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# Fish Supply Chain Model at the Gentuma Fishing Port, North Gorontalo Regency

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**ABSTRACT**

*It is hoped that the results of this study can become a guideline or benchmark for the supply chain system, especially for fishermen, collectors and business actors engaged in activities that support the Gentuma fish catch industry. The model displays latent or non-latent relationships and reciprocal relationships in terms of . This multifactor or multicriteria model will address complex problems as a kind of hierarchy. This research utilizes two types of data, namely primary data and secondary data. Primary data was obtained through direct interviews with the parties involved, including fishermen and suppliers as well as companies that play a role in the supply chain. Hierarchy is defined as the representation of complex problems in a multi-level structure, where the first level is the goal, followed by the factor level, criteria level, sub-criteria level, and so on until the last alternative level. Hierarchies allow complex problems to be broken down into easier and smaller to manage subproblems, then broken down into more manageable and smaller subproblems. The conclusions that can be drawn from the research are as follows: This research identifies a supply chain model where the distribution flow of commodities and information is only for the domestic market. One of the efforts made by fishermen is to cut the supply chain at the collector level, which allows them to sell fish at a higher price than the price purchased by collectors. The majority of fishermen are willing to be involved in the supply chain, but there are several factors that can be used as a measure of fishermen's willingness, namely the influence of price changes at the collector level, the collector's commitment to complying with payments, and norms in selling fish to financiers.*

**KEYWORDS:** *Supply Chain Management, Fisheries Industry, Production, Gentuma, North Gorontalo.*

## A. INTRODUCTION

It is hoped that the results of this study can become a guide or benchmark for the supply chain system, especially for fishermen, collectors and business actors engaged in activities that support the Gentuma fish catch industry. is concerned with developing a comprehensive marketing strategy for a system through the use of more effective supply management. Models/patterns are the basic representation of a modeling language. In general, patterns are defined as certain observations or abstractions of an object or actual situation. The model displays latent or non-latent relationships and their reciprocal relationships in terms. From various aspects of reality being studied, it can be said to be complete. The first step in developing a pattern is identifying what factors are relevant and appropriate. Modeling also refers to a way of assisting the conceptualization and derivation of something complex, or to determine the response of a system to human intervention (action). Models can be utilized as management and research tools. Generally, models are used as a tool to collect information about best practices for cultivating algae resources. The use of patterns in research is a general problem solving method (Eriyatno, 2003).

Developing fisheries and fishermen's income through better implementation is a process of community activity in increasing production in the fisheries sector. If the expansion of fisheries in

the world of work is related to the need for working hours, then the technology that needs to be developed is fish processing machines that are capable of handling many working hours with high results. Fishing units have high productivity and fishermen productivity, so fishing units are chosen biologically and economically. Fisheries development is urgently needed to provide protein for the Indonesian people (Monintja, 2000).

The fisheries sector will also face various obstacles, including: export destination countries, including Europe and the United States, which reject exported seafood products because they are suspected of being contaminated with heavy metals on the grounds that the product quality is not guaranteed and does not meet the requirements. Their position is weak in setting product prices, because prices depend on export destination countries such as Japan, the United States, the European Union and South Korea. To prevent this phenomenon, fisheries development must be carried out through the development of the agricultural industry. This is because the agricultural industry, especially fisheries, requires the availability of raw materials to develop without being supported by fishing activities which produce the main raw materials. The availability of primary raw materials must be supported by infrastructure in the form of facilities (fishing equipment and vessels) and fishing ports. This is done simultaneously, harmoniously and in line with global seafood needs (Wahyuni, 2002). The development of the capture fisheries sector is still hampered by (1) the low application of technology in the marine and fisheries sectors; (2) weak in management; and (3) lack of economic and political support (Adrianto and Kusumastanto, 2004).

The fishing industry in Indonesia is divided into two main categories: low investment to large size commercial fishing and high investment commercial fishing, also called industrial fishing. The differences between the two groups can be seen in the fishing gear used. Businesses with small investments to date have been largely driven by motor fleets with a gross tonnage (GT) of two to thirty. The size of the investment made in this project ranges from small to large, depending on the type of fishing gear used. Operational area fishing is usually concentrated in coastal areas in the catch range of 0.3 to 12 million. In contrast, the mixed industry uses a fleet of fishing vessels weighing around 30 GT and rather large fishing gear and fishing aids. Fishing areas are usually divided into fishing zones ranging from 12 million to 200 million (Directorate General of Capture Fisheries, 2005).

**B. Fishing Gear**

Generally, ships anchored at the Gentuma Fishing Port use purse seine fishing equipment. According to Sadhori (1985) in Kurnia, et al (2013), purse seine fishing tools are often referred to as pocket nets because when used, the shape of the net resembles a bag. Apart from that, purse seines are sometimes known as drawstring nets because they are equipped with a drawstring at the bottom of the net which functions to hold the bottom of the net together during operation, by pulling the drawstring.

The fish are collected in the bag as the principle of catching fish with a purse seine is a picture of fish with a net, after which the bottom net is narrowed. The purpose of canting is to reduce the size of the caught fish so that it cannot be eaten and eventually swells. The primary material usually used to make primary containers is nylon or vinylon in the size of the container, adjusted to the type of fish to be trimmed (Mustaridin, 2011).

**C. FAD Catching Aids**

FADs are a fishing device used by fishermen at the Gentuma Fishing Harbor apart from using a purse seine. As an aid in the fishing process, FADs are a technology that aims to collect fish in certain water areas. The aim is to concentrate fish in the area so that it makes the catching process easier using appropriate fishing gear (Satria, 2009).

According to Soeboer et al. (2008), FADs are a type of fishing gear that can be used more effectively. The efficiency achieved in terms of fishing is more hunting in nature, more precisely than local fishing. Each fishing area can be identified so as to reduce operational capital costs. Based on experimental evidence, the use of FADs can increase fuel consumption and chick collection time while increasing catches.

**D. Supply Chain Management (MRP)**

The competitive world forces businesses to find new ways to deliver and create value for consumers. Businesses must be able to deliver products more effectively, quickly and efficiently. The ability to integrate the latest insights and knowledge regarding supply chain connectivity and supply chain management is expected to increase competition. Whether we realize it or not, supply chain management is always present in any business world, whether the supply chain is managed or not. Even if organizations are not active in implementing the supply chain concept, supply chains still exist as a business phenomenon (Yuniar, 2015).

**E. Supply Chain Orientation (ORP)**

Although some of the above perspectives on supply chain planning are helpful in definition, there is evidence that the existing literature attempts to define the two concepts using the same terminology for supply chain management. First, coordinating the supply chain system from a holistic perspective, with the distribution of each tactic seen in a broader strategic context (referred to as MRP as a management philosophy) is more accurately called Supply Chain Orientation/Supply Chain Orientation. In contrast, the second implementation that follows this strategy, namely a list of companies that differ in their approach to passing inspections, is more accurately referred to as Supply Chain Management/Pass Through Inspection Management. This perspective is supported by Mentzer et al. (2001) in their definition of the next key concept, namely Supply Chain Orientation, which is defined as an action carried out by a systemic organization and involves strategic planning of tactical activities needed to overcome various problems in a Supply Chain. Thus, a business can be said to have a supply chain orientation only if its management can recognize the implications of selling products, services, money, as well as bottom-up information from customers.

**F. AHP(ANALYTIC HIERARCHY PROCESS)**

One method used in making policies isAnalytic Hierarchy Process (AHP) was developed by Thomas L. Saaty from the Wharton School of Business in the 1970s to formulate complex problems and economic, social, scientific and managerial problems. AHP helps model problems and perspectives in a structured manner so that they can be explained clearly, then analyzed and analyzed further (Marimin, 2004).

According to Supriadi et al. (2018), Thomas L. Saaty developed the AHP model which is a type of decision support model. This multifactor or multicriteria model will address complex problems as a kind of hierarchy. Hierarchy is defined as the representation of complex problems in a multi-level structure, where the first level is the goal, followed by the factor level, criteria level, sub-criteria level, and so on until the last alternative level. Hierarchies allow complex problems to be broken down into easier and smaller to manage subproblems, then broken down into more manageable and smaller subproblems. AHP is often used as a problem solving technique due to the following limitations compared to other methods:

A. Hierarchical structure that includes selected criteria down to the most in-depth sub-criteria.

B. Considering the validity of tolerance limits in accordance with various criteria and alternatives chosen by policy makers.

C. Considering the persistence of the analysis results on the sensitivity of policy making.

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According to Marimin (2005), the basic idea and working principle, namely AHP, involves several steps, namely establishing a hierarchy, evaluating criteria and alternatives, setting priorities, and logical consistency. These stages are explained as:

A. The problem to be solved is divided into elements such as criteria and alternatives, then arranged in a hierarchical structure.

B. Criteria and alternatives are assessed through pairwise comparisons. In many cases, a rating scale from 1 to 9 is considered the best scale to express preferences.

C. Priority determination. Each alternative and criterion must be carried out in a pairwise comparison. This relative value is divided to determine the relative value of all other options. Qualitative and quantitative criteria can be compared with predetermined priorities and weights. Weighting or superiority that has been determined by mathematical manipulation or through mathematical permutation.

D. Logistical continuity. Each element is logically weighted and continuously improved according to logical criteria. The continuity ratio is a quantity used to determine whether or not there is a relationship between an action in the past and the consequences it caused. The consistency ratio should not exceed 0.10 if the criterion analysis is completed consistently. The help of software can be taken opinion settings based on AHP.

Astana (2013) states that AHP is a simple and flexible method that facilitates creativity in designing solutions to a problem. This method conceptualizes problems in a hierarchical form and takes into account various considerations to determine relative priorities. Approaching the solution using the AHP method, there are basic principles of the Analytical Hierarchy Process explained by Saaty (1986) in the work of Astana (2013):

1. Decomposition: Once the problem is defined, decomposition is needed to break down the problem as a whole into its smallest elements. The decision hierarchy structure can be classified as complete and incomplete. A decision hierarchy is said to be complete if all elements at one level are related to all elements at the next level, while an incomplete decision hierarchy is the opposite. The form of the decomposition structure consists of: [further details will be described based on the text mentioned]

First Level: Decision Goal (Goal)

Second Level: Criteria

Third Level: Alternatives

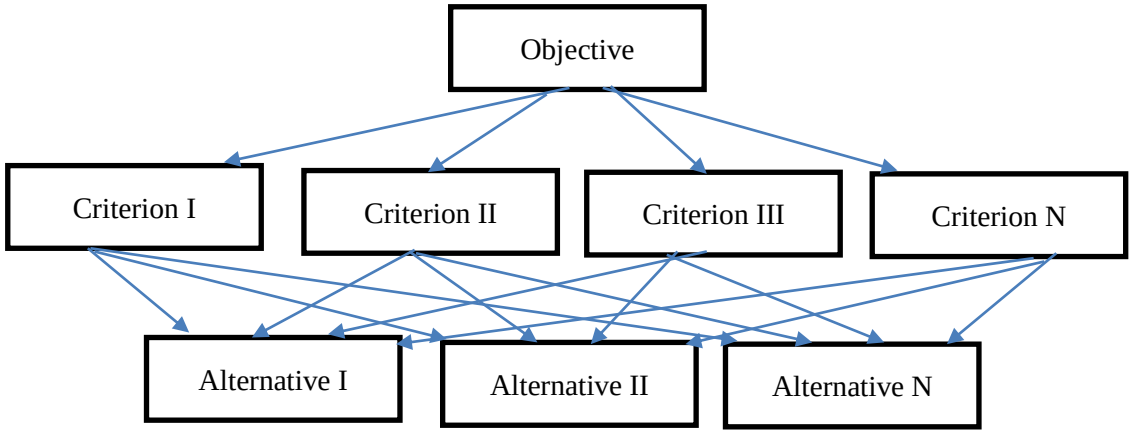


Figure 1. Process Hierarchy Structure

The problem hierarchy is used to support the decision making process by paying attention to each decision making element in the system. Most problems are difficult to solve because the solving process is carried out without much thought as a system with a certain structure.

2. Comparative assessment. This principle consists of examining the value of two elements at a certain level relative to the level in question. This analysis is the first part of AHP because it influences the prioritization of each element.
3. Priority synthesis. Since pairwise comparisons are performed at each level, the eigenvectors are given local priority for each pairwise comparison matrix. Therefore, to make a global comparison, we need to perform a composition between local priorities.
4. Logical consistency. Consistency has two meanings. First, similar objects can be grouped based on their diversity and relatedness.

In the AHP method, Kadarsyah and Ramdhani (1998) explain a series of steps as follows:

1. Define the problem and determine the desired solution: This first step is to identify the problem you want to solve in a clear, detailed and easy to understand manner. Possible solutions are explored as answers to existing problems. These solutions may be different, and this phase is the basis for developing next steps.
2. Create a hierarchy that aligns with key objectives. After identifying the main objective as the highest level, the next step is to identify suitable criteria to refine or determine the alternatives that we have identified and decided on. Each criterion has a different level of intensity. The hierarchy continues with subcriteria (if necessary).
3. Create a pairwise comparison matrix that reflects the relative contribution or influence of each element to the goals or criteria at the level above it.
4. The matrix used has a soft touch, has a strong consistency of handling skills, can collect the necessary additional information, and can analyze the priorities comprehensively in order to change the process trajectory, which reflects the dual aspect of prioritization, namely dominating and dominating, with an approach with matrix. Calculating the relative importance of a particular element compared to other elements, as based on the decision maker's considerations. To start the process of making random comparisons, identify some criteria from the level closest to the target, say K, then from the level below, identify the elements being compared, say E1, E2, E3, E4, and E5.
5. Explain the inverse relationship so that the number of evaluations is nx [(n-1)/2]. where n is the number of items being compared. The comparison results for each element are expressed in numbers/values 1 to 9 which show the level of comparative importance of each element. If an element in a mathematical set is compared with itself, the comparison result is 1. Scala 9 is now fully functional and can be used to set strengths between elements. The comparison results are based on samples that match the comparative elements. The degree of correlation between the two variables (Importance Intensity) as reported by Saaty (1986)in Astana (2013) as below:

1 = Both elements are equally important. Both elements have the same number of errors.

3 = Experience and judgment easily favor one element over another. One factor is slightly more important than the other.

5 = Some factors are more important than others. Compared with other factors, experience and judgment are very strong indicators of the factor.

7 = Some factors are clearly more important than others. Very powerful components have been proven in practice.

9 = Some elements are truly more important than other elements. Evidence favoring one element over another provides the highest possible level of confirmation.

2,4,6,8 = The value between two adjacent considerations. This value is given when there are two trade-offs between two options. On the other hand, if activity i is given a numerical value compared to activity j, then j will have the opposite value compared to activity i.

## RESEARCH METHODS

This research was conducted in 2023, located at the Gentuma Fishing Harbor, North Gorontalo Regency, Gorontalo Province. This research utilizes two types of data, namely primary data and secondary data. Primary data was obtained through direct interviews with the parties involved, including fishermen and suppliers as well as companies that play a role in the supply chain. Meanwhile, secondary data is in the form of information regarding the company's current performance which can be obtained from the company's internal files. Information related to the situation of the marine fisheries industry, production, as well as various phenomena related to supply chain management can be found through sources such as the internet, scientific journals, the Central Statistics Agency (BPS), the Provincial Maritime and Fisheries Service, and the North Gorontalo Regency Maritime and Fisheries Service .

This research took samples from business actors located in the Gentuma Fishing Port Area, North Gorontalo Regency, Gorontalo Province who have direct networks with fishermen or fishing boat owners based at the Gentuma Fishing Port.

Data is collected using several methods, including:

1. The literature review, mainly focuses on production processes such as fishing methods, quality of caught fish, consumer views, marketing strategies, and Supply Chain Management.
2. Direct field surveys include analysis of various files related to the production process, distribution channels (including the supply chain mechanisms used), marketing strategies, buying and selling transactions of caught fish, and all factors that support the running of the business.
3. Conduct interviews with various parties involved in the supply chain in the Gentuma Fishing Port Area, to understand their activities and roles in the supply chain, as well as their desire to be involved in supply chain management/planning. This triangulation approach, which includes literature studies, surveys and interviews, is expected to complement each other to obtain the required data.

### D. Data Processing and Applications

The collected data will be presented through qualitative and quantitative analysis. To analyze fishermen's involvement, descriptive analysis is used which presents data in tabular form, while companies and other stakeholders are analyzed using process hierarchy analysis techniques. Quantitative descriptive analysis methods are used to identify factors that significantly influence fishermen's involvement in current supply chain management. Meanwhile, qualitative descriptive analysis is used to evaluate the effectiveness of existing supply chain management. The results of this analysis will be combined and processed to formulate alternative strategies that support the formulation of fair and sustainable supply chain management.

### 1. Descriptive Analysis

Descriptive analysis is one approach that can be taken. The descriptive analysis method is a technique used to examine the condition or characteristics of a human group, object, condition, system of thought, or series of current events. The aim is to provide a detailed, factual, accurate description, picture or explanation of the facts, characteristics and relationships between the phenomena being studied (Nazir, 2003).

In this context, analytical descriptive methods are used to describe the situation and conditions of economic actors and assess the effectiveness of the supply chain management implemented. This analysis also investigates the relationship with factors influencing the participation of fishermen and suppliers, depending on their specific characteristics. The data required for this descriptive analysis was obtained through in-depth interviews which aimed to obtain detailed and comprehensive information about the conditions and situations of economic actors. The Analytical Hierarchy Process (AHP) method is then used to develop strategic alternatives that can be adopted by business stakeholders. The goal is to create a coordinated and connected supply chain.

**2. Quantitative Descriptive Analysis**

This descriptive analysis is based on data presented in table format. In this research, several variables are used as indicators to understand and ensure that the variables in question are not the same as variables that cannot participate in the supply chain.

One of the main findings of this research is the factors that influence entrepreneurs' ability to engage in supply chain management. A very thorough method was used for analysis: quantitative descriptive method. Respondents were asked to indicate whether they were willing to participate in supply chain management. The ability to participate in supply chain management above is considered a dependent (non-independent) variable and is also influenced by a number of independent (independent) variables.

The independent variables are trust, commitment, cooperative norms, interdependence, compatibility, breadth of relationships, additions outside professional relationships, and perceptions of maintenance as a potential source of environmental uncertainty. Because the independent variable's focus is on perception, this analysis asked respondents to rank their level of agreement using the following criteria: strongly agree, agree, neutral, disagree, and strongly disagree.

The variables above will be converted into questions with the same format that will be answered by fishermen and collectors. Based on their current employment conditions, the guards were dismissed.

3. **Hierarchy Process (AHP) Analysis**

The main objective of this research is to determine a management strategy or supply chain planning for fairly caught fish. Fairness here refers to the equal distribution of value from the initial supplier to the final consumer. According to Taylor (2014), AHP is a way of ranking various decision alternatives and selecting the best one based on several criteria. AHP produces a numerical assessment that assigns a ranking to each decision alternative based on the extent to which each alternative meets the criteria set by the decision maker.

The stages carried out when research using the AHP method are as follows:

**1. Hierarchy Arrangement**

AHP's working philosophy is the process of transforming any complex process that lacks structure, strategy and dynamics into smaller components that can be integrated into a larger hierarchy. The smaller subsets known as the aforementioned variables are then given a value based on a significance threshold, which is a numerical value that subtly conveys relative importance when compared to other variables.

**2. Assessment of Criteria and Alternatives**

Marimin (2008) states that AHP allows users to intuitively provide relative evaluations of certain key criteria (or alternative key criteria for certain key criteria) by carrying out pairwise comparisons.

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**Table 1. Value and Definition of Qualitative Opinion (Saaty, 1983)**

| Mark | Information |
|---|---|
| **1** | Criterion/alternative A is as important as criterion/alternative B |
| **3** | A is slightly more important than B |
| **5** | A is clearly more important than B |
| **7** | A is clearly more important than B |
| **9** | A is absolutely more important than B |
| **2,4,6,8** | When in doubt between two adjacent values |

Standards and alternatives are determined by comparing results. According to Saaty (1983), the best scale for expressing opinions on all topics is 1 to 9. The definition of the Saaty Scale and the range of qualitative opinions are shown in the table above.

**3. Priority Determination**

For each criterion and alternative a pairwise comparison must be carried out. The relative value is then divided to determine the relative value of all other options. Qualitative and quantitative criteria can be compared against predetermined assessments to determine priorities and outcomes. Weights and priorities are undermined by mathematical manipulation or through mathematical elaboration. In this Analytical Hierarchy Process method, calculations will be carried out using several mathematical operations. There are three ways to determine weight, namely:

Step 1:

Wi/Wj = aij (i, j = 1,2, ..., n)

Wi = input weight in row

Wj = input weight in the column

Step 2:

Wi = aij Wj (i, j = 1,2, ..., n)

In general, the existing cases have the form:

Wi = (i, j = 1,2, ..., n) $\frac{1}{n} \sum_{j=1}^{n} aij\ wj$

Wi = mean of ai1 w1, ..., ain wn

Step 3:

If the aij estimate is good it will tend to be close to the wi/wj ratio. If n also changes then n is changed to λmax so that we get:

Wi = (i, j = 1,2, ..., n) $\frac{1}{\lambda max} \sum_{j=1}^{n} aij\ wj$

Horizontal processing

Intended to set priorities for decision elements at each level of the decision hierarchy. In accordance with Saaty (1983), the steps are as follows:

a. Line multiplication (z)

$$Z_1 = \sqrt[n]{\prod_{j=1} aij}$$

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b. Calculation of priority vectors or eigenvectors

$$eVP1 = \frac{\sqrt[n]{\prod_{j=1} aij}}{\sum_{i=1}^{n} \sqrt[n]{\prod_{j=1} aij}}$$

eVPi is the ith priority vector element

c. Calculation of maximum eigenvalues

$VA = a_{ij}$ x VP dengan $VA = (V_{ai})$

$VB = VA/VP$ dengan $VB = (V_{bi})$

$\lambda_{max} = \frac{1}{n} \sum_{i=1}^{n} aij$ $VB_i$ untuk i = 1, 2, ..., n

VA = VB = Vektor antara

d. Consistency index (CI) calculation:

The slope of this index is intended to reveal the consistency of responses, which may have an impact on the results. The following rumors are used:

$$C1 = \frac{\lambda max - n}{n-1}$$

To assess whether the CI value at a certain level is considered adequate or not, it is necessary to consider the standard ratio that is considered optimal, namely when CR ≤ 0.1. The formula for determining the CR value is as follows:

$$CR = \frac{CI}{RI}$$

The RI value is the random index value issued by Oarkridge Laboratory, in the form of the following table:

**Table 2: random index values issued by Oarkridge Laboratory**

| N | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **R.I** | 0.00 | 0.00 | 0.58 | 0.90 | 1.12 | 1.24 | 1.32 | 1.41 | 1.45 | 1.49 | 1.51 | 1.48 | 1.56 |

Vertical Processing

This hierarchy is used to prioritize each element with respect to the most important elements. If NPpq is set as the highest priority, then the influence of p on q on the main goal is as follows:

NPpq =

For p = 1, 2, ..., r

T = 1, 2, ..., s

Note: $\sum_{t=1}^{s} NPHpq\ (t, q-1) x\ NPT\ (q-1)$

NPpq = priority value of the influence of the p-th element at the q-th level on the main target.

NPHpq = priority value of the p-th element to the q-th level

NPTt = priority value of the influence of the t-th element on level q-1

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## RESULTS AND DISCUSSION

### A. Supply Chain

Description*supply chain*which will be discussed consists of supply chain structure, supply chain management and supply chain resources.

#### 1) Supply Chain Members

In the view of Stock and Lambert (2001), all companies or organizations involved can be grouped into two categories, namely primary members and supporting members. Primary members, or also known as main members in the supply chain, include all business units that are concretely involved in operational or managerial activities in a business process. In this supply chain, the members are fishermen as main suppliers, collectors as collectors, companies (local).

#### a) Fisherman

Fish fishermen are grouped into freelance fishermen and attached fishermen. Freelance fishermen sell fish to any collector they like with the consideration that the harvest price is in accordance with the current market price, while fishermen are bound/fixed to sell fish to certain collectors. There is no legally or institutionally binding written contract between fishermen and collectors. Freelance fishermen provide and prepare their own fishing boats along with petrol and fishing nets, while some bonded fishermen are provided with petrol and fishing nets by their collectors. The obligation of bound fishermen is to sell all fish catches that have been ordered by collectors with good quality fish. Some tied fishermen whose fishing capital is provided by collectors do not sell their fish to other collectors even though the prices at other collectors are better. The price of fish from fishermen is determined entirely by collectors.

According to Windasai et al., (2021) empowerment of fishing communities can be explained as an effort that is carried out consciously, planned, systematic and sustainable. The aim is to build the social, economic and political independence of fishing communities by managing the potential resources they have, with the hope of achieving sustainable social prosperity.

#### b) Fish Collectors

There are 23 collectors. Each collector has a number of permanent fishermen and freelance fishermen as fish suppliers. Collectors provide fishing capital loans to fishermen, with the guarantee that all the fish caught by the fishermen will be sold to the collector. If there is not enough fish ordered by the collector, the collector will buy the fish from freelance fishermen or fellow collectors. Collectors supply fish to local companies. Mutual cooperation like this is very effective for companies. However, there is a bad side for the collectors, because with this kind of bond the collectors do not have a good bargaining position in determining the price of fish, because the price of fish is completely determined by the company. This is what causes fishermen to have no bargaining position with collectors. In this research, interviews were conducted with 23 collectors.

There is a group of fish fishermen who are trying to cut the supply chain of the collector element, where they organize, collect fish together and sell them directly to companies like collectors. This group functions the same as collectors. This initiative is very beneficial for group members, because fishermen can determine prices for themselves. At the very least, the price determiners for their fish catch are not the collectors, but the company directly. The hope of the members of this fishing group is to increase the welfare of the members. Sengkey et al., (2020) said that raw fish rasokan from Nain Island fishermen which is then sold to collectors or traders, then distributed to restaurants or directly to consumers, is an activity that has been going on consistently from year to year.

#### c) Company

Companies in the fish supply chain in Gentuma include local companies. In this research, 1 company

was interviewed, namely a fish processing company. The company receives a daily supply of fish from collectors, these fish are sorted according to the type and quality desired by the company. The company also makes marketing efforts to consumers.

Evaluation of supply chain performance must be carried out using appropriate methods. The aim is for companies to be able to identify and manage activities that have the potential for ineffectiveness and high risk. Effective supply chain risk management is a basic requirement for companies. This functions as a tool that can regulate and minimize the possibility of failure, so that company performance can reach optimal levels (Senja, 2018).

**d) Activities of Supply Chain Members**

Fishermen carry out fishing activities at the fishing location using vessels ranging in size from 15 GT to 45 GT which are fueled by Diesel as a means of transportation to the fishing location, namely inFisheries Management Area (WPP) 716 covers the Sulawesi Sea and the north of Halmahera Island. The distance traveled from the Gentuma Fishing Port to the fishing location is around 12 miles. The fishing aids used by fishermen, namely FADs or Purse seine fish pontoons, have been prepared. The fish that have been caught are put into the hold/storage room on the ship with an ice block cooler. Next, the caught fish are stored in the collector's holding area. The fish are immediately counted and sorted based on the type and needs of the order and paid immediately. For fishermen who are loaned nets or petrol, payment is made by making regular deductions from fish sales from fishermen.

Collectors sort the fish they receive from fishermen and pay them. Fish from fishermen will be stored until Friday, because every Friday collectors will send fish to the company. Selection (sorting) of fish based on size, health condition of the fish which includes agility, color and level of damage to the fish's fins or skin.

**2. Flow Patterns in the Supply Chain**

There are three flows that need to be managed in a supply chain, namely: the first is the product flow that runs from the source (upstream) to the destination (downstream); the second is the flow of money from destination to source; and the third is the flow of information which can flow either from source to destination or vice versa. The fish supply chain model consists of fishermen, collectors, companies. The flow of fish commodities starts from fishermen as the main supplier. Fish catches are collected at collectors. Every day the collectors deliver the fish to local companies. The purchase price of this fish is determined entirely by the company, so collectors also determine the price to fishermen based on the price from the company minus the costs that collectors have to incur for storage and transportation operations. This is in accordance with research conducted by Toding et al., (2019) which states that the flow of information in the skipjack tuna supply chain in Tanawangko, Minahasa Regency, flows in two directions, namely from upstream to downstream and vice versa. , from downstream to upstream. Between actors in the supply chain, the information conveyed includes product price, product quality, product stock, and purchase quantity. Supply chain actors from the source (upstream) provide information about product prices, product quality and product stock, while supply chain actors from the downstream direction provide feedback in the form of price negotiations, appreciation or complaints regarding product quality, as well as information regarding the number of orders and purchases.

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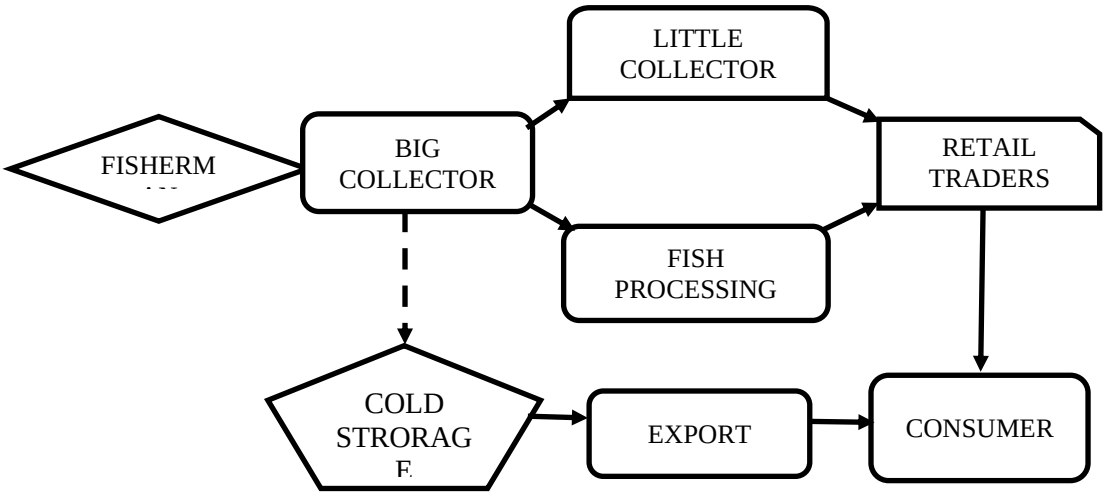


Figure 5. Gentuma Fishing Port Supply Chain Flow Pattern

Source: Research Results (2023)

Note:

---------- Collectors supply fish to companies (1 way)

———— Collectors supply fish to several places (more than 1 direction)

**3. Supply Chain Management**

In this case fishermen are the main producers who act as fish catchers. Collectors organize fishermen's catches and periodically send them to the company. The company carries out the sorting process, maintenance, packaging and export activities, giving orders to collectors. Assistance and counseling on the fishing and post-catching processes is provided by several companies to their suppliers, namely collectors and fishermen. Good planning/management and strategy are needed to support the supply chain activity process to obtain supply chain optimization.

**b. Cooperation Agreement**

Clear and concise protocols do not exist from company to employee or from employee to employer in the workplace. Working together is carried out by adhering to the principles of mutual respect by forming commitments, constantly feeling betrayed, and always needing each other. Fishermen can only sell goods to collectors who are the starting point for trading, such as petrol and net loans. Collectors will only sell the goods to one company at a time. This is in accordance with Kusumawati et al., (2019) who stated that there is no written agreement between distributors, collecting traders and producers. Collaboration is carried out based on the principle of trust, by maintaining commitment, as well as interdependence and need for each other.

**c. Transaction System**

The existing payment system at the fisherman level is implemented directly. When fishermen return from fishing, the fish are immediately recorded and counted, and paid immediately. Unless the collector is running out of cash, payment will be postponed until the fish is delivered to the company. The delay in payment is at least a week, because fish deliveries to the company are usually made once a day. Meanwhile, the payment system at the collector level is implemented in various ways, depending on the agreement between the collector and the company. There are collectors who are paid directly by the company because they send the fish directly to the company, there are also those whose payment is transferred to the collector's account.

**4. Supply Chain Resources**

According to Rahman (2013) one of the factors that drives increased development is the existence of adequate infrastructure. Many developing countries experience obstacles to economic growth due to the lack of adequate infrastructure. The physical resources in the fish supply chain process include fishing areas, sea conditions and weather, as well as transportation facilities and infrastructure. Gentuma is an area with small islands united by the sea, because this fishing area is exposed around small islands, so when carrying out fishing activities, fishermen need small boats to take them to the fishing area.

Fishermen's departure to sea is greatly influenced by the weather. If bad weather is characterized by rain and strong winds, fishermen will not go to sea. Likewise with the process of transporting fish which is carried out every day to the company. If the weather is bad, the fish delivery can be postponed until the next day, until the weather starts to calm down.This transportation problem needs to be considered, considering that only via sea transportation can these fish be transported to the company. There is no solution that can overcome the problem of sea transportation which is very dependent on the weather.

**b. Technology Resources**

Fishermen still use very simple technology to catch fish. In fact, the use of simple technology using purse seins is what customers are interested in as an environmentally friendly product, because previously, many fishermen caught fish using methods that damaged the environment and also damaged the quality of the fish.

Collectors use simple technology but have adequate facilities.*Cold storage*is one of the technology options that can be used with the main aim of maintaining quality and reducing product damage during the storage process until it reaches consumers (Hakim and Erliza, 2019).

**c. Human Resources**

There are a lot of human resources involved in the fisheries supply chain activity process, there are around 33 fish fishermen and 23 collectors. Fishermen work 5 – 8 hours a day to catch fish. Collectors work after the fishermen go home from sea every day, from afternoon to evening. If the next day is the schedule to deliver the fish to the company. The company has several employees who can help with processes in the factory/company, from purchasing, sorting, to packaging.

**1. The Role of Factors and Their Proportions in Goals**

At AHP telang a goal is set, namely creating fair fish supply chain management. In achieving this goal, the priority scenarios that will be implemented to achieve it are obtained, namely the scenario is transparent cooperation between all parties (47.4%), which means that almost half of the goals can be achieved by implementing this scenario. Then follows the second scenario, namely increasing human resource capacity by 28.1%, developing access and technology by 17%, and with 7.5% intervention from the government, the goal will be met 100%.

The most important factors that can support the achievement of this scenario are trust and commitment (49%), cooperation norms (26.1%), government policy (18.6%) and concern for the environment (6.3%). This means that, according to experts, trust and commitment are the main advantages/priorities in creating a fair supply chain management, but still combined with other factors.

This is in accordance with Rahardian's (2011) statement which suggests that the level of trust plays a crucial role in determining the stability of a relationship. Cooperative business relationships will develop in line with increasing levels of trust and commitment between business partners.

**2. Actors' Roles and Their Proportions in the Scenario**

Synergy and collaboration between collectors, companies and outlets have a very vital role in

ensuring a smooth supply chain. Effective collaboration and coordination can provide significant strategic and financial benefits for all parties in the chain. The two main factors that determine success in implementing cooperation between supply chain actors are the willingness to share information and benefits (Said et al., 2006).

**3. Formulation of Goals and Their Proportions in the Scenario**

The formulation of goals plays a very big role in determining the scenario that will be taken. This can be seen from how much the scenario that has been created can answer the desired goal to achieve the goal. In Figure 6 it can be seen that the four objectives that have been created have an equal percentage of each other. Increased welfare of fishermen by 52.4%, sustainability of fishermen and collectors' businesses by 26.3%, increase in product quality by 14% and preservation of natural resources by 7.2%. This means that in every scenario created, each individual can proportionally achieve the goals they want to achieve, each party can achieve an adequate level of graduation.

Increasing the welfare of fishermen is very important because according to Putri et al., (2016) the level of community welfare reflects an increase in the quality of family life, because community welfare is the essence of the development process. Families that enjoy higher levels of well-being indicate that they have a better quality of life. As a result, the family is able to create better conditions to improve their welfare.

**4. Scenario Priority in Achieving Goals**

InTo reach the goal, strategic scenarios are formulated. The highest priority in the scenario is transparent cooperation between all parties (47.4%), so that the focus on the strategy in question is considered effective in achieving fair management of the Gentuma fisheries supply chain. The next scenario is increasing human resource capacity (28.1%), developing access to technology and information (17%), and government intervention in policy (7.5%).

According to Yuniar (2012) in carrying out cooperation, the important thing to understand together is the principle of transparency. In this context, transparency includes creating clear understandings in long-term agreements between supply chain members. This involves establishing a joint communication forum so that all parties in the supply chain have knowledge of market conditions, applicable regulations, and most importantly, encouraging honesty between working partners, such as cooperation between companies, collectors and farmers. By implementing transparency, fair trade can be easily achieved. Transparency in this collaboration can be realized through the even distribution of information regarding markets and prices.

## CONCLUSION

Conclusions that can be drawn from the research are as follows:

1. This research identifies a supply chain model where the distribution flow of commodities and information is only for the domestic market. One of the efforts made by fishermen is to cut the supply chain at the collector level, which allows them to sell fish at a higher price than the price purchased by collectors.
2. The majority of fishermen are willing to be involved in the supply chain, however there are several factors that can be used as a measure of fishermen's willingness, namely the influence of price changes at the collector level, collectors' commitment to complying with payments, and norms in selling fish to financiers.

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