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Analysis of Fish Supplies at the Poumako Fishing Port, Mimika Regency, Central Papua Province - Indonesia

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ABSTRACT: One of the feeder ports in Fisheries Management Area (FMA) 718 is the Poumako fishing port in Central Papua Province, which encompasses fishing grounds in the sea of Aru, Arafuru, and Eastern Timor. As a supply of fish for different consumer locations on the island of Java, the port is crucial to Indonesia's marine fisheries supply chain. Therefore, in fisheries management policies at FMA 718, it is necessary to predict fish catches as assessment materials. This research aims to analyze the availability of fish supplies at the Poumako Fishing Port. Secondary data from the Ministry of Maritime Affairs and Fisheries (MMAF) provided the production of fish that landed between January 2018 and October 2023 for analysis. In addition, secondary data from the Poumako Fishing Port and interviews with port management were used to reveal the dynamics of fish supply at the Fishing Port. Data was analyzed descriptively. Fish catch predictions were investigated by the Triple Exponential Smoothing method. The research results show that Poumako Fishing Port has significant roles in the local and national fish supply chains. The trend of fish catches landed at Poumako Fishing Port is parabolic. There is a trend of increasing production in 2018–2021 and decreasing production in 2022–2023. The catch fisheries production is predicted to decline in 2024. Therefore, it is necessary to improve port facilities and management to increase marine fisheries production at the Poumako Fishing Port in the future.

KEYWORDS: Fishing production, trend, prediction, fishing port, Poumako

I. INTRODUCTION

In the Minister of Maritime Affairs and Fisheries Regulation Number PER.08/MEN/2012, it is stated that the definition of a fishing port includes two things: (1) a place enclosed by both land and sea and (2) has a supporting function for the fisheries business system that facilitates mooring activities/ anchoring of fishing vessels, loading/unloading of fish equipped with shipping safety facilities and fisheries supporting activities. Based on this definition, fishing ports play a significant role in ensuring the availability of fish supplies because they are centers for collecting catches, places for fishery product transactions, providers of fish processing, storage, and distribution facilities, and sources of data in sustainable marine fisheries management.

Fishermen and fishing ports are linked because fishermen need port accessibility and infrastructure to support fishermen's activities effectively and efficiently, supporting fishing efforts, product processing, and distribution of catches. Meanwhile, fishing ports are not only places for loading and unloading fish but also play a role in managing fisheries resources, such as monitoring fishermen's fishing gear, fishing permits, fishing areas, and fishing quotas, as well as recording catches for fisheries resource management. In other words, fishing ports have the functions of production, processing, and marketing of fisheries supply chains (Nasution et al. 2023). Therefore, fishing ports enable employees to engage in fishing and related activities.

Poumako Fishing Port in Central Papua Province has a strategic role in managing the supply of fish caught by fishermen in FMA 718. Poumako Fishing Port is one of 499 Fish Landing Bases in Indonesia (BPS-Statistics Indonesia 2022). This port is in the category of a Fish Landing Base with an auction place. Fish landed from Poumako Fishing Port fluctuate throughout the year. These fluctuations are caused by many factors including the fishing season (Imron et al. 2021), water oceanographic conditions (Ningsih et al. 2021), weather conditions in the waters such as rainfall and wind (Sari et al. 2021; Manapa et al. 2023), development of the fishing technology and human resources (Rizal et al. 2018), specifications of fishing equipment and methods (Pratama et al. 2020; Istrianto et al. 2021), and port supporting facilities (Rosalia et al. 2018).

Poumako Fishing Port is one of six fishing ports in FMA 718. Four fishing ports are in Papua Province, and the others are in Maluku Province. Apart from the Poumako Fishing Port in Papua, there is the Merauke Nusantara Fisheries Port in Merauke Regency, Sumur Aman Fishing Port (Mappi Regency), and Omor Fishing Port (Asmat Regency). Meanwhile, in Maluku, there are two fishing ports in the Aru Islands Regency, namely Dobo and Kalar Kalar. However, the fish that landed at Poumako Fishing Port not only come from

FMA 718. Many fishing vessels operating around FMA 718 come from Java and have central permits with vessel sizes >30 GT (Yuliaty et al. 2019). These ships make Poumako a port of call, especially during storms.

Some variables, such as the size of the vessel and the gear used for fishing, affect the kind and quantity of fishing production. Therefore, the government-issued regulations for marine fisheries management can be sustainable to avoid competition between industrial fisheries and small-scale fisheries in fishing areas. The regulations are made by the Minister of Maritime Affairs and Fisheries Regulation Number 58/PERMEN-KP/2020 concerning Capture Fisheries Businesses. Ships measuring <10 GT have a fishing area of up to 12 nautical miles, ships measuring 10-30 GT have 4-12 nautical miles, and ships measuring >30 GT have more than 12 nautical miles. Larger ship sizes have larger engine capacity, fuel storage, and hatches, allowing fishermen to catch and store more fish during fishing trips.

Apart from fishing area regulation, the type of fishing gear is also regulated to reduce the impact of unwanted production. Some commonly used fishing gear include fishing rods for large pelagic fish, nets for demersal fish, and purse seine for small pelagic fish. Using inappropriate fishing gear like trawls can result in overfishing, high bycatch, and harm the marine ecosystem. Therefore, trawls have been prohibited since 2015 through the Minister of Maritime Affairs and Fisheries Regulation Number 2/PERMEN-KP/2015 concerning Prohibition of the Use of Trawls and Seine Nets in Fisheries Management Areas.

It is crucial to know the supply of fish landed at Poumako Fishing Port with proper data collection. Accurate information about fishing production is significant in fisheries management, like facility planning, business investment development, and fisheries resource management. Electronic log books (e-log books) are an alternative to provide speed and accuracy in reporting fish catches directly from the vessels during fishing operations (Nugroho et al. 2015).

The Ministry of Maritime Affairs and Fisheries has required fishing vessels measuring over five GT to be equipped with a fishing log book in accordance with Minister of Maritime Affairs and Fisheries Regulation Number 33 of 2021 concerning Fishing Logbook, Monitoring on Board Fishing Vessels, and Fish Transporting Vessels, Inspection, Testing and Marking of Fishing Vessels, as well as Management of Fishing Vessel Manning. The Logbook contains information about fishing vessels, fishing equipment, fishing areas, and fish caught. The catch composition, temporal and spatial distribution, and catch rates of important economic species in fisheries resources can be analyzed using a logbook (Patmiarsih et al. 2023). However, the challenge faced is that fishermen often do not fill a logbook with the coordinates of the fishing area and the number of catches (Pratiwi et al. 2021).

Information obtained from the fisheries supervisor at Poumako Fishing Port is that filling in the e-logbook of fishing vessels that land fish at Poumako Fishing Port will only start in 2022. This filling is only limited to ships measuring 30 GT and above. Filling in the e-log book is still difficult to implement for vessels under 30 GT due to limited administrative staff at Poumako Fishing Port and weak internet signal conditions. Catch data has been compiled manually by fisheries supervisors and Mimika Regency Fisheries Service officers based on fishermen's reports. Therefore, it is necessary to improve facilities and increase human resources and governance of the Poumako Fishing Port to support filling in the e-log book.

Information about time series data on fish catches landed at Poumako Fishing Port in predicting fish catch production in the future is crucial. This information, among other things, improves the port's performance in supporting the national fisheries product supply chain. Therefore, this research aims to analyze the availability of fish supplies at the Poumako Fishing Port, Mimika Regency, Central Papua Province.

II. METHODS

This study uses time series data as the basis for its quantitative analysis. In addition, in February 2024, interviews were conducted with the management and fisheries supervisor of Poumako Fishing Port to forward the discussions.

A. Time series data patterns

Time series data is collected sequentially over time on an ongoing basis (Wei 2006). Previous studies on fish availability and supply based on time series data have been conducted at various fishing ports in Indonesia, such as Nizam Zachman Fishing Port (Muninggar 2008), Kutaraja Fishing Port (Nasution et al. 2019), Sibolga Fishing Port (Salmarika et al. 2022), and Pekalongan Fishing Port (Pamungkas et al. 2021). The exponential smoothing prediction model was used in the studies.

Exponential smoothing is divided into single, double, and triple exponential smoothing. Each model is according to the time series data pattern. Fisheries data generally has a pattern that depends on the season and has an increasing and decreasing trend that can change drastically. For this reason, the method used is three times smoothing, namely Triple Exponential Smoothing (TES). The TES method is used when the data shows trend and seasonal patterns (Nasution et al. 2019).

The fish supply data available in this research is time series data on fish landings recorded at Poumako Fishing Port from January 2018 to October 2023. This data is secondary data obtained from the Directorate General of Capture Fisheries, Ministry of Maritime Affairs and Fisheries. The pattern of fish catch data recorded at Poumako Fishing Port is shown in Figure 1.

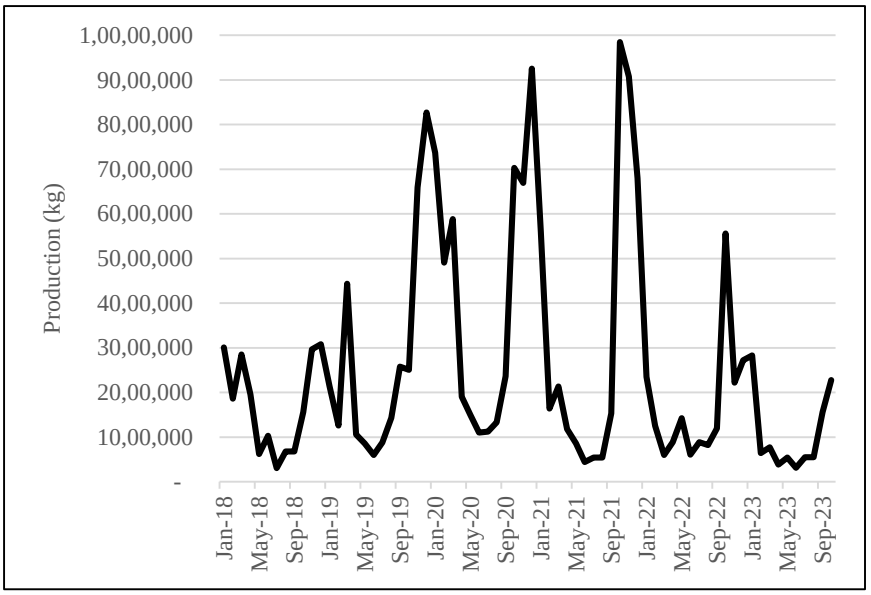

Figure 1. Data patterns of fish catches recorded at Poumako Fishing Port, January 2018-October 2023 (data processed)

Figure 1 shows that the pattern of fish catch data recorded at Poumako Fishing Port increased in 2018-2023. Next, there will be a downward trend in 2024.

B. Prediction calculations

There are three predictions of exponential smoothing methods: single, double, and triple. Prediction of fish catches in this study uses the Triple Exponential Smoothing (TES). The method used if time series data shows the development of increases and seasonal fluctuations that get bigger as the period increases (Pamungkas et al. 2021). Predictions are made to estimate fish catches from November 2023 to December 2024. Prediction calculations are as follows.

$$L_t = \alpha \frac{Y_t}{S_{t-m}} + (1 - \alpha)(L_{t-1} + b_{t-1}) \quad \text{..... (1)}$$

$$b_t = \beta(L_t - L_{t-1}) + (1 - \beta) b_{t-1} \quad \text{..... (2)}$$

$$S_t = \gamma \frac{Y_t}{L_t} + (1 - \gamma) S_{t-m} \quad \text{..... (3)}$$

$$F_{t+m} = (L_t + b_t m) S_{t-s+m} \quad \text{..... (4)}$$

Where,

Y_t = Actual data from the t[th] period
L_t = Level smoothing
b_t = Trend smoothing
S_t = Seasonal smoothing
α, β, γ = Model parameter value (0<x<1)
F_{t+m} = Forecasting at time *t*

C. Accuracy of the prediction model

The accuracy of the forecasting method is used to show how precise the forecasting value is to the actual data. Mean Absolute Percentage Error (MAPE) is used to calculate the accuracy of the forecasting method, which is calculated by dividing the absolute error by the actual data for that period, then averaging it, using the following formula (Hajjah and Marlim 2021).

$$MAPE = \frac{\sum(\frac{Actual - Prediction}{Actual} x\ 100\%}{n} \quad \text{..... (5)}$$

Where n = amount of data

Next, the prediction calculation results will be linked to the MAPE value criteria (as stated in Table 1).

Table 1. Interpretation of MAPE values

MAPE value	Prediction Criteria
x <10%	Very good
10% ≤ x < 20%	Good
20% ≤ x < 50%	Quite good
x ≥ 50%	Bad

III. RESULTS AND DISCUSSION

A. Level of Exploitation of Fish Resources in FMA 718

The management of marine fisheries resources in Indonesia is divided into Fisheries Management Areas (FMA) closely related to fishing ports. FMA is a concept that divides Indonesian marine waters into several management areas that have certain boundaries to facilitate fisheries management in Indonesia. Each FMA has a management authority that supervises and manages fisheries activities in the area so that fisheries resource management can be more effective. Institutional strengthening and support for facilities and infrastructure are needed to support FMA-based sustainable fish resource management (Kusdiantoro et al. 2019), including support for fishing ports. Table 2 presents the FMA for capture fisheries in Indonesia.

Table 2. Fisheries Management Areas (WPP) in Indonesia

FMA's code	Location
571	The waters of Strait of Malacca and Andaman Sea
572	The waters of Indian Ocean in west of Sumatra and Sunda Strait
573	The waters of Indian Ocean from the south of Java to the south of Nusa Tenggara, Sawu Sea, and western part of Timor Sea
711	The waters of Karimata Strait, Natuna Sea, and South China Sea
712	The waters of Java Sea
713	The waters of Makassar Strait, Bone Bay, Flores Sea, and Bali Sea
714	The waters of Tolo Bay and Banda Sea
715	The waters of Tomini Bay, Maluku Sea, Halmahera Sea, Seram Sea, and Berau Bay
716	The waters of Sulawesi and north of Halmahera Island
717	The waters of Cenderawasih Bay and Pacific Ocean
718	The waters of Aru Sea, Arafuru Sea, and East Timor Sea

Source: the Decree of the Minister of Maritime Affairs and Fisheries Number 19 of 2022

Capture fisheries management is very important in FMA 718, because the level of utilization of fish resources in this area has been fully exploited or even over-exploited (Table 3). This information is contained in the Decree of the Minister of Maritime Affairs and Fisheries Number 19 of 2022 concerning Estimation of Potential Fish Resources, Number of Allowable Fish Catches, and Level of Utilization of Fish Resources in FMAs of the Republic of Indonesia.

Table 3. Level of exploitation of fish resources in FMA 718

Fish Resources	Potential (tons)	Number of catches allowed (tons)	Utilization Rate	Information
Small pelagic fish	836,973	669,579	0.51	Fully exploited
Large pelagic fish (non-tuna and skipjack)	818,870	655,096	0.99	Fully exploited
Demersal fish	876,722	701,378	0.67	Fully exploited
Coral fish	29,458	23,588	1.07	Over-exploited
Penaeid shrimp	62,842	50,274	0.86	Fully exploited
Lobster	1,187	950	0.97	Fully exploited
Crab	1,498	1,198	0.85	Fully exploited
Swimming crab	775	620	0.77	Fully exploited
Squid	9,212	7,370	1.28	Over-exploited
Amount	**2,637,565**			

Note: Utilization level <0.50 = Moderate, fishing effort can be increased; 0.50-0.99 = Fully-exploited, fishing effort maintained with close monitoring; ≥ 1 = Over-exploited, fishing efforts must be reduced.

B. General conditions of the Poumako Fishing Port to support capture fisheries production

1. Number of Fishermen and Fishing Vessels

The number of fishermen recorded at Poumako Fishing Port in the 2019-2022 tends to increase. There were 5,622 fisherman overall in 2019; by 2022, that number will rise to 11,730. This number consists of full-time and part-time fishermen (Figure 2).

The number of full-time fishermen at Poumako Fishing Port continues to increase from 2019 to 2022, while the number of part-time fishermen tends to fluctuate. The increasing number of full-time fishermen indicates that fishing is increasingly attractive to fishermen. Poumako Fishing Port is one of the fishing ports which is a landing place for fishing vessels with a size of ≥ 30 GT originating from the island of Java, such as from Nizam Zachman Fishing Port (Jakarta), Karangsong (Indramayu, West Java), and Bajomulyo (Pati, Central Java), as well as fishing boats from Papua Province, namely from Poumako and Merauke.

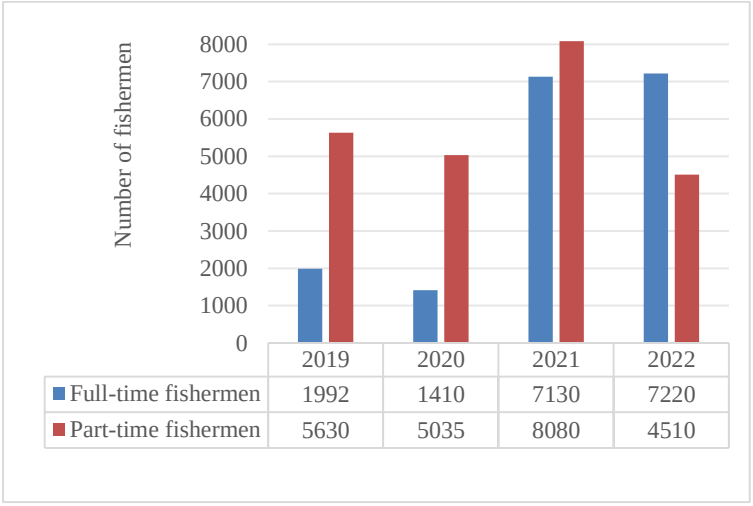

Figure 2. Number of fishermen in Poumako Fishing Port in 2019-2022 (Source: Poumako FP, 2023; data processed)

Based on e-logbook data from the Directorate General of Capture Fisheries, Ministry of Maritime Affairs and Fisheries, there were 137 fishing vessels > 30 GT that landed their catch in Poumako in the period July 2022 to November 2023 (Table 4). Almost half of the large fishing vessels come from the Bajomulyo Fishing Port, Juwana - Pati, Central Java.

Table 4. Number of vessels ≥ 30 GT landing fish at PP Poumako (July 2022 - November 2023)

Port of departure	Number of vessels	
	Units	%
Bajomulyo, Juwana - Pati	67	48.91
Poumako, Mimika - Central Papua	31	22.63
Karangsong, Indramayu , West Java	16	11.68
Nizam Zachman, Jakarta	13	9.49
Merauke, South Papua	4	2.92
Dobo, Aru Islands - Maluku	2	1.46
Klidang Lor, Batang - Central Java	1	0.73
Kejawanan, Cirebon - West Java	1	0.73
Mayangan, Probolinggo - East Java	1	0.73
Pekalongan, Central Java	1	0.73
Amount	**137**	**100.00**

Data source: Directorate General of Capture Fisheries - MMAF (data processed from e-logbook)

The importance of the Poumako Fishing Port for industrial and small-scale fishing is clarified in Tables 4 and 5. As indicated by Table 5, the majority of small-scale fishing vessels, 503 units (51.16%), measuring up to 5 GT, were registered at the Poumako Fishing Port in 2022. Next are commercial fishermen with vessels bigger than 30 GT (38,08%). Large fishing vessels of Java Island origin are significant to the national fish logistics system.

The Poumako Fishing Port still has the potential to grow as a feeder port and support the national fish supply chain. As a result, precise recording through e-logbook completion is necessary. In addition to technology, data recording officers have a significant role in providing accurate and excellent fisheries data (Priadi 2022).

Table 5. The size of vessels registered at Poumako Fishing Port

Ship size	Year (units)							
	2019		2020		2021		2022	
	Amount	%	Amount	%	Amount	%	Amount	%
<3 GT	419	52.57	425	47.12	434	47.33	503	45.07
<3-5 GT	19	2.38	31	3.44	33	3.60	68	6.09
>5-30 GT	87	10.92	147	16.30	151	16.67	120	10.75
>30 GT	272	34.13	299	33.15	299	32.61	425	38.08
Amount	**797**	**100.00**	**902**	**100.00**	**917**	**100.00**	**1,116**	**100.00**

Source: Poumako Fishing Port, 2023

2. Fishing Gear and Fish Catch Production

Based on data from Poumako Fishing Port, the fishing gear widely used by fishermen in 2022 is small pelagic purse seines with one vessel and gillnets (Table 6). According to information from the Fisheries Supervisor at Poumako, both fishing gears are generally operated by large vessels from Java. For traditional fishermen in Poumako, fishing rods and nets are the fishing gear commonly used to catch fish around the coast, 33.42% of the recorded fishing gear.

Table 6. Types of fishing gear in Poumako Fishing Port

Type of fishing gear	Year (units)							
	2019		2020		2021		2022	
	Amount	%	Amount	%	Amount	%	Amount	%
Oceanic gillnet	54	6.78	76	8.43	78	8.51	75	6.72
Fixed gillnet	126	15.81	130	14.41	105	11.45	183	16.40
Small pelagic purse seine with one vessel	98	12.30	276	30.60	386	42.09	265	23.75
Drifting gillnets	402	50.44	301	33.37	267	29.12	220	19.71
Others (fishing rods, nets)	117	14.68	119	13,19	81	8.83	373	33.42
Amount	**797**	**100.00**	**902**	**100.00**	**917**	**100.00**	**1,116**	**100.00**

Source: Poumako Fishing Port, 2023

Based on the frequency of operation of fishing gear for vessels measuring > 30 GT recorded in the e-log book in July 2022-November 2023, drifting gillnets were operated most frequently as many as 4,290 times (69.76%) out of 6,150 fishing attempts. Meanwhile, the fish group frequently caught is demersal fish, reported 2,561 times (41.64%). Table 7 shows the types of fishing gear used and the fish groups that were caught.

According to Damayanti (2020), small pelagic purse seines operated by fishermen at Bajomulyo Fishing Port, Juwana-Pati, catch types of fish such as scad, mackerel, trevally, sardine, and tuna. Small pelagic purse seines with one vessel landed at Poumako also caught large pelagic fish, although they were not the target catch. Groups of large pelagic fish recorded as being caught in FMA 718 are skipjack tuna (*Katsuwonus pelamis*), silky shark (*Carcharhinus falciformis*), Sicklefin weasel shark (*Hemigaleus microstoma*), skipjack tuna (*Euthynnus lineatus*), longtail tuna (*Thunnus tonggol*), queen mackerel (*Scombronemus lineolatus*), longrakered trevally (*Ulua mentalis*), blacktip reef shark (*Carcharhinus melanopterus*), king mackerel (*Scombronemus guttatus*), sailfish (*Istiophorus platypterus*), and shortbill spearfish (*Tetrapturus angustirostris*).

Table 7. Types of fishing gear and groups of fish caught at FMA 718 that reported in Poumako Fishing Port

Type of fishing gear	Group of fish caught (times)											
	Squid		Demersals		Coral fish		Small pelagics		Large pelagics		Total	
	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%	Amount	%
Oceanic gillnet	0	0	806	31.47	263	18.48	32	2.27	0	0	1101	17.90
Fixed gillnet	0	0	10	0.39	6	0.42	3	0.21	2	0.27	21	0.34
Small pelagic purse seine with one vessel	7	100	84	3.28	14	0.98	32	2.27	601	80.13	738	12.00
Drifting gillnets	0	0	1661	64.86	1140	80.11	1342	95.24	147	19.60	4290	69.76
Total	**7**	**100**	**2561**	**41.64**	**1423**	**23.14**	**1409**	**22.91**	**750**	**12.20**	**6150**	**100**

Source: Directorate General of Capture Fisheries - MMAF (data processed from e-logbook)

Drifting gillnets catch almost all groups of fish recorded in the e-log book. Of the various types of fishing gear operated in FMA 718, drifting gillnets predominantly catch small pelagic fish groups (95.24%), followed by demersal and coral fish groups recorded at 80.11% and 64.86%, respectively. Meanwhile, oceanic gillnets catch more demersal and coral fish.

Not all of the fish caught in FMA 718 have been recorded appropriately. The Fisheries Supervisor in Poumako informed us that e-logbook recording is only for vessels measuring > 30

GT. Filling in the e-logbook is still not done by small-scale fishermen who operate 5-30 GT vessels.

According to the e-logbook kept by the Directorate General of Capture Fisheries, 216 different fish species were landed at the Poumako Fishing Port. Of them, 78 species (36.11%) were demersal fish with a total production of 8,091,151 kg. However, small pelagic fish species—that is, 61.59% of fish—dominate in fish production. Figure 3 displays the distribution of fish groups and their production that landed at Poumako Fishing Port.

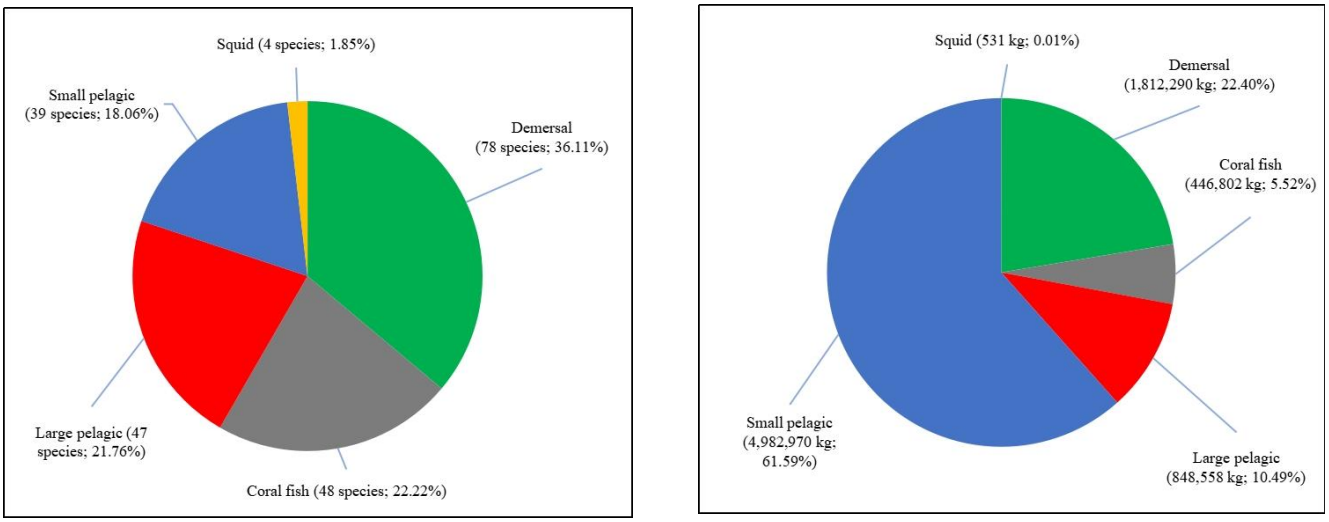

Figure 3. Fish groups (left image) and fish catched (right image) landed at Poumako Fishing Port
Source: Directorate General of Capture Fisheries - MMAF (data processed from e-logbook)

3. Fishing Season and Fishing Area

Fishermen's activities are very dependent on the fishing season. Lukum et al. (2023) stated that there are two fishing seasons in Indonesia, namely the east season (during the dry season) which t 718 occurs in the west season, namely between October and Marakes place in April-September, and the west season (during the rainy season) in October-March. Fishing seasons vary by FMA area. In Gorontalo Waters (FMA 717), the fishing season occurs during the east monsoon. In contrast, the fishing season at FMA 718 occurs in the west monsoon (Tambun et al. 2018; Picaulima et al. 2022). Oceanographic factors influence differences in fish catch seasons in Indonesia (Pamungkas et al. 2021).

The fishing season at FMAch (Table 8). The average monthly production of fish landed at Poumako Fishing Port based on time series data from January 2018 to December 2022 is 2,738,535 kg.

Based on Table 8, the seasonal index can be calculated using the moving average method over a 12-month (annual) period for the total fish landed at Poumako Fishing Port. The fishing season index is shown in Figure 4. The Figure shows that the fishing season at Poumako Fishing Port occurs in October and continues to increase until it reaches its peak in December every year. The fishing season index value then decreased from January to March. The fishing index value during the western season (October to March) is between 80.64%-228.67%. The highest fishing season index value at Poumako Fishing Port of 228.67% occurred in December. This means that in December, the volume of fish landings is around 2.29 times the average monthly catch during the year.

Table 8. Average catch of fish landed at Poumako Fishing Port

Month	Production per year					Average (kg)
	2018	2019	2020	2021	2022	
January	3,006,274	2,137,062	7,370,030	5,594,794	2,349,049	4,091,442
February	1,859,966	1,257,420	4,904,377	1,638,124	1,251,390	2,182,255
March	2,849,786	4,437,077	5,879,971	2,131,753	599,742	3,179,666
April	1,956,274	1,057,642	1,900,112	1,178,980	882.187	1,395,039
May	620,609	859,930	1,493,529	855,461	1,420,765	1,050,059
June	1,026,360	602.159	1,102,113	439,370	604,488	754,898
July	306.312	881.153	1,118,724	540.215	887,006	746,682
August	679,398	1,433,152	1,331,335	540,752	822,300	961,387
September	680,638	2,580,907	2,365,823	1,533,123	1,191,229	1,670,344
October	1,556,600	2,504,910	7,027,258	9,845,098	5,560,045	5,298,782
November	2,963,000	6,591,765	6,691,683	9,071,794	2,215,521	5,506,753

December	3,082,265	8,272,730	9,250,396	6,801,600	2,718,555	6,025,109
Average (kg)	1,715,624	2,717,992	4,202,946	3,347,589	1,708,523	2,738,535

Source: Directorate General of Capture Fisheries, MMAF (January 2018-December 2022).

The number of fish landed at Poumako Fishing Port begins to decline in the east season (April-September), with a fishing season index value between 23.27% - 58.67%. This means that during the east season, the number of fish landed at Poumako Fishing Port only reaches around 23-59% of the average monthly catch. Compared with the average catch of fish landed during the peak season in December, the volume of fish landed during the east season is reduced by 10.18-25.66%. Understanding the fishing season index is essential to enhancing Poumako Fishing Port's performance, particularly during the peak fishing season.

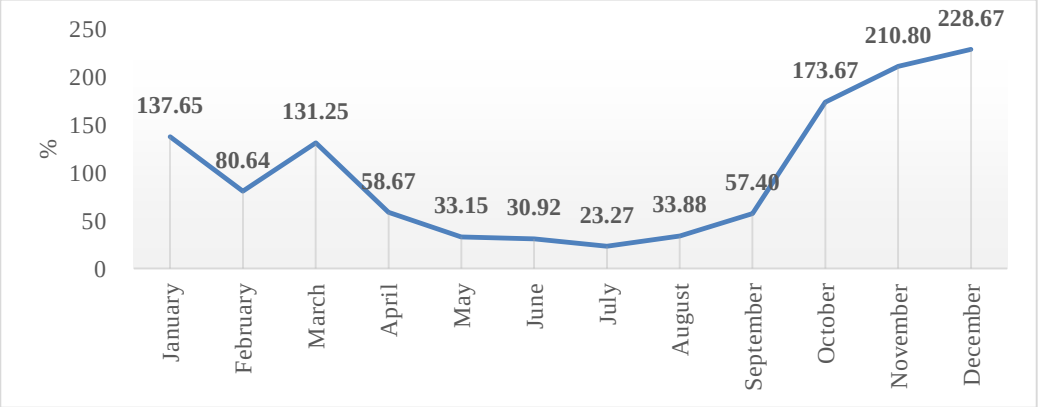

Figure 4. Fishing season index for fish landed at PP Poumako (data processed)

Based on e-log book data, the number of fishing vessels that landed their catch at Poumako Fishing Port from July 2022 to November 2023 was 136 units with a size of > 30 GT (Table 9). Fishing vessels that land their catch in Poumako also have fishing areas in areas other than FMA 718. Vessels that catch fish only in FMA 718 amount to 70.59% of all that land their catch in Poumako Fishing Port. There were 15 vessels (11.03%) that caught fish outside FMA 718, especially in FMA 712 (Java Sea Waters), but their catches were landed in Poumako. This is not surprising because fishermen with large fishing vessels mostly come from Java, especially from Juwana-Pati, Central Java. Before the fishermen caught fish at FMA 718, they had caught fish first at FMA 712.

Table 9. Number of vessels and fishing areas in Poumako Fishing Port

Fishing areas	Number of vessels	
	Units	%
FMA 718	96	70.59
FMA 712	13	9.56
FMA 573	2	1.47
FMA 718; FMA 712	16	11.76
FMA 718; FMA 714	1	0.74
FMA 718; FMA 573	5	3.68
FMA 718; FMA 712; FMA 714	1	0.74
FMA 718; FMA 712; FMA 573	1	0.74
FMA 718; FMA 712; FMA 714; FMA 573	1	0.74
Amount	**136**	**100.00**

Source: Directorate General of Capture Fisheries, MMAF (data processed from e-logbook)

C. Trends and Predictions of Fisheries Production

1. Fisheries Production Trends

Trends in fish catches can be seen from data on the movement of fish catches landed at the Poumako Fishing Port sourced from the Directorate General of Capture Fisheries, Ministry of Maritime Affairs and Fisheries from January 2018 to October 2023. To find out whether there are trends and seasonal variations in the data In this time series are presented in Table 10.

Table 10. Trend model of fish catches at Poumako Fishing Port (January 2018 to October 2022)

Trend models	R value ^{2}	Significance value
Linear	0.005	0.549
Quadratic	0.125	0.012*
Cubic	0.125	0.031*
Exponential	0.028	0.169

* Significant model

Based on Table 10, we can see that the best trend model for time series data on capture fisheries production landed at Poumako PP for 70 months (January 2018-October 2023) is the quadratic trend model (Figure 5) with the largest R^2 value (0.125) and a significant value (α) is the smallest (0.012). The R^2 value shows that fish catches are influenced by time variations of 12.5% with a probability or chance of error <5%.

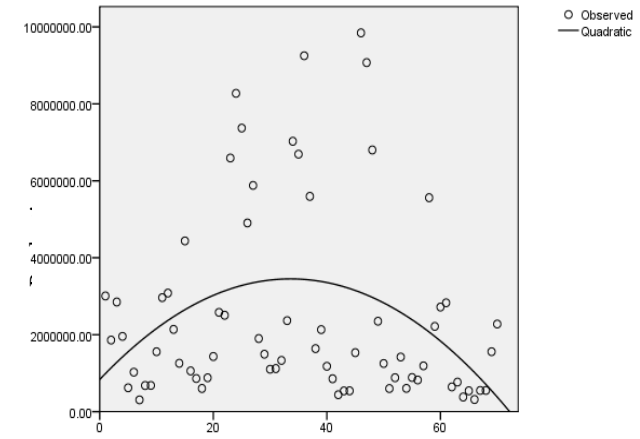

Figure 5. Trends in catches of fish landed at Poumako Fishing Port

Figure 5 shows that fish catches initially increased rapidly until the middle of the period and then began to decline until the end of the recording period. The results of observations spread over a wide range (not gathered) indicate seasonal variations in fish catches. Based on these trends and seasonal variations, the Triple Exponential Smoothing (TES) method is appropriate for predicting production in the future (Nasution et al. 2019).

2. Prediction of Fisheries Production

The results of prediction calculations using the TES method are presented in Figure 6. The MAPE value in the prediction calculation is 47.825%, which shows that the prediction model is quite good (Hajjah and Marlim 2021).

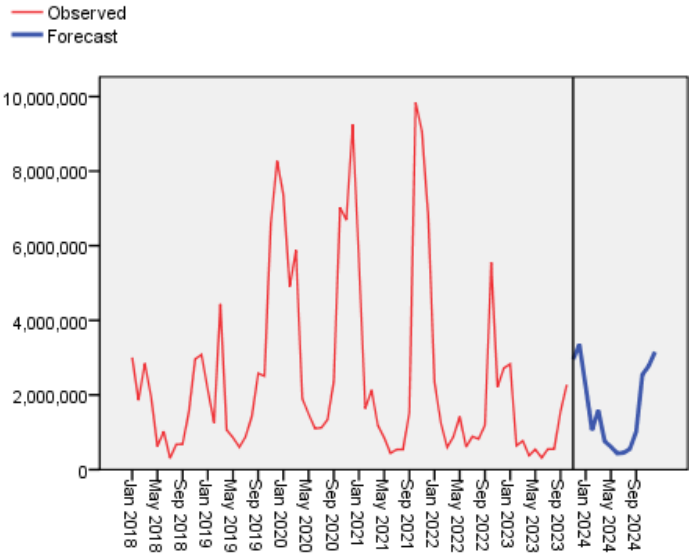

Figure 6. Prediction of fish catches at Poumako Fishing Port

Based on Figure 6, the fish catch at Poumako Fishing Port from November 2023 to December 2024 can be predicted as follows (Table 11).

Table 11. Prediction of fish catches at PP Poumako

Month	Prediction (tons)
November 2023	2,960
December 2023	3,360
January 2024	2,230
February 2024	1,060
March 2024	1,590
April 2024	759
May 2024	612
June 2024	435
July 2024	450
August 2024	552
September 2024	1,000
October 2024	2,550
November 2024	2,780
December 2024	3,150

Based on the prediction results shown in Table 11, the amount of fisheries production that landed at Poumako Fishing Port is predicted to decline. In the future, Poumako Fishing Port's management may utilize this assessment to increase the production of the catch fisheries.

IV. CONCLUSIONS

Fish supplies are one of the parameters in sustainable fisheries management of FMA 718, especially in Poumako Fishing Port, Central Papua Province. The trend in the number of fish catches landed at Poumako Fishing Port from 2018 to 2021 continues to increase and begins to decline since 2022. On the contrary, the number of fishermen who work as full-time fishermen in the same period tends to increase.

A dominant number of ships measuring > 30 GT comes from Bajomulyo Fishing Port, Juwana-Pati, Central Java. Number of fishermen with large fishing vessels at Poumako Fishing Port is 38.08% of the total fishing vessels. The fishing gear used most by fishermen is small pelagic purse seines with one vessel, followed by drifting gillnets and fixed gillnets. The dominant fish catch production is from the small pelagic fish group, but the dominant type of fish caught comes from the demersal fish group.

The peak fishing season occurs in the west season (October - March), and the lean season occurs in the east season (April - September). The peak fishing season occurs in December, while the lowest is in July. The fishing area for fishermen who land fish at Poumako Fishing Port is mainly at FMA 718. However, around 10% of the fish landed came from FMA 712. Catch production at Poumako Fishing Port shows a quadratic (parabolic) trend in 2018-2022. In 2024, fish production in Poumako Fishing Port is expected to decline.

RECOMMENDATIONS

There is a need to improve port management in recording captured fisheries data through e-logbooks because data recording is still not done optimally. Program support from the

Ministry of Maritime Affairs and Fisheries, as well as the availability of facilities and human resource capacity at Poumako Fishing Port, are significant factors in supporting the optimization of e-logbook recording so that fisheries production data can be obtained at the Poumako Fishing Port, Mimika - Central Papua more accurate.

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