

Determining the Optimal Distribution Center Location using Center of Gravity Approach for Fishery Logistics: A Case in Southern part of East Java

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Abstract:- Main commodities of Capture Fisheries in the Southern Region of East Java are Tuna, Tongkol and Skipjack (TTS). To enter the export market, several strategic matters need to be considered, including product commodities, competitiveness, and product quality. Therefore, a study of the conditions, situations and distribution patterns in the Southern Region of East Java is needed to obtain results that are in accordance with the characteristics of the Southern Region of East Java. In this study, an analytical study was carried out using cost optimization calculations and determining the location of the Distribution Center (DC) using the Center of Gravity (CoG). As well, it takes a modern and DC mode of transportation to overcome these conditions. There are 3 (three) distribution alternatives, namely the first alternative is direct delivery using a Colt Diesel Double (CDD) with a total shipping cost of Rp. 50.19 Billion, the second alternative is inbound delivery using the CDD reefer with a total shipping cost of Rp. 60.64 Billion and the third alternative is direct delivery using CDD reefer with a total shipping cost of Rp. 83.46 Billion. The design of a new distribution pattern certainly changes the existing distribution flow by adding DC facilities.

Keywords:- Southern Region of East Java, TTS, DC, CoG.

I. INTRODUCTION

Production Pelagic capture fisheries production in East Java Province is highly dependent on production from its southern coastal areas, including from Pacitan, Trenggalek, Malang, Puger and Banyuwangi districts [6][11]. The main commodities of pelagic fish on the southern coast of East Java include tuna, tongkol, and skipjack (TTS). These three types of pelagic fish are the main commodities, especially in the Fish Auction Place (FAP) in Pacitan, Trenggalek, and Malang Regencies. The accessibility and availability of infrastructure are still inadequate[7]. This problem is caused by production locations which are mostly located in remote areas. Provision of sufficient electricity needs to meet cold chain systems, such as cold storage, air blast freezer, contact plate, ice flake

machine, and others[4][7]. The low accessibility, as well as the inadequate availability of infrastructure, results in high logistics costs. The national logistics system is still unable to connect fishery production centers with the market efficiently and effectively [5][9].

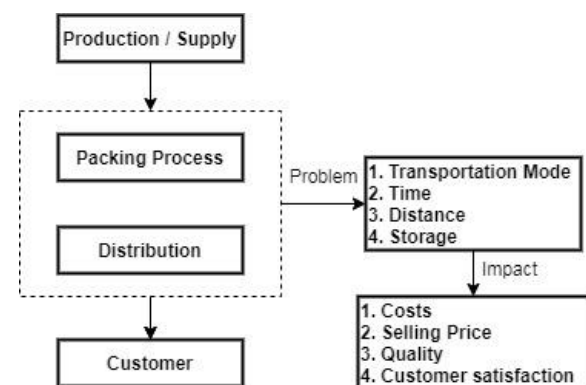


Fig. 1. Distribution Problem Diagram

This condition is exacerbated by the limited means of transportation both on land and sea, as well as limited facilities for the cold chain system in transportation facilities. Thus, quality assurance and safety, traceability, and sustainability of industrial raw materials are still low. Difficulty accessing fishery industry infrastructure also results in imbalance in national consumption of fishery products, and causes the overall price of fishery product commodities to become less competitive in the domestic market. Fishery industry policy has not been able to develop as expected because it is influenced by the low quality of policy governance[13]. In general, current fisheries policies in Indonesia do not have a clear direction and are less systematic to support the acceleration of the national fisheries industry[18][21]. The unavailability of a road map related to these efforts makes it more difficult for related institutions to be able to synergize effectively and efficiently. The development paradigm in East Java Province should be developed in coastal areas, creating large cities based on fisheries and maritime affairs. Several industries have the potential to develop rapidly, if supported by the development of good facilities and infrastructure. Potential industries that are feasible to be developed are the

fishing industry and the processing industry [8][19][21][22][23]. This industry will increase Regional Original Income if it is created and managed properly and sustainably.

II. LITERATURE REVIEW

A. East Java Capture Fisheries Potential

The potential of fishery resources in East Java is still quite large, especially for sea capture fisheries in the south of East Java Province. The main commodities in the Southern Region of East Java are Tuna, Tongkol and Skipjack (TTS). In 2012, the utilization rate of marine capture fisheries resources in southern East Java only reached 77.95% of the potential for sustainable use [6][11].

B. Fishery Industry

The increase in fish catch should ideally be accompanied by the addition of cold storage facilities as well as a capable ice factory to ensure that there is no wastage from the process of transferring the catch to the processing plant [15]. As for the utilization or processing of fish traditionally or on an industrial scale[5][7][8].

C. Fisheries Management Area (FMA)

For the purposes of fishing and fish breeding businesses with a view to the sustainability of fish resources and the environment[15][16]. The government needs to regulate fishing in the waters of the Republic of Indonesia so that it does not exceed the capacity or take in the Permitted Catch Amount. Furthermore, fish resources are grouped into Fish Resources Group, namely the grouping of fish resources consisting of several types of fish that have the same or nearly the same biological and environmental characteristics.

One of the ways to manage fishery resources in Indonesian marine waters is the preparation of a map of the Indonesian Fisheries Management Area (FMA RI). The map of FMA RI has undergone changes and updates in accordance with the demands of fisheries management developments and administrative status. The map of FMA RI was first published in 1999 through the Decree of the Minister of Agriculture No.995 / Kpts / IK 210/9/99 concerning Potential Fish Resources and Permissible Catch Amount, which includes a designated Fishery Management Area Map 9. With the passage of time and developments in fisheries management and the development of the concept of Monitoring, Controlling and Surveillance (MCS), the FMA function is not only necessary for determining the potential and level of utilization but also as a management basis in terms of licensing and supervision[6][11][16].

D. National Fish Logistics System (NFLS)

The National Fish Logistics System, hereinafter referred to as NFLS, is a management system for the supply chain of fish and fishery products, materials and production tools, as well as information starting from procurement, storage, to distribution, as an integral part of a policy to increase the capacity policy and stabilization of the fishery production system. upstream downstream, controlling price disparities, as well as to meet the needs of domestic consumers. processing

of fish resources is all efforts including integrated processes in information gathering, analysis, planning, consultation, decision making, allocation of fish resources, and implementation and enforcement of laws and regulations in fisheries, carried out by the government or other authorities aimed at making resources fish can be utilized optimally and achieve a sustainable productivity of aquatic biological resources continuously[5][7][14].

E. Supply Chain Management

In general, Supply Chain Management (SCM) examines logistics issues. In this case, logistics is a problem that stretches for a long time, from basic materials to finished goods that are used by end consumers and are organized as a supply chain of goods [13][20][25]. SCM is an approach that is used efficiently to integrate suppliers, factories, warehouses and shops so that products are produced and distributed in the right number, location and time. All of this is done in order to minimize costs incurred by the overall system while maximizing customer satisfaction. In managing the supply chain, it is necessary to consider the costs and roles in each component in the manufacture and distribution of products according to customer desires. The purpose of supply chain management is to increase efficiency and minimize costs for the entire system. The system in question is all activities and components from transportation to distribution and from raw goods to finished goods[13][21].

F. Centre of Gravity (CoG)

The Center of Gravity method is a mathematical technique used to find the best location for a distribution point which minimizes distribution costs. This method takes into account the distance to the market location, the number of goods to be shipped to that market, and the shipping costs to find the best location for a distribution center[1]. The first step in the center of gravity method is to place the location in a coordinate system. It can be used to find the optimal location coordinates for a facility. Like the main function of a load-distance method, it minimizes the distance that loads travel but also gives the x and y coordinates for the location. The formula used in the center of gravity calculations are as follows[1][17]:

$$x^* = \frac{\sum_i l_i R_i x_i / d_i}{\sum_i l_i R_i / d_i} \quad (1)$$

$$y^* = \frac{\sum_i l_i R_i y_i / d_i}{\sum_i l_i R_i / d_i} \quad (2)$$

where:

x^* = x coordinate of the located facility

y^* = y coordinate of the located facility

l_i = total load at point

R_i = transportation rate to point i

d_i = distance to point from the facility to be located

x_i = x coordinate of point

y_i = y coordinate of point

III. RESEARCH DESCRIPTION

A. Identification and Formulation of Problems

At this stage, namely identifying and formulating problems from research to support the next stage.

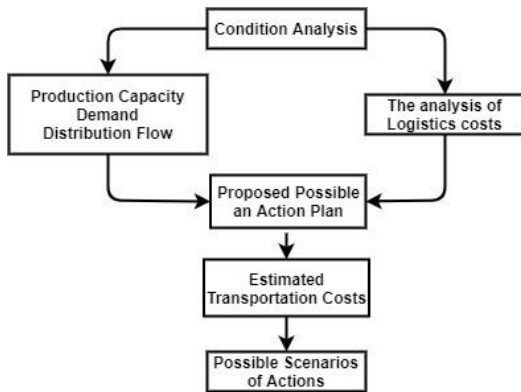


Fig. 2. Frame of Mind

B. Literature Review

Before starting the research, the first step that needs to be done is a literature study. The literature study is undertaken to obtain information on theories related to research topics, including:

- Supply Chain Management (SCM);
- East Java Capture Fisheries Potential;
- Determining the Optimal Distribution Center (DC) location.
- National Fish Logistics System (NFLS)

In addition, literature studies are conducted to find an overall picture of what other people have done, how other people do it and how different the research will be. Study literature needed from proceedings, journals, books and thesis.

Many factors influence the location of a logistics center. Choosing a location from a logistics center can integrate three main sustainability criteria, namely economic, environmental, and social[1][2][5][17]

Previous research on determining DC locations in East Java used the AHP method with results in Gresik. AHP method was used to develop a hierarchy of selecting the best bonded logistics center location based on the knowledge and experience of several experts in the field. This method is very effective in measuring opinions, which are based on personal experience and knowledge, to develop a consistent decision framework.

However, in determining the location of DC, it is also necessary to know the distance from the supply location and the distance to the demand location. So that the authors use the CoG method in determining the logistics center.

C. Condition Analysis

The data taken to conduct this research consists of primary data and secondary data. Primary data is done by

collecting data related to the capture fisheries industry. The areas that became the survey locations for primary data collection were Pacitan, Trenggalek, Malang, Jember and Banyuwangi. This location was chosen because it was considered to have fulfilled the purpose of sampling to obtain the required information and data. In addition, these 5 districts are regions that have the largest fishing port in the southern region of East Java. Primary data collected in the field were obtained from observations, both in the form of interviews with related parties and documentation. Primary data is more focused on the performance of the fisheries sector in the economic, social, environmental and institutional sectors as well as the problems faced by each sector. This primary data is needed to determine the existing conditions of the capture fisheries industry in the field. Meanwhile, secondary data has started before going to the field to collect information about previous research and the latest developments regarding the capture fisheries industry in general. In addition, when going to the field, secondary data was also collected related to the study conducted. Secondary data collected includes, among others, fishery production time series data, local regulations related to fisheries management[4][5][9][14][23].

D. The Analysis of Logistics Costs

A transport model with m sources and n destinations, can be represented by a node. The arc that connects source and destination represents the route of delivery of the item. The quantity of supply at source i is a_i and the demand at destination j is b_j . The unit cost of transport from source i and destination j is c_{ij} . Suppose X_{ij} represents the quantity of goods shipped from source i to destination j[12][24].

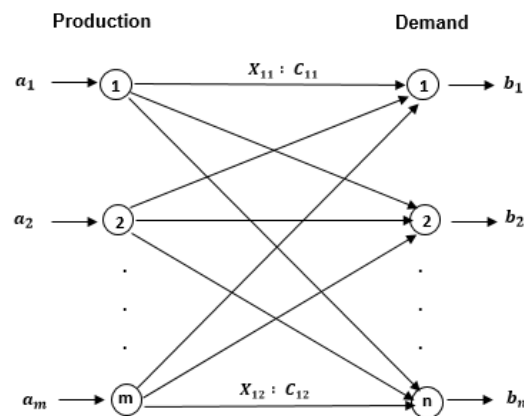


Fig. 3. Transport Model Diagram [12][24]

E. Proposed Possible an Action Plan

Arrange an action plan after validation so that it is hoped that it will answer the problems in the supply chain of the capture fisheries industry in the Southern Region of East Java. Formulation of action plans in the form of supply chain system recommendations and determining strategic locations to support economic improvement in the Southern Region of East Java. This includes all the logistics management activities mentioned, as well as activities that promote coordination of processes and activities across marketing, sales, product design, finances and information technology[4][14][23].

F. Conclusion

This stage is the final stage in carrying out this research.

IV. DISCUSSION AND CONCLUSION

A. Condition Analysis Results

Management of marine resources in Indonesia involves business and infrastructure actors. The port becomes an intermediary medium or entry point for fish on land, which has specially designed equipment to load and unload ships anchored. The Directorate General of Fisheries (1994), divides Fishery Ports (FP) based on function, accommodation capacity, distribution and scope into [5][10]:

- Ocean Fishing Port (OFP) is (Type A)
- Domestic Fishing Port (DFP) is (Type B)
- Coastal Fishing Port (CFP) is (Type C)
- Landing Fishing Port (LFP)

Fish is a perishable commodity. After being lifted from the ship, the fish must be handled appropriately to maintain maximum fish quality. The marketing system is complex because of the perishable nature of the commodity. In an effort to maintain the quality and quality and food safety of fish products, it is also necessary to support facilities and infrastructure to support the fisheries supply chain, where in fisheries production areas both capture and cultivation need to be supported by the development of infrastructure such as ice factories, cold storage, waterblast, and insulated trucks.

TABLE I. THE PRODUCTION LEVEL OF FISHING PORT

No	Location	Production (kg)
1	CFP Muncar – Banyuwangi	1.358.783
2	CFP Puger – Jember	1.437.400
3	CFP Pondok Dadap - Malang	9.945.638
4	DFP Prigi – Trenggalek	20.016.191
5	CFP Tamperan - Pacitan	2.939.824

From the issues obtained from the analysis can compile a statement transformation as follows:

- There are no agencies or related parties that allow fishermen to obtain production facilities and infrastructure
- Lack of facilities to improve the quality of fishermen
- Lack of modern modes of transportation as a means of shipping fish.
- There are no related parties that allow guarantee or supervision of traditional fish processing industry products

TABLE II. THE DEMAND LEVEL PER LOCATION

No	Location	Demand (kg)
1	Surabaya	7.139.576
2	Sidoarjo	7.139.565
3	Pasuruan	10.709.351
4	Malang	3.569.784
5	Banyuwangi	7.139.560

B. Estimated Transportation Costs

Transportation has a significant impact on consumer and customer satisfaction. The goods to be sent from each supply

location and the number of requests requested by each demand, as well as shipping costs from each supply location to the demand location are different. So in this case it is necessary to calculate the estimated transportation costs of the Capture Fisheries Supply Chain in the Southern Region of East Java.

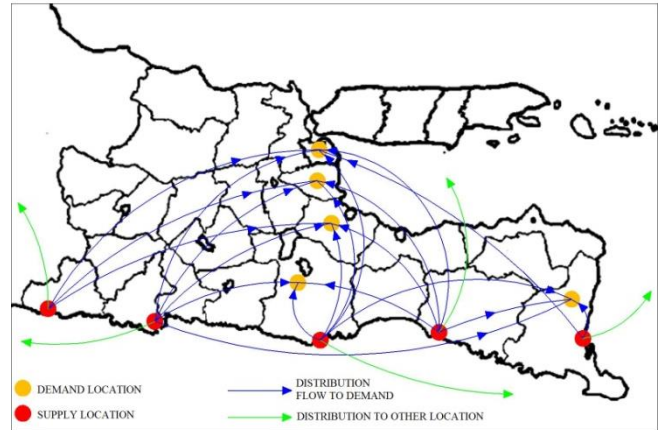


Fig. 4. Map of Fisheries Distribution in the Southern Region of East Java

In Figure 4, there is a distribution channel in the existing conditions in the southern region of East Java. Each supply location sends goods to the demand location according to demand. With the distribution activity, there will be transportation costs. So that the estimated cost calculation incurred is Rp. 36.6 billion.

C. Location of the Distribution Center (DC)

To determine the location of the supporting facilities or distribution center (cold storage) using the Center of Gravity (CoG). This method is a model for determining which location to choose if a distribution center has to serve several distribution centers[1][17]. This model is based on choosing the coordinates of the point of a distribution center which gives the shortest total distance to the entire center of the production zone that must be met[2][3][10][17]. After the data was put in order, the Center of Gravity method was used to find the actual center of gravity based on the shipment volumes. Distribution Center points are at coordinates x, y(-7.9, 112.6).

D. Possible Scenarios of Actions

Action plans will be carried out to realize changes and fix problems arising from the stages that have been carried out. In the conditions in the Southern Region of East Java, the main commodity of capture fisheries, namely TTS, has a high economic value, so that if the process is carried out from upstream to downstream, it will greatly impact the quality of the fish so that the selling value will decrease[20]. One of the most important aspects for maintaining fish quality is the process of sending fish from fishing ports to the location of the fish processing industry[7]. It is recommended that the formulation of an action plan be implemented to stakeholders based on the results of the analysis[18]. The results of the analysis conducted show that the model design is formulated based on the problems faced in the fish distribution process in the Southern Region of East Java. So that 3 alternatives are

given in distributing fish. The distribution pattern of fisheries with conditions in the field is shown in Figure 5, namely from each fishing port sending fishery products to all industrial locations so that it will cause some locations not to meet their needs and are not structured in supervision.

There are 3 alternatives for fish delivery:

- Alternative 1: Direct delivery using the CDD Bak type transportation with a total price of Rp. 50.19 Billion.
- Alternative 2: Center with inbound transportation using CDD Bak and outbound using CDD Reefer with a total price of Rp. 60.64 Billion.
- Alternative 3: Using CDD Reefer type transportation with a total price of Rp. 83.46 Billion.

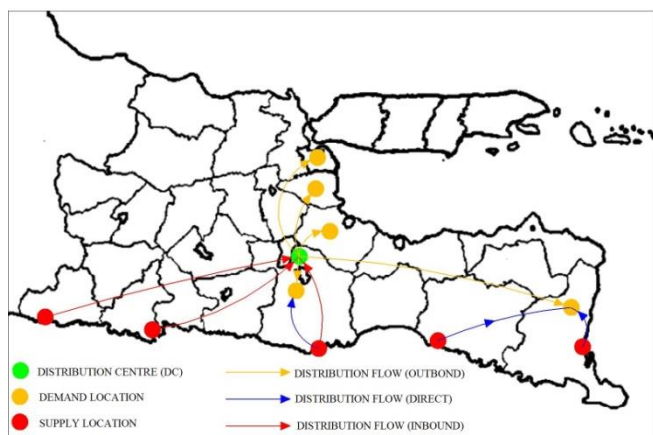


Fig. 5. Distribution Pattern in the presence of DC

Shipment of fish from the fishing port to the location of the Distribution Center (DC) uses the CDD trough type of transportation with a total cargo of 4 ton or commonly known as inbound. Meanwhile, from DC to demand location using CDD Reefer. The results of the calculation of the total cost of Rp.60.64 Billion. The facility of distribution centers are fully recommended to be provided in order to create more structure and systematic of a certain distribution center.

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