



Ecosystem approach to coral fish management domain fishing techniques at PPI Ie Meulee, Sabang City

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ABSTRACT

The study was conducted from June to July 2024 located in PPI Ie Meulee, Sukajaya District, Sabang city, Aceh Province. The data collection methods include primary data (interviews and questionnaire) and secondary data (from relevant institutions and references). The sampling was done using the purposive sampling method with 21 respondents. Data analysis used was ordinal-based on liker 1,2,3 to each indicator, such as destructive or illegal fishing methods, modifications to fishing gear and auxiliary equipment, fishing capacity and effort, catch selectivity, the compliance of the function and size of fishing vessels with legal documents, and the certification of fishing crew members according to regulations. The overall average indicator score are 3. The results of the study showed that the fishing technique domain was categorized as good, with a composite value of 75.00.

Introduction

Fisheries management is an obligation as regulated in Law No. 31/2004 which was reaffirmed in the revision of Law No. 45/2009. Naturally, fisheries management is always related to three main dimensions that are interconnected, namely: (1) the dimension of fisheries resources and their ecosystems; (2) the dimension of the utilization of fisheries resources to support the social and economic welfare of the community; and (3) the dimension of fisheries policy itself (Ariyanto, 2022).

According to the National Working Group (NWG) EAFM, the Directorate of Fish Resources, Ministry of Marine Affairs and Fisheries (Directorate of SDI, Ministry of Marine Affairs and Fisheries, 2014) Ecosystem approach in fisheries management or Ecosystem Approach to Fisheries Management (EAFM) is a concept of how to balance the dimensions of management through an integrated and ecosystem-based approach. The ecosystem approach (EAFM) is a concept of fisheries

management approach in aquatic ecosystems by considering knowledge of abiotic, biotic components, and human interactions while still balancing social and economic objectives (FAO, 2003) in (EAFM, 2014). According to Hiew (2012) in a written journal Makalipessy (2023) EAFM requires managing the relationships between the core of the fishery, such as fish and fishermen, and other ecosystem elements, including human systems related to management. The EAFM indicators that have been set are: (1) fish resource domain; (2) ecosystem and habitat domain; (3) fishing technique domain; (4) social domain; (5) economic domain; (6) institutional domain.

According to Pranita *et al.* (2021), the primary goal of fisheries management using the Ecosystem Approach to Fisheries Management (EAFM) is to achieve sustainability in three key aspects: fish resources and habitats, socio-economic factors, and governance. The EAFM concept is designed to balance various societal objectives in fisheries

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management while considering the ecological, social, and economic implications involved (Weerawat and Worranut, 2019).

In line with the principles of EAFM, the application of the ecosystem approach in fisheries management can also be seen in various regions of Indonesia. One example is Sabang City, which is the westernmost region of Indonesia. Sabang City has five islands, namely Weh Island, Klah Island, Rubiah Island, Selako Island and Rondo Island. The Ie Meulee Fish Landing Base (PPI) is located on the east coast of Weh Island. The Weh Island area is mostly filled with coral reef ecosystems that are spread across almost the entire coast. The diversity of coral fish on the east coast of Weh Island is quite high with abundant coral fish stocks. Coral fish are demersal fish that have important economic value in Sabang City. Fishermen continue to carry out fishing activities, where this activity takes place uncontrollably and is carried out continuously. In addition, there has been an increase in the number of fishing fleets and fishing gear which has resulted in overfishing (Wani, 2022). Irrational and uncontrolled fishing, if carried out continuously, can cause a decline in stocks and even lead to extinction (Mardhiyah, 2017). Several regions in Indonesia have implemented the EAFM concept. Based on research conducted by (Bete et al. 2022), the status of capture fisheries management using the Ecosystem Approach to Fisheries Management (EAFM) in the fishing techniques domain in Kakuluk Mesak District, Belu Regency, falls under the moderate category in applying EAFM principles. Meanwhile, according to research by (Mesha et al. 2025), coral reef fisheries management using the ecosystem approach in the fishing techniques domain at the Pasiran Fish Landing Base (PPI) achieved a "Good" category, with a composite score of 78.

According to Nugroho (2022), coral reefs are ideal spawning grounds and nursery grounds for reef and pelagic fish. Coral reefs play an important role in the reef fish community. The fish community is a major component of coral reefs and plays an important role in the ecosystem, for example as herbivores that help control algae growth and are commercially important in the fisheries sector.

The number and size of reef fish are key indicators of the overall health of the coral reef ecosystem. Coral reefs in healthy and well-managed waters will increase the diversity of fish communities. Conversely, in deteriorating environmental conditions, only certain populations are able to survive and thrive (Edrus, 2020).

This study focuses on the domain of fishing

techniques. This domain was chosen because it has an important role and has a direct impact on fisheries productivity and ecosystem sustainability. By implementing the right techniques, the potential for overfishing can be minimized, thus maintaining the stability of reef fish. In previous studies, it has been studied that reef fish in the Sabang area have decreased, mostly due to damage to coral reefs caused by fish bombing activities and the use of toxic materials (Mustaqim, 2018). Seeing the problems in the management of existing capture fisheries, a study of capture fisheries management based on an ecosystem approach is needed through an assessment of the domain of fishing techniques at PPI Ie Meulee, Sabang City.

Materials and Methods

Location and time of research

This research was carried out for one month, namely in July 2024 at the Ie Meulee Fish Landing Base (PPI), Sabang city. Atools and materials used in this study such as stationery, laptops, scale board, and questionnaire sheets (21 sheets). The data used in this study include primary data and secondary data. The primary data collected consists of fish length data and interview results from questionnaires that are directly observed in the field. Sampling of fish length is done by measuring the entire population of coral fish that are predominantly caught by fishermen. Measurement of fish length is done by measuring the total length of the fish. Interviews were conducted with competent informants who were selected purposively, taking into account their diversity. The selection of informants was carried out using the snowball technique, where the first informant was selected by local residents, then information about the next informant was obtained in a chain (Erawan et al., 2017). The informants were reef fish fishermen. The results of the field survey showed that the population of reef fishermen was relatively small, only 21 respondents. Therefore, it was decided to conduct a comprehensive census. Meanwhile, secondary data is information data from literature and reports from related agencies. The secondary data collected were statistical data on capture fisheries in Ie Meulee Village in Sabang City for the last 5 years (2019 - 2024) and other related journal literature.

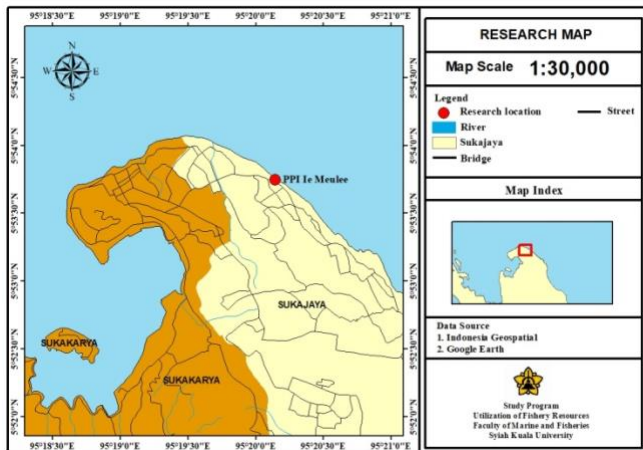


Figure 1. Maps of the Sabang PPI research location shown in the red dot area.

Data analysis

The data analysis used is based on the National Working Group (NWG) EAFM module of the Directorate of SDI, Ministry of [Marine Affairs and Fisheries of the Republic of Indonesia \(2014\)](#) which consists of the following 4 stages:

1. Assessment of each indicator

The assessment of each indicator uses a Likert score based on ordinal 1,2,3 where the higher the score, the better the assessment status. Of the six indicators, the most important indicator with the largest importance weight (30%) is the destructive or illegal fishing method. Furthermore, based on the large importance weight value, the modification of fishing gear and fishing aids (weight 25%), fishing capacity and effort (weight 25%), selectivity of fishing gear (weight 15%), suitability of ship size function with legal documents (weight 10%), and crew certification according to regulations (weight 5%).

2. Calculate the index value

The index value is obtained by converting the score value with the number 100 and its weight value on each indicator. The division of the weight value for each indicator is determined by the level of importance of the indicator in the domain of fishing techniques. The calculation of the index value uses the following formula:

$$Cat-i = Sat-i \times 100 \times Wat-i$$

Information:

Cat-I = Index value of the ith attribute/indicator

Sat-i = Score of attribute/indicator i

Wat-i = weight of the ith attribute/indicator, ([Wani et al., 2022](#)).

Table 1. EAFM Indicator Score Value Limits

Lower Limit	Upper Limit	Description	Color
0	1.5	Not enough	Red
1.5	2.5	Currently	Yellow
2.5	3	Good	Green

(Source: [Adrianto et al., 2014](#); [Sulistiyowati et al., 2018](#))

3. Calculating composite values

The EAFM indicator assessment is a multi-criteria system that culminates in a composite index related to the level of achievement of fisheries management in accordance with the EAFM principles. The total index value obtained is then analyzed using a simple composite analysis based on the arithmetic mean which is then displayed in the form of a flag model with criteria such as this composite value is a conversion of the total value of all indicators. To calculate the composite value, use the following formula:

$$NK-i = \left(\frac{cat}{cat-max} \right) \times 100$$

Information:

NK-I = i-th composite value.

Cat = Total index value of all attributes/indicators.

Cat-max = Maximum total index value.

Table 2. EAFM composite value criteria

Source: [NWG EAFM, 2014](#)

Value Range		Flag Model	Description
Low	Tall		
1	20	Red	Bad at implementing EAFM
21	40	Yellow	Lack of implementation of EAFM
41	60	Yellow	Currently implementing EAFM
61	80	Green	Good at implementing EAFM

4. Descriptive Analysis

[Hasan \(2004\)](#) explains that descriptive analysis is a form of research data analysis to test the generalization of research results based on one sample. Furthermore, [Hasan \(2001\)](#) explains that descriptive statistics are part of statistics studying how to collect data and present data so that it is easy to understand ([Nasution, 2017](#)). Descriptive analysis aims to change the conclusions of processed data so that it can be easily understood in the form of more concise and clear information. This analysis is used to describe the conditions of fisheries management

at PPI Ie Meulee and discuss the results of EAFM research in the domain of fishing techniques.

Results

1. Assessment of Fishing Technique Domain Indicators at PPI Ie Meulee, Sabang City

a) Domain of Destructive and/or Illegal Fishing Techniques

In the domain of destructive and/or illegal fishing techniques, no violations of fishing practices were found by fishermen using tools or materials that could damage the ecosystem and fish resources.

Table 3. Number of violations that occurred at PPI Ie Meulee

Location	Frequency of violations >10 cases/year	Frequency of violations 5-10 cases/year	Frequency of violations <5 cases/year
Ie Meulee	-	-	-

b) Modification of Fishing Gear and Fishing Aids

The length sampling of reef fish landed from 3 boat trips amounted to 28 fish, 5 grouper fish (*Epinephelinae*) and 23 bearded fish (*Mullidae*). The size of the catch can be seen in [Figure 2](#).

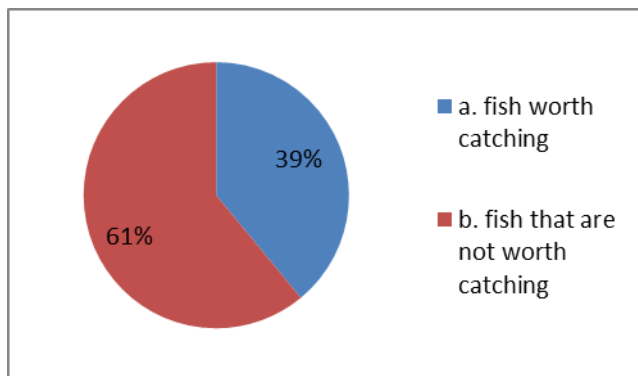


Figure 2. Size of coral fish catch at PPI Ie Meulee

c) Fishing Capacity and Fishing Effort Indicators

This indicator uses secondary data, namely total annual production over a period of 4 years (2020-2023) ([Table 3](#)).

d) Selectivity of Capture

Selectivity of fishing is the ability of fishing gear to select or fishing method that only catches certain types and sizes of fish desired. Selective fishing gear only catches fish that are on target. From the results obtained, the fishing gear used by PPI Ie Meulee fishermen uses handline fishing gear ([Table 4](#)).

e) Compliance of Function and Size of Fishing Vessels with Legal Documents

Table 4. Fishing Capacity and Ratio 2020-2023

Fishing capacity using total annual production			
No	Year	Fishing capacity (kg/year)	Ratio
1	2020	19287973728	1
2	2021	22018913280	0.88
3	2022	22221335160	0.99
4	2023	23433559560	0.95
Average		21740445432	0.95

This indicator looks at the conformity of legal documents with the actual activities of the function and dimensions of the size of the vessel in carrying out fishing operations ([Table 5](#)).

Table 5. Specifications of Coral Fishing Vessels at PPI Ie Meulee

No	Ship Owner Name	Ship Size (L x W x D) m	GT	HP/PK	Information
1	Mr. Zaini	8.00 x 1.70 x 0.85	2	32	In accordance
2	Maisir	10 x 3 x 0.65 x 7 x 1.50 x	2	32	In accordance
3	Ikhar	0.80 x 5 x 1.50 x	1	32	In accordance
4	Ishak	0.55 x 6 x 1.30 x	2	15	In accordance
5	Abu Bakar	0.65 x 8.5 x 1.70 x	2	15	In accordance
6	Hasballah	80 x 8.10 x 1.60 x	3	32	In accordance
7	Idul Adha	0.75 x 8.00 x 1.63 x	1	32	In accordance
8	Ivana	0.75 x 8.00 x 1.60 x	1	32	In accordance
9	M. Hafnan Syahrul	0.70 x 8.00 x 1.65 x	1	32	In accordance
10	Ramadhan	0.85 x 7.50 x 1.65 x	1	32	In accordance
11	Mulyadi	0.80 x 5.40 x 1.42 x	1	32	In accordance
12	Sony Sopian	0.55 x 8.00 x 1.58 x	1	15	In accordance
13	Jaisul Usra	0.74 x 6.20 x 1.70 x	1	32	In accordance
14	Syafii	0.60 x 5 x 1.50 x	1	32	In accordance
15	M. Husain	0.42 x 5.68 x 1.53 x	1	32	In accordance
16	Zulfikar	0.40 x 8.30 x 1.58 x	1	20	In accordance
17	Tarmizi	0.74 x 7.90 x 1.60 x	1	32	In accordance
18	Sofia Zainun	0.75 x 8.30 x 1.54 x	1	32	In accordance
19	Yusuf	0.73 x	1	32	In accordance

20	Dedy Wachhyuly	7.00 x 1.60 x 0.90	1	32	In accordance
21	Rizwan	8.00 x 1.80 x 0.90	2	32	In accordance

f) Certification of Fishing Vessel Crew in Accordance with Regulations

From the results of observations and interviews with reef fish fishermen, the crew members who operate fishing vessels do not have any certificates.

2. Assessment of Coral Fisheries Management at PPI Ie Meulee

The EAFM indicator assessment uses a simple composite approach with the flag modeling technique. After obtaining the score, weight, and index values, the composite value, flag color, and description will be obtained according to the range of values, the results of the assessment and calculation of the EAFM fishing technique domain can be seen in the [Table 6](#).

Table 6. EAFM Indicator assessment

Indicator	Score	Weight	Index
1. Destructive fishing	3.00	30	9000
2. Modification of fishing gear and fishing aids	1.00	25	2500
3. Fishing Capacity and Effort	1.00	15	1500
4. Selectivity of capture	3.00	15	4500
5. Compliance of the function and size of the fishing vessel with legal documents	3.00	10	3000
6. Certification of fishing vessel crew in accordance with regulations.	1.00	5	500
Amount			21000

The composite of the fishing technique domain can be seen in [Table 7](#).

Table 7. EAFM Composite VALUE of Coral Fish at PPI Ie Meulee.

Fishing Techniques	Composite Value	Flag Model	Description
Doman	700000	70	Good in implementing EAFM

Discussion

Overview of Research Location

Sabang City is the westernmost region of Indonesia. Sabang City has five islands, namely Weh Island, Klah Island, Rubiah Island, Selako Island and Rondo Island. The Ie Meulee Fish Landing Base (PPI) is located on the east coast of Weh Island. The Weh Island area is mostly filled with coral reef ecosystems that are spread across almost the entire coast. The diversity of coral fish on the east coast of Weh Island is quite high with abundant coral fish stocks.

1. Assessment of Fishing Technique Domain Indicators at PPI Ie Meulee, Sabang City

a) Domain of Destructive and/or Illegal Fishing Techniques

The indicator of destructive and/or illegal fishing methods received a score of 3 with a frequency of violations of less than five years. Based on the results of observations and interviews with fishermen in the field with reef fish fishermen at PPI Ie Meulee, it was said that no environmentally unfriendly fishing gear was found, because all reef fish fishermen used simple handline fishing gear to catch reef fish. One of the factors causing the decline in marine fishery resources is the use of destructive fishing gear such as bombs or prohibited fishing gear ([Bete et al., 2022](#)). Based on the results of interviews with fishermen, it was stated that the violations that usually occur are violations related to prohibitions on days when it is forbidden to go to sea, such as Fridays, sea feast days and religious holidays, where these cases are not included in the category of violations referred to in this indicator. According to [Rato et al. \(2020\)](#) sanctions for violators of the Laot Customary Law, being detained not to go to sea for 7 (seven) days and if fishermen succeed in catching fish during 'abstinence from sea' days, their catch will be confiscated.

b) Modification of Fishing Gear and Fishing Aids

The length sampling of reef fish landed from 3 boat trips was 28 fish, 5 tomato groupers (*Cephalopholis sonnerati*) and 23 longbarbel goatfish (*Parupeneus macronemus*). The results of data analysis showed that the measurement of the total length sample of grouper fish caught was between 13-15 cm, meaning that the groupers caught were still below the Length of Maturity (LM), while bearded fish were between 12-23.5 cm long, of which bearded fish had 11 fish (48%) that were larger than their Lm, and 12 fish (52%) below their Lm. If the two fish are added up, the reef fish that are suitable for catching are 11

fish (39%) and fish below their Lm are 17 fish (61%). The fishing gear used by the fishermen is in accordance with applicable regulations. However, further provisions are needed regarding fishing gear and fishing aids so that there are no modifications that ignore the regulations. This uncontrolled modification can make fishing gear less effective and has the potential to endanger the sustainability of fish resources (Sulistiyowati et al., 2018). Based on the NWG EAFM module, the indicator of modification of fishing gear and fishing aids received a score of 1, which means that more than 50% of the target species size is $< L_m$.

c) Fishing Capacity and Fishing Effort Indicators

Fishing capacity means calculating the maximum amount of fish catch that can be obtained in a certain period of time (year) by one ship or fleet if operated optimally, where the effort and catch are not hindered by various fisheries management actions that hinder it. The unit used for fishing capacity is tons/year (Wiyono, 2011). This assessment is carried out indirectly, namely by looking at the ratio value between fishing capacity in the base year (previous year) compared to fishing capacity in the last year. This indicator uses secondary data, namely total annual production in the period (2020-2023). From these data, the average fishing capacity ratio for the 4 years was 0.95. Referring to the NWG EAFM module, the fishing capacity obtained a score of 1, namely the fishing capacity ratio < 1 . According to Makailipessy and Abrahamsz (2023), a ratio (R) of less than 1 indicates that fishing capacity has not reached an optimal level. Excessive increases in fisheries inputs, such as fishing gear, the number of vessels, and the frequency of fishing trips, can lead to fishing capacity exceeding the appropriate limits, a condition known as overcapacity. If this situation persists, it may increase the risk of overfishing, which could ultimately hinder the achievement of sustainable fisheries management (Pradnya et al., 2020).

d) Selectivity of Capture

Fishing selectivity is a fishing activity that is associated with the area, time and diversity of the catch. The selection of this indicator is done because low fishing selectivity will have a direct impact on the sustainability of fish resources. Fishing selectivity is identical to the nature of environmental friendliness, meaning that fishing gear has good or high fishing selectivity, meaning that the fishing gear is environmentally friendly fishing gear (NWG EAFM, 2014).

The level of fishing selectivity can be determined using the classification data of the level of fishing selectivity. Based on the results obtained, the fishing gear for reef fish in PPI Ie Meulee is included in the category of high fishing selectivity, with the fishing gear used being a fishing rod. Marasabessy et al. (2021) stated that handlines are fishing gear with high selectivity for fish size, environmentally friendly, low-cost to produce, and capable of delivering high-quality catches. These advantages are supported by Rahayu (2016), who explained that handlines allow for the regulation of the minimum target fish size by selecting the appropriate hook size. Therefore, this indicator gets a score of 3 according to the NWG EAFM module.

e) Compliance of Function and Size of Fishing Vessels with Legal Documents

The assessment of this indicator is carried out on vessels that have legal documents. Based on the results of observations and interviews with reef fish fishermen at PPI Ie Meulee, Sabang City, all vessel sizes are the same as the data listed in PSDKP. This indicates that there are no errors or misuse of legal documents and their functions. Therefore, the indicator of the suitability of the function and size of fishing vessels with legal documents gets a score of 3, the sample does not comply with legal documents.

f) Certification of Fishing Vessel Crew in Accordance with Regulations

This indicator is assessed by assessing ownership of Fishing Vessel Technical Expert (ATKAPIN) and Fishing Vessel Nautical Expert (ANKAPIN) certificates (Bete et al., 2022). Based on the results of interviews with reef fish fishermen, most of the crew members operating fishing vessels in PPI Ie Meulee do not have a Fishing Vessel Nautical Expert (ANKAPIN) or Fishing Vessel Nautical Expert (ATKAPIN) certificate except for the ship's captain. Many fishermen working on the ship do not have or are not even familiar with the certificate, so there were no certified crew members (0%). Based on the EAFM NWG module, this indicator gets a score of 1 because the certificate ownership rate is less than 50%.

2. Assessment of Coral Fisheries Management at PPI Ie Meulee

The fishing technique domain obtained a composite value of 70 with a good description in the application of EAFM and the light green flag model. This composite value technically shows that the management of reef fish in PPI Ie Meulee is good

and in accordance with the EAFM criteria. Most indicators get a score of 3. The indicator for modification of fishing gear and fishing aids, fishing capacity and effort and the indicator for certification of fishing vessel crews in accordance with regulations get a score of 1. Therefore, improvements need to be made to indicators that are not yet optimal, with a focus on supervision and control related to licensing of fishing fleets, fishing gear, and improving the quality of fishermen through certification training at PPI Ie Meulee, Sabang City.

Conclusion

Coral fish in Sabang City have high economic value which are caught using handline using 1-2 GT vessels. The results of the study can be concluded that the condition of coral fish management in PPI Ie Meulee based on the ecosystem approach in the domain of fishing techniques obtained a composite value of 70 with a good description. In the flag modeling model of the EAFM composite index, it is light green, which means that the condition of coral fish management in PPI Ie Meulee is technically adequate in implementing EAFM. This is because there are several indicators whose scores are not perfect and even get a score of 1.

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