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Modelling of Sustainable Blue Swimming Crab Supply Chain in East Java Using Soft System Methodology

Pemodelan Rantai Pasok Rajungan Berkelanjutan di Provinsi Jawa Timur Menggunakan Soft System Methodology

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Abstract

Blue swimming crab (*Portunus pelagicus*) is one of Indonesia's highest-export fishery commodities. Capture fisheries are dominated by fishermen with low productivity, efficiency, and income levels. There is a high-profit disparity between upstream and downstream actors, where fishermen get the lowest profit. This study aims to identify the causes of profit disparities between supply chain actors and propose a supply chain model to solve the profit disparity problem. The supply chain actors observed were fishermen, mini plants, processing companies, and exporters of blue swimming crab. Determining variables that affect profit gain based on the business activities of the supply chain actors of blue swimming crab was carried out. The conceptual model was made using the Soft System Methodology (SSM). The analysis result showed that the causes of profit disparity were the vast number of fishermen, lack of product value understanding, minimum capital and access to capital, awareness of fishing gear utilization, and the individual fisherman's work system. The conceptual model of the blue swimming crab supply chain proposed consists of the formation of fishing groups, coordination between fishing groups and *Perum Perindo*, collaborating with *Pokja* and fishing groups, and increasing collaboration between all supply chain actors of blue swimming crab.
Keywords: blue swimming crab, fishermen, Soft System Methodology, supply chain

Abstrak

Rajungan (Portunus pelagicus) merupakan salah satu komoditas perikanan ekspor tertinggi di Indonesia. Usaha ikan tangkap didominasi oleh para nelayan dengan tingkat produktivitas, efisiensi, serta pendapatan yang rendah. Disparitas keuntungan yang tinggi terjadi antara pelaku rantai pasok dari hulu dan hilir. Nelayan memperoleh keuntungan paling rendah. Penelitian ini bertujuan mengidentifikasi penyebab disparitas keuntungan antara pelaku rantai pasok dan mengusulkan model rantai pasok sebagai solusi permasalahan disparitas keuntungan. Pelaku rantai pasok yang diamati adalah nelayan, mini plant, perusahaan pengolah rajungan, dan eksportir. Identifikasi variabel yang memengaruhi perolehan keuntungan berdasarkan aktivitas bisnis pelaku rantai pasok rajungan. Model konseptual dibuat menggunakan Soft System Methodology *(SSM). Hasil analisis menunjukkan bahwa penyebab disparitas keuntungan adalah jumlah nelayan yang sangat banyak, pemahaman yang kurang terhadap nilai produk, modal dan akses permodalan yang minimum, kesadaran dalam penggunaan alat tangkap yang aman, dan sistem kerja nelayan yang masih dilaksanakan secara individu sehingga nelayan menerima keuntungan yang paling kecil di antara pelaku rantai pasok dari hulu dan hilir. Model konseptual rantai pasok rajungan yang diusulkan adalah pembentukan kelompok nelayan, koordinasi antara kelompok nelayan dan Perum Perindo, kolaborasi antara Pokja dan kelompok nelayan, dan meningkatkan kolaborasi antara seluruh pelaku rantai pasok rajungan.*
Kata kunci: *nelayan, rajungan, rantai pasok,* Soft System Methodology

INTRODUCTION

Indonesia is the largest archipelago country in the world, with an 81,000 km coastline. These conditions provide a fishery resources potential of around 70 million hectares per year, divided into 54 million hectares of public waters resources, and the rest are aquaculture products resources (Direktorat Kelautan dan Perikanan, 2014). East Java is a province in Indonesia with a coastline of

approximately 2,916 km. The 1,600 km long coastline is a marine area with fishery production potential reaching 338.9 thousand tonnes in 2010 (Batubara et al., 2017). Based on the catch type classification, marine capture fisheries are divided into pelagic fish, demersal fish, and non-fish groups. One type of capture fisheries product with high economic value is the blue swimming crab (*Portunus pelagicus*) (Batubara et al., 2017). Blue swimming crab has been the second main export commodity after tuna. The top country for blue swimming company exports is the United States of America (USA), reaching 450 tons per day (Agustina et al., 2014).

95% of the blue swimming crab supply chain actors generally consist of fishermen, mini plants, and processing companies. The blue swimming crab supply chain model existing is shown in Figure 1. The upstream sector actors in the blue swimming crab commodity are fishermen who try to meet high demand, but mini plants dominate the blue swimming crab business as price controllers. The controlled price by mini plants causes fishermen as actors on the upstream side of blue swimming crab fishing gets small profits(Agustina et al., 2014).

The fishermen observed in this study were fishermen with low capital resources, so their harvest capacity was low. Each fisherman is required to have a ship owner nationality called *Kartu Pas* as an identity card stating that he is registered as a fisherman. Each fisherman reports his fish harvest to the working group called *Kelompok Kerja (Pokja)* for record harvest data and fishing areas. The harvested fish is sold at the mini plant. One mini plant has 60-100 fisherman partners. The mini plant processes blue swimming crabs (steaming and sorting) and then sells them to the blue swimming crab processing company. Blue swimming crab processing company fulfill export requests based on a make-to-order production strategy. Requests from processing companies to mini plants are specified blue swimming crab. The blue swimming crab processing company will receive the entire quantity of blue swimming crab sold by the mini plant if it complies with the required specifications. Blue swimming crab processing companie usually set a minimum delivery target for mini plants because the number of blue swimming crab harvests exceeds the number of requests. The government also has a fish processing unit called *Unit Pengolahan Ikan (UPI)* for blue swimming crab commodities in the Brondong, Paciran, and Probolinggo areas under the supervision of the Indonesian fisheries public company called *Perusahaan Umum Perikanan Indonesia (Perum Perindo)*. Activities carried out by UPI only rent building facilities for storing fishery products to the private sector.

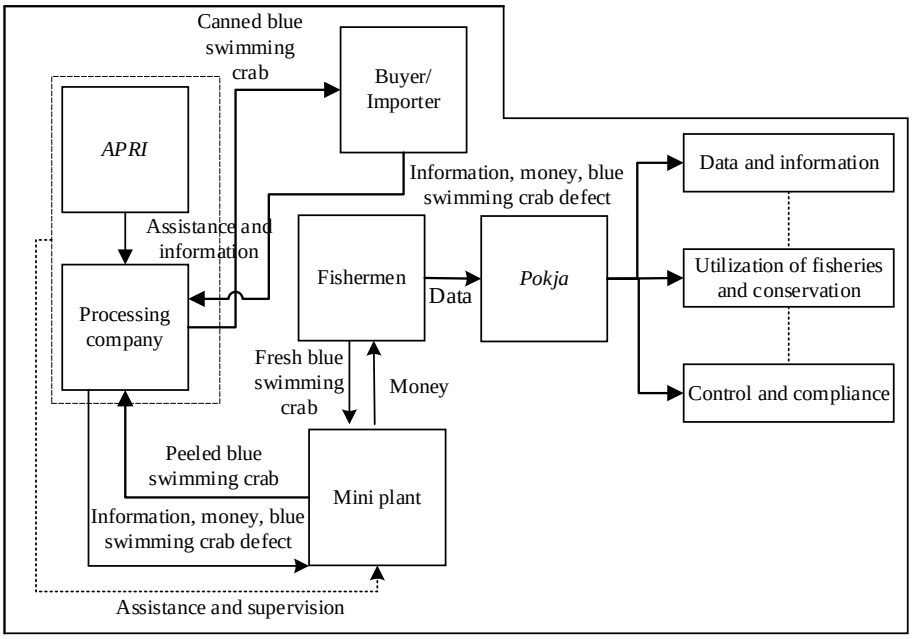


Figure 1. Model of the Existing Blue Swimming Crab Supply Chain
Note:
——— Relations between stakeholders in a transactional form
····· Relations between stakeholders in a coordination form

Another actor in the blue swimming crab supply chain is the Indonesian crab management association called *Asosiasi Pengelolaan Rajungan Indonesia* (APRI), a collection of blue swimming crab processing entrepreneurs. The purpose of establishing this organization is to support an environmentally friendly blue swimming crab management program. APRI also assists blue swimming crab processing company in obtaining certification for blue swimming crab products from the Marine Stewardship Council (MSC), Seafood Watch, and the Sustainable Fisheries Partnership (SFP) Rating and assists the Ministry of Maritime Affairs and Fisheries called *Kementerian Kelautan dan Perikanan* (*KKP*) in collaboration with *Pokja* to collect blue swimming crab data. *Pokja* is part of the organizational structure of the Fisheries Management Institute for the Republic of Indonesia's Fisheries Management Area called *Wilayah Pengelolaan Perikanan Negara Republik Indonesia* (*WPPNRI*), conducted by the Fisheries Management Agency called *Lembaga Pengelola Perikanan* (*LPP*), which has roles and functions according to their fields (Soemodinoto & Kartawijaya, 2014). *APRI* works with crab processing companies to assist and supervise the mini plants to ensure the process runs according to established procedures. KKP, as a government institution, is responsible for monitoring and evaluating the performance of supply chain actors. The Ministry of Maritime Affairs and Fisheries issued Government Regulations governing the Prohibition of Catching and Exporting Lobster, Crab, and *Rajungan* (Kementerian Kelautan dan Perikanan, 2016b) as well as Ministerial Decrees governing Plans for the Management of Crab Fisheries in the Indonesian Fisheries Management Area (Kementerian Kelautan dan Perikanan, 2016a).

The profit earned by the fishermen and the mini plant is shown in Table 1. The profit obtained by the mini plant for each 80 kg production capacity is IDR 50,000,000. In contrast, the profit obtained by fishermen for each harvest is IDR 10,000/kg, and the average harvesting capacity is 5 kg. The profit per kg and yield obtained by fishermen is minimal, so many small blue swimming crab fishermen have changed professions.

One approach often used to address fishermen's problems is to design supply chains and evaluate them using quantitative methods (Pamuji et al., 2018). The majority of supply chain actors in the blue swimming crab business are small business actors. Quantitative techniques are not suitable for solving problems in the small business sector due to software limitations and complex mathematical models (Celuch et al., 2007). Soft System Methodology (SSM) is suitable for solving complex human behavior problems (Proches & Bodhanya, 2015). SSM is an approach to organizing unstructured and difficult-to-define problems involving human-technology interactions. This method helps to understand the different perceptions of involved actors in the system to provide an in-depth problem understanding. The method characteristics include structuring the problem rather than solving the problem and facilitating dialogue between stakeholders to get a bigger picture of the problem (Daellenbach & McNickle, 2005). The method commonly used is Focus Group Discussion (FGD) (Andayani et al., 2016; Nurhasanah et al., 2020).

Andayani et al. (2016) have conducted research using the SSM method. This research discusses the unsustainability problem of red chili production in developing red chili agribusiness clusters designed by Bank Indonesia. The supply of red chilies was hampered. This research result was solutions for developing cluster models based on transparency, fairness, and integration between all stakeholders using the SSM model. Nurhasanah et al. (2020) also used SSM to discuss designing intelligent supply chain systems for the natural fiber industry. System design is carried out to optimize the natural fiber supplies' sustainability that provides economic and environmental benefits. These studies show that SSM can facilitate dialogue between stakeholders to structure problem situations. Therefore, research on the blue swimming crab supply chain.

Table 1. Selling prices and production capacity of blue swimming crab supply chain actors

Actor	Selling Price (IDR)	Production Cost (IDR)	Capacity	
			Harvest Season	Famine Season
Fishermen	15,000-40,000/kg	15,000-30,000/kg	5-6 kg	1-3 kg
Mini Plant	230,000-260,000/kg	180,000-210,000/kg	100-120 kg	50-70 kg

aims to identify differences in profits between supply chain actors and propose a supply chain model to solve the problem of profit disparity using SSM

METHODS

The research was conducted in Lamongan, Pasuruan, and Probolinggo Regency, blue swimming crab-producing areas in East Java, Indonesia. The supply chain flow studied is the peeled blue swimming crab supply chain. These research objects are fishermen, mini plants, processing companies, and Perum Perindo. Other parties who became actors in this study were *KKP*, *Pokja*, and *APRI*. The sample selection of each actor using the purposive sampling method. This sample study included five fishermen, two mini plants in each region, crab processing companies, and Perum Perindo.

This research uses a descriptive approach, which describes the supply-chain pattern of peeled blue swimming crabs in the observation area. The data used in this study are primary data and secondary data. Primary data was collected from fishermen, mini plants, and processing companies involved in the supply chain and *Perum Perindo* as a government stakeholder. Secondary data was collected from the Department of Fisheries, Statistics Indonesia, and other relevant agencies. The purpose of data collection is to obtain as much information as possible about the problems faced by each actor and to identify the variable costs that cause high-profit disparities using interview techniques.

The research stages are shown in Figure 2. The research began with a preliminary survey and literature study to determine the flow of blue swimming crab supply chains in East Java. The data needed is information about the flow of blue swimming crab products from upstream to the processing companies, the process stages carried out by each actor, and the technical and financial problems actors face in the supply chain. The next stage is to identify the existing supply chain model by using the information data that has been obtained previously. System elements of the existing supply chain model are also identified. System elements include components, inputs, outputs, activities, interactions, and transformations.

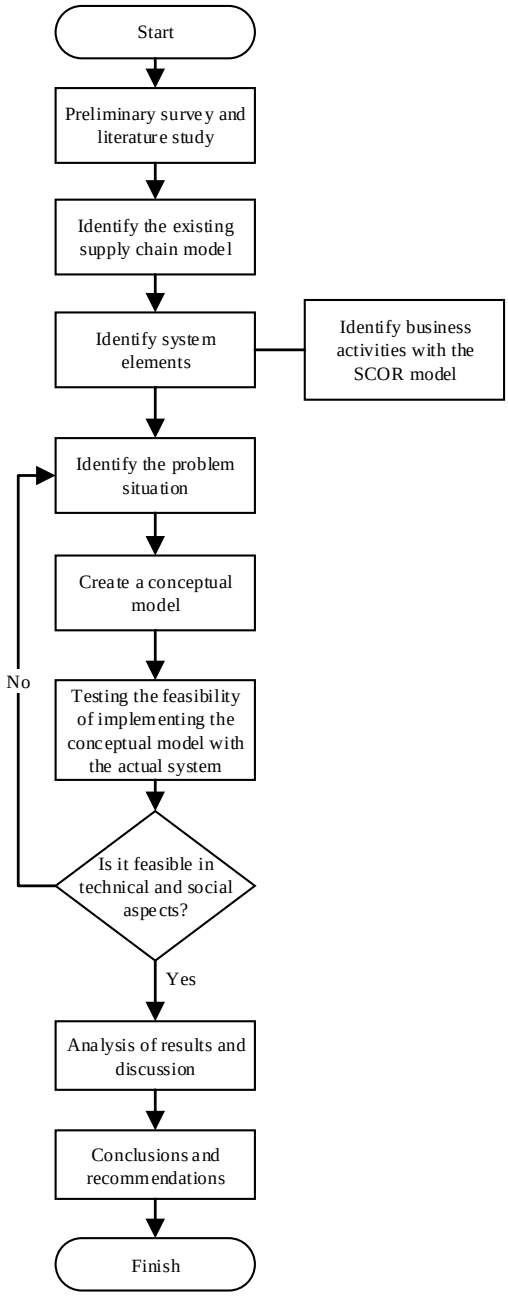


Figure 2. Research Methods

The next stage was the SSM stage (in Figure 2, starting from the stages of identifying problem situations and creating a conceptual model to test the feasibility of implementing a conceptual model with a real system). The SSM method in more detail consists of 7 processes, shown in Figure 3. The problem situation identification stage consisted of 2 processes: concluding the problem from an unstructured situation (process 1) and identifying alternative viewpoints or problem themes (process 2). This stage described

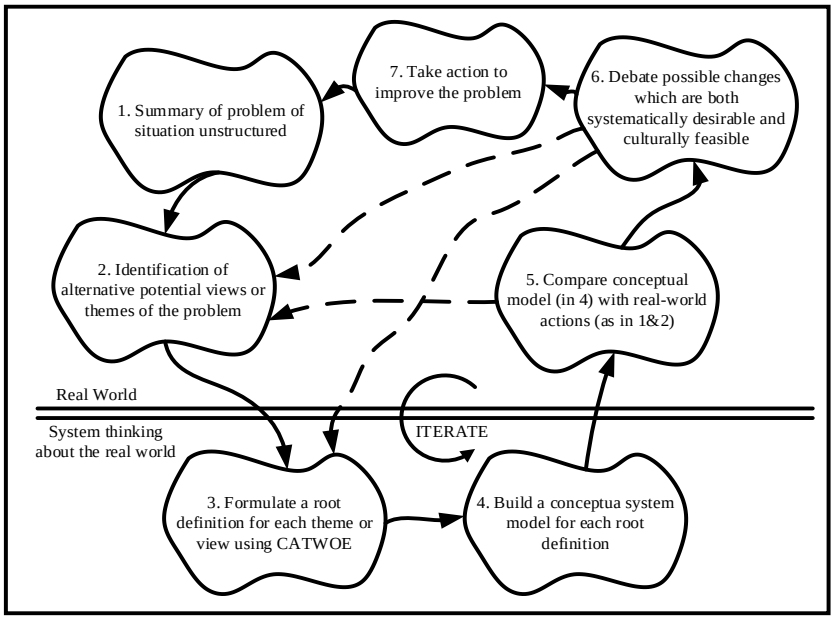


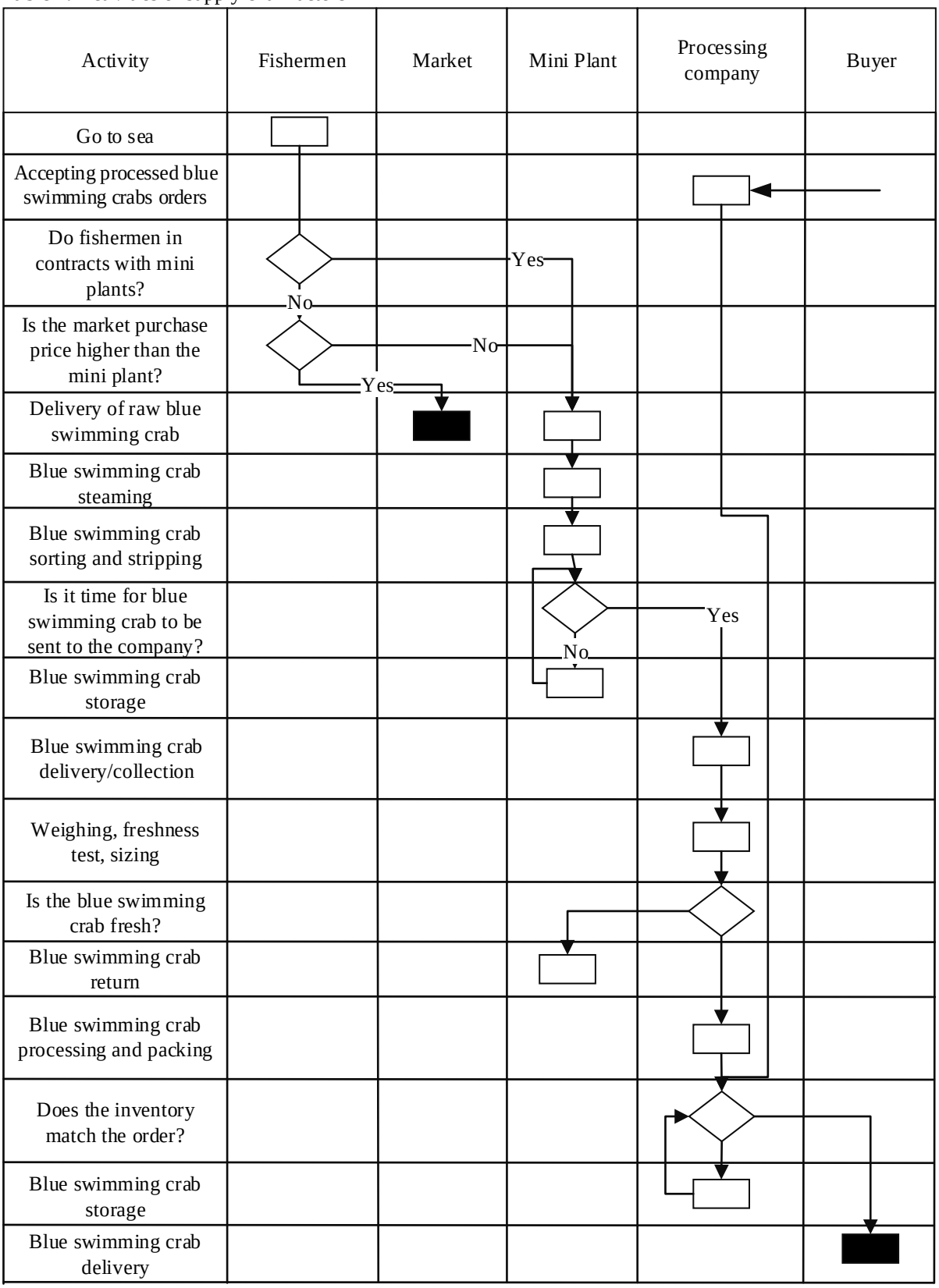
Figure 3. Proses Soft System Methodology (Daellenbach & McNickle, 2005)

real problem situations using diagrams (Mind Maps, Rich Picture Diagrams, Influence Diagrams) that showed structural or process elements. The conceptual model creation stage began with identifying the root definitions that described the goals of all stakeholders and the problems that arise to achieve the goals by identifying Customers, Actors, Transformation, World Views, Owners, and Environment (CATWOE) (process 3). The customer was the party that benefited or impacted the owner's decision. The actor was the user who carried out the owner's decision/policy. The transformation described the goals to be achieved by stakeholders. World View/Weltanschauung showed the point of view of all stakeholders to achieve goals. The owner was the decision maker. The environment showed the challenges/obstacles to achieving the desired goals. The following process was to create a conceptual model that described stakeholder activities according to the root definition (process 4). Testing the feasibility of implementing the conceptual model with the actual system was compared to the conceptual model created with the actual system (process 5). The conceptual model was submitted to stakeholders for comments and input regarding the possibility of implementing the proposal (process 6). If the alternative proposal cannot be carried out systemically or culturally, then the stages will be repeated from process 2. If the proposal in process 6 cannot be carried out due to inaccuracies in defining the CATWOE elements, then the stages are repeated from process 3. The SSM method's final process was implementing the conceptual model following the actual system (process 7). The next stage of research was to analyze the proposed model implementation and conclude the causes of profit disparity and the proposed supply chain model as a solution to the profit disparity problem.

RESULTS AND DISCUSSION

The causes of profit disparities differences in the blue swimming crab supply chain actors were identified in this study. The profit disparity is the difference between the selling price and production costs received by the blue swimming crab supply chain actors. Tjiptono (2015) stated that internal and external factors influence the selling price. Internal factors include company marketing, marketing mix, the minimum value for profit, and organizational decisions. External factors include the nature of the market, demand, availability/supply, competition, and external conditions (such as economic and social conditions). Different variables influence the selling price determination of each actor in the blue swimming crab supply chain. The variables considered to affect the selling price in this study are based on the supply chain business activities of peeled blue swimming crab, presented in Table 2.

Table 2. Activities of supply chain actors



Note: The black box indicates that in this study, product flows are identified only up to certain actors; for example, the black box in the Market column means that observations are made until the blue swimming products from fishermen are sent to the market.

The number of blue swimming crab fishermen in the Java Sea is around 50% of the total 90,000 crab fishermen in Indonesia. This number is the highest in the fisheries management area in Indonesia (Direktorat Jenderal Perikanan Tangkap, 2020). The fishermen's fishing yields average 5-6 kg/day during the harvest season and only 1-3kg during lean season. Fishermen often do not even get crabs beside of harvest season. Private fishermen own the boats used for fishing with a boat size of <5 Gross Tonnage (GT). The harvest was done using fish traps called *bubu*, destructive seine, and trawl nets called *cantrang* or mini bottom trawl called *arad*. Most fishermen's harvests are sold to mini plants, and fishermen deliver. Fishermen usually compare market and mini plant purchase prices. Products were sold to those who offer higher prices. The mini plant location was near the sea, so fishermen could easily send their harvest results.

The main activities carried out by the mini plant were sorting, grading, and steaming. The mini plant buys all the fishermen's harvest. Each mini plant had an average of 60-80 fishermen. The character of mini plants was divided into two, mini plants with contracts and those without contracts with processing companies. The difference was the certainty of product purchases at mini plants with contracts with processing companies. The number of mini plants in the Java Sea was the highest in the fisheries management area in Indonesia (Direktorat Jenderal Perikanan Tangkap, 2020). These mini plants were around 57% of Indonesia's total 311 mini plants (Triyanti et al., 2021). Each mini plant had a place to carry out the stripping process, and some mini plants had cold storage. The employees were day laborers due to supply uncertainties. Labor wages depend on the work duration because all blue swimming crab will be processed on the same day it was received. The peeled blue swimming crabs were separated into several parts: colossal and jumbo lump, backfin, claw meat, claw finger, and special.

Peeled blue swimming crab were stored in a jar according to their type. The average yield of peeled blue swimming crab was 30%. The average selling price for peeled blue swimming crab was IDR 230,000/kg, but the price becomes higher when there was a product shortage, between IDR 240,000/kg and IDR 260,000/kg. The high demand and export value have made blue swimming crab a commodity sought after by processing companies. The processing company will accept any peeled blue swimming crab type if it was fresh. Therefore, the mini plant only needed to maintain product quality to remain fresh when a processing company received it. Delivery was done by the mini plant or the processing company (depending on the contract agreement). Shipping costs and risks to product quality were the sender's responsibility.

Processing companies met most export demand through a pasteurization process to kill bacteria and extend peeled blue swimming crab shelf life. Processing companies got orders by participating in marketing events in destination countries. All processing companies that export their products must have the MSC label to ensure safe product quality from farm to fork. Peeled blue swimming crabs that did not comply with export qualifications will be processed into processed products for local market consumption. The Covid-19 pandemic affected all global sectors but did not significantly affect the peeled blue swimming crab export demand. According to Adi (2020), the demand for peeled blue swimming crab exports decreased when the pandemic started for approximately three months, and then the demand returned to normal. This condition showed that blue swimming demand was very high. High demand allowed for over-exploitation. Based on the Ministry of Maritime Affairs and Fisheries, several provisions must be obeyed, such as the size and weight of the blue swimming crab that may be caught, recording the blue swimming crab caught, and releasing blue swimming crab outside the specified size (Kementerian Kelautan dan Perikanan (2016b). The processing company will send a numerator to the mini plant to calculate and record the catch. The acquisition calculation results of captured crabs will be reported to the National Fisheries Institutes (NFI's) Crab Council.

The export market determined the blue swimming crab qualifications, starting from the type and quality (free of metal, bacteria, and viruses). Therefore, processing companies must ensure that product quality is in good condition by testing the quality (sensory testing) when the raw materials arrive. The parameters tested were freshness, aroma, and metal content. Peeled blue swimming crab that was not fresh will be returned to the mini plant. Processing companies provided specific tolerances regarding the peeled blue swimming crab type sent. The peeled blue swimming crab would be accepted within

tolerance limits even if the type did not match the order. The tolerance depends on the processing company that received the peeled blue swimming crab from the mini plant. APRI cooperates with processing companies to assist and supervise the process at the mini plant as one of the efforts made to ensure the production process hygiene at the mini plant. Processing companies with significant capital chose to buy the entire mini plant product because demand tends to be constant or even increase, but supply was limited. The processing company implements a traceability system as a condition for product acceptance in the export market. Shipping was done using transportation owned by the processing company and involved Third Party Logistics (3PL). The processing company was responsible for the product until it was received at the destination port. According to Adi (2020), exporters will not return the product unless the condition is terrible. Negotiations were held to discount the product if the product received did not meet the exporter's specifications.

Existing supply chain flows and actors' activities (Figure 1. and Table 2) were used to describe the problem situation using the Influence Diagram (ID) model shown in Figure 4. ID describes the relationship between variables to obtain each supply chain actor's cost and revenue overview. ID uses diagram conventions, including squares representing controlled inputs, circles representing components, clouds representing data, constraints, and uncontrolled inputs, ovals representing outputs, and arrows representing relationships between variables (Daellenbach & McNickle, 2005). ID in this study shows the variables that affect profit disparities.

Figure 4. Influence Diagram of the Profit Disparity Model in the Blue Swimming Crab Supply Chain

The ID and business activities of the blue swimming crab supply chain show that fishermen carry out activities and incur fewer total costs compared to the other two actors. Most fishermen had a contractual relationship with the mini plant due to capital loans for operational costs and personal needs, so all fishermen's harvest must be sold to the mini plant. Some fishermen sometimes sold the blue swimming crab in the market if the price increased. Fishermen had several alternatives for catching blue swimming crab, including *bubu*, *cantrang* or *arad*. The Ministry of Maritime Affairs and Fisheries stated that the purchase price of raw blue swimming crab using *bubu* is more expensive than *arad* or *cantrang* (Kementerian Kelautan dan Perikanan, 2016a). Bubu was safer for blue swimming crabs and the environment, but the catch amount was decreased. Fishermen send raw blue swimming crab to the mini plant, with shipping costs borne by fishermen. Shipping costs were relatively low because the fishing area location was close to the mini plant. The phenomenon encountered in the field was that many blue swimming crab fishermen eventually stopped looking for blue swimming crab and switched to other commodities due to their low yields (during the famine season). Other information obtained was minimum supervision from the government regarding fishing regulations so that fishermen could go to sea anywhere and anytime as long as they had a boat.

The mini plant was the actor who processes raw blue swimming crab into a peeled blue swimming crab to be supplied to processing companies. The mini plant cooperated with fishermen or collectors (buyers of fishermen's harvests) to get blue swimming crab supplies. The costs incurred by mini plants were much higher than those of fishermen. The cost components incurred by the mini plant can be seen in Figure 4. The mini plant faced a problem because there were very few blue swimming crabs in the sea during the lean season. Mini plant owners asked fishermen to go to sea in other areas with accommodation costs (transportation, lodging, consumption while fishing, and operational fishing costs) borne by the mini plant owner. The selling price of peeled blue swimming crab followed the market price. Prices will be higher during the lean season. The selling price was proportional to the total costs incurred.

Processing companies process blue swimming crab into canned blue swimming crab products using a pasteurization process to maintain product quality and freshness for extended shelf life. Peeled blue swimming crab received from the mini plant will be weighed, tested by sensors, graded, sorted, then processed into canned peeled blue swimming crab. The processing company accepted all the peeled blue swimming crab sold by the mini plant if the product was fresh. The processing company gives a mixed-type tolerance of 2% for peeled crab. Peeled crabs that did not meet the demand specifications will be processed/sold to processing companies for the local market. Canned blue swimming crab products that meet the quantity and specification of export demand were sent directly to the destination port using their cold storage trucks or 3PL. The investment needed to create a processing company includes factory buildings, pasteurization machines, sensory testing equipment, and cold storage.

Other actors in the blue swimming crab supply chain include *KKP*, *Perum Perindo*, and *APRI*. *KKP* is an organization in charge of fisheries and marine affairs with the aim of "Creating an Indonesian Marine and Fisheries Sector that is Independent, Advanced, Strong and Based on National Interests". One of the units supporting *KKP's* goals is Perum Perindo. According to Pamungkas (2019), Perum Perindo is a state-owned enterprise in Indonesia called *Badan Usaha Milik Negara (BUMN)* that improves the quality of transparent and accountable company management. Perum Perindo also encourages regional and national economic growth, state income, and national development by developing the marine and fisheries sector. Perum Perindo's line of business includes pre-production, cultivation, and post-production activities. Post-production activities for the East Java area were carried out at UPI Brondong (Lamongan Regency) and Mayangan (Probolinggo City), while a blue swimming crab processing center is planned to be established at UPI Mayangan. Survey data from UPI Mayangan show that land with facilities for processing and storing captured fish products were available, but there was no blue swimming crab processing yet. Cold storage facilities were leased to external parties.

Some of the problems that occurred in the blue swimming crab supply chain were related to fishermen, including (Fishery Progress, 2018):

1. Many blue swimming crab catches that still laying eggs and under the set size
2. Many blue swimming crab catches were still not reported and recorded in capture fisheries statistics
3. Increased market demand for blue swimming crab products that require certain specifications
4. Limited access/facilitation of financing for fishermen
5. Non-selective/damaged fishing gear was still used
6. The low level of knowledge and awareness of fishermen, collectors, mini plants, and stakeholders regarding the importance level of blue swimming crab sustainability
7. The low enforcement of the laws and regulations implementation
8. The low involvement of blue swimming crab fishermen in decision-making management

This problem also occurred in the supply chain for peeled blue swimming crab in Lamongan, Pasuruan, and Probolinggo Regencies.

Identification of components and activities in the blue swimming crab supply chain was then carried out based on the problem situation overview by defining CATWOE, shown in Table 3. The next stage was to build a conceptual model (proposed blue swimming crab supply chain model), which was used to identify CATWOE in the blue swimming crab supply chain, shown in Figure 5.

Several conceptual model proposals were then presented to stakeholders during interviews. The conceptual model was selected based on interviews and adjustments based on literature studies. The conceptual model chosen in this study was the peeled blue swimming crab's supply chain model shown in Figure 5. A different entity in the proposed model was a group of fishermen consisting of fishermen in a specific area. Fishermen groups were a combination of individual fishermen from the same area. The aim of forming fishermen groups was to facilitate coordination between supply chain actors and oversight from the government. *Pokja* that had roles and functions according to their fields were in the fishermen group. One was the data and Information Pokja collected data on blue swimming crab catches (Fishery Progress, 2018). The existence of fishermen's groups facilitated the coordination of fishermen with other stakeholders. Nuryanti & Swastika (2011) stated that forming farmer groups could improve farmers' bargaining position, especially in procuring facilities and marketing. Djamhari (2006) stated that cluster implementation could increase concentrated productivity in one location. Blue swimming crab fishermen can also implement group formation to achieve the same positive impact as farmer groups.

The next stage of SSM was to compare the conceptual model with the existing system. The comparison results between the conceptual model and the existing system are shown in Table 4. The proposed alternative solutions to improve blue swimming crab fishermen's living standards are the fishermen groups' establishment; coordination between fishermen groups and Perum Perindo, the collaboration with Pokja and fishermen groups; and increasing collaboration between all actors in the blue swimming crab supply chain.

Some of the causes of fishermen getting low profits were blue swimming crab fishermen's lack of product value understanding, minimum capital, lack of awareness of using safe fishing gear, and many fishermen working individually (Wibowo et al., 2016). This condition was different from what the mini plant experienced. The mini plant has information on peeled blue swimming crab selling prices and significant capital. The fishermen have been selling the raw blue swimming crab at the

Table 3. CATWOE list

Actors	Customers	Owner	Transformasi	World Views	Environment
Fishermen, mini plants, processing companies, exporters/buyers, *Perum Perindo*, and *APRI*	Fishermen	Marine and Fisheries Ministry	Improving the living standard of fishermen	Collaboration of all stakeholders for the blue swimming crab sustainability that can improve the living standard of fishermen	The limited fishermen's ability (technically and financially), lack of access to information and technology, and cultural habits of fishing communities

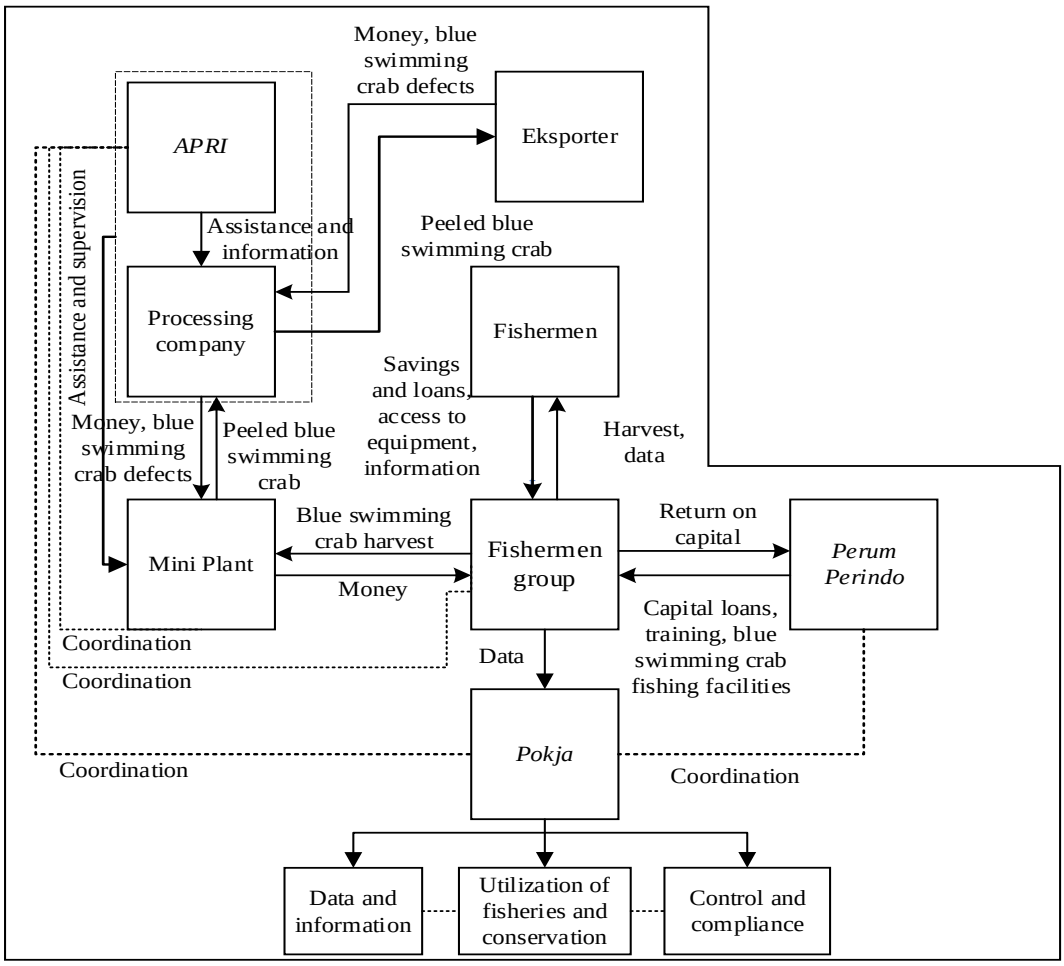


Figure 5. The Proposed Blue Swimming Crab Supply Chain Conceptual Model
Note:
——— Relations between stakeholders in a transactional form
····· Relations between stakeholders in a coordination form

mini plant. The mini plant carried out sorting, grading, and steaming activities causing the profit between fishermen and mini plants to be very significant.

The government had established an institution tasked to improve the performance of the blue swimming crab supply chain by providing assistance to fishermen and overseeing the process of safe blue swimming crab fishing. The government's goal was to assist fishermen and supervise blue swimming crab fishing, which was challenging because there were too many fishermen. One possible solution was forming fishermen groups in one area/cluster to coordinate more efficiently. Another expected impact was that fishermen could sell blue swimming crab in larger quantities, and the blue swimming crab had sorted, graded, and steamed before being sold to the mini plant, so the price will be higher (Ilmi & Riniwati, 2018). The production activity carried out by the mini plant was stripping. Fishermen could carry out sorting, grading, and stripping activities from a financial and technological perspective. However, fishermen did not want to carry out these activities because fishermen were more concerned with quantity than quality, so the size of their catch varied. Fishermen only thought that their catch could be sold entirely. Fishermen also needed to learn that the blue swimming crab size affects the selling price (Lubis & Satria, 2013). Perum Perindo and Pokja, as goverment institutions, will find it easier to assist, give a capital source, train, and supervise blue swimming crab business actors, including fishermen.

A common challenge was fishermen's difficulty in changing their habits. For example, they were more concerned with quantity than quality. One program that can be implemented is forming a pilot fishermen group. The expected goal is that the success of the pilot fishermen

Table 4. Action plans for the East Java blue swimming crab supply chain

Activity (Model)	Exist/Not Exist	Implementation	Actor	Obstacle	Alternative Solutions
Establishment of fishing groups	Not Exist	1. Determination of blue swimming crab - producing areas 2. Establishment of fishing groups through local government in collaboration with Pokja 3. Provision of certain benefits (capital assistance, ease of facilities) for fishermen who are members of fishermen groups 4. Fishermen groups counseling to increase product value (conducting sorting, grading, and selling activities according to blue swimming crab size)	Fishermen, local government, mini plant	1. Changing the habits of fishermen who usually sell to collectors 2. Gather fishermen to form fishing groups	1. Create a pilot group of fishermen (Rakhmanda et al., 2018) 2. Capital assistance, assistance and supervision to pilot fishermen groups
Coordination between *Perum Perindo* and fishermen groups	Not Exist	1. Environmentally safe blue swimming crab catching and capital funding for fishermen to catch blue swimming crab (so far, the funding has come from the mini plant, so a contract with the mini plant binds fishermen) 2. Assistance and supervision of fishermen's activities to ensure that blue swimming crab catches to comply with Ministerial Decrees and Regulations	Fishermen, Pokja, Perum Perindo, local government	1. Changing the fishermen minds to cooperate with Perum Perindo 2. Facing fishermen who are uncomfortable with supervision	*1.* Perum Perindo provides assistance to fishermen groups in the form of fishing gear (*bubu*) and capital in accordance with the role of *Perum Perindo (perumperimdo.co.id)* 2. Perum Perindo provides easy access and capital relief
Coordination between *Pokja* and fishermen groups	Exist	Fishermen are currently required to have a *Kartu Pas* a fisherman's identity card	Pokja and fishermen	Minimum knowledge of information technology	Assisting fishermen groups regarding the application of information technology
Increased collaboration of all stakeholders with fishermen groups	Not Exist	Creating a forum group discussion between all stakeholders including fishermen groups	Processing company, mini plant, fishermen groups, *Pokja, APRI*, and *Perum Perindo*	Increase awareness regarding the importance of collaboration all stakeholders	Initiate pilot clusters that involve all actors in the blue swimming crab supply chain (Sharma & Anupam, 2014).

group program can motivate other fishermen to copy all the activities carried out by the pilot fishermen group. The success of forming fishermen groups is expected to benefit individual fishermen and all actors in the blue swimming crab supply chain. The government's active role through the *Perum Perindo*, *Pokja*, and *APRI* institutions is expected to support the success of the fishermen's group program, which can increase fishermen's products' prices.

CONCLUSIONS

The causes of the profits disparity that leads fishermen to receive relatively small profits were a large number of fishermen, fishing habits that emphasize quantity and the use of unsafe fishing gear, implementation of individual work systems, minimal supervision and assistance to fishermen, and no integrated coordination between all supply chain actors. The proposed blue swimming crab's supply chain conceptual model consists of the establishment of fishermen groups, coordination between fishermen groups and Perum Perindo, the collaboration between Pokja and fishermen groups, and increasing collaboration between all blue swimming crab's supply chain actors. This conceptual model is expected to help increase fishermen's products' prices so that fishermen's profits also increase. Coordination and collaboration between the entire supply chain will benefit all of blue swimming crab's supply chain actors. Fishermen groups will facilitate coordination between all actors as a solution for many fishermen. Coordination will facilitate the supervision and guidance of fishermen as actors who provide blue swimming crab products. It will be easier for the government to monitor and evaluate the performance of all supply chain actors if there is good coordination.

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