



Analysis of Supply Chain Model of Dogol Shrimp (*Metapenaeus ensis*) Capture in Pangandaran, West Java, Indonesia

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Authors' contributions

This work was carried out in collaboration among all authors. Author RFW designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors AN and IBBS managed the analyses of the study. Author AAH managed the literature searches. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/AJFAR/2020/v8i130131

Editor(s):

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- Complete Peer review History: <http://www.sdiarticle4.com/review-history/58306>

Original Research Article

Received 02 May 2020
Accepted 09 July 2020
Published 03 August 2020

ABSTRACT

This research aims to analyze the management of the dogol shrimp supply chain in terms of product flow, financial flow, information flow and risk as well as marketing margins of each chain involved in KUD Minasari fish market, Pangandaran Regency, West Java Province. The method used is descriptive qualitative and quantitative using primary and secondary data with snowball sampling methods. The analytical tool used is the analysis of supply chain conditions, risks and consequences of dogol shrimp supply chains. The results of this study showed that the process of product flow of the dogol shrimp supply chain in KUD Minasari, Pangandaran Regency involving fishermen, wholesalers, small traders, restaurants and end consumers is quite well related to channeling from fishermen who have not been supported by fishermen's knowledge related to shrimp quality. The dogol shrimp supply chain distribution channel is divided into 8 types of

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marketing with a significant difference in whether the fish market is involved or not. The marketing channel of dogol shrimp catches in Pangandaran Regency shows that the structure of the second chain with business actors is fishermen → fish auction → large traders → small traders → consumers are more efficient with a marketing margin of Rp. 35,000 / kg or 31.81%, farmer share by 75.87%. The largest market share value of 59.25% is on the 8th channel with restaurants as a marketing agent.

Keywords: Distribution channels; dogol shrimp; Pangandaran; risk; supply of dogol shrimp.

1. INTRODUCTION

Capture fisheries production in Pangandaran in 2015 amounted to 61.201,20 tons to 800,50 tons in 2016 [1]. The main commodity in Pangandaran is shrimp rebon (*Acetes*), dogol shrimp (*Metapenaeus ensis*), lobster (*Nephropidae*), red snapper (*Lutjanus bitaeniatus*), white snapper (*Lates calcarifer*), grouper (*Epinephelus*), black pomfret (*Parastromateus niger*), mackerel (*Scomberomorus*), beltfish (*Trichiurus lepturus*), and cob (*Euthynnus affinis*). One of the commodities that almost always meets the catch of Pangandaran fishermen at the fish farm is the dogol shrimp (*Metapenaeus ensis*). Pangandaran fishermen who catch dogol shrimp using trammel net and dogol nets, the consistent catch makes dogol shrimp rank 3 out of the 10 largest capture fisheries production in Pangandaran, with a total production of 128,203 kg [2].

The potential of fisheries in Pangandaran is so great, but the welfare of fishermen is still low. Upstream and downstream production systems that have not been integrated as the main reason for the low welfare of Pangandaran fishermen [3]. Upstream - downstream fishery products are from fishermen to the last consumers. Talking about the upstream-downstream production system is very closely related to the supply chain, because the supply chain is an activity that creates the product until the product is delivered to its final user by involving several parties in the activity [4].

The dogol shrimp supply chain (*Metapenaeus ensis*) pays attention to several aspects that can influence the smooth distribution process to the end consumers. In addition to meeting consumer demand, this form of regulation in the shrimp supply chain also aims to benefit every link involved. So, we need an approach to the supply chain system in the form of an approach to determine product flow, financial flow,

information flow, because it will affect decision making in each of the existing links [5]. Appropriate decision making will be beneficial in maintaining the supply and quality of the dogol shrimp commodity. When delivering products to end consumers is demanded as efficiently as possible while maintaining product quality.

The production flow of fish catches in the supply chain that is too long will add costs because price is the highest-ranking factor, followed by shipping and quality [6]. The fish supply chain is characterized by long supply waiting times combined with significant supply and demand uncertainty [7]. The distribution network mapping and matters relating to distribution technicalities along with their operational costs within a certain period also need to be studied because there are changes in price patterns in each supply chain to reach consumers [8]. However, no one has specifically conducted a comprehensive supply chain research model on dogol shrimp commodities in Pangandaran so that the flow of the dogol shrimp supply chain in Pangandaran has not been properly mapped. Based on the above, this study aims to:

- a. Analyzing the supply of dogol shrimp in Pangandaran Regency.
- b. Analyzing the marketing margins obtained in each supply chain of dogol shrimp sales

2. MATERIALS AND METHODS

The research site was conducted in KUD Minasari fish market, Pangandaran district, West Java. The time of the research is March 2019 – February 2020. The research method was carried out by the survey method. The survey method is one part of the descriptive type of research method to make a situation description or event [9]. This method will explain the results of quantitative and qualitative data processing.

The research method used in this study is a case study with case units at the fish auction place located in the Pananjung Fish Market area, Pangandaran. The object studied in this research is in the form of dogol shrimp chain actors in the Minasari KUD fish auction as a marketing institution that plays a role in channeling dogol shrimp to consumers [9].

The sampling technique in this research was carried out by the snowball sampling method. Snowball sampling is a sampling technique with the help of key-informants, and from this key informant will develop according to the instructions. In this case the researcher only revealed the criteria as requirements to be sampled. The technique is a technique for determining a sample that first starts out small and then grows [10].

Analysis conducted using descriptive analysis conducted using quantitative. Descriptive analysis was used to analyze the dogol shrimp supply chain in Pangandaran. Descriptive analysis representing the type of statistics used to analyze data by describing or analyzing the data collected to produce conclusions that are needed for generality or generalization [11]. Supply chain development can be done by using [12]:

- a. Network Structure. The structure of the chain is examined using a member of the chain that explains who each member or parties involved in the supply chain contribute to their respective roles. Commodity flows from upstream to downstream and distributed to various locations, with the help of members, and the supply chain, as well as partnerships carried out from various parties.
- b. Chain Objectives. The chain objectives are examined using a target market that explains the model of the supply chain that occurs in the marketed product which discusses who the customer is and what is needed from the product he wants.
- c. Chain Management. Chain management is examined using (1) management structure that explains the parties that become the regulator and the main supply chain in terms of activities in the supply chain, (2) partnerships explain the partnership relationships formed and between the members of the chain, (3) regulate contractual and transaction systems explain the form contractual agreement

agreed upon in establishing a cooperative relationship between the transaction system and the parties involved, (4) government support explains the role of government as policy maker in managing and supporting the supply chain process.

- d. Chain Resources. Chain resources look at the potential resources possessed by supply chain members to know the potentials that can support the supply chain. Chain resources are examined using physical resources, technological resources, human resources, and capital resources.
- e. Chain Business Process. The business process chain explains the processes that occur in the supply chain to find out whether the entire supply chain flow has been well integrated or not and explains how through a certain strategic action able to realize an established and integrated supply chain. Chain business processes are examined using business process relationships between members of the supply chain, distribution patterns, trust building, and risk aspects.

Supply chains in abnormal conditions, there are risks that can threaten the sustainability of the supply chain, both those that are easy to replace and those that are not easy to replace quickly within their management timeframe [13]. This risk value is referred to as the risk consequence (α) which can be calculated using the following formula:

$$\alpha = \frac{\delta \text{ replace}}{\delta \text{ collapse}}$$

Information:

α = consequences of the risk of a product in the supply chain

δ replace = the time required for a supply chain to replace a sub-product or time needed to handle disruptions from one product flow, and return to normal scheduling conditions with the same quality level.

δ collapse = the time of the sub-product fails to be completed before the supply chain loses at a critical point in its market service.

Assessment indicators for supply chain sustainability risks are presented in Table 1 [14].

Table 1. Value of risk consequences

Consequences	Information	α
Urgent	Irreplaceable	1,0
Needed	Not easy to replace	0,6
Required	Easily replaced	0,3
Wanted	Easily replaced	0,1

Marketing margin is the difference in price of dogol shrimp at the consumer level with prices at the producer or fisherman level. The difference in price or marketing margin is due to the profits taken by marketing institutions and the costs incurred in marketing dogol shrimp. Margin can be expressed as a payment given to them for their services. The marketing margins are systematically formulated as follows:

$$M_p = P_r - P_f$$

Information:

M_p = Dogol shrimp marketing margin (Rp/pcs)

P_r = Dogol shrimp prices at the consumer level (Rp/pcs)
 P_f = Dogol shrimp prices at the producer level.

A distribution system is said to be efficient if the level of marketing margin is less than 50 percent of the price level paid by consumers.

3. RESULTS AND DISCUSSION

3.1 Product Flow Analysis, Information Flow and Financial Flow

Dogol shrimp supply chain conditions in KUD Minasari fish auction are analyzed descriptively including chain structure, chain management, chain resources, and business chain processes. Results of the analysis of product flow, information flow, and financial flow of the dogol shrimp supply chain at KUD Minasari fish auction can be seen in detail in Table 2.

Table 2. Analysis of product flow, information flow and financial flow

Component	Supply chain conditions
Network Structure	There are five chain structures with chain members consisting of fishermen (suppliers), large traders (wholesalers), small traders (retailers), restaurants and consumers (consumers)
Chain Objectives	The target chain is aimed at the domestic market with the target market being intermediary traders, namely large traders and small traders in the East Priangan area which includes Pangandaran Regency, Ciamis Regency, Banjar City, Tasikmalaya Regency and City, Garut Regency and Garut Regency, Sumedang Regency, Cimahi City, Regency and the city of Bandung and its surroundings.
Chain Management	Fishermen are members of the supply chain who have a big hand. The partnership formed is a cooperative that is fishermen forming business groups, one of which is fish auction, so that all fishermen who are members of KUD Minasari sell their catch to this fish auction place which is then bought by large traders, small traders and restaurants. The transaction system used is cash to the manager of the fish auction which is then given to fishermen with a deduction of retribution money to fish auction as savings for fishermen if in a famine. The government provides operational assistance such as ships, nets for fishermen and baskets, scales, and other operational tools for fish auction and small traders or large traders.
Chain Resources	Chain resources include dogol shrimp resources. Chain resources consist of physical resources which include production resources such as boats and dogol nets. Human resources in shrimp fishing there are only 2 to 3 fishermen in each trip, 26 employees of the fish auction, three restaurants, six workers on large traders and small traders. Technological resources include communication tools such as mobile phones and scales both digital and analog. The capital resources of each business actor come from private capital.
Business Process Chains	There are differences in the product flow cycle chain the first to fourth with the fifth to the eighth chain, namely the involvement of fish auction in the product stream.

Dogol shrimp supply chain conditions there are eight chain structures with chain members consisting of fishermen, wholesalers, small traders, restaurants and end consumers. The target chain is aimed at the domestic market with the target market being intermediary traders, namely large traders and small traders in the Eastern Priangan region. In dogol shrimp supply chain management, fishermen are members of the supply chain who have a large share. The partnership relationship formed is a cooperative namely fishermen forming business groups, one of which is fish market. The government provides operational assistance such as ships, nets for fishermen and baskets, scales, and other operational tools for fish market and middlemen or large traders. Chain resources include dogol shrimp resources. Chain resources consist of physical resources which include production resources such as ships and dogol nets. Human resources in catching shrimp are only 2 to 3

fishermen on each trip, 26 fish market employees, 3 restaurants, 6 workers at large traders and small traders. Technology resources include communication aids in the form of cellular telephones and scales both digital and analog. The capital resources of each business actor come from private capital. There is a difference in the product flow cycle in the first and second chains with the third and fourth chains, namely the involvement of fish market in its product flow.

Collectors need to pay attention to the process of distributing fresh fish / shrimp with standards in accordance with SNI 2729: 2013 on Fresh Fish, so that the quality of dogol shrimp is maintained until the next distribution location. Table 3 describes the comparison between the distribution process as stipulated in the SNI with the distribution process implemented by fish auction and small and large traders.

Table 3. Gap analysis of Dogol shrimp supply chain

No	SNI Transportation, Handling and Supply Chain	Dogol Shrimp Supply Chain in Pangandaran
1.	Vehicles used for transporting fish / shrimp must be able to maintain the cold temperatures needed by fresh fish / shrimp.	Distribution and marketing using fiber containers covered with plastic wrap, and given ice. Fiber containers are placed on the car / motorcycle pickup.
2.	Raw materials received at the processing unit are organoleptically tested and handled quickly, carefully and sanitary according to the principles of good and correct handling techniques in cold conditions.	Raw materials received by fish auction which are then distributed by large and small traders are not organoleptically tested.
3.	Fish are separated based on quality, type and size quickly, carefully and sanitary in cold conditions.	Fish / shrimp are only separated by type and size but not in hygienic conditions.
4.	Fresh fish / shrimp are arranged in insulated containers (styrofoam) and given ice to maintain cold temperatures.	Shrimp have been arranged in an insulated container (styrofoam) and given ice to maintain cold temperatures.
5.	Has top management who coordinates all activities of the supply chain members	Lacking top management, supply chain members are not integrated with one another
6.	Has a framework that allows the development of specific goals, targets and management strategies	Does not have a framework
7.	Have threat assessment procedures and threat control actions, both internal and external	Cannot assess threats and avoid existing threats
8.	All activities are documented, implemented and maintained	Not doing documentation, administrative records are only carried out by fish auction
9.	Personnel responsible for qualification in terms of education, training and / or experience. Record of competence and training documented	Personnel are not qualified in terms of education, training and / or experience. Record of competence and training not documented

3.2 Supply Chain Structure

Dogol shrimp supply chain structure in KUD Minasari Pangandaran examines the members of the chain, namely the members who form the supply chain through the role of each member. Chain members are all members who interact directly or indirectly in supply chain activities from the starting point to the point of consumption. Chain members are divided into two namely the main members and supporting members of the supply chain. The main members of the supply chain are identified based on the flow of shrimp products starting from fishermen to end consumers. The search for dogol shrimp product flow has eight chain structures. The identified chain structure shows the existence of key members through their direct involvement in the supply chain business process from production to marketing or until the product is in the hands of the user. The main members in question are shrimp fishermen, fish auction, large traders, small traders, restaurants, and end consumers. While supporting members in the supply chain are the government in helping, product delivery couriers and pick up car rental companies. The main members in the supply chain are interconnected according to their respective positions and roles in achieving the main objectives of the supply chain, namely meeting the desires and needs of the end consumer. A clearer picture can be seen in Fig. 1.

Based on the description of the supply chain structure above, it shows that the longest chain is in chain 1 because it involves all members of the chain. All major members hold their respective roles according to their position in the supply chain. In detail the role of the main members of the shrimp supply chain can be seen in Table 3.

The most important thing from a good supply chain management is a good collaborative relationships and information centralized from all parties involved. All parties carry out their duties appropriately to achieve one common goal, which is to provide satisfaction to consumers and be able to achieve prosperity for all parties involved in the supply chain.

3.3 Supply Chain Risks and Consequences of Dogol Shrimp

When dogol shrimp stock in raw material providers is not available, then for 10 consecutive days, restaurants, large traders, and small traders will suffer losses in the sense of not being able to meet consumer demand. This is assumed within 30 days the demand for dogol shrimp supply has not been fulfilled. This situation is closely related to uncertain weather conditions for fishermen to go to sea, although catching dogol shrimp is not affected by the

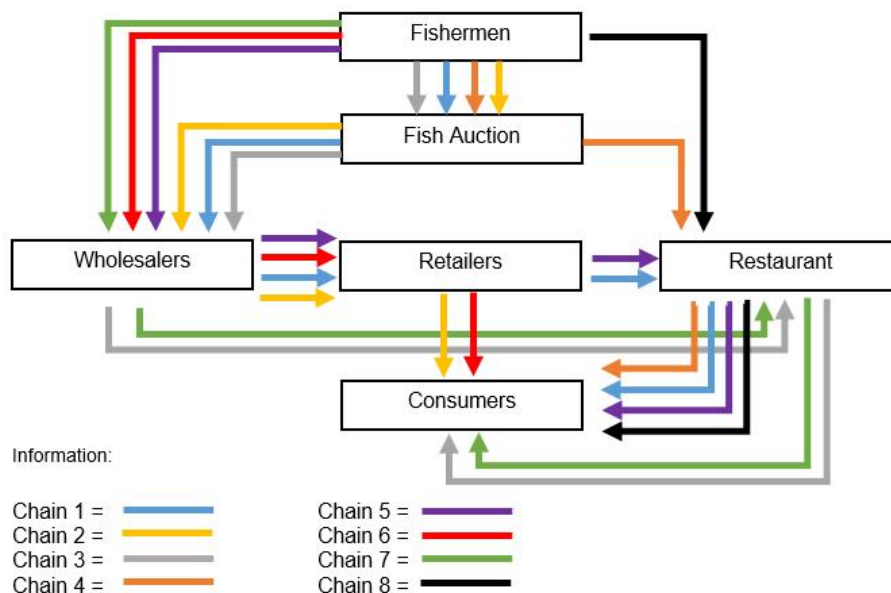


Fig. 1. Marketing channel

weather, but the condition of the small fishing fleet in Pangandaran causes fishermen to be reluctant to go to sea in extreme weather conditions because it endangers the safety of the fishermen themselves. In addition, it is also difficult to catch and the number of fishermen who are not too many causes uncertain results. Based on the results of interviews for 3 days, restaurants, wholesalers, and small traders can restore this to its original state by purchasing dogol shrimp from other fish auction or outside the city (Cilacap) which is quite far away and requires more costs incurred or buy other types of shrimp that have a price and taste not much different. So that the availability of dogol shrimp as the main raw material has a value of 0.3 which means that the consequence of the risk is that it is easily replaced because of its required nature.

Late payments occur when payments are not made in cash, in other words, due payments. However, this delay condition never lasts long, generally 2-3 days a maximum of 1 week. Payment of this tempo is done in accordance with an agreement agreed by both parties and occurs at small traders or restaurants to large traders. And occurs in large traders or restaurants to fishermen if fish auction is not operating. Some of the reasons for delays in payment are at the level of small traders or dogol shrimp restaurants that have piled up and have not been sold to end consumers and the distribution is too massive from the level of fishermen to large traders. Overdue payment agreements are 2-3 days to a maximum of 7 days but there has never been a payment due past that limit. The resulting value of late

payment is 1.0, which means that the risk consequence is that it is irreplaceable because of its important nature.

The success of the distribution of dogol shrimp in the domestic market is largely determined by 2 things, namely the quality of shrimp and the ability of large traders to distribute from one place to another. When the quality of the shrimp is poor, the freshness of the shrimp is not in good condition either, it is hard or has a strong fishy odor before it is processed. Shrimp storage process with cold conditions containing the quality of awake shrimp. The ability of large traders to distribute from one place to another largely determines the physical dogol shrimp. The expected product is to have an intact condition without defects such as tears or holes. The condition of defects in dogol shrimp greatly affect the selling price, it can even go down 40% - 50% and even not sell at all. Therefore, if the shrimp quality is not good and the distribution is not careful, the traders will suffer losses. Both conditions cannot be returned to the desired state because it is a natural factor which in 2 days of marketing the trader does nothing to the dogol shrimp. The result value is 1.0, which means the consequence of the risk is irreplaceable. The results of the analysis of the consequences of dogol shrimp supply chain risks are explained in detail in Table 4.

3.4 Marketing Margin

Marketing margins are calculated to determine the difference in price at the level of fishermen with prices at the level of large traders, small traders, restaurants, or end consumers.

Table 4. Role of major member supply chain

Level	Member	Role of members
Supplier	Fishermen	Carrying out the process of dogol shrimp production through capturing at pangandaran sea and selling it to fish auction through the auction process or directly to large traders or restaurants
Distributor	Fish auction	Conduct and or assist fishermen in the process of selling dogol shrimp catches to large traders or restaurants through the auction process
Wholesaler	Large traders	Doing dogol shrimp purchases to fish auction and fishermen and selling to small traders or restaurants
Retailer	Small traders	Make shrimp purchases to large traders and sales to restaurants or customers
Manufacturer	Restaurant	Buy shrimp to fishermen or fish auction or large traders or small traders and sell to consumers
Consumer	Consumer	Make fish purchases to small traders or restaurants

Marketing margin is the difference between the price paid by the final consumer and the price received by the previous marketing institution. Marketing costs are all costs incurred to transport products from one institution to the next marketing institution outside the profits obtained by the marketing institution [15]. Marketing margins are often used as an indicator of marketing efficiency. The amount of marketing margins in various marketing channels can be

different, because it depends on the length of the marketing channel and the activities that have been carried out and the expected profits by marketing agencies involved in marketing. The price difference occurs because of the benefits and costs incurred by each chain member in distributing dogol shrimp to end consumers. The detailed calculation of the marketing margin of dogol shrimp can be seen in Table 5:

Table 5. Results of analysis of risk consequences

Risk	<i>replace</i> <i>collapse</i>	Score	Consequences	Information
Shrimp stock availability	$\frac{10}{30}$	0,3	Easily replaced	Is Required
Late payment	$\frac{7}{7}$	1,0	Irreplaceable	Urgent
Shrimp distribution	$\frac{2}{2}$	1,0	Irreplaceable	Urgent

Table 6. Dogol shrimp marketing margin

Marketing Institute	Chain I (Rp/Kg)	Chain II (Rp/Kg)	Chain III (Rp/Kg)	Chain IV (Rp/Kg)	Chain V (Rp/Kg)	Chain VI (Rp/Kg)	Chain VII (Rp/Kg)	Chain VIII (Rp/Kg)
Fisherman								
Selling price	110.000	110.000	110.000	110.000	95.000	95.000	95.000	100.000
Fish auction								
Purchase price	110.000	110.000	110.000	110.000				
Selling price	120.000	120.000	120.000	120.000				
Margin	10.000	10.000	10.000	10.000				
Wholesalers								
Purchase price	120.000	120.000	120.000		95.000	95.000	95.000	
Selling price	132.000	132.000	132.000		132.000	132.000	132.000	
Margin	12.000	12.000	12.000		37.000	37.000	37.000	
Small traders								
Purchase price	132.000	132.000			132.000	132.000		
Selling price	144.000	145.000			144.000	145.000		
Margin	12.000	13.000			12.000	13.000		
Restaurant								
Purchase price	144.000		132.000	120.000	144.000		132.000	100.000
Selling price	160.000		160.000	160.000	160.000		160.000	160.000
Margin	16.000		28.000	40.000	16.000		28.000	60.000
Consumer								
Purchase price	160.000	145.000	160.000	160.000	160.000	145.000	160.000	160.000
Total Margin (%)	50.000 (45,46%)	35.000 (31,81%)	50.000 (45,46%)	50.000 (45,46%)	65.000 (68,42%)	50.000 (45,46%)	65.000 (68,42%)	60.000 (60%)

Note: Prices above are based on the average dogol shrimp sales from each link

In the eight marketing chains the lowest marketing margin is found in the second chain channel with a total margin of Rp. 37,000 / kg or 33.63%. The margin is calculated from the reduction between the fishermen's selling price and the consumer's purchase price, the results are then divided by the fisherman's selling price and expressed as a percentage. Small marketing margins are more efficient than high marketing margins [16]. While the largest marketing margin values are in the chain channels V and VII with a total margin of Rp.65,000/ kg or 68.42%. Chain channels I, II, III, IV, VI are efficient because marketing margins are less than 50 percent of the price purchased by consumers. A distribution system is said to be efficient if the level of marketing margin is less than 50 percent of the price level paid by consumers [17].

4. CONCLUSION

Based on research conducted on the Analysis of Supply Chain Model of Dogol Shrimp (*Metapenaeus ensis*) Capture in Pangandaran, it can be concluded as follows:

1. The process of product flow, information flow, financial flow of the supply chain of dogol shrimp catches in Pangandaran, there are 8 marketing channels with a significant difference in the involvement or absence of fish auction in the channel. Dogol shrimp supply chain involving fishermen, wholesalers, small traders, restaurants, and end consumers is quite well-run related to the distribution of fishermen who have not been supported by fishermen's knowledge related to fish quality. Contractual agreements in chain management are still running informally, making it difficult to predict the quantity of fish that must be sold to each chain. The business process chain is constrained by a lack of supply of product flow when uncertain weather conditions for fishermen can go to sea. Risks that must be faced by large traders, small traders and restaurants are the availability of shrimp stocks (0.3), late payment (1.0) and shrimp distribution (1.0). The value of the consequence of the risk is easily replaced and is not replaceable.
2. The marketing channel of dogol shrimp catches in Pangandaran shows that the structure of the second chain with business actors is fishermen → fish auction → large traders → small traders → final consumers

are more efficient with a marketing margin of Rp. 35,000 / kg or 31.81%.

CONSENT

As per international standard informed and written participant consent has been collected and preserved by the authors.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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Peer-review history:
The peer review history for this paper can be accessed here:
<http://www.sdiarticle4.com/review-history/58306>