

Measuring The Fish Logistics Performance Index in The Indonesian Fisheries Supply Chains (A Study Case Of Poumako Fishing Port Of Mimika, Central Papua)

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Abstract. Indonesia is an archipelagic nation and there is an unequal population distribution, economic access, and price disparities between the islands. To tackle such challenges The Indonesian Ministry of Marine Affairs and Fisheries (MMAF) intends to establish the National Fish Logistics System to construct and develop an integrated, fishery product supply chain management. The research aims to determine the fish logistics performance index (hereafter F-LPI) in corridor Mimika-Java (Jakarta/Surabaya) in 2021 using F-LPI measurement methoe developed by MMAF. The results of the assessment and calculations for the Mimika-Surabaya/Jakarta corridor resulted in an F-LPI score of 65.74 which is included in the “Good” category. The dimensions of benefits and governance have the largest dimension index values of 92.32 and 81.91 (very good) respectively, while the index value for fisheries product procurement management has the lowest dimension index value of 40.15 (poor) and for dimension of Efficiency and Connectivity are fair and good. These results then become the basis for several improvement steps at the location such as fishing port management, additional cold chain facilities, and consolidation of logistics actors at the location.

1 Introduction

Indonesia is the biggest archipelago country in the world. whreas sea area comprises nearly two-thirds of the nation's total land area, with a shoreline of 108,000 km [1]. The territory consists of various islands with five major islands (Sumatra, Java, Kalimantan, Sulawesi, and Papua). The majority of the population resides in the western region, specifically Java and Sumatera, whereas a lesser population inhabits the eastern region, including the island of Papua. Long-distance differences in population distribution lead to disparities in economic development and access. In addition, the disparity in distance between the western, central, and eastern regions of Indonesia leads to an imbalanced distribution of products, resulting in a vast price disparity.

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With geographical condition allows fisheries in Indonesia to become a national economic locomotive and play an important role in national food security and nutrition. With a fishery production potential of 21,872,810.30 ton in 2021 [2]. Referring to Law No. 18 of 2012 pertaining to food, explaining that food is the most essential basic human need and that the state is responsible for ensuring the availability, affordability, and satisfaction of adequate food consumption, safe, high-quality, and nutritionally-balanced food consumption at the national and regional levels, uniformly across the territory of the Unitary State of the Republic of Indonesia. Due to several issues, including the perishable nature of fish, seasonality, disparities in production centres with consumers and industry, lack of availability of cold chain facilities, and lack of information on availability, seasonality, and projections of fish production, the abundant potential of Indonesia's fish resources has not been optimally utilized. This results in an oversupply during harvest and a shortage during famine in certain regions, resulting in uncertainty in supply (quantity and quality) and price disparities for fish across regions. In addition, the exorbitant cost of distribution is a factor. As a strategy to address this issue, The Ministry of Marine Affairs and Fisheries Regulation No. 5/2014 mandates the Ministry of Marine Affairs and Fisheries to implement the National Fish Logistics System or *Sistem Logistik Ikan Nasional* (SLIN) with the objective of constructing and developing an integrated, effective, and efficient fish and fishery product supply chain management system to increase capacity and stabilize fisheries production systems upstream-downstream, control price disparities, and meet domestic consumption needs.

To measure the performance of National Fish Logistics System, a measurement system called F-LPI was developed by using the guideline from World Bank's Logistics Performance Index (LPI). LPI calculated by the World Bank is an indicator of the condition of a country's logistics environment in which logistics operators operate [3]. LPI evaluates logistics performance in general; therefore, to evaluate the performance of fish logistics index in Indonesia, a distinctive measurement method is required that can compare performance between fish distribution channels. Currently, the fish logistics system still relies on the general commodity logistics system, so performance measurement must be conducted with carefully and precision, to obtain a fish logistics system performance index that is robust, specific, inclusive, and highly compatible, it is necessary to design a performance measurement instrument that can be expressed as an index [4]. This study describes the measurement of Fish Logistics Performance Index in the corridor Mimika - Surabaya/Jakarta from May to December 2021, as well as the formulation of policies based on improvement dimensions to enhance the performance of the fish logistics system in this corridor. Understanding FLPI is important for developing fishing port management. This research aims to determine the fish logistics performance index (hereinafter F-LPI) in the Mimika - Java corridor (Jakarta/Surabaya) in 2021. The selection of the Mimika Fishing Port is very important for understanding the fisheries logistics system of the fisheries management area in eastern Indonesia. This will be very useful for the Government in its research-based Fishing Port development policy.

2 Material and methods

2.1 Research area

According to Decree No. 115 of 2020 by Directorate General of Marine and Fisheries Product Competitiveness, Ministry of Marine Affairs and Fisheries, Indonesia has five fishery logistics corridors. The five corridors consist of the Kendari-Surabaya/Jakarta corridor, the Makassar-Surabaya/Jakarta corridor, the Bitung-Surabaya/Jakarta corridor, the

Ambon-Surabaya/Jakarta corridor, and the Mimika-Surabaya/Jakarta corridor. The research is concentrated on the corridor Mimika – Surabaya/Jakarta (Figure 1). The formation of corridors based on location points as production centers, collection centers, and distribution centers or supporting logistics networks in each region that are integrated into a single distribution chain, then the criteria for determining corridors are to follow the existing supply chain or distribution chain with the objective of understanding field conditions and enhancing the supply chain of fishery products through program facilitation, facilities, and infrastructure [5].

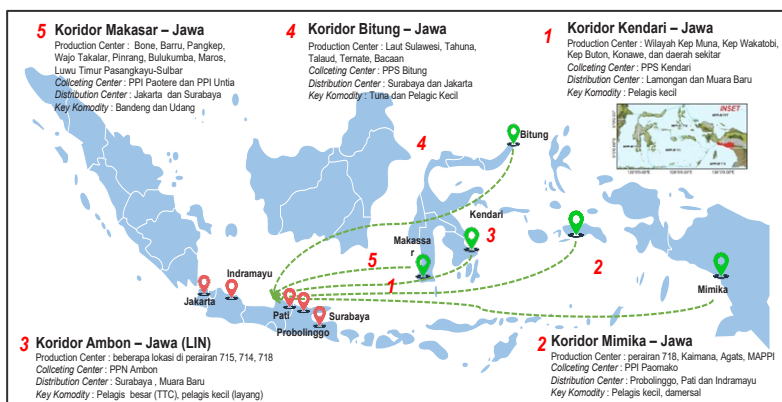


Fig. 1. Corridors of national fish logistics system.

2.2 Data collection

The data collection process consisted of multiple steps, beginning with the training of data collectors to have a shared comprehension of the requirements of the data collected. This is significant because questionnaires and interviews were used to gather data so that enumerators could delve deeper into information regarding the attributes and dimensions of fish logistics performance measurement. The respondents were selected using a non-probabilistic sampling technique, namely, purposive sampling. The selection of respondents is conducted by data collection officers who are representatives of institutions that have the potential to become respondents, i.e. parties or actors who can provide the necessary data and information to obtain an overview of the attributes used in the evaluation of the fish logistics performance index and are directly involved in the fish supply chain business processes, such as actors businesses (fish owners, fish processing units, or suppliers), logistics service providers, provincial/district/city forestry and fisheries offices and other related agencies.

2.3 Attributes and measurement dimensions

The key driver of National Fish Logistics System basically adopts the National Logistics System (SISLOGNAS) model so that the determining factors are the same which include: (1) commodities, (2) infrastructure, (3) logistics service providers, (4) information technology, (5) human resources, (6) Institutions and (7) regulations and policies [6].

Some important notes for the measurement of the logistics index are: many versions, influenced by the emphasis of the measurement, influenced by the model area coverage (local, regional, national, global) and influenced by data availability [7].

The formula for calculating F-LPI is [4] :

$$F - LPI = (A \times IDP) + (B \times IDE) + (C \times IDK) + (D \times IDM) + (E \times IDTK)$$

Where as:

- F-LPI = Fish logistic performance index (%)
- IDP = Management of Fishery Products Procurement index (%)
- A = Weighted dimension of Management of Fishery Products Procurement
- IDE = Efficiency dimension index (%)
- B = Efficiency weighted dimensions
- IDK = Connectivity dimension index (%)
- C = Connectivity weighted dimensions
- IDM = Benefit dimension index (%)
- D = Benefit weighted dimensions
- IDTK = Governance dimension index (%)
- E = Governance weighted dimensions

As for determining the weight per dimension and the predicate of evaluation results using pairwise comparison method based on a questionnaire, determine the results as shown in Tables 1 and 2. The division is performed by examining the minimum score that can be obtained from F-LPI calculation, which is 14.29 if all questionnaire items are worth one point, and the maximum value, which is 100 if all questionnaire items are worth seven points. From this range, five categories of F-LPI achievement results are derived.

Table 1. Weighted Dimensions of F-LPI

Dimensions	Weight
Management of Fishery Products Procurement	15%
Efficiency	30%
Connectivity	25%
Benefit	10%
Governance	20%

Table 2. Categories of F-LPI Values

Range	Category
14.29 to 31.43	Very poor
31.44 to 48.57	Poor
48.58 to 65.72	Fair
65.73 to 82.86	Good
82.87 to 100	Very good

3 Results and discussion

3.1 Overview of business process and fisheries facilities in Poumako Mimika

According to Decree of the Indonesian Minister of Maritime Affairs and Fisheries number 51/PERMENKP/2016, Mimika Regency with core zone Poumako fishing port is one of the 13 locations of the Marine Fisheries Integrated Centre (MFIC). MFIC acts as an integrated marine and fisheries business centre from upstream to downstream based on the principles of integration, efficiency, quality, and high acceleration. The determination of MFIC is important in the fisheries area development program to support the SLIN. MFIC however

needs a good accessibility and connectivity to eliminate the economic disparity between the more developed one as west Indonesia and east Indonesia which is least developed [8].

The proximity of Poumako fishing port to the fishing area in Fisheries Management Area (FMA) 718 (Arafura sea) makes it a berth for fishing vessels operating in FMA 718, resulting in a significant expansion of the fishing industry in this region. These events prompted the government to intervene in orders to improve and accelerate the industrialization of fisheries by implementing policies that promote increased productivity and aggressiveness in the fisheries industry and by constructing and developing supporting facilities in the Mimika MFIC region. The development of facilities and infrastructure at the Poumako Fishing Port is needed to increase Regional Original Income [9]. Therefore, regional governments need to participate in developing fishing ports by providing and improving port facilities [10].

The Poumako Fishing Port facility began construction in 2016, coordinated by the Directorate General of Marine, Coastal and Small Islands involving related parties within the Ministry of Maritime Affairs and Fisheries and the Regional Government. Assistance from the Ministry for the development of the Poumako Fishing Port as MFIC Mimika has been carried out since 2016. The construction of Poumako Fishing Port facilities is one of the key factors in supporting the SLIN for the Timika - Java corridor. Table 3 displays the program interventions that have been carried out by the Ministry of Maritime Affairs and Fisheries and the Regional Government for the development of the MFIC Mimika.

Poumako's main commodities are small pelagic fishes (e.g. *Rastrelliger* sp. *Sardinella* sp, *Decapterus* sp.) and are mostly sold outside the area using sea transportation services. In 2018 – 2019, the majority of shipments from Timika are sent to Surabaya (65%), Jakarta (19%), and Semarang (15%), with an average domestic volume per shipment of 169 tons/send to the Surabaya area, 150 tons/send to the Semarang area, and 63 tons/send to the Jakarta area. Occasionally, fishing vessels from Java are used to collect fish and transport them to homebase the provenance of the owner of the fish [5]. Using fish carrier vessels influences the dynamics of shipments from Timika to Java.

Table 3. Program intervention at MFIC Mimika [11]

No.	Funding government agencies	Program intervention
1.	Directorate General of Marine, Coastal and Small Islands	<ul style="list-style-type: none"> • Fisheries Master Plan and Business Plan • MFIC accompanying team • 10 Auxiliary Fisheries Extension Officers
2.	Directorate General of Capture Fisheries	<ul style="list-style-type: none"> • 36 units of gill net fishing equipment • 4 units of basic longline fishing equipment
3.	Directorate General of Fishery Products Processing and Marketing	<ul style="list-style-type: none"> • Single Cold Storage capacity 100 tons • Single Cold storage 200 tons • Ice flake machine capacity 1.5 tons • Ice factory capacity 15 tons • 170 cool box units • 8 chest freezer units • 6 packages of fish processing tools • 1 unit of refrigerated car • 1 unit crane • Floating dock
4.	Directorate General of Aquaculture	<ul style="list-style-type: none"> • 21 packages of fish farming facilities • 1 package of biofloc cultivation
5.	Mimika Regency Fisheries Service	<ul style="list-style-type: none"> • Mama- Mama Papua "Iwaro" Fish Market

Some of the facilities and infrastructure that are available at PPI Poumako include: fish auction, Poumako fishing port office, ice factory with a capacity of 15 tons, pump house,

office of unit Surveillance for Marine and Fisheries Resources Timika, mooring wharf, water facilities, electricity facilities, 100 ton cold storage, security post and parking area. The current facilities are deemed insufficient, and the Poumako Fishing Port must be transformed from a fish landing service center to a logistics service centre in order to optimize the results of fish resource utilization. To increase fish buying and selling transactions at the Poumako Fishing Port, an integrated and readily accessible information system that can display the number of ship arrivals, the number, size, and type of fish landed, and available fish stocks is not yet available. This lack of information discourages logistics service providers from enhancing the schedule for transporting fish, which contributes to the Poumako Fishing Port's high logistics costs.

3.2 Production of capture fisheries

Since the formation of MFIC in 2016, the number of vessel visiting Poumako to unload and sell their capture has increased significantly, which has led to a significant increase in catches landed in Poumako every year (Figure 2). It is anticipated that the improvement of services and facilities for the fishing industry, as well as the cold chain, will increase the interest of vessel owners in making Poumako their home port, given its proximity to the fishing area. The figure also indicates an increase in the number of fishing fleets, but the catch is diminishing annually, indicating that fishing pressure on fish resources is increasing [12]. On the other hand, excessive exploitation of fish resources will reduce the number of captures, which could reduce the income of fisher families [13].

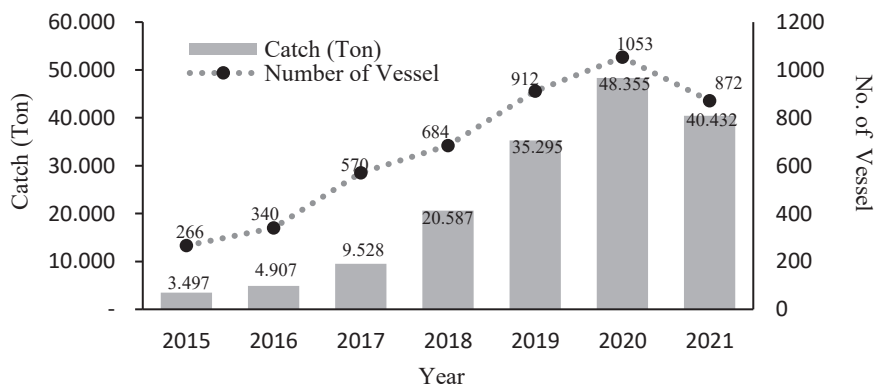


Fig. 2. Vessel unloading and catch production Poumako fishing port 2015 – 2021.

The capture fisheries productivity in 2021 is 40,432 tons, with scad mackerel (*Decapterus* spp.) constituting the largest commodity at 21,776 tons. Other than the mackerel scad, the five largest commodities are sardines (*Sardinella* sp) at 6,542 tons, sharks at 1,994 tons, sea catfish (*Arius* sp.) at 1,654 tons, Indian mackerel (*Rastrelliger* sp.) at 1,552 tons, and croaker/Gulamah at 1,080 tons (Figure 3). The dominant fishing gear used by fishers in Poumako consists of small pelagic purse seines, gill nets, ocean gill nets, drift gill nets, squid jigging and bottom longlines, This is evident from the varieties of fish caught, which are dominated by small pelagic fish with affordable prices and high public consumption.

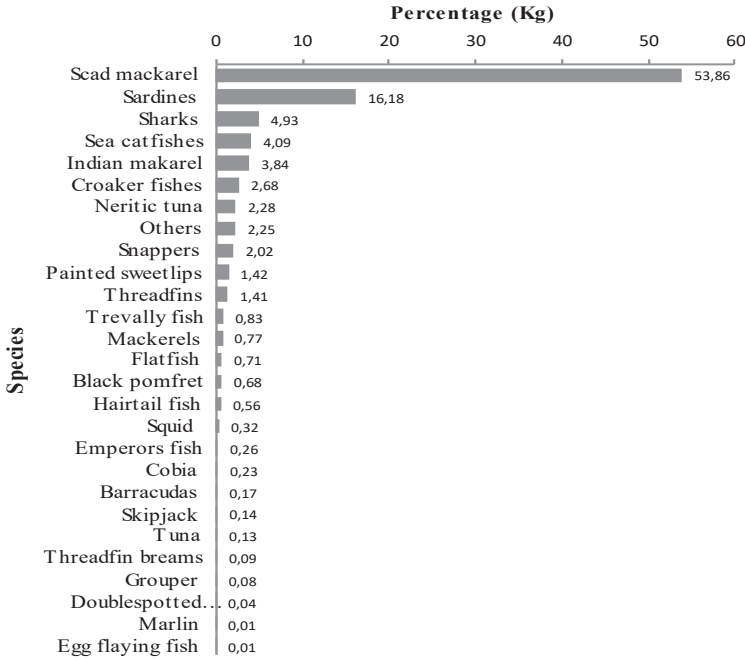


Fig. 3. Percentage (kg) of catch composition in 2021.

Figure 4 depicts the amount of fish landed at PPI Paumako From January to December of 2021. The total landing yield was 40,431,810 kg, where the harvest season runs from October to March, with the highest production occurring in October with 9,953,688 kg and the lowest in June with 450,488 kg. The catch fluctuations are influenced by oceanographic conditions where changes are greatly influenced by season [14]. The monthly production of fisheries in Poumako is in accordance with environmental conditions in Arafura waters, where in March the wind speed continues to increase and causes waves high and reaches its peak in June (west season) causes fishermen to have trouble going to sea, and fish production have increased since August and reached a peak in September along with a decrease in wind speeds and an increase in chlorophyll-a concentrations in September [15] [16].

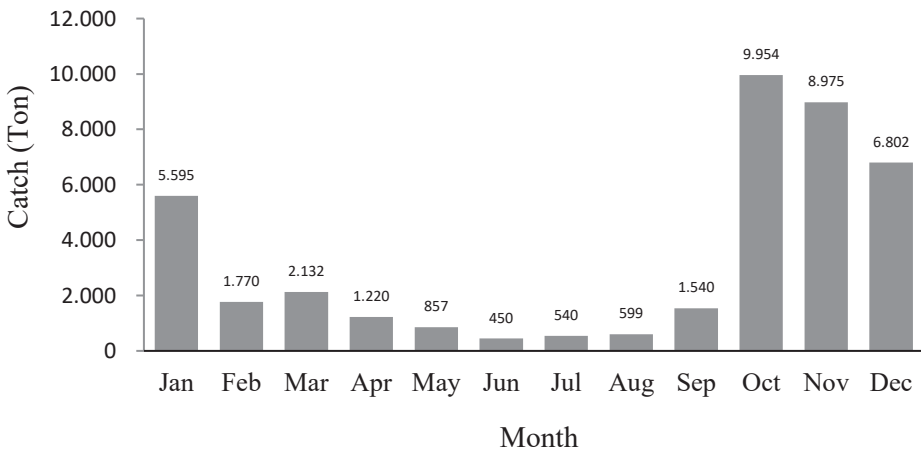


Fig. 4. Catch production by month Poumako fishing port 2021.

3.3 The final of F-LPI

For the purpose of calculating F-LPI data was collected via purposive sampling interviews conducted by enumerators. In the district of Mimika, respondents to the F-LPI 2021 include eight business actors (fish owners, fish processing entities, and suppliers), one logistics service actor, and two local government agencies. The results of the data collection and calculation of the fish logistics performance index in the corridor Mimika -Surabaya/Jakarta are presented in Table 4 and Figure 5.

Table 4. Results of F-LPI on Corridor Mimika - Surabaya/Jakarta

Dimensions	Score Results	of	Score Max.	Weighted Dimensions	F-LPI
Management of Fishery Products Procurement	16.86		42	0.15	6.02
Efficiency	22.69		42	0.30	16.21
Connectivity	40.09		56	0.25	17.90
Benefit	19.39		21	0.10	9.23
Governance	114.68		140	0.20	16.38
Aggregate F-LPI					65.74

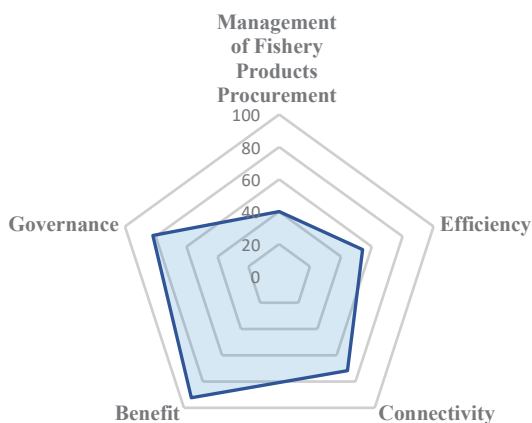


Fig. 5. The radar chart of F-LPI index corridor Mimika - Java 2021.

The Mimika – Surabaya/Jakarta corridor received a "Good" of F-LPI with score at 65.74 based on the results of the assessment and calculation in 2021. According to these results, the greatest dimension index for the Benefits dimension and the Governance dimension is 92.32 and 81.91, respectively. Influencing performance on both dimensions are the following:

- Transportation infrastructure availability that influences the increase or convenience of fish procurement, storage, and distribution
- The availability of information and communication technology that influences the expansion/ease of fish procurement, fish storage, and fish distribution.
- Availability of Human Resource Management, which influences the increase/ease of fish procurement, storage, and distribution
- Availability of actors and logistics service providers that influence the increase or convenience of fish procurement, storage, and distribution
- It is believed that the logistics system plays a significant role in regional economic development.

Maintaining the factors that have a significant impact on logistics performance in the Mimika - Surabaya/Jakarta Corridor will ensure that business actors and other stakeholders continue to be satisfied with fish logistics performance. It is known that the dimension index value of fisheries product procurement management, which is 40.15, contains the lowest dimension value. These factors influence performance on these dimensions:

- a. Publication and access to published fish production data
- b. Publication and access to official data on fish needs for local consumption
- c. Publication and access to official data on fish needs for the processing industry
- d. Publication and access to incoming and outgoing fish data
- e. Availability of storage facilities owned by the government and the private sector
- f. Publication and access to data on the number of fish that can be made available for transport by logistics service providers

The performance of the factors in the dimensions of the management of procurement of fishery products should be improved so that the performance of fish logistics can be increased. Data publication plays an important role in this dimension. The need for further coordination between the District/City/Provincial Marine and Fisheries Offices and related Director in MMAF such as the Directorate General of Capture Fisheries (DGCF), The Directorate General of Aquaculture (DGA) and the Fish Quarantine and Quality Control Agency (FQIA) as data trustees to publish data owned and dissemination of how to access the data to relevant stakeholders.

4 Conclusions

The results of the assessment and calculations for the Mimika - Surabaya/Jakarta corridor resulted in an F-LPI score of 65.74 which is included in the "Good" category. The dimensions of benefits and governance have the largest dimension index values of 92.32 and 81.91 (very good) respectively, while the index value for fisheries product procurement management has the lowest dimension index value of 40.15 (poor) and for dimension of Efficiency is fair and Connectivity is good. These results then become the basis for several improvement steps at the Poumako Fishing Port such as additional cold chain facilities (cold storage, ice factory, refrigerated vehicles) and consolidation of logistics actors at the location.

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