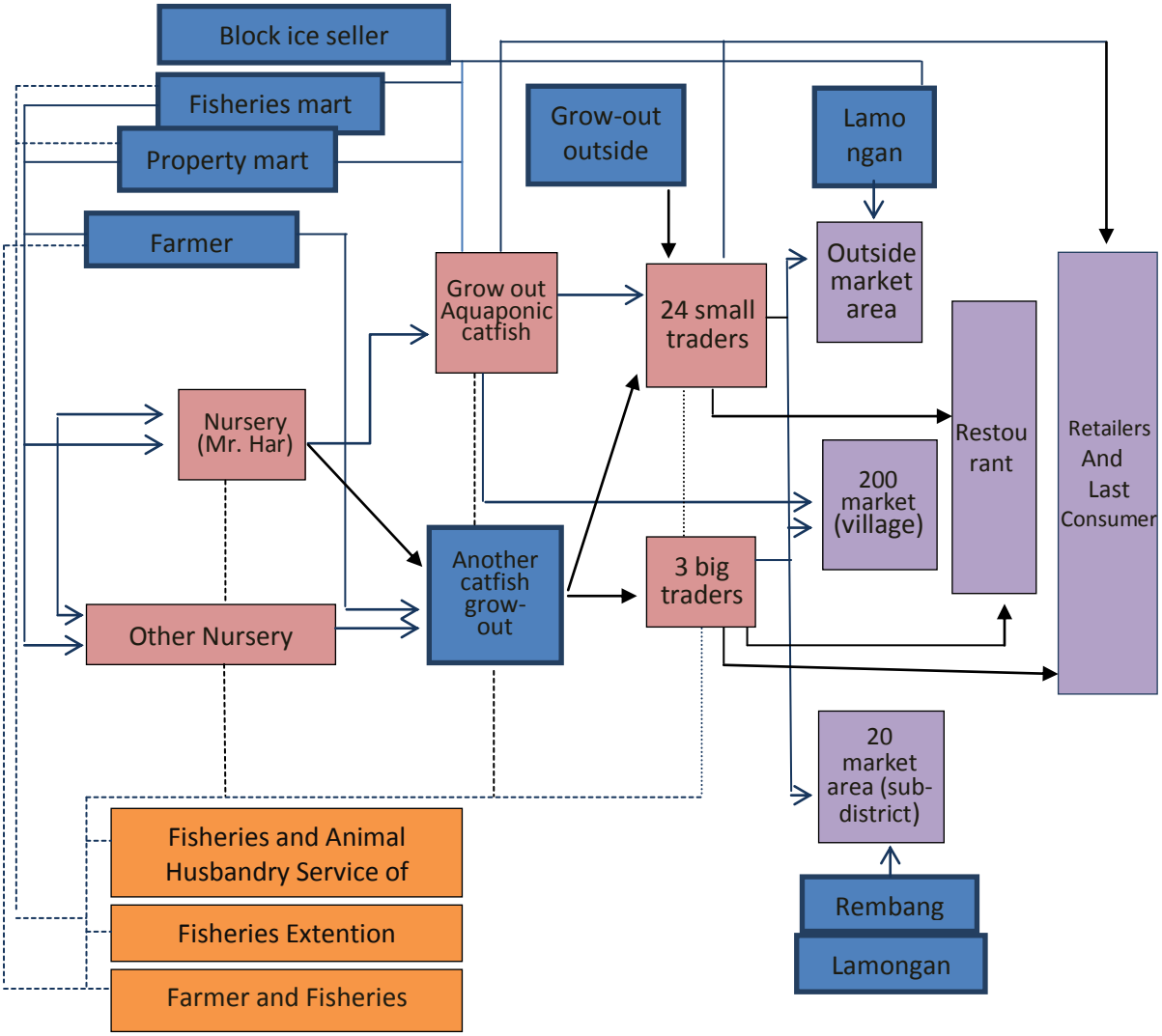

Figure 4. Value Chain Scheme of Integrated Business

a. The Main Actor

The main actorwas from the nursery business field. The nursery business owned by Mr. Harsono became one of the samples used in this study.Its input capacity in one month was 125,000 fish and its output is 100,000. The output was distributed to all groups of aquaponics catfish farmers andother cultivators because the output was more than the input capacity of the group.Thus it was necessary to add more cultivators as output recipients. There were other business actors in the nursery field either in the form of groups or private business.Its total input or output capacity was highercompared with the input output capacity of nursery business owned by Mr. Harsono.

The next main actor was grow-out business field.In this study, the researchers conducted an interview with Mr. Solikan, one of the group leaders of aquaponics cartifsh farmers. The monthly input capacity of his business was only 3,000 fish and the output was 2,600 fish. If the number was multiplied by 6, the results were 18,000 and 15,600 respectively. Menawhile, the distribution was performed by small

scale collectors in each area .The colletorsmight sell the fish directly to individual customer or sell the fishin the market. In addition to the aquaponics group in the grow-out business in Tuban,there werealso many people who run grow-out business earlier. They had more input and output capacity. According to fishery service,the total input of all grow-out business in one month was 2,204,000 fish and the total output was 1,763,200 fish which were distributed to large or small scale collectors andsellers at village and sub-district markets.

The last main actor wascollecting trader. Collecting trader was categorized into two categories based on the product quantity, small scale and big scale collector.Based on the interview resultwith Mr. Solahudin and Mr.Ifan Fadila, the total input capacity of small collectors was 200 kg per day;since there were 24 collectors, the total input neededby small collectors was 1,200,000 fish per month.Meanwhile,the total input capacity of big collectors was1,000 kg per day; since there were 3 collectors, the total input neededbybig collectors was 750,000 fish per month. The collectors mostly distributed the fish to market traders spread in the village-level markets, sub-districts and even outside the region. There were also some collector who directly distributed the catfish to food stalls owner, product processor, and retail merchants.

b. Input Provider

The next actor in the value chain scheme was the input provider.The input provider in this research was fingerlings seller.Most of the people who run nursery and grow-out business bought the catfish fingerlings in Pare. Furthermore, nursery and grow-out businessmen needed property store to buy tarpaulin pond, pipe etc in order to support their business activities.They also needed building materials store to buy the materialssuch as cement and sand for building the pond. Then, there was also a fishery store namely Krisna Ps which supplied feed, salt, dolomite etc. Next, ice cube seller helped the collectors prolong the freshness of the fish. The last input provider was collector fromother cities such as Lamongan and Rembang who provided catfish stock when the local collectors could not fulfill the catfish demand.

c. Output Recipient

The actor who received the output was the actor whose function is as the goods receiver from the production of the previous actors. In this research, the output receiver consisted traders in the village level market, sub-district level and even outside the city. In the village market,the input capacity of catfish was 50 kg per day; assuming that there was10 markets in each sub-district thus the there was 2,500,000 fish.Meanwhile,the input capacity catfish in the sub-district level was 400 kg per day,assuming that there were 20 markets in sub-district level thus the input capacity of catfish was 2,000,000 per month. The collecting traders also sold catfish in another city such as Lamongan. Its input capacity was 600 kg per day. Then the input capacity of catfish per month was 150,000 fish. The other output recipientswere food stall owners, processed product managers, retail traders, and final consumers.

d. Institution / Agency

Institution or agency became the supervisor and coordinator for other actors so that activities could run on target.The institutions wereFisheries and Animal Husbandry Service of Tuban Regency, fisheries counselor, and group of farmers. Fisheries and Animal Husbandry Service became the bridge between actors, the initiator of the program, and program executor. Then, there were also fisheries counselors who accompanied the main actors.They had to assist the farmers in utilizing science and technology.Fishery counselor sometimes had a double role as other actors who provided input such as feed, probiotics, etc. Lastly, there were farmer groups who shared information about their business, mutual opportunities, andexcessive orders.

Seeing from the above data, there were many main and supporting actors. The flows that occurred in the scheme were very complicated. Thus the value chain was more difficult to be mapped. Then, the absorption or the needs of catfish among market traders was significantly highup to more than 10 tons per day. The number did not include the demand from food stalls owners, products processor, and retail traders who directly bought the catfish from the collectors. Thus, there was a contradiction regarding the problem which was told by the fish farmers. They said that the collectors did not want to buy fish due to low demand in the market demand. However, the market absorption and number of demand from other actorswere very high. By looking at this case, it could be concluded that there was a breaking of information between the farmers and marketers.

The results of this study were also similar with the results of the KMl trading chain entitled "Beverages-food Industry Cluster Development Based on Value Chain in Indonesia" written by Lasmono Tri et al which mentioned that there were several actors who were interconnected with each other in the value chain from upstream to downstream. Meanwhile in HeruIrianto's research entitled "Analysis of Value Chain and Efficiency of Agribusiness Marketing of Auricularia Mushrooms in KaranganyarRegency",it was revealed that there

weresome actors who played double roles as *pembaglong*andcollectors.In this research, there were also actors who had double roles as fisheries counselorsand feed and probiotics distributors.

4.3 Price Margin and Value Margin Identification

The following analysis was set out to answer the third objective of identifying value and price margin. In general, margin was the difference; Margin in this case was divided into two: value margins and price margin. Value margin was the difference in value between the first seller and the final buyer, whatever formed the service that the seller gave to the buyer.Meanwhile, price margin was the difference between the purchase price and the selling price that has not been reduced by the operational cost in each production activity. The marketing flow can be seen in Figure 5.

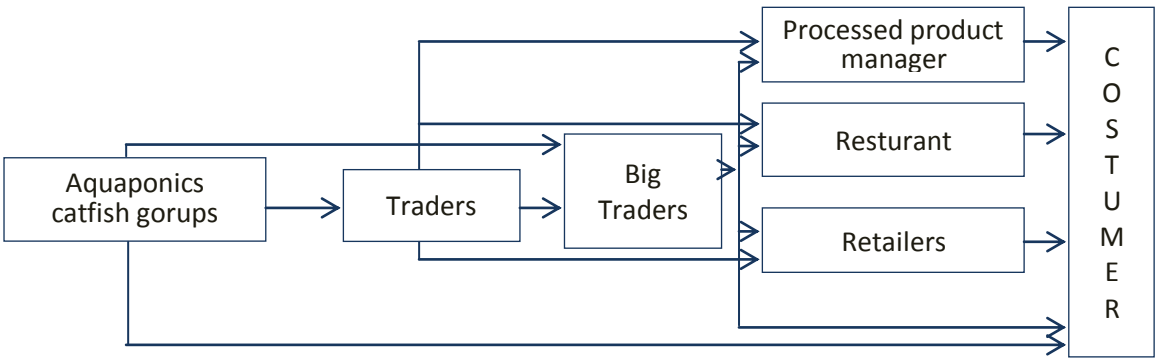

Figure 5. Marketing Flow of Aquaponics Catfish

Based on the identification result, the marketing flow was very diverse. Indeed in practice the marketing flow was not just one branch .This was in line with the result of hierarchy structure of risk level identification in a research from Hidayat et al(2012) entitled "Risk Identification Model and Strategy to Increase Added Value on Oil Palm Supply Chain", the research also indicated that there was not only one branch. There were 12 marketing flows of aquaponics fish, thus the price margin and value margin were set according to the flow identification results. The following tables describe the price margin and values margin that have been compiled.

Table 1. Price Margin and Value Margin

No..	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Collecting trader	Market seller	15,500	18,000	2,500	Available stock, cheapprice, fresh fish
2	Market seller	Processor	18,000	21,000	3,000	Available stock, standard price, fresh fish
3	Processor	Consumer	21,000	50,000	29,000	Standard price, tasty product, durable life dating
Total of Price Margin					34,500	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Collectin g trader	Market seller	15,500	18,000	2,500	Available stock, cheapprice, fresh fish
2	Market seller	Diner	18,000	21,000	3,000	Available stock, standard price, fresh fish
3	Diner	Consumer	21,000	40,000	19,000	Standard price, tasty product, durable life

						dating
Total of Price Margin					24,500	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Collecting trader	Market seller	15,500	18,000	2,500	Available stock, cheapprice, fresh fish
2	Market seller	Retail seller	18,000	21,000	3,000	Available stock, standard price, fresh fish
3	Retail seller	Consumer	21,000	24,000	2,000	Standard price, nearby area, practical
Total of Price Margin					7,500	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Collecting trader	Market seller	15,500	18,000	2,500	Available stock, cheapprice, fresh fish
2	Market seller	Consumer	18,000	22,000	4,000	Available stock, cheap price, fresh fish
Total of Price Margin					6,500	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Market seller	Fish product processor	17,000	21,000	4,500	Without collecting trader, available stock, cheap price, fresh fish
2	Fish product processor	Final consumer	21,000	50,000	29,000	Without collecting trader, available stock, standardprice, fresh fish
Total of Price Margin					33,000	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Market seller	Diner manager	17,000	21,000	4,000	Without collecting trader, available stock, cheap price, fresh fish
2	Diner manager	Final consumer	21,000	40,000	19,000	Without collecting trader, available stock, standard

						price, fresh fish
Total of Price Margin					23,000	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Market seller	Retail seller	17,000	21,000	4,000	Without collecting trader, available stock, cheap price, fresh fish
2	Retail seller	Final consumer	21,000	24,000	3,000	Without collecting trader, available stock, standard price, fresh fish
Total of Price Margin					7,000	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Market seller	Final consumer	17,000	22,000	5,500	Without collecting trader, available stock, cheap price, fresh fish
Total of Price Margin					5,000	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Collecting trader	Fish product processor	15,500	20,000	4,500	Knowing each other, available stock, cheap price, fresh fish
2	Fish product processor	Final consumer	20,000	50,000	30,000	Knowing each other, available stock, standard price, fresh fish
Total of Price Margin					34,500	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Collecting trader	Diner manager	15,500	20,000	3,500	Knowing each other, available stock, cheap price, fresh fish
2	Diner manager	Final consumer	20,000	40,000	20,000	Knowing each other, available stock, standard price, fresh fish
Total of Price Margin					23,500	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Collecting trader	Retail seller	15,500	20,000	3,500	Knowing each other, available stock, cheap price, fresh fish
2	Retail seller	Final consumer	20,000	24,000	4,000	Knowing each other, available stock, standard price, fresh fish
Total of Price Margin					7,500	

No.	Marketing Institution		Purchase Price (IDR/Kg)	Selling Price (IDR/Kg)	Price Margin (IDR)	Value Margin (Service)
1	Grow-out	Final consumer	-	20,000	-	Price decrease, fresh fish, knowing each other
Total of Price Margin					-	

In addition to the normal distribution flow, there was also listed in the chain of catfish value in Tuban Regency where farmers were cutting some actors' task. In another word, the farmers were bypassing the role of the connected actors, for example, from the farmer to the market. It was usually done when the pool was not visited by the collecting trader, so the farmers sold the catfish to the market, in one condition that the market trader might give a cheaper price. It was IDR 17,000/kg, but the catfish was sold under the same price so that the earning margin was still high. In another flow situation, the collecting trader sold the catfish without passing the market first. This condition occurred because there was a bond of kinship that both, the farmers and the collecting trader were already known each other. Therefore, the collecting trader was having a gut to skip the market process. Under this kind of circumstances, both, the farmers and the collecting trader gained benefit from each other. The collecting traders themselves would get an increase of margin value because of the price gap between market's selling price and direct consumer's price. When the collecting traders made a direct selling to the following people: the fish product processor, the manager of the food stalls, and retail traders, they got a margin value by IDR 3,500 / kg. On the other hand, the manager of processed fish products and other players will get a lower purchase price by IDR 1,000/kg. The last possibly occurred circumstance was the direct catfish selling to the consumer. Usually, farmers sold their catfish to their neighbors. It was around IDR 20,000/kg. This condition usually occurred when the collecting traders and the market did not want to buy the farmers' product. Nevertheless, the business transaction process was still running on a small scale.

From the preceding margin data, it was unknown whether the business actors were good in the field of collecting or market trading. In accordance with the objectives of Value Chain Analysis, the most appropriate margin was the margin of normal marketing flow that passed through all the fields. Therefore, all fields could still run without having any lose. On the contrary, the short marketing flow only benefited some areas of business only.

The result of this research was in line with the Wibowo's research result which was conducted in 2004. It explained that indeed in the collecting trader field, the margin and scale were. They also gained more benefits when their margin was compared with the advantages gained by other fields, for example from business field of nursery and the grow-out business field. In Suhartini and EviYuliawati's research in 2014 which was entitled Value Chain Analysis for Improving Competitiveness of Batik Products, it was stated that the higher the margin then the productivity of the workers would be higher as well. If we associated the results of the above researches when the margin could be slightly higher, then the productivity and the number of actors in the grow-out field would be also increased. Meanwhile, Widisastirani'sresearch in 2015 which was entitled the Supply Chain Management of RawitChili Seed (the case in Idep foundation, BatuanKaler Village, Sukawati District, Gianyar Regency), stated that the lowest margin was the margin on the shortest marketing floe. The result was similar to the previously stated researches findings that mentioned the shortest flow had the lowest margin.

4.4 Short-Term and Long-Term Business Analysis

Short-term business analysis aimed to determine the level of business success in a short period or short term. In this activity, the only thing that could be calculated as business analysis was only related to the catfish activities. The other activities which were associated with Chinese cabbage still could not be calculated because during its business practice, it had never met success due to a number of constraints. The one which was included in the calculation of short-term analysis were as follows:

a. Capital

The capital used in the aquaponic catfish farming business in Tuban Regency for running its business came from the assistance which was provided by the government. The amount of used capital in the cultivation of aquaponics catfish was IDR 52,677,000. The business capital consisted of fixed capital or investment (IDR 25,260,000), the current capital (IDR 27,417,000), and the working capital (IDR 29,983,500).

b. Cost

Based on the research of catfish farming business, fixed cost was the amount of costs which was obtained from the depreciation value in which the amount of cost was not dependent upon the result of output level. The amount of the money spent in one year of cultivation production was IDR 12,666,500. Meanwhile, the definition of variable cost was the amount of cost incurred for cultivation activities in which the amount of the cost depended upon the high low of produced catfish's number. The number of variable costs incurred in the year of production was IDR 27,417,000.

c. Revenue

Total revenue could be obtained from the multiplication of the resulting product (Q) with the purchase price (P). The total revenue on catfish cultivation business reached up to IDR 48, 360,000.

d. RC Ratio

The calculation of RC Ratio in one year of catfish cultivation obtained a value of 1.206. It indicated that the revenue of the aquaponics catfish business was 1.206 timed the total cost incurred during one production. Based on RC Ratio value, it was known that aquaponic catfish cultivation business experienced an advantage because of value RC Ratio> 1.

e. Profit

The profit gained on the business of catfish cultivation for one year was IDR 8,787.50. This value was as a reduction result of total revenue (IDR 48,360,000) with total cost (IDR 40,083,000). It could be concluded that the net profit for Mr. Suikan was arguably only little. The profit would be increase if the number of the pond and production were multiplied so that it could cover the additional costs.

f. BEP (Break Event Point)

The results of BEP calculations on aquaponics catfish farming business on the basis sales was IDR 29,252,886 per production. It indicated that if the revenue of catfish farming business in one production was IDR 29,252,886 then the business faced no profit or loss. Meanwhile, the total BEP value on the unit basis was 1,887.002 kg per production. It meant that if sales on cultivation business was as much as 1,887. 002 kg then the business was not experiencing profit and it did not have to deal with loss either.

Then, a long-term business analysis was aimed to see the level of business success financially in a long period of time. It is usually measured for at least five years and terms and conditions are applied for the multiplication years. The calculation of long-term analysis includes as follows:

a. Net Present Value (NPV)

The calculation results for long-term business on aquaponics catfish farming business obtained the NPV of IDR 10,021,796. When the NPV value was more than 0 (zero), it meant that the aquaponics catfish business was feasible to run.

b. Internal Rate of Return (IRR)

The calculation of IRR for long-term business on aquaponics catfish farming business was 25%. The IRR value was greater than 12% (interest rate) which meant that the business of catfish cultivation was feasible to run

c. Net Benefit Ratio (Net B/C)

The result of Net B / C for long-term business in the aquaponics catfish farming was 1.40. This Net B / C value was more than (one). It could be assumed that the cultivation of aquaponic catfish was feasible to be executed.

The conclusions for both analysis results were the analysis of short-term business obtained a profitable result and for the long-term business analysis obtained decent results. The results of this study were also similar to the results of previous study conducted by Ilahi in 2016. It calculated the business analysis on the cultivation of catfish grow-out that showed also useful and decent conclusions.

4.5 Developing a Production Strengthening Strategy with GSM (Grand Strategy Matrix) Analysis

This section was set out to answer the fifth objective of the strengthening production strategy in aquaponics catfish farming. It covered a discussion of the strategy to be carried out by the farmers. It was based on the results of value chain analysis using Grand Strategy matrix (GSM) in each business field of aquaponics catfish farming business. The analysis of strengthening strategy was based on two evaluative dimensions of competitive position and market growth. It was already in accordance with the previously mentioned statement by David (2006) on strategy analysis using GSM. The GSM table on nursery efforts can be seen in Table 2

Table 2. Grand Strategy Matrix (GSM) Analysis Result in Nursery Field

No	Value Chain Component	Information	Problem	Strategy	Strategy of GSM Analysis
1.	Input logistics	The decreased quality of spreading fingerlings stock's condition	The fingerlings procurement was taken from a distant place so that the condition also decreased	Buying new fingerlings that had good quality	Divestment
2.	Operation	Manual sorting	Traditional knowledge on sorting method	Simplified sorting method	Development
3.	Output logistics	Demand was not in accordance with target	The catfish grow-out group did not have fixed fingerlings spreading schedule.	Arranging harvest schedule and conducting a survey about fingerlings spreading preparation from the grow-out group	Integration
4.	Marketing and selling	Limited to the nearby groups and famers	Limited number of production and output receiver network	Multiply the number of output receiver	Development
5.	Service	Giving the technological assistance for groups	Unsustainable activity	Maximizing the technological assistance efforts	Integration
6.	Buying	The fingerlings took a longer period during transport	The decreased quality of seed's condition	Buying fingerling from the nearby area	Divestment
7.	Technological development	The packing method was still using jerry can. It did not use a plastic wrap filled with oxygen.	The farmers did not have their own oxygen supply. Therefore, the delivery process took a lengthy period of time.	Self-buying oxygen.	Development
8.	Human resources management	Self-employed	Limited	Requiring additional helper to increase the number of product output	Development

9.	Company infrastructure	Limited for every activity	Limited infrastructure	need to be equipped for maximum result	Development

Based on the above table, it was known that on the input logistical activities the suggested strategy was divestment. The divestment itself was meant as the release of capital, which could be interpreted also as finding other suppliers. For the suggested strategy on operation section was development that had a meaning to optimize sorting process. Next, it was the output logistic. It was suggested to do an integration process between the nursery groups with the grow-out group about the following stage: harvest time, fingerlings spreading, and pond preparation. The next activity was marketing and selling. It is suggested to do development by multiplying the network of grow-out farmers. The following recommended service was by integrating consistently the performing of technology assistance among the group of farmers. On the purchasing activity, the suggestion was divestment, by looking for other seed suppliers. The recommended activity on the technology development was using the development strategy by buying oxygen. The next activity was the management of human resources which was suggested to add new labor. The last was the company's infrastructure activity which was advised to use development strategy by developing and adding additional infrastructure to multiply the number of the production. The next GSM table on the grow-out field can be seen in Table 3.

Table 3. Grand Strategy Matrix (GSM) Analysis Result of Grow-out Business Field

No	Value Chain Component	Information	Problem	Strategy	Strategy of GSM Analysis
1.	Input logistics	Qualified fingerlings' condition because it was taken from nearby government's coaching group	No problem found yet	Buying fingerlings from the nearby nursery group	Divestment
2.	Operation	Optimized cultivation effort by using probiotics, etc.	Facing unoptimized result on cabbage production which was resulting on additional costs.	Optimizing the cabbage production or end the mustard production	Integration Divestment
3.	Output logistics	Occasionally receiving small scale order	Small scale order may end up giving an effect to another catfish due to pond's draining activity	Rejecting small scale order	Divestment
4.	Marketing and selling	Collecting traders' demand was not in accordance with target.	Sometimes, the collecting traders did not collect the catfish.	Multiply the number of other collecting traders and create processed products	Development and Divestment
5.	Service	Related solely to customers' demand	Lack of fish nutrients information	Service was equipped with fish nutrients information	Integration
6.	Buying	Ready stock was supported by the catfish nursery group	No problem found yet	Keep buying seed from the nearby catfish nursery group area	Development
7.	Technological development	There was not any information about post harvesting	There was not any socialization about the involvement of	Creating post harvesting technology	Development

		technology.	post harvesting technology.		
8.	Human resources management	Self-employed	Limited	Requiring additional helper to increase the number of product output	Development
9.	Company infrastructure	Limited for every activity	Limited infrastructure	need to be equipped for maximum result	Development

Based on the above table it can be seen that each production activity of nursery field has a different strategy by looking at the information and problems respectively. For the input logistics activity, zero problem was found because the view of information was very positive and therefore no further suggestion was needed. Then, the recommended strategies of operation were divestment for Chinese cabbage and integration. It could be interpreted also as the release of capital because the Chinese cabbage production had become a failed production. Along with integration strategy, it was meant that the Chinese cabbage production should be reintegrated with catfish production so that it could be maximized. On the output logistic section, it was suggested to do divestment related to small scale buying because it was considered to affect the catfish condition. For marketing and sales activity, it was advisable to develop and diversify; development meant to develop market network by having more collectors, while to diversify was meant by making processed products. The suggested activity for service enhancement was by acknowledging buyers with fish nutrients information. Buying activity did not receive any suggestion since it was considered to be appropriate already. Furthermore, the technology development activity was suggested using the development strategy by buying tool to make processed products. The next activity was human resource management with the suggestion of development by adding new labor. The last activity was company infrastructure with the suggestion of development strategy by developing and adding additional infrastructure to multiply the number of production. Then, the last strengthening production strategy is the field collectors' business that can be seen in the GSM business table in Table 4

Table 4. Grand Strategy Matrix (GSM) Analysis Result of Collector Traders Business Field

No.	Value Chain Component	Information	Problem	Strategy	Strategy of GSM Analysis
1.	Input logistics	Fresh catfish condition because it was taken from nearby farmers and its number was plenty.	No problem found yet	Keeping the good relationship with farmers so the collectors would be able to get fresh catfish supply.	Development
2.	Operation	Getting an ease on catfish transport because of the accessible distance	No problem found yet	Keeping the good relationship with farmers so the collectors would be able to get fresh catfish supply.	Development
3.	Output logistics	Requiring additional cost for example like ice cube, etc.	Without ice tube adding, the catfish condition would be degrading.	Own an ice tube network distribution	Integration
4.	Marketing and selling	High market demand	Incapability of pickup service yet there should be an actor who	Multiply the number of catfish input by adding more network on	Development

			could supply the catfish demand.	enlargement group	
5.	Service	Visiting the catfish pond during the pickup period only	Lack of information about the catfish size in each pond	Make a routine visit to the catfish farmers to understand the catfish condition	Integration
6.	Buying	Make daily buying to every farmer	Sometimes, the farmers canceled the harvest period due to lack of post harvesting preparation	Make a routine visit to the catfish farmers to understand the catfish condition	Integration
7.	Technological development	The collectors did not own technology.	Limited marketing technology	New technology input	Development
8.	Human resources management	Self-employed	Limited	Requiring additional helper to increase the number of product output	Development
9.	Company infrastructure	Limited for every activity	Limited infrastructure	need to be equipped for maximum result	Development

Based on the above table, the input logistics activity and the operation activity did not receive any suggestion. The collectors were supposed to maintain a good relationship with the farmers so that they would get a certain number of fish stocks. Next, the output logistics was recommended to do an integration process with the supplier of ice cubes. Meanwhile, on the marketing and selling activity, it was advisable to do the development by maximizing the existing catfish inputs from the enlargement business and by adding network to the recipient of output. The following activities were the service and buying activity. It was suggested that the collectors do integration with market actors and farmers by surveying each place. The technology in the field of collecting business was considered to be sufficient. Therefore, it did not need a further suggestion. The next activity was the management of human resources with the suggestion of the development by adding new labor. Lastly, the suggestion for infrastructure activities of the company was by developing and adding additional infrastructure to multiply the number of production.

Furthermore, the most widely used strategy was the development strategy type. It was similar to previous study which was taken from Ilahi's research in 2016. The development strategy came out more often than the rest outputs. It could be assumed that the strategy was already appropriate but it was less optimal. In addition, divestment, integration and diversification were already emerged. If those things worked in accordance then the output of would be more optimal, in this case was the maximum results obtained by each of the identified actors.

V. CONCLUSIONS

1. There were three main actors identified based on the analysis results. They were business actors in the field of nursery, grow-out, and collectors. Each main actor had supporting actor.
2. The needs of catfish consumption or absorption for the collectors and the market was very high. The grow-out group from the Tuban region itself could not meet the needs of the market. Therefore, it is necessary to add other business actors in the field of nursery and grow-out.
3. There were 12 marketing flows in the value chain of catfish farming in Tuban. The total numbers were 12 flows and the total price margin was more varied, ranging from IDR 5,000 to IDR 34,000 which was spread in every existing marketing flow.
4. Based on the financial analysis result, the overall business of aquaponics catfish grow-out was profitable and feasible to be continued.

5. The results taken from the production strengthening strategy in each of the main actors were having different results with four varied outputs, ranging from divestment, diversification, integration and development.

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