E-ISSN : 2987-1050, P-ISSN : 2987-1026
DOI: https://doi.org/10.38035/sjtl.v1i1
Received: 25 March 2023, Revised: 1 April 2023, Publish: 10 April 2023

Siber Nusantara Research
Siber Journal of Transportation and Logistics (SJTL)
+62 812 1046 7572 https://research.e-siber.org research.siber.info@gmail.com Jalan Marina Indah Raya No. 1 Pantai Indah Kapuk, Kamal Muara, Penjaringan, Jakarta Utara, Indonesia.

Dynamic Model of Tuna Logistics System in Padang City

Ebit Bimas Saputra[1], Amalina Maharani[2], Farhan Saputra[3]
[1] Dinasti Publishers Group, Jakarta, Indonesia, ebitbimas99@gmail.com
[2] Jambi University, Jambi, Indonesia, maharani.amalina94@gmail.com
[3] Bhayangkara University Jakarta Raya, Bekasi, Indonesia , farhansaputra121@gmail.com

Corresponding Author: ebitbimas99@gmail.com

Abstract: Indonesia is a maritime country that has large fishery resource potential and is spread over 11 Fishery Potential Areas (WPP). Therefore this research was conducted in order to obtain alternative strategies that can be implemented in an effort to increase the supply of tuna in the city of Padang using a system dynamic method approach. Based on the results obtained, increasing the amount of tuna supply can be done through existing policies in each scenario. The policies that can be carried out are: providing a fuel subsidy policy if scenario 1 is implemented, investing in the procurement of longline tuna vessels, licensing policies for increasing company capacity, and providing a fuel subsidy policy if scenario 2 is implemented, investing in the procurement of traditional vessels, investing in the procurement of longline tuna vessels, policies licensing for company capacity building, and providing fuel subsidy policies if scenario 3 is implemented. Determining the policies to be implemented for the next few years, this depends on policy makers who have considered the advantages and disadvantages of each scenario.

Keywords: Tuna Fish, System Dynamics Models, Simulation, Logistics Systems .

INTRODUCTION

Indonesia is a maritime country that has abundant fishery resources, with an area of aquaculture land of 28.5 million hectares. The potential for this vast area of land places Indonesia as a country blessed with large marine resources. The potential of existing marine resources has the potential for development, one of which is for the development of capture fisheries in the sea and in public waters (lakes, reservoirs, rivers and swamps) (Ministry of Maritime Affairs and Fisheries, 2014). Marine fishery potential in Indonesia is spread over 11 Fishery Potential Areas (WPP), namely; Andaman Sea (Malacca Strait), West Sumatra Sea, Southern Java Sea, Java Sea, Karimata Strait, Makassar Strait, Banda Sea, Halmahera Sea, Sulawesi Sea, Papua Sea and Aru Sea (Ministry of National Development Planning/Bappenas, 2015).

Some of the captured fishery products in the Indonesian fishery area are exported to foreign countries and the other part is used to meet domestic (domestic) consumption needs.

Indonesia's main export destination countries are currently dominated by countries in the Asian region which are indeed countries that are located adjacent to Indonesia. These countries are Japan, the United States, Thailand, Vietnam and China (Rahajeng, 2012).

One type of fishery resource that makes a major contribution to Indonesia's production and export volume is the tuna commodity. The advantage of this type of fish is that it contains high protein, low meat and fat and then contains the minerals calcium, phosphorus, iron and sodium, vitamin A and vitamin B, which are nutritious and healthy. In addition, this fish has a high selling value, and is one of the most sought-after types of fish and many live in Indonesian sea waters (Rahajeng, 2012). Therefore, tuna is the main commodity which is a source of state income in Indonesia's fishery export activities.

One of Indonesia's Fisheries Potential Areas (WPP) is included in areas that have great potential for tuna, namely in the sea waters of West Sumatra province or more precisely, namely the waters of the west coast of West Sumatra. Based on the Office of Maritime Affairs and Fisheries of West Sumatra Province, West Sumatra Province (West Sumatra) is geographically located at 10 ^{South} Latitude-30 ^{South} Latitude and 9800 ^{East} Longitude-1020 ^{East} Longitude. West Sumatra has a long coastline of 1,973,246 km, a sea area of 51,060.23 km² with a territorial zone area of 57,880 km² and an exclusive economic zone area of 128,700 km². With these sea conditions, the potential for marine fisheries is greater than offshore and oceanic fisheries. Based on the characteristics of the fish habitat or environment, West Sumatra has quite promising potential for large pelagic fish resources, including tuna, skipjack tuna, tuna and mackerel (Office of Maritime Affairs and Fisheries of West Sumatra Province, 2015). This condition is in line with the President's speech on December 18, 2006 in Padang, where West Sumatra was proclaimed a center for tuna for the western part of Indonesia and the establishment of the Samudera Bungus Fisheries Port as a Center for Industrialization Development of Cakalang Tuna (TTC) by the Minister of Maritime Affairs and Fisheries based on Decree no. 7/Kepmen-KP/2013 (Food Security Agency, 2015).

The great potential of tuna owned by West Sumatra has not been utilized optimally. If the fishery potential is optimally utilized, it will certainly provide big benefits for the region because the government can increase sales of tuna production to export destination countries. One of the areas in West Sumatra where the utilization of its fishery potential that has not been optimally exploited is the fishery potential in the city of Padang. According to the Head of the Maritime Affairs and Fisheries Service (DKP) for the City of Padang, the potential for catching tuna in the western waters of Sumatra, which is included in the City of Padang, has only been explored for around 20% of the total potential in the area. The sustainable potential of tuna along the west coast of West Sumatra reaches 915,000 km2 with the potential for tuna reaching 124,630 tons per year (Faisal, 2014).

Table 1. Production of Tuna in Padang City

Year	Total Production (Tons)
2006	6,961.1
2007	3,213.7
2008	763.8
2009	4,731.2
2010	521.8
2011	4,000.8
2012	4,155.9
2013	4,257.3

Source: BAPEPDA W Sumatra Province 2012, and BAPEPDA Padang City 2015

Table 1 shows the amount of tuna production in Padang City in 2006 – 2013. It can be seen that the highest production of tuna was in 2006, which was 6,961.1 tons. As stated by the Head of the Maritime Affairs and Fisheries Service (DKP) of the City of Padang, the potential for tuna per year can reach 124,630 tons, while the maximum potential for tuna that can be utilized is only 6,961.1 tons in 2006-2011. This proves that the potential of tuna in the city of Padang has not been optimally exploited.

The huge potential for tuna that is owned and not optimally utilized by the government, this of course must be addressed immediately by increasing the production of this tuna. Increasing tuna production to meet foreign export needs and domestic (domestic) needs is urgently needed, because the demand for tuna is quite large for export needs and domestic consumption needs.

In an effort to increase the production of tuna, the logistics system for tuna needs to be identified first. In the composition of KP Regulation No. 5/PERMEN-KP/2014, the National Fish Logistics System (SLIN) is a supply chain management system for fish and fishery products, production materials and tools, as well as information ranging from procurement, storage, to distribution, as an integral part of a policy to increase capacity and stabilizing the upstream-downstream fisheries production system, controlling price disparities, as well as meeting domestic consumption needs (Simatupang, 2016). According to Fauzi, the fisheries sector has a component structure consisting of three main components, namely the resource base , the primary fishing industry, and the processing and trading industries (Adam and Surya, 2013).

Based on the explanation regarding SLIN and the component structure in the fisheries sector, the Tuna Logistics System is a tuna supply chain management system (material flow and tuna information) based on the tuna business flow which consists of the component structure of the fisheries sector, namely the resource base .), primary fishery industry, and processing and trading industry. The resource base component is a tuna resource in marine waters that functions as fish stock available in the waters. The primary fishery industry component concerns the direct harvesting of fish resources (fishing effort), while the processing and trading industry component concerns fish processing activities carried out by the fish processing industry and also plays a role in marketing fish products to consumers (Adam and Surya, 2013).

Based on the description that has been described, this final project research was carried out using a system dynamics approach, by simulating a model of the tuna logistics system according to the actual situation. The development of a dynamic model of the tuna logistics system needs to be carried out because the problem of tuna in the city of Padang is a fairly complex logistics system problem involving various interacting variables. Therefore this research needs to be carried out regarding the problem of the potential for tuna that has not been used optimally, so that later it is expected that there will be a policy in an effort to increase the supply of tuna in Padang City for the future.

LITERATURE REVIEWS

Supply Chain Management (SCM)

According to Indrajit and Djokopranoto, supply chain is an organizational input system for distributing production goods and services to its customers (Aminudin, 2014). Chopra and Meindl (2007) have another definition of supply chain, namely all parties involved, either directly or indirectly, in trying to fulfill consumer demand. The supply chain does not only involve manufacturers and suppliers, but also involves transportation, warehouses, retailers, and even the consumers themselves.

According to Jebarus, Supply Chain Management is a further development of product distribution management to meet consumer demand. This concept emphasizes an integrated pattern involving the process of product flow from suppliers, manufacturers, retailers to consumers. From here, activities between suppliers and final consumers are in one unit without large barriers, so that the information mechanism between the various elements takes place in a transparent manner (Widyarto, 2012). Another definition of Supply chain management is a management of the flow of materials and information and capital that follows from the beginning to the end of the business chain to optimize the fulfillment of the needs of each entity in the supply chain (Aminudin, 2014). Supply chain management (SCM) is one of the approaches used to achieve efficient integration of suppliers, manufacturers, distributors, retailers and customers so that merchandise can be produced and distributed in the right quantities, at the right locations, at the right time, with The goal is to achieve the minimum cost of the overall system and also achieve the desired service level.

Logistics

According to *the Council of Logistics Management (CLM)* , *logistics* is part of the supply chain management process *that* plans, realizes and controls the efficiency and effectiveness of the flow and storage of goods and services and related information between points of consumption to meet customer needs (Hayati, 2014).

Another definition, logistics is the flow of materials, information, and money between consumers and *suppliers* . Logistics activities include transportation, warehousing, *inventory management* , *materials handling* , and everything related to information processing. The main goal of logistics is to coordinate all these activities to meet consumer needs at minimum cost (Frazelle, 2002).

According to Bowersox (2006), the logistics system is the strategic management of the movement and storage of goods, spare parts and finished goods from *suppliers* , between company facilities and to customers with the aim of delivering finished goods and various materials in the right amount. when needed in a condition that can be used to the location where the item is needed (Sutanto and Sumarauw, 2014).

According to Harrison and Van Hoek, explaining that planning, and controlling the delivery and distribution of products from *suppliers* to storage areas is part of logistics.

System Dynamics (*System Dynamics*)

System dynamics was first introduced by Jay W. Forrester in the 1950s at the American *Massachusetts Institute of Technology* (MIT). System dynamics or *system dynamics* is a method used to describe, model, and simulate a system that is dynamic (changing from time to time), (Aminudin, 2014). According to Wirabhuana, the dynamic system method is a methodology for understanding various problems from a system point of view, where the elements of the system interact with each other in a feedback relationship to produce a certain behavior. The interactions in this structure are translated into mathematical models which are then simulated with the help of a computer to obtain historical behavior (Aminudin, 2014).

Simulation Models

Simulation is a way to re-describe a condition in a situation through a model with the aim of learning, testing, training and so on. Model is a simple representation of a system (Harrell *et al* ., 2004). According to Scriber (1987), simulation is modeling a process or a system in such a way that the resulting model describes the actual system. By studying how the model behaves, it can be obtained an understanding and understanding of how the actual system behaves (Harrell *et al* ., 2004).

Simulation is an imitation of a dynamic system by using a computer model to evaluate and improve the state of a working system (Harrell *et al* ., 2004). The simulation carried out in this final project is a simulation on a *system dynamics* (a system that changes due to changes in time). In its implementation, simulation is usually carried out using software *on* a computer, using this *software* a model is built based on the conceptual model that has been done before. *The software* used in this final project to simulate a dynamic system is Powersim Studio 2005 *software* .

METHODS

The object of this research is tuna fishing in Padang City by examining the logistics flow of tuna in Padang City, one of which is in the Bungus Ocean Fishing Port (PPS Bungus) Padang City which carries out tuna export activities.

This study applies System Dynamics *as* a model to describe real situations. System dynamics is a method used to describe or model complex problems that arise due to causal tendencies of various variables in a dynamic system (changing from time to time). With system dynamics, the state of the system can be viewed and interpreted from time to time by stakeholders to determine and take appropriate action in resolving policy issues.

Analysis is carried out on the results of the model design that has been made, then analysis of the simulation results of the designed model, then analyzes the model simulation results after carrying out a number of policy scenarios, and then analyzes the selection of scenarios that are run.

RESULTS AND DISCUSSION

Model Analysis

The model designed in this final project is a real system representation of the tuna logistics system in the city of Padang, the design of the model is carried out using a system dynamic method approach. The use of this method is because the tuna logistics system in Padang City is a system that interacts with each other among the variables and changes over time. In this logistics system there are three subsystems that interact with each other, namely the supply subsystem, production subsystem, and demand subsystem which interact in it.

The supply subsystem is a subsystem that describes how the supply of tuna obtained from fishery potential areas changes catches over time due to the influence of the number of fishing gear units, average catch, delay times *caused* by seasons or natural conditions, and efforts to increase catch yields in a certain time.

The production subsystem describes how to fulfill the desired amount of export production and changes over time due to the amount of tuna supply in the supply subsystem which also changes over time, limited company production capacity, and the rate of unscheduled export shipments.

The demand subsystem illustrates how the level of demand for tuna is good for fulfilling export needs and domestic needs which also change over time, because the desired export target is achieved each year, as well as population growth which affects the amount of tuna consumption needed.

The interaction between the three subsystems is formulated by entering the input data in *the stock flow diagram* using the PowerSim *software* , then it is verified and validated so that a simulation output is obtained that is in accordance with the current situation.

Model Simulation Results

The model design has been validated, then a simulation is carried out on the model, so the simulation results are obtained at the present time and in the next few years. Based on the simulation results, the recapitulation results are shown in Table 2 and Figure 1.

Table 2. Potential Utilization Levels of Tuna

Year	Tuna Catch Potential (tonnes)	Number of Catches Tuna (tons)	% Potential Utilization
2012	99704.00	4124	4.14%
2013	99637.31	4058	4.07%
2014	99620.78	4064	4.08%
2015	99590.21	4338	4.36%
2016	99346.17	4191	4.22%
2017	99321.02	4357	4.39%

2018	99140.79	4288	4.33%
2019	98935.52	4385	4.43%
2020	98893.83	4275	4.32%
2021	98619.40	4239	4.30%
Average			4.26%

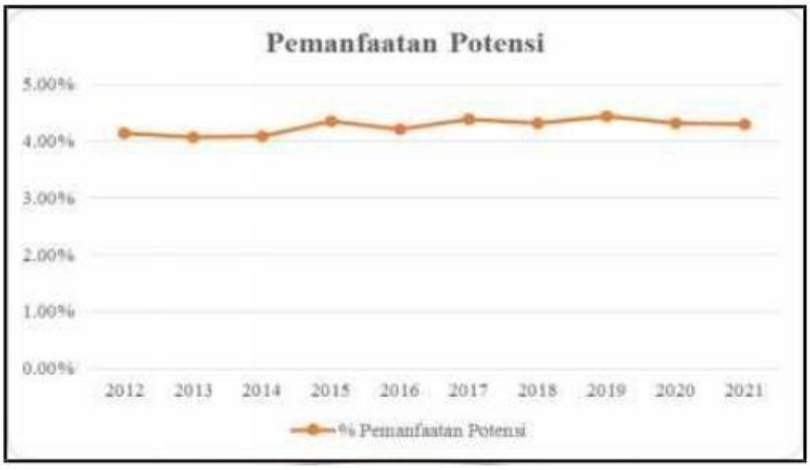

Figure 1. Graph of Tuna Potential Utilization

Table 2 shows the level of potential utilization of tuna from the number of catches obtained each year. In the table it can be seen that the average utilization rate for tuna potential in 2012-2021 is 4.26%. This shows that without efforts to increase the utilization of existing potential, for the next five years (2017-2021) the utilization rate for tuna will be expected to remain in the range of 4% as shown in the table.

In the 2012-2021 range, the level of potential utilization tends to decrease and increase as shown in Figure 1. Rises and decreases in utilization rates occur, due to the amount of tuna caught (total tuna production) which is influenced by unpredictable seasonal conditions. However, these natural factors are not the main source of the cause, but resource factors such as inadequate facilities for catching tuna are also one of the supporting factors that result in the number of catches decreasing during unfavorable season conditions.

Consumption of tuna for domestic needs and export needs affects the total demand (*demand*) overall in the flow of the tuna logistics system. The level of fulfillment of demand (*demand*) for tuna is one of the important things to know, because meeting consumer needs will certainly provide satisfaction for the consumers themselves. Based on the simulation results, the results of the recapitulation of the level of fulfillment of the overall *demand* and the level of fulfillment of export *demand* are shown in Table 3 and Figure 2.

Table 3. Overall Demand Fulfillment Rate

Year	Amount Tuna Catch (tonnes)	Total Demand (tons)	% Fulfillment Requests
2012	4124	6406	64.37%
2013	4058	6455	62.87%
2014	4064	6506	62.46%
2015	4338	6557	66.15%
2016	4191	6610	63.41%
2017	4357	6663	65.38%
2018	4288	6718	63.83%
2019	4385	6773	64.74%
2020	4275	6829	62.60%
2021	4239	6886	61.57%
Average			63.74%

Average (2017-2021)	63.63%

Figure 2. Graph of Overall Demand Fulfillment

In Table 3 it can be seen that the average level of fulfillment of the overall *demand* that can be achieved is 63.74% each year. Of course, this figure can be said that the fulfillment of consumer demand *cannot* be done as much as possible. So efforts to increase the average level of fulfillment of the overall *demand need to be done.*

In the graph of Figure 2, for 2017-2021 it is estimated that the overall level of *demand fulfillment* tends to decrease over time. The same thing happened in 2012-2016, which also tended to decline. This situation occurs because the overall total *demand* continues to increase every year due to the population growth rate which continues to increase over time, while this is not accompanied by the amount of tuna production which should also increase. Where it can be seen that the amount of tuna production in 2012-2016 tends to decrease over time, and in 2017-2021 the amount of tuna production is expected to increase and decrease but tends to decrease over time.

The level of fulfillment of export *demand* can be seen in Table 4 and Figure 3.

Table 4. Level of Fulfillment of Export Demand

Year	Tuna Exports (tonnes)	Export Demand (tons)	% Fulfillment Export
2012	670.47	3086	21.73%
2013	670.47	3086	21.73%
2014	662.05	3086	21.27%
2015	685.37	3086	22.21%
2016	714.87	3086	23.17%
2017	664.01	3086	21.52%
2018	634.91	3086	20.57%
2019	660.70	3086	21.41%
2020	576.71	3086	18.69%
2021	710.49	3086	23.02%
Average			21.63%
Average (2017-2021)			21.04%

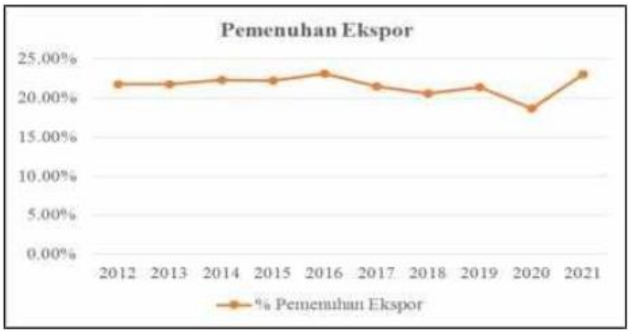

Figure 3. Graph of Export Demand Fulfillment

In Table 4 it can be seen that the average level of fulfillment of export *demand* that can be achieved is 21.63% each year. This figure can be said that the level of fulfillment of demand (*demand*) for exports is still far from the maximum level of fulfillment of *demand* that must be done. So that an effort to increase the average level of fulfillment of export *demand certainly needs to be done.*

In 2017-2021, in Figure 3 it is estimated that the level of fulfillment of export *demand* will increase in 2016, and then decrease in the following year, and the highest peak will be in 2021 of 23.02%. The increase and decrease occurred due to a lack of supply of tuna caught by fishermen for export tuna processing companies. One of the reasons for this lack of supply was that some fishermen did not catch tuna when they thought that at that time it was not the time for tuna to be abundant in sea waters, so they chose not to go on a voyage to catch fish. They think that if they keep catching tuna they will feel a loss because later the results obtained will not be able to cover the operational costs of the fishing they do. One of the operational costs that are quite large is the cost of fuel oil while at sea. Therefore, one of the policies that can be carried out by the government to help the fishermen's economy is to provide a fuel policy that is in favor of fishermen.

Scenario Design Simulation Results

The model simulation results show that by continuing to run the same tuna logistics system as at present, it can be seen that the results obtained for the next few years have not yet seen an increase in the utilization of available tuna potential as explained in sub-chapter 5.3. Therefore, three alternative possible scenarios were designed. Comparison of the simulation results of the three scenarios with the simulation results in the initial conditions can be seen in Table 5, Figure 4, and Figure 5.

Table 5. Results of Comparison of Number of Catches in Scenarios

Year	Total Demand (Tons)	Total Tuna Catches (Tons)				% Demand Fulfillment Whole			% Increase in Capture from Initial Conditions		
		Condition Beginning	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
2012	6406.00	4123.6	4297.4	4262.8	4339.0	67.08%	66.54%	67.73%	-	-	-
2013	6455.60	4058.0	4182.4	4070.0	4415.8	64.79%	63.05%	68.40%	-	-	-
2014	6506.87	4063.6	4161.0	4122.0	4195.8	63.95%	63.35%	64.48%	-	-	-
2015	6559.00	4337.6	4151.4	4355.6	4340.6	63.29%	66.41%	66.18%	-	-	-
2016	6612.33	4191.4	4128.0	4595.8	4033.6	62.43%	69.50%	61.00%	-	-	-
2017	6666.53	4356.8	4841.0	6069.8	6784.4	72.62%	91.05%	99.07%	11.11%	39.32%	55.72%
2018	6721.73	4288.2	5194.2	5734.4	6689.8	77.27%	85.31%	99.52%	21.13%	33.73%	56.00%
2019	6777.93	4384.6	4957.4	5615.6	6338.4	73.14%	82.85%	93.52%	13.06%	28.08%	44.56%
2020	6835.00	4275.0	5070.2	5623.6	6806.0	74.18%	82.28%	99.58%	18.60%	31.55%	59.20%
2021	6893.67	4239.4	4873.0	5839.8	6876.6	70.69%	84.71%	99.75%	14.95%	37.75%	62.21%
Average (2017-2021)						73.58%	85.24%	98.83%	15.77%	34.08%	55.54%

Based on Table 5 It can be seen that in the overall *demand* fulfillment category , it is estimated that the average % of *demand fulfillment* in 2017-2021 for the three scenarios is respectively 73.58%, 85.24%, and 98.83%. When compared with the % of total *demand fulfillment* in the initial conditions, namely with a value of 63.63%, the results of the three scenarios show that there is an increase in *demand fulfillment* with the implementation of this scenario. Whereas in the category of comparison of increased catches from initial conditions, it can be seen that in 2017-2021 it is estimated that the catches of each scenario compared to the catches of the initial conditions experienced an average increase of 15.77% in scenario 1, 34.08% in scenario 2, and 55.54 % in scenario 3. This shows that implementing one of the three scenarios will result in a change in the form of an increase in the number of catches for 2017-2021.

Figure 4. Graph of Overall Demand Fulfillment Comparison in Scenarios

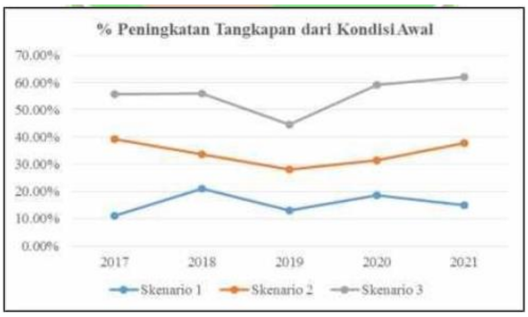

Figure 5. Graph of Comparison of Increasing Catches in Scenarios

Besides the comparison of the three scenarios with the initial conditions, the graphs in Figure 4 and Figure 5 also show the comparison between the three existing scenarios. In the two graphs it can be seen that the results obtained in scenario 3 are greater than scenario 2 and scenario 1. Meanwhile, the results obtained in scenario 2 are greater than scenario 1. The difference in results obtained in the three scenarios is influenced by how much the number of changes made each scenarios to be able to increase the total number of catches.

Table 6. Results of Comparison of Production Value in Scenarios

Year	Production Value (Rp)				% Increase in Production Value from Initial Conditions		
	Initial Conditions	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
2012	IDR 97,890,218,881.60	IDR 105,647,353,373.60	IDR 106,785,067,425.00	IDR 98,943,593,355.40	-	-	-
2013	IDR 90,972,069,489.20	IDR 102,174,555,042.80	IDR 90,634,711,078.00	IDR 109,595,087,295.00	-	-	-
2014	IDR 107,816,159,016.00	IDR 95,630,548,950.60	IDR 98,869,325,609.00	IDR 100,690,370,598.20	-	-	-
2015	IDR 105,288,163,776.60	IDR 101,752,961,311.80	IDR 101,018,245,620.20	IDR 105,645,822,317.40	-	-	-
2016	IDR 102,173,661,171.40	IDR 92,048,694,076.20	IDR 114,219,753,250.40	IDR 92,268,736,948.60	-	-	-
2017	IDR 108,943,624,299.20	IDR 115,772,440,476.20	IDR 144,403,069,252.00	IDR 164,549,782,265.80	6.27%	32.55%	51.04%
2018	IDR 107,900,555,420.20	IDR 114,698,887,900.20	IDR 135,390,552,957.20	IDR 146,839,450,349.80	6.30%	25.48%	36.09%
2019	IDR 106,676,515,452.40	IDR 114,337,284,436.00	IDR 134,338,737,098.60	IDR 153,399,104,174.20	7.18%	25.93%	43.80%
2020	IDR	IDR	IDR	IDR	29.38%	42.68%	79.82%

	94,883,870,297.40	122,760,332,731.80	135,382,760,976.00	170,622,989,018.80			
2021	IDR 98,393,661,041.00	IDR 118,073,768,230.20	IDR 150,098,638,822.60	IDR 169,324,940,165.40	20.00%	52.55%	72.09%
Average (2017-2021)					13.83%	35.84%	56.57%

Changes in several variables in each scenario result in changes in the form of an increase in the total catch which will also result in changes in the value of tuna production that will be obtained later, as shown in Table 6.

In Table 6 it can be seen that the average increase in production value from initial conditions in 2017-2021 for each scenario is expected to increase by 13.83% in scenario 1, 35.84% in scenario 2, and 56.57% in scenario 3. The magnitude of the difference in the acquisition value of production value from catch is affected by the number of catches that can be produced in each scenario and the price of the tuna itself (producer price) which varies over time. These price changes cause a decrease and increase in the acquisition of production value obtained by each scenario. So that when the catch increases, but the price of tuna is low, it causes the acquisition of production value to be lower than when the catch increases which is also accompanied by a high price for tuna.

The simulation of changes made to the scenario does not only affect the level of fulfillment of the overall *demand* and the total number of catches, but also affects the level of fulfillment of export *demand and the amount of increase in export production.* The scenario simulation results can be seen in the table and figure below.

Table 7. Results of Comparison of the Number of Exports in the Scenario

Year	Export Demand (Tons)	Total Tuna Exports (Tons)				% Export Fulfillment			% Export Increase from Initial Conditions		
		Condition Beginning	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3	Scenario 1	Scenario 2	Scenario 3
2012	3086	670.47	669.54	531.61	733.54	21.70%	17.23%	23.77%	-	-	-
2013	3086	670.47	669.54	531.61	733.54	21.70%	17.23%	23.77%	-	-	-
2014	3086	687.33	593.85	657.54	721.61	19.24%	21.31%	23.38%	-	-	-
2015	3086	685.37	585.35	673.60	678.22	18.97%	21.83%	21.98%	-	-	-
2016	3086	714.87	521.38	711.05	530.54	16.90%	23.04%	17.19%	-	-	-
2017	3086	664.01	1123.68	1857.98	1580.49	36.41%	60.21%	51.21%	69.23%	179.81%	138.02%
2018	3086	634.91	1368.98	1694.43	1521.97	44.36%	54.91%	49.32%	115.62%	166.88%	139.71%
2019	3086	660.70	1264.89	1563.55	1482.40	40.99%	50.67%	48.04%	91.45%	136.65%	124.37%
2020	3086	576.71	1232.63	1566.90	1704.64	39.94%	50.77%	55.24%	113.73%	171.69%	195.58%
2021	3086	710.49	1221.65	1752.19	1819.68	39.59%	56.78%	58.97%	71.94%	146.62%	156.12%
Average (2017-2021)						40.26%	54.67%	52.55%	92.39%	160.33%	150.76%

Based on Table 7 It can be seen that in the category of level of fulfillment of export *demand* , it is estimated that the average % of export fulfillment in 2017-2021 for the three scenarios is respectively 40.26%, 54.67%, and 52.55%. When compared with the % of *demand fulfillment* in the initial conditions, namely with a value of 21.04%, the results of the three scenarios show that there is an increase in *demand fulfillment* with the scenario that is carried out.

Meanwhile, in the comparative category of increased export production from the initial conditions, in Table 7 It can be seen that in 2017-2021 it is estimated that the number of exports for each scenario compared to the number of exports in the initial conditions has increased by an average of 92.39% in scenario 1, 160.33% in scenario 2, and 150.76% in scenario 3. This shows that by doing one of the three scenarios results in a change in the amount of exports that almost doubles from its initial condition.

Policy Comparison Analysis on Scenario Selection

Based on the results of each scenario described in the previous sub-chapter, it can be seen that scenario 3 is a scenario that has the value of fulfilling the overall *demand* , as well as a higher level of increase in the number of catches compared to other scenarios. Meanwhile, at the level of fulfilling export *demand* and increasing the number of exports, scenario 2 and scenario 3 have the same value and are greater than the value obtained in scenario 1. So if sorted from the best scenario, the sequence is scenario 3, scenario 2, and the last is scenario 1.

The difference in scenario results is influenced by the design changes made to each scenario. The bigger and more changes are made, the greater the scenario results will be obtained. Change plans contained in each scenario if one of these designs is not carried out or the magnitude of the changes made is different from the initial scenario, then the policies in each scenario are still valid to be implemented, it's just that the results that will be obtained later will be slightly different from the results of the design changes made thoroughly in each scenario.

Even though scenario 3 is the best scenario to be able to obtain greater results than other scenarios, in determining the scenario used in real situations, it depends on the policy and decision makers (in this case, the government). Because in each scenario there are policies where the government must spend different capital or investment for each scenario.

Differences in capital or investment that must be issued by the government to be able to achieve the desired goals can be seen as follows:

1. In Scenario 1: The policy that needs to be carried out by the government is to only provide fuel subsidies for tuna *longline vessels* that are already in PPS Bungus. Thus increasing the frequency of unloading tuna boats every week.
2. In Scenario 2: The policy that needs to be implemented is investment in the procurement of *longline* tuna vessels with an increase of 5 units of tuna vessels in 2017. Then, there is an increase in the catch for exports by 80% which results in an additional export production capacity of 50%, the government must provide a permit policy for tuna processing companies to increase production capacity, one of which is by adding additional land areas for the company or licensing for new tuna processing companies. In addition, implementing a fuel policy by providing fuel subsidies for *longline tuna boats* that are already in PPS Bungus also needs to be carried out by the government in an effort to increase the frequency of unloading tuna boats every week at PPS Bungus.
3. In Scenario 3: The policy that needs to be implemented is investment in the procurement of traditional vessels for traditional fishermen in an effort to increase the catch of traditional vessels by 25%. This was followed by an investment policy for the procurement of *longline* tuna vessels with an additional 5 units of tuna vessels in 2017. This was also followed by a policy of granting licenses for tuna processing companies to increase production capacity, one of which was by adding additional land areas for companies or licensing a new tuna processing company in an effort to increase catches for export by 80% which also resulted in an additional 50% export production capacity. In addition, implementing a fuel policy by providing fuel subsidies for tuna *longline vessels* that are already in PPS Bungus also needs to be carried out by the government. So that the frequency of unloading tuna boats every week at PPS Bungus can be increased.

Based on the explanation of the scenarios above, it can be concluded that the determination of policies to be carried out for the next few years depends on policy decision makers who have considered the advantages and disadvantages of each existing scenario.

CONCLUSION

To achieve the objectives of the research, based on the results obtained, it can be concluded that there are several alternative policies that can be implemented in the 3 existing scenarios, the following are policies in each scenario:

1. Scenario 1: The policy that can be implemented is to provide a fuel subsidy policy.
2. Scenario 2: Policies that need to be implemented are investing in the procurement of tuna *longline vessels*, licensing policies for increasing company capacity, and providing fuel subsidy policies.
3. Scenario 3: Policies that need to be implemented are investment in the procurement of traditional vessels, investment in the procurement of longline tuna vessels , licensing policies for increasing company capacity, and providing fuel subsidy policies.

The determination of policies to be carried out for the next few years depends on policy makers who have considered the advantages and disadvantages of each scenario.

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