

The Describing of Logistics Processes of Marine Crab Farmers in a Southern Province of Thailand

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Abstract:

Background and Objectives: In the context of Thailand, the food industry is considered the foundation of various products, with the food industry being of the utmost importance to the country's economic system. The marine aquaculture and natural fisheries industry is a major driver of the Thai economy, with the main production capacity in the southern region of the country, which is flanked by the two largest and longest coastlines, the Andaman Sea and the Gulf of Thailand. This qualitative research aimed to describing of Logistics Processes of Marine Crab Farmers in a Southern Province of Thailand.

Methods: The data were collected from 18 carb farmers and 4 middlemen who have consistently purchased marine crabs through interviews and observations.

Results: The findings revealed that the logistics management of the marine crab farming group consisted of 5 important processes: 1) Sourcing; Consisting of baby sea crabs, raw materials for raising sea crabs, and equipment for raising sea crabs. 2) Production; The condition of the crabs is adjusted by nurturing the crabs in cages before releasing them into the pond. 3) Storage, 4) Distribution, and 5) Transportation; The claws were tied with a large band of rubber bands and packed into a plastic bag tied to the mouth of the bag before being packed into a foam crate to wait for the car to pick up and deliver to restaurants and hotels in the Bangkok area. Additionally, there were 9 related farming activities: 1) Demand forecasting; It did not meet the predicted target, 2) Logistics communication; Most of them are middlemen, 3) Procurement; Ordered crab balls from the Department of Fisheries, Pak Meng District, Trang Province, 4) Customer service; Through telephone and line to contact crab trading, 5) Transport; The farmer is responsible for the transportation costs, 6) Materials handling and packaging; It is a procurement in and around the area, 7) Inventory management; Crab babies are prepared in the crab nursery pond to rest and wait for the crabs to be ready to be released into the pond for the next time, 8) Location selection; It is an abandoned pond from shrimp farming and 9) Reverse logistics; Incomplete crabs are returned to be released back into the pond to continue to be raised as complete crabs.

Conclusions: Data synthesis shows that sea crab farmers pay attention to material handling and packaging. Farming equipment from the neighborhood and the survival rate of the baby crabs are important and distributed through middlemen who have been in contact for a long time through LINE and telephone channels.

Keywords: Logistics Processes; Logistics Activities; Marine Crab Farmers

Introduction

Thailand's food industry is important to the country's economic system. It is also a foundation for various products such as agriculture, fisheries, livestock, and other fields. Thailand's food industry has advanced production technology and can be exported to more than 200 countries with an average value of more than 800,000 million baht annually. In 2015, Thailand generated income of 897,529 million baht from food exports, becoming the number 1 food exporting country in the world. The strength of Thailand's food exports is a variety of food types, including frozen and processed foods. As a result, food exports can be distributed throughout the world. Moreover, Thailand has a marine aquaculture industry and fishing from nature. Fishing is considered an important occupation that drives the country's economic system, generating additional national income by exporting fish products. Exporting frozen marine products such as crabs, shrimps, and fish to foreign markets in various countries can also help reduce the international trade deficit in some ways. The southern part of Thailand has the most coastal area as this region is flanked by two important seas: the Gulf of Thailand and the Andaman Sea. On the Gulf of Thailand side, the total coastline length is 2,055.18 kilometers. On the Andaman Sea side, the total coastline length is 1,093.14 kilometers. With the described geography, the southern region of Thailand is suitable for fishing occupations. [1]

At present, the seafood market is increasingly popular. The demand for seafood is so high that fishermen cannot catch enough marine animals to meet market demand. The explanation is that sailboat fishing depends on various factors such as the climate and the ship's condition. Nakhon Si Thammarat Province is a southern coastal province in Thailand. The population is engaged with fishing and raising aquatic animals as their main occupations. A number of farmers in the community of Koh Phet Subdistrict, Hua Sai District, Nakhon Si Thammarat Province, Thailand earns their living by breeding sea crabs. Initially, they catch baby crabs from natural sources and release them into rearing ponds until they grow enough for selling. An increasing number of farmers have caused insufficient baby crabs for all farmers. They have to purchase crab larvae from other sources, which costs them more farming expenses. Currently, the community of Koh Phet Subdistrict, Hua Sai District, Nakhon Si Thammarat Province has a high production capacity for breeding sea crabs for distribution to various sources. The farmers use the services of middlemen to help with distribution. Logistics activities, therefore, play an important role in helping drive the business forward since logistics bring their products to consumers. Following the initial chain until the final step, logistics is important in supporting the growth of the overall economic and social system, meaning the quality of people's lives in countries is better developed [2].

Logistics process gives importance to customers' needs and satisfaction and is considered a part of the supply chain (Office of the National Economic and Social Development Board, online) [3]. The structure of logistics starts from the upstream to the downstream, containing sub-activities that connect and help the supply chain operate efficiently [4] and [5]. The people involved must plan, execute, and control the flow and reverse flow of activities from the beginning to the end of the process such as receiving orders and procuring materials and equipment, production, product storage, warehouse management, and distribution and transportation of products to customers [6]. Also, services and information must be well coordinated to respond efficiently to customer needs. Logistics activities are activities that require the constant coordination of each activity in order to provide efficient and effective work to meet customer satisfaction at an appropriate cost. Logistics activities are activities that support operations within every organization, connecting all departments inside and outside the organization both in terms of demand and supply. The main logistics activities involve forecasting customers' needs, planning what will occur in the future, and managing logistics communication and order, resulting in the organization having a competitive advantage in purchasing and managing raw material needs to ensure continuity of service and customers' maximum satisfaction. The activities include material handling and packaging, efficient product storage and distribution, receiving goods and product forwarding, selection of factory location, warehouse management, and accepting product returns from customers. These factors affect the business and the operating costs of the entire system in the long term [7].

The research team is interested in studying and collecting data by observing the management process and logistics activities related to sea crab farming in order to analyze the problems from such activities and suggest solutions

to increase the efficiency of management processes and logistics activities for crab farmers, as well as those who are interested in increasing the value of the seafood market, as well as government agencies in considering allocating budgets to promote seafood production line with the government's soft power policy. Therefore, this is the origin of the study of sea crab farming in a large-scale sea crab project in the community of Koh Phet Sub-district, Hua Sai District, Nakhon Si Thammarat Province.

Objective

1. To analyze the logistics process of the crab farming group in Ko Phet Subdistrict Area ,Hua Sai District, Nakhon Si Thammarat Province, Thailand.
2. To analyze the logistics activities of the sea crab farming group in Ko Phet Subdistrict Area ,Hua Sai District, Nakhon Si Thammarat Province, Thailand.

Literature review

Concepts about logistics

Logistics is a delivery management system of products, information, and other resources that need transportation from the point of origin to the place of consumption according to customer needs. Logistics involves integrating transportation information, inventory management, raw material management, and packaging. It is one channel of the supply chain that increases the value of time and space. In this regard, the Industrial Standards Institute by the Ministry of Industry (2007) gives the meaning of logistics in the strategic plan for developing the logistics system of Thailand for the years 2007 - 2011 as the process of planning operations to control efficiency and effectiveness in the flow, storage of raw materials, inventory in the finished product process, and related information from the starting point to the point of use, which corresponds with consumer needs. In other words, logistics is a process that brings the right products from the right source at the right timing, quality, and quantity, and at the right cost to the right place to increase cost efficiency, products/ services reliability and security, and the responsiveness to the customers' needs [8].

Logistics process

It is a combination of all activities of suppliers, production, distribution, and transportation of raw materials, involving manufacturers, raw material suppliers, wholesalers, warehouses, inventory, retailers, and customers [9]. All aspects of the business are covered in order to meet the customers' needs systematically. A successful business is not limited to one duty of the business; all duties are important, covering aspects of new product development, marketing, operations, distribution, financial management, and customer management. Heizer. [9] stated that logistics management is an integration of all activities among suppliers, production, distribution, and customers in the supply chain. These integrated tasks may include information giving, planning in advance, payments and credits, exchanges of information or ideas, designs, and raw material handling. Niven. [10] also described the logistics process as a process that links the entire system from the origin to the destination of products and services. It is a process for planning operations and controlling efficiency and effectiveness in product or service distribution and storage, and information from the starting point to the point of usage, aiming to align with the needs of consumers. It is also an integration of business processes starting from the final consumer and going all the way to the earliest product, services or information distributor to increase the value for consumers [11].

Logistic activities

According to the Logistics Division, Department of Industrial Promotion. [12] and Lambert et al. [3], activities in logistics can be classified into 9 activities as follows: 1) Forecasting customer needs or planning is the prediction of what will happen in the future, based on analysis of past data, current information, and experience. The forecast can be used to monitor the changing trend in the business or environment that will affect the business and set policies to enable the business to achieve its objectives. 2) Logistics communication activities are a logistics process that focuses on good communication resulting in the the efficient linkage of data and the organization's competitive advantage. The order management process covers everything from receiving orders from customers, communicating with customers,

and checking inventory balances and customer details. The connection between the organization and the customers can easily influence the level of customer satisfaction. In order to avoid problems, this process should take as little time as possible. 3) Purchasing and procurement activities are the management of demand for raw materials to ensure continuity in production and distribution processes, purchasing and selecting procurement sources, hiring, quantity of purchases, and purchasing time. 4) Providing customer services and support activities can create maximum satisfaction for the customers. 5) Transportation activities to deliver the right product to the right place and time with the lowest cost of transportation is necessary. Transportation methods, therefore, vary in the geographic environment in each country. Moreover, transportation depends on the type of goods and services. The customer's needs or wants must be taken into consideration in choosing a transportation method in order to be able to compete with others. 6) Material and packaging handling activities: In the field of logistics, efficient material and packaging management can effectively reduce the damage to productivity, and good packaging can facilitate movement and storage well, as well as reduce the cost of crab farmers and middlemen. 7) Inventory Management refers to the efficiency in storing products in the warehouse, the factory, distribution center, or other agencies as well as receiving delivered products, and forwarding products from the factory to the distribution centers. 8) Selection factory location and warehouse management activities are important plans that affect the business in the long term. The location of the factories and warehouses will affect operating costs for the entire system, such as transportation costs, communication costs, labor costs, utility costs, and warehouse construction costs. Therefore, the location should be chosen carefully in accordance with the type and nature of the business. 9) Reverse logistics activities are related to receiving product returns from customers because there is a problem with the product's performance, the customer has changed their minds, or the product needs a repair or replacement. Reverse logistics activities are also about eliminating waste generated from production process, product distribution, or packaging. The process starts from collecting, storing, and transporting waste to the point of destruction, reusing, and remanufacturing [13]. The costs of reverse logistics can incur to both consumers and producers.]

Research Conceptual Framework

From the extensive review ,the research conceptual framework can be defined as shown in Figure1 .

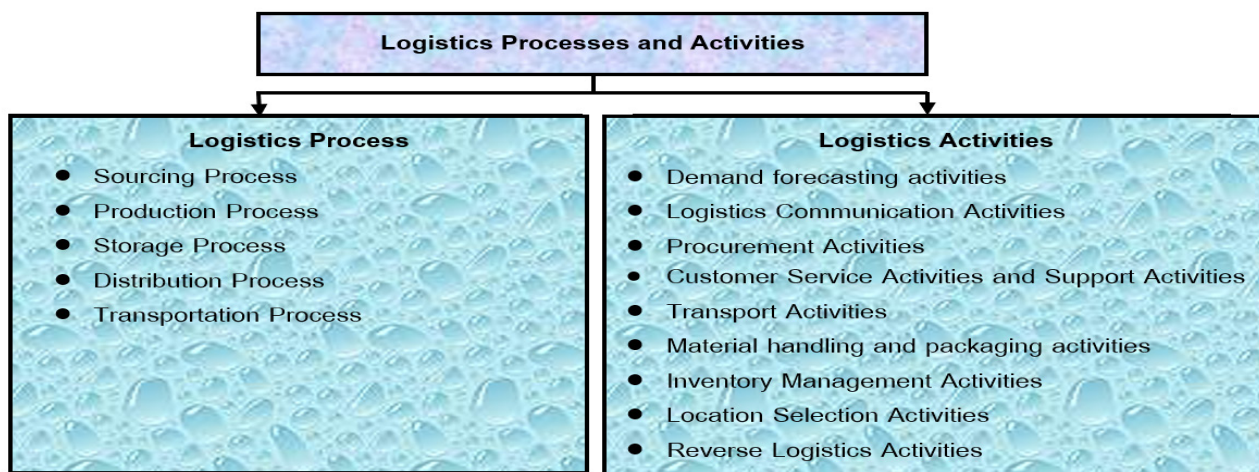


Figure1 . Research Conceptual framework

Source: Author

Methodology

The research team used a specific sampling method, it is defined as: Sea crab farmers in the large-scale sea crab project Koh Phet Subdistrict, Hua Sai District, Nakhon Si Thammarat Province. In this study, the main group of information providers consisted of: 1) Farmers who raise sea crabs who have been raising sea crabs for at least 10 years, who are considered to have high knowledge, skills, experience and expertise in raising sea crabs, resulting in

high survival rates and high quality, there are 18 case out of a total of 30 case, 60%. And 2) Middlemen who buy sea crabs who have been buying sea crabs from farmers continuously for at least 5 years because they have knowledge, skills, experience and are highly specialized in transportation, there are 4 case out of a total of 7 case, 57.14%. Principal contributors were happy to provide information in this study for this research.

Table 1. Sample Population

Sample	Total	Amount	%
Farmers who raise sea crabs	30	18	60
Middlemen who came to buy sea crabs	7	4	57.14

Research tools

1. The observation used in this research was divided into 2 types, namely 1) Participant Observation and 2) Non-Participant Observation, in which the researchers conduct in-depth interviews and observed the methods, steps of the sea crab farming process, and the patterns of group product distribution of the Sea crab farmers and middlemen in the area of Ko Phet Subdistrict, Hua Sai District Nakhon Si Thammarat Province, Thailand. The details of the processes and procedures in crab farming such as preparation of manholes/nursery ponds, sea crab rearing ponds, methods of raising sea crabs, and dealings between farmers and middlemen were recorded in the observation form.

2. Unstructured in-depth interviews used in this study focused on 9 activities of logistics management systems, including 1) Demand forecasting activities, 2) Logistics communication activities, 3) Procurement activities, 4) Customer service activities and support activities, 5) Transportation activities, 6) Procurement of raw materials and farming equipment, 7) Inventory management activities, 8) Choosing a farming location, and 9) Logistics activities.

3. The camera is used to record still images while the research team is in the research storage area.

Data analysis

The researchers collected data on the sea crab logistics system from the sea crab farmers in Ko Phet Subdistrict, Hua Sai District, Nakhon Si Thammarat Province, Thailand and the middlemen who came to buy sea crabs from farms to distribute to consumers. The interview was used for the data collection. The collected information from sources e.g. interview, focus group, observation, and the documents were categorized into 2 parts (the information on the crab farmers and information on the middlemen). The accuracy and the completeness of the information and responses have been checked by persons involved in field data collection. The interview data were reviewed and themes that emerged from the obtained data were identified using a coding technique. The data were analyzed according to the scope and purposes of the study using thematic analysis.

Research Results

Rakchad [14] said that farmers used abandoned shrimp ponds to raise sea crabs to prevent the ponds from going to waste. In the beginning, the farmers obtained baby crabs from natural sources. Later, when they joined a large sea crab project, the crab hatchlings were ordered from the Fisheries Department in a nearby province in Pak Meng District, Trang Province. A large sea crab project has begun raising sea crabs since 2018 and has registered with the Fisheries Department, Nakhon Si Thammarat Province in order to improve the efficiency of crab farming and increase the sales of products at a higher price. It creates career stability for farmers as well as developing a model for distributing products within the group without going through middlemen to increase income for farmers.

1. Analyze of Logistics Processes; The logistics process of the sea crab farmer group in Ko Phet Subdistrict, Hua Sai District, Nakhon Si Thammarat Province, Thailand included 5 processes.

1.1) Sourcing Process; The procurement process comprised the following procedures: 1) Procurement of sea crab larvae, 2) Procurement of raw materials for raising sea crabs, and 3) Procurement of equipment for raising sea

crabs. Regarding the procurement of sea crab larvae, the farmers purchased crab larvae of 0.5 centimeters in size from 2 sources, namely, the Fisheries Department in Pak Meng District, Trang Province, and from local sellers. For the procurement of raw materials to raise sea crabs, crab food used included catfish, tilapia, and sea bass. These raw materials were caught by the residents in the local area. In relation to the procurement of equipment to raise sea crabs, farmers purchased the equipment from the local market. The equipment included: 1) chopping knives, 2) chopping board, 3) rubber cloth (for blocking ponds), 4) *Sai*, a local fishing tool, 5) large rubber band (for tying crab claws), 6) Plastic bags (for holding crabs), 7) Water buckets (for holding crabs when caught), and 8) Sacks (for transferring).

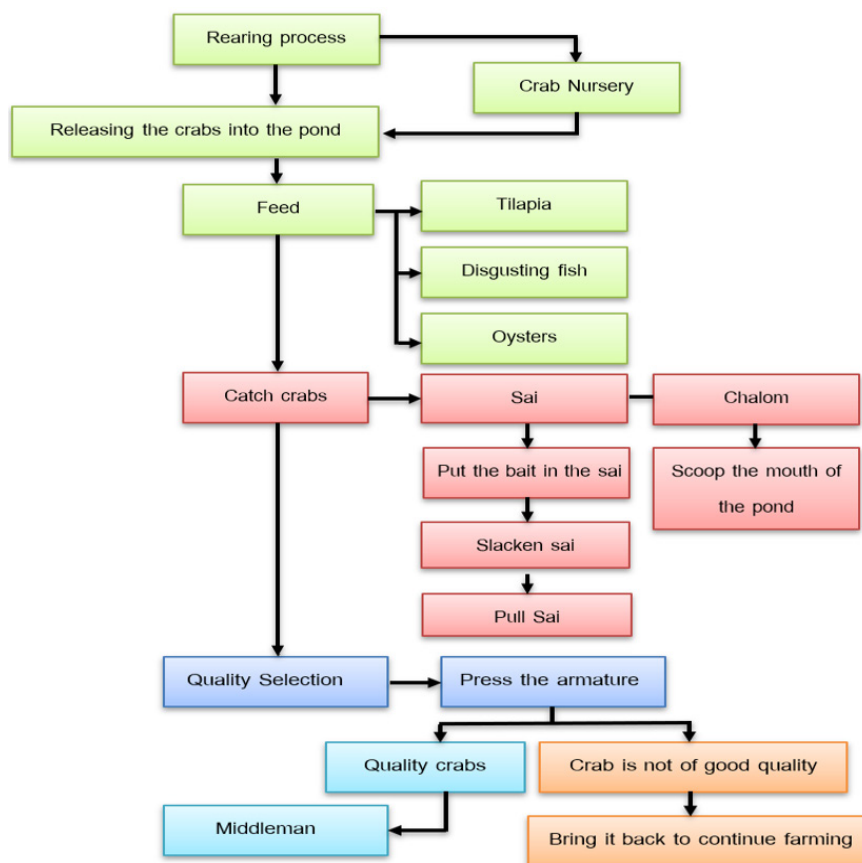


Figure 2. Production Process

Source: Author

1.2) Production Process; In the process of raising sea crabs, the condition of the baby crabs is adjusted before releasing them into the pond to ensure that the baby crabs have a high survival rate. The baby crabs were fed after being released into the pond and the feeding was done 2-3 times a week. The food given to the crabs included tilapia, catfish, and sea bass. After raising for 5-6 months, they were harvested. The farmers caught them by using baits which were thrown into the pond. After waiting about 5-10 minutes, crabs came and ate the bait in the sai, then pulled up. In case the crabs were near the mouth of the pond, they were scooped out with a chalorm, a local bamboo basket. After that, they were placed in a tank in order to select quality. The farmers pressed the shells to see whether the crabs' meat was suitable for selling. The crabs which were not of quality were released back into the pond.

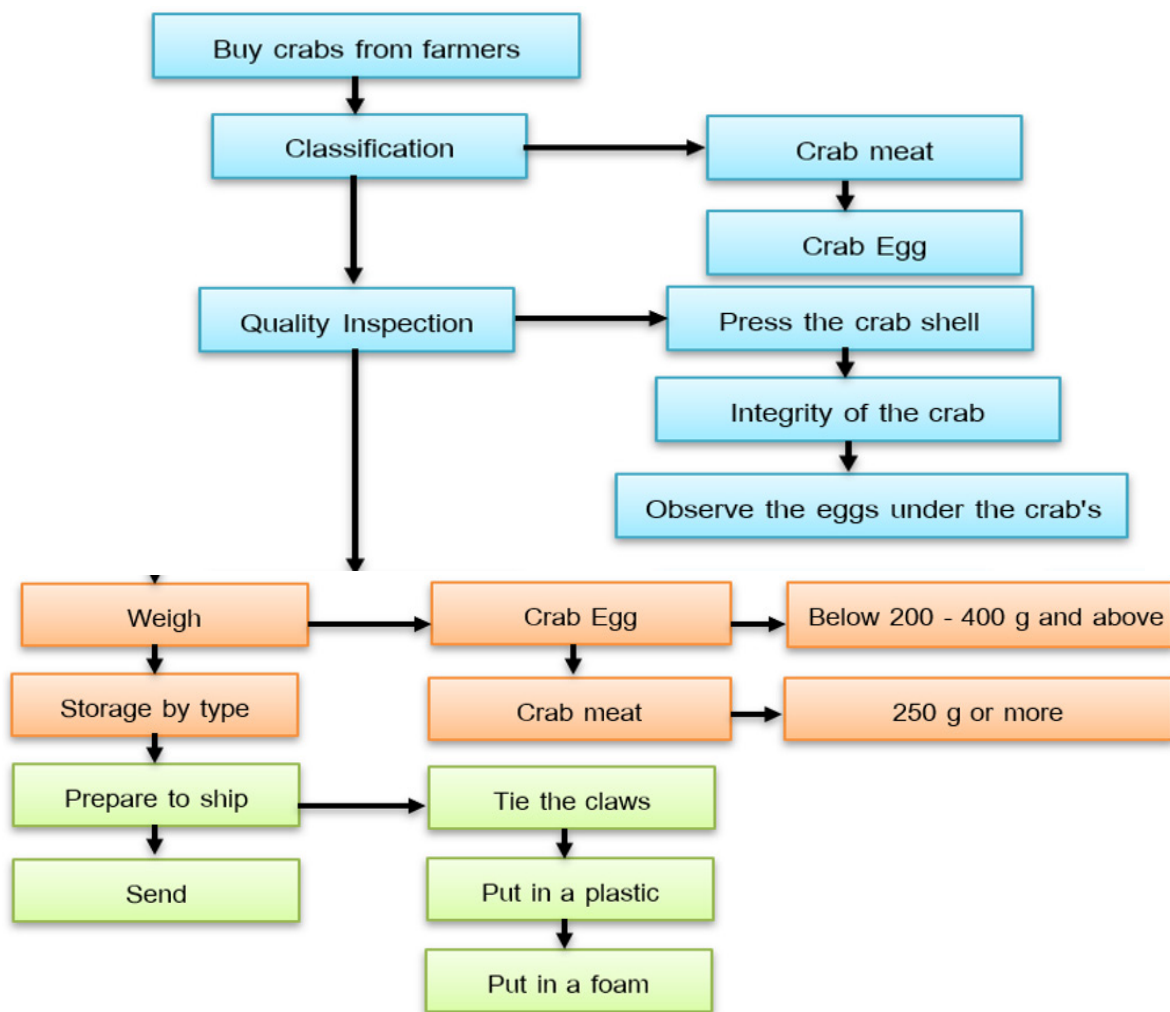


Figure 3. Storage Process, Distribution Process and Transportation Process

Source: Author

1.3) Storage Process, 1.4) Distribution Process, and 1.5) Transportation Process; It was found that the middleman arranged a specific place in the community to buy crabs from the farmers. They also purchased crabs from farmers' ponds from time to time. The farmers separated the crab types, namely, meat crabs and egg crabs. After that, the middlemen inspected the quality of the crabs; the meat must be firm and the claws and body should be intact. For egg crabs, the farmers pressed the crabs' shell to check the eggs on the underside of the egg crab's abdomen. When the crabs grew up, they were weighed. The following is the specific price of crab meat: Crab meat weighing 250 grams is 180 baht per kilogram; 300 grams is 220 baht per kilogram; 400 grams is priced at 360 baht per kilogram; and 600 grams and above is priced at 500 baht per kilogram. The price of crab eggs depends on the size of the crabs. The crab eggs were divided into 4 sizes: under 200 grams is 350 baht per kilogram; 200-290 grams is 460 baht per kilogram; 300-390 grams is 560 baht per kilogram, and 400 grams or more is 660 baht per kilogram. In the shipping process, the middlemen tied the crab claws with large rubber bands, put them into small plastic bags, and packed them into foam crates to wait for collection and delivery to restaurants and hotels in Bangkok, the capital city of Thailand.

2. Analyze of Logistics Activities; The logistics activities of the group of sea crab farmers in Ko Phet Subdistrict, Hua Sai District, Nakhon Si Thammarat Province, Thailand included 9 activities.

2.1) Demand forecasting Activity; [14] reported that there was an amount of production the farmers failed to meet the customers' needs because the farmers raised an uncertain amount of crabs in the ponds, resulting in unpredictable production. Crabs sized 0.5 centimeters were received from the Fisheries Department, Pak Meng District, Trang Province. Moreover, the ponds used for raising crabs were not the same size. Farmers calculated the ratio of

300-400 crabs per *rai* (a measurement unit of land in Thailand, equaling 1600 square meters). The farmers did not like buying crabs from residents because they got mixed crab species, such as black crabs and green crabs. The uncertain number of crabs that survived each time was due to weather conditions that affected the temperature and amount of oxygen in the water. The approximation period of 4-5 months was used to raise crabs to reach their fully grown state and ready to be sold. The quantity of crabs that were caught and sold each time was uncertain. The middlemen did not determine the quantity for each purchase. The standard crab size is 200-400 grams. As regards the price, the farmers sold crabs at different price rates: 200 grams is 400 baht per kilogram, 300 grams is 500 baht per kilogram, and 400 grams is 600 baht per kilogram.

2.2) Logistics Communication Activities; [14] explained that the farmers contacted middlemen to bring the market-size sea crabs to sell. Sometimes, they were contacted by small customers to purchase the crabs directly from their ponds. Generally, the middlemen did not specify the time of purchasing, and the local language was used in the interaction since the farmers and the middlemen were locals. Logistics communications began from receiving orders from customers. The middlemen received orders from retail customers. They had been in contact both by phone and online. After the middlemen received the order, they contacted the farmers via Line and by phone. When the farmers received orders from the middlemen, they caught the crabs and sent them to the middlemen. Then, the middlemen delivered the crab according to the order of the customers

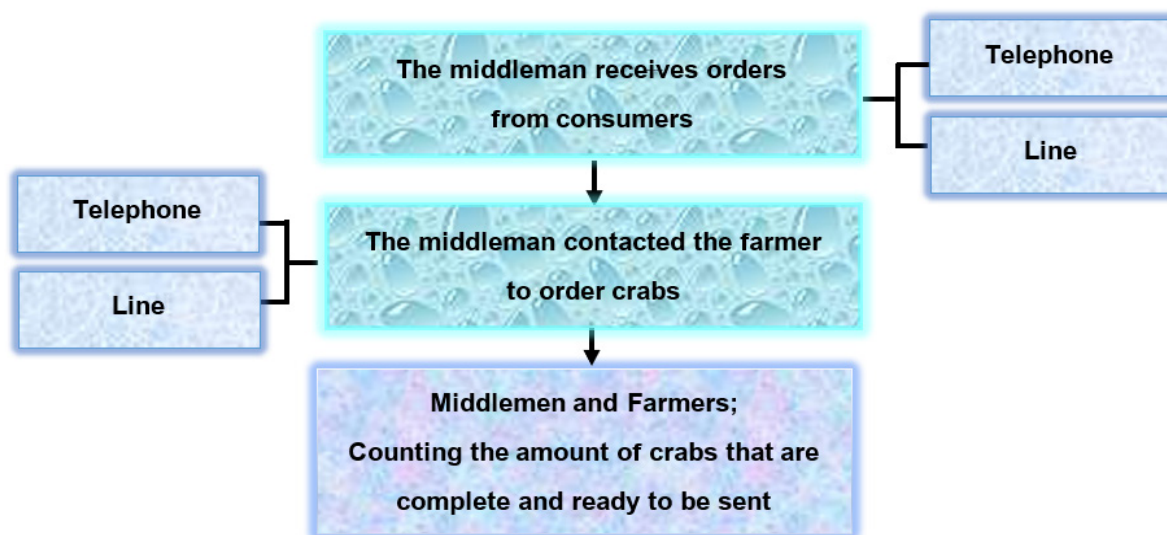


Figure 4. Logistics Communication Process

Source: Author

3. Procurement Activities; [14] explained that the farmers refused to buy crabs from ponds of residents who found them in natural sources because they would get mixed crab species (sea crabs, black crabs, and green crabs). The farmers chose to buy crabs from the Fisheries Department, Pak Meng District, Trang Province, instead. However, the farmers sometimes had to wait for a long time of 3-2 months before receiving the crabs, so some farmers decided to buy crabs from the residents' ponds, but they only bought them if they already knew the species of the crabs. The species of crab larvae used by the group of sea crab farmers in the project were sea crabs. The stocking ratio per *rai* was 400-300 crabs. The survival rate was more than %50. The chance of survival of the crabs depended on the weather conditions and oxygen in the water. During rainy seasons, the farmers must put up rubber sheets around the pond to prevent the crabs from falling out of the pond.

Each individual farmer in the group must specify the amount of raw materials required. Once the quantity was determined, the order would be placed. When receiving baby crabs, the quality of the baby crabs must be inspected. Moreover, they inspected whether the baby crabs were intact or alive. After checking the quality of the baby crabs, the price was agreed upon and started trading. The final step was to release the crabs into the nursery pond.

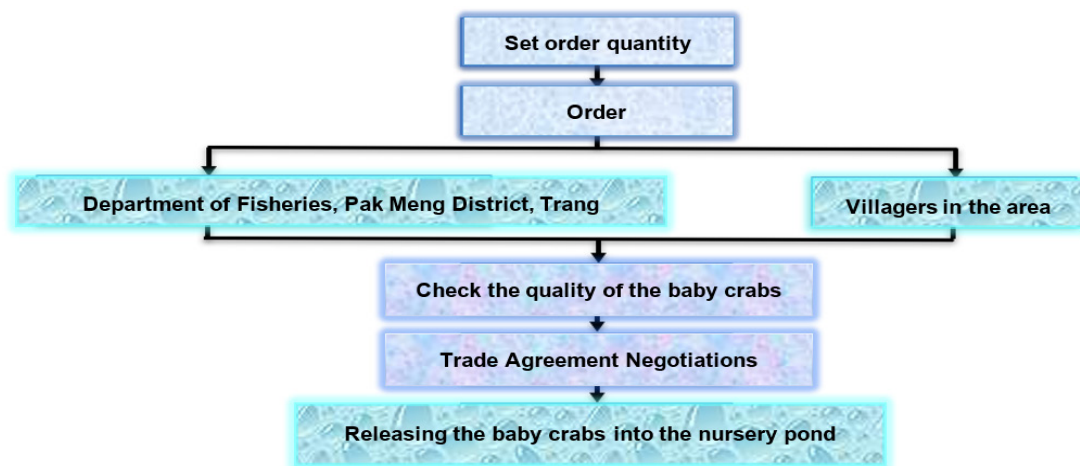


Figure 5. Procurement Process

Source: Researcher

4. Customer Service Activities and Support Activities; [11] explain that services are provided to middlemen and customers through telephone and line channels in the trading process, by middlemen contact crab farmers directly, after he receives the order from the customer. They will notify the farmers so that they can catch the crabs according to the size required by the market. It was found that middlemen and small customers were very satisfied with buying crabs from farmers and came back to buy again. Crab farmers and middlemen and small customers have been trading for a long time. Therefore, the trading process is going well, from the interviews.

5. Transport Activities; [11] clarified that the farmers were responsible for the cost of transporting the larvae crabs and the market-size crabs to the middlemen and the transportation from middlemen to customers, which were land transportation using motorbikes for transportation in the local area and cars for transportation to other provinces. Time of transportation depended on the delivery destination appointed by the middlemen.

The crab farmers ordered crab larvae from the Fisheries Department in Trang Province. They confirmed with other farmers about the quantities of crab larvae needed by all farmers each time, called to order crab larvae, and prepared vehicles to distribute crab larvae to farmers in the project. The farmers inspected the quality of crab larvae by looking at their strength. The baby crabs could be released into the pond if they were ready. If the baby crabs were less qualified in any way, the farmers would put them in nursery ponds, wait for them to be ready, and then release them into the rearing ponds. Transportation of crab larvae starting from farmers in a group of farmers in the project contacted the Fisheries Department in a nearby province in Pak Meng District, Trang Province. They used cars to transport the baby crabs to the large-scale sea crab project. After the farmers received quality crab fry from the Fisheries Department according to the quantity ordered, they kept them in nursery ponds before releasing them into big ponds.

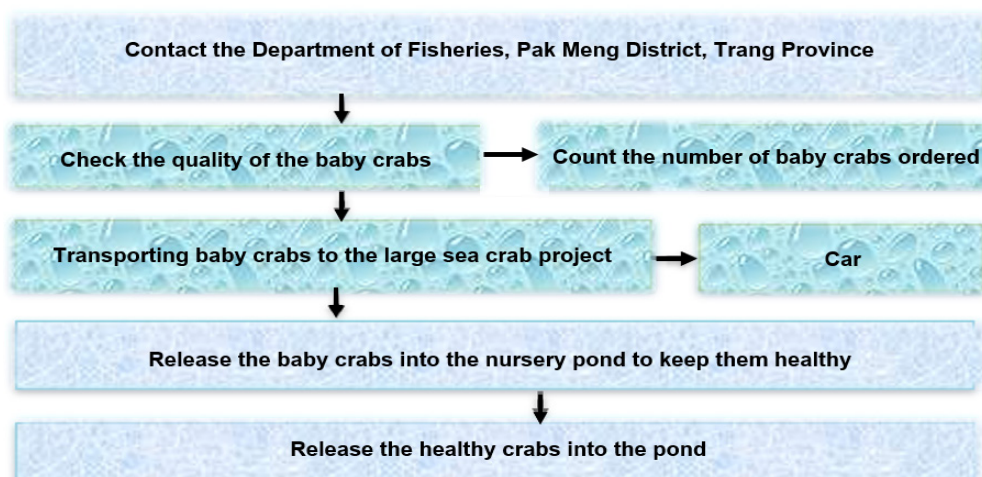


Figure 6. Crab Larvae Transportation

Source: Author

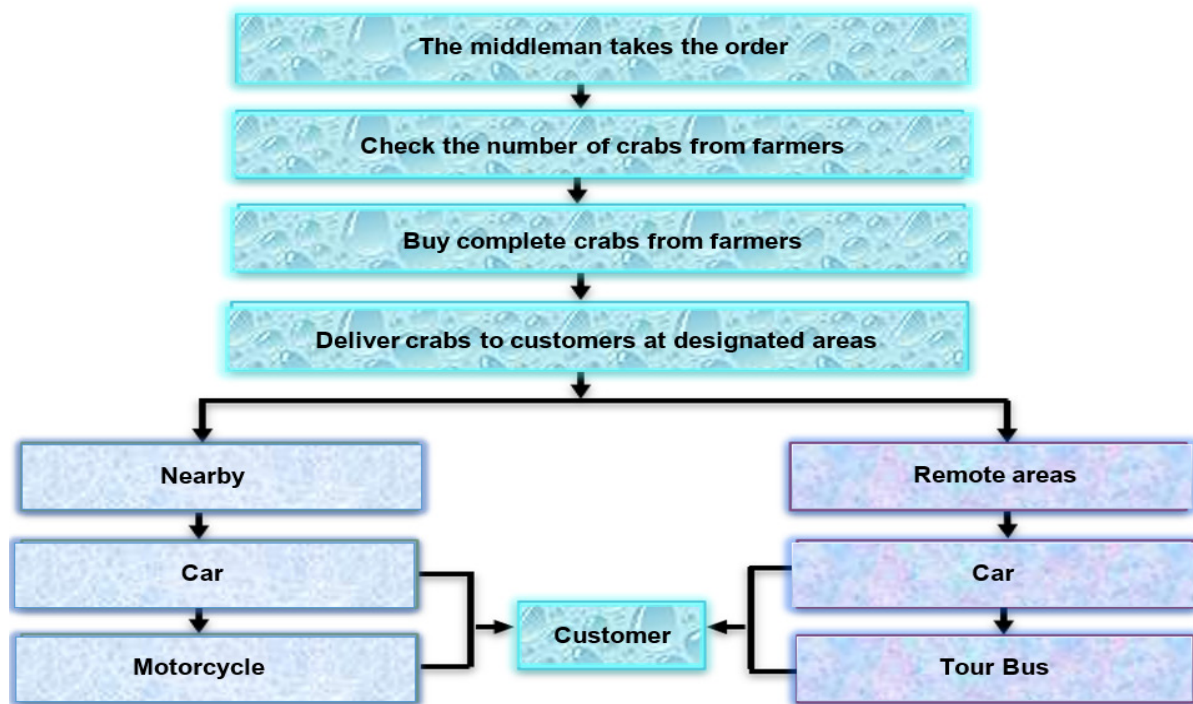


Figure 7. Market-Size Crab Transportation

Source: Author

The transportation of market-size crabs started with customers' contacting with the middlemen. The middlemen were responsible for checking the conditions of the crab meat and crab eggs. If the crabs were full of meat, the middlemen would transport them in the required quantity to the location specified by the customers. Often, the destinations of transportation were restaurants in Bangkok. It took approximately 10-9 hours. In addition, there were also consumers coming to purchase crabs directly from the farmers at their ponds.

6. Material Handling and Packaging Activities; [11] Explain the activities of handling materials and packaging and equipment in crab farming as follows:

6.1) Baby crabs; Baby crabs raised by the farmers were obtained from the Fisheries Department, Pak Meng District, Trang Province, Thailand and from local farmers.

6.2) Crab ponds; Crab ponds were used to raise baby crabs purchased from the Fisheries Department.



Figure 8. Baby Crabs

Source: Author



Figure 9. Crab Ponds

Source: Author

6.3) Market-size crabs; Crabs raised to the size of the market will be prepared for sale. But while the immature crabs are released back into the pond.

6.4) A crab catcher; A crab catching tool or *Sai* in the local language was used to catch crabs from the ponds to sell. Crabs' food, usually chopped fish, were put into the crab catcher and then the tool was thrown into the pond. It took about 5-10 minutes before the crabs came into the tool and then they were pulled out of the pond.



Figure 10. Market-Size Crabs

Source: Author



Figure 11. Crab Catcher (Sai)

Source: Author

6.5) Crab food; The farmers used catfish and tilapia to feed crabs. These fish could be found from the local natural sources. They could be bought at an affordable price from nearby areas. The farmers chopped the Clam, Pike eel and tilapia into small pieces before using them as food for raising baby crabs.



Figure 12. Fish

Source: Author



Figure 13. Chopped Tilapia

Source: Author

6.6) Rubber cloth; Rubber cloth was used to install around the pond to prevent the baby crabs from leaving the pond during the rainy season.



Figure 14. Rubber Cloth

Source: Author

6.7) Plastic bags and large rubber bands; Rubber bands were used to tie the crabs' legs and claws after catching them from the pond. The farmers put them in plastic bags and sent them to the middlemen.



Figure 15. Plastic Bags

Source: Author



Figure 16. Large Rubber Bands

Source: Author

7. Inventory Management Activities; Farmers will prepare crabs in the nursery pond so that the crabs have a body size of about 4-6 cm. and are strong and ready to be released into the pond for normal rearing, which will reduce the mortality rate of baby crabs by 30-40%.

8. Location Selection Activities; The ponds used to raise crabs were usually abandoned ponds from shrimp farming. It is a beneficial use of the original pond. The size of the ponds used for raising crabs varied in size, approximately 1-3 square *rais* (a Thai land measurement unit). During the rainy season, farmers have to lay rubber mats around the pond to prevent the crabs from falling out of the pond. The survival rate of a crab with perfection ready for sale is above 50%, depending on weather conditions and oxygen in the water.

In terms of inventory management activities, the selection of locations for crab farming and logistics activities are reported by Chonthira, B. et al. (Interview, 2022, November 26).

9. Reverse Logistics Activities; The unqualified crabs whose meat was not full directly affected the selling price. They might be sold at a lower price than the normal crabs. Therefore, they would be returned to the farmers and released back into the ponds to be raised into perfect crabs and sold in the future. The problem of unqualified crabs was still encountered in a large crab farming projects in Ko Phet Subdistrict, Hua Sai District, Nakhon Si Thammarat Province, Thailand.

Conclusion and Discussion

The logistics process gives importance to the needs and satisfaction of customers. It is important and is part of the supply that starts from the upstream to the downstream. The farmers purchased larvae crabs from 2 sources: the Department of Fisheries in a nearby province in Pak Meng District, Trang Province and from local farms. The crab food that farmers used to raise crabs includes catfish, tilapia, and sea bass. The farmers caught them from the nearby

canals and rivers. They also purchased crab food from the residents who sell them regularly. The farmers sought the raising crab equipment from local markets. When raising sea crabs, farmers help the crabs adapt by nurturing them before releasing them into the pond after the crabs are 23- weeks old, and by the time the crabs are ready to catch, the shelf life will be about 56- months. By the time the crabs were ready to catch, the shelf life would be approximately 56- months. The farmers put bait in a crab trap and then throwed it into the pond. After 510- minutes, crabs came to eat the bait in the crab trap and then the crab trap would be pulled up. In case the crabs are on the wall of the pond, they would be scooped out with a basket. The caught crabs would be placed in a tank to be screened for quality by pressing the shell to test whether the crab meat was ready for selling. Those that did not meet the standard would be released back into the rearing ponds until they were fully grown and marketable. The qualified crabs would be sold to the middlemen. Moreover, it was found that the middlemen were the ones who contacted them to buy and sell crabs at the agreed meeting points. Sometimes, they purchased crabs from the farmers at the ponds. The farmers sorted the crabs into 2 types for selling: meat crabs and egg crabs. After that, the quality of the crabs would be checked again by the middlemen. They would ensure the meat was tight and body were intact. They checked the eggs on the underside of the egg crab's abdomen by pressing on the crab's shell. If the crabs were perfect, The middlemen tied the crab claws with large rubber bands and secured them in plastic bags before packing them into foam crates for transportation and delivery to the restaurants and hotels in Bangkok. The synthesis of data shows that sea crab farmers participating in the sea crab project give importance to material handling and packag. The raising equipment and the survival rate of baby crabs is the priority from the farmers' perspective because they have to wait for the baby crabs which are ordered from the Fisheries Department from nearby province in Pak Meng District, Trang Province. The order takes 23- months before the farmers receive the baby crabs. Therefore, when ordering baby crabs from the Fisheries Department, the clear demand for crab larvae should be informed to the sea crab project center in order to order sufficient crab larvae for all farmers. It also reduces the waiting time to receive the baby crabs from the Fisheries Department [15] and [16].

The baby crabs ordered from the Department of Fisheries are about 0.5 cm. in size and need to be raised in the nursery until the baby is about 46- cm. in size, which will take 4560- days to help the baby have a survival rate of 60%70-. If a crab farmer wants to shorten the nursery period, farmers should order baby crabs from a community farm that is standard and reliable. The crab fry purchased from local farmers will be larger than those ordered from the Department of Fisheries, with a size of 25- cm. and it is also important that crab farmers should pay attention to the packaging used in transportation to prevent and reduce damage caused by the transportation process. This can increase the survival rate of the crabs in case they are released into the nursery pond without going through the nursery process [17]. The suitable form of distribution of products should also be taken into account, according to the concept of 7 types of distribution [18]. The appropriate distribution format can help reduce costs incurred from shipping and maintain the good quality of the products [19], [16] and [20]. The farmers should join together and deal directly with the consumers to deliver the products in order to bring in higher income from the product sales [19]. Based on the concept of contemporary logistics management in business, communication and collaboration among the farmers can help support value creation and adjustments to improve the ability to create profits for businesses [16].

Limitations and Future Research

The results of the logistics process research are only collected from sea crab farmers in the southern provinces of Thailand in 2022. The climatic environment is an important factor affecting the efficiency of the logistics process in different years. Therefore, it is recommended to increase the data collection period to 35- years and conduct studies from sea crab farmers in other areas to better understand the logistics process.

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