

*Original Research*

# Assessing the Ecosystem Approach to Fisheries Management in Indonesian Inland Fisheries

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## Abstract

Inland waters provide huge fish resources and are exploited as food security by local people. The method used in this study was intended to evaluate the performance of the management in terms of the Ecosystem Approach to Fisheries Management (EAFM). The study was conducted in five districts in Indonesia, namely Cilacap, Sukabumi, Kampar, Kapuas, and South Barito, from February to August 2019. The primary data were gathered through observation and interviews with fishers, local government, indigenous community, NGO, and other stakeholders. The secondary data were collected from previous studies. The EAFM domains are presented in a questionnaire that refers to the technical guidelines for assessing fisheries management indicators with an ecosystem approach. The indicators are grouped into seven domains in rating the current management of inland fisheries. The Likert score is used to measure respondents' attitudes to a particular question or statement. The score criteria used in examining fishery management by EAFM tools-based ordinal 1,2,3, designed to measure opinion or perception from the questionnaires. The results showed that the economy and stakeholder domain were poor categories, indicated by a red flag. Nevertheless, the management conditions, especially for the managed fish resources domain, were classified as good.

**Keywords:** inland fisheries, EAFM, management, assessment

## Introduction

Fishery products of inland waters generally represent the livelihood of poor people [1]. Usually, the fishing communities who exploits this aquatic resources live in villages situated in remote areas, consequently, an important contribution fisheries in maintaining food security of the local people is often overlooked [2] or less appreciated.

In terms of sustainability, the policy framework needs to minimize the impact on fish resources and the environment. An ecosystem approach was first introduced in the early 1980s, which gained formal acceptance in 1992. This became an underpinning concept of the Convention on Biological Diversity (CBD) that was later described as a strategy for the integrated management of lands, waters, and living resources, promotes conservation and sustainable use in an equitable way [3]. Further, [3] explained that the ecological approach is a strategy to promote sustainable development. The application of the ecosystem approach helps reach a balance of the three objectives of the CBD i.e. conservation; sustainable use; fair and equitable sharing of the benefits arising out of the utilization of genetic resources.

Effective fisheries management has always been a challenge in the complex multi-species, multi-gear fisheries without fish landing places. Traditional approaches in inland fisheries have largely been ineffective because management measures often do not take important aspects of the fisheries into account [4]. For preventing a decline in fish resources and the environment, the need for more effective and equitable management is increasingly evident.

The Ecosystem Approach to Fisheries Management (EAFM) is an integrated approach that strives to balance a diversity of objectives, both the human and ecological dimensions of sustainability [5]. The EAFM application in inland fisheries of Indonesia have been studied such as a review on indicators and reference values in Indonesia [6] and sustainability of endemic fishes in Lake Laut Tawar Aceh [7]. Indonesia possesses the vastest inland waters in Southeast Asia, with a total area of 13.85 million ha composing of 12.0 million ha rivers and flood plains, 1.8 million ha natural lakes, and 0.05 million ha man-made lakes/reservoirs [8]. The fish in inland waters is available throughout the year, but the fish biomass caught varies from one season to another. The life span of each fish is variable and is determined by the characteristics of the ecosystem and habitats. The exploitation of fishery resources is also practiced in various ways based on the types of ecosystems. As a country with huge inland waters, the appropriate management system of fish harvesting must be applied.

The Ecosystem Approach to Fisheries Management (EAFM) considers the surrounding conditions of the marine and fishery sectors. This paper describes the application of EAFM to evaluate the performance of inland fishery in Indonesia based on reference

indicators. The result of this study could be used to recommend the EAFM for the improvement of fisheries of prioritized species in a certain area.

## Material and Methods

### Study Sites and Data Collection

The research was conducted in five districts in Indonesia, namely Cilacap, Sukabumi, Kampar, Kapuas, and South Barito (Fig. 1) from February to August 2019. The primary data was gathered through observation and interview with fishers, local government, indigenous community, NGOs, and other relevant stakeholders. Meanwhile the secondary data was collected from reports and studies obtained from various agencies in marine affairs and fisheries, environment and forestry, public works and housing, provincial and regency agencies for the development board, and river management authority. The results were consulted through focus group discussion with inland fisheries stakeholders in each area.

### EAFM's Indicator Testing

The EAFM domains are presented in a questionnaire that refers to the technical guidelines for assessing fisheries management indicators in inland waters with an ecosystem approach issued by the Directorate of Fish Resources Management [9]. The indicators are grouped into seven domains in rating the current management of inland fisheries (Table 1). In addition, the Likert score is used to measure respondents' attitudes to a particular question or statement. In this study, the score criteria used in examining fishery management by EAFM tools-based ordinal 1,2,3, were designed to measure opinion or perception from the questionnaires.

The ranking of each indicator was indicated using simple rules, whereby a highest impact on the indicators is specified as the first ranking and so on.

Indicators are assessed and then analyzed using a simple composite based on arithmetic average. This model was set up into three quartiles ranged from minimum, modus, and maximum values of each domain then displayed in the flag modeling [9, 10]. For simplicity, the results are shown as flag models into red (poor), yellow (fair), and green (good) as shown in Table 2.

To determine the range of fishery management status in the inland aquatic ecosystem, [9] provided the stages of assessing the composite index as follows:

1. Determining the ranking value ( $n_{rij}$ ) for each x-th indicator and z-domain, which describes the effect of each indicator on the existence/sustainability of the domain, where the highest rank has the most influence, and vice versa;
2. Ensuring the criterion value ( $n_{kij}$ ) of each indicator in each domain;

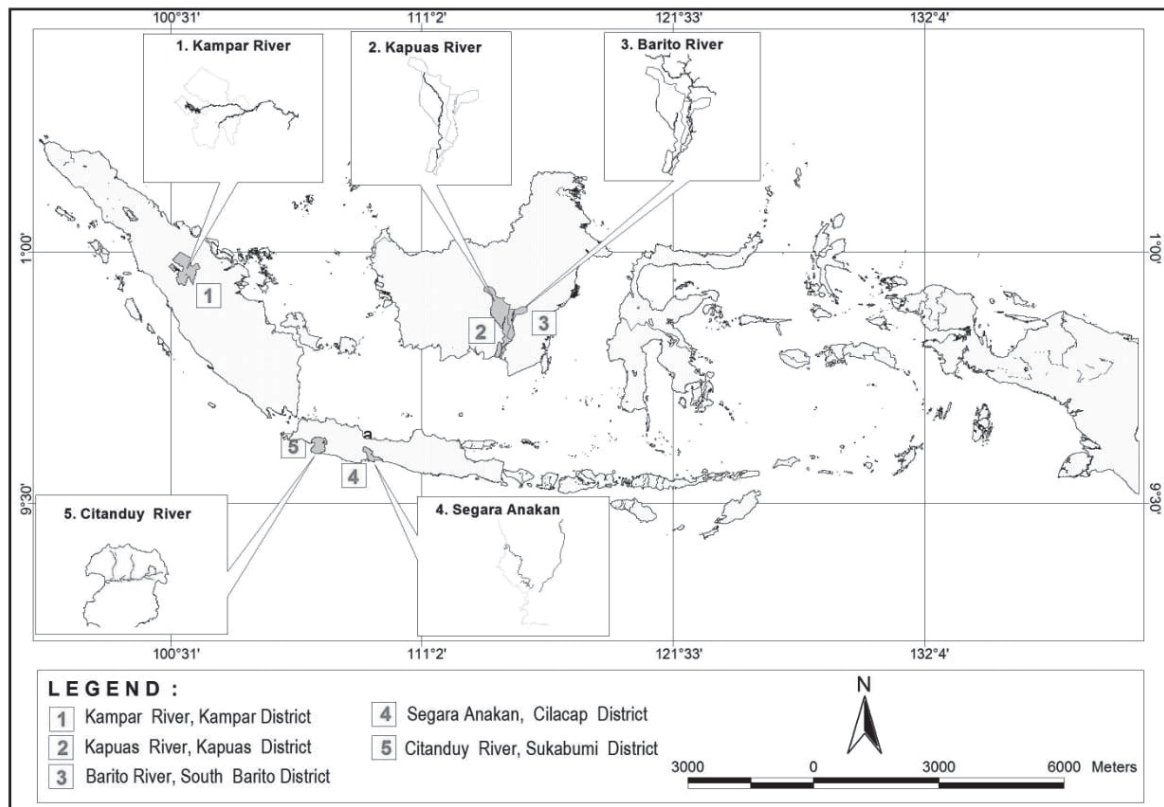


Fig. 1. Study sites.

3. Determining the weight of the ranking ( $b_{rij}$ ) for each  $x$ -th indicator and  $z$ -domain, namely by dividing the total weighted value (number 100) with the accumulative ranking of all indicators then multiplied by the rank value or scale of each indicator;
4. Calculating the composite of each  $x$ -th and  $z$ -domain ( $CI_{xz}$ ) indicator, namely by multiplying the criteria values with rankings and weights or  $CI_{xz-1} = n_{rij} \times b_{rij}$ ;
5. Calculating the composite index of the  $z$ -th domain ( $CD_z$ ), namely through the composite sum or aggregate of all indicators from a domain or  $CD_z = CI_{xz-1} + CI_{xz-2} + CI_{xz-3} + CI_{xz-4} + CI_{xz-5} + CI_{xz-6} + CI_{xz-7}$
6. Calculating the average composite index of the entire domain (Average), by averaging the number of composite indexes of all domains or  $C_{Average} = \text{AVERAGE}(CD_z-1 + CD_z-2 + CD_z-3 + CD_z-4 + CD_z-5 + CD_z-6 + CD_z-7)$

## Results and Discussion

All domains of the observation and interview's results, were aggregated as an expression of actual conditions of fisheries management (Table 3). The composite value was obtained by multiplying the score times the weight of the corresponding domain and

the weight of the indicator itself. The sum of indicator composite was added together as domain aggregate.

Based on a thorough evaluation of 34 EAFM's indicators (Table 3), the existing fisheries management status in Indonesia's inland fisheries is depicted as a flag model (Table 4). The flag represents in three colors: red, yellow, and green. The differences in colors show that the fishery management has not yet applied or has applied the principles of sustainable fisheries optimally or not. After getting the flag, it continues by establishing a strategic plan to improve the condition of the existing domains and indicators.

### Assessment of Inland Fisheries

Indonesia is a large country occupied by a great area of inland waters, usually as open-access waters, such as rivers, swamps, lakes, and reservoirs [11]. Fisheries in inland waters for many communities are a key component of both diets as food security, livelihood, cultural and religious identity, recreation, and serve as a source of income for millions of people globally [12, 13, 14]. Capture fisheries provide a valuable contribution to food security in any part of developing countries, including Indonesia. However, the community's understanding of the sustainable management of fish resources is still very low; thus, they exploited the resources without paying attention to its sustainability [15].

Table 1. Domain, indicator, relative important, and criteria for indicator using Likert's score.

Domain	Indicator	Number of ranking	Score criteria
Habitat quality	Water level fluctuation	1	Fluctuation: 1=absent, 2=less, 3=naturally
	Aquatic pollution	6	Compared to standard quality: 1=below, 2=equal, 3=better
	Lake bank formation	3	1=none, 2=1-14 m, 3=> 15 m
	Protected area	2	1=none, 2=present, not managed properly, 3=existed and well managed
	Habitat alteration (modification)	5	1=high, 2=low, 3=no modification
	Siltation and reduction of habitat area	7	1=high, 2=low, 3=no siltation
	Spawning area	4	1 = heavily damaged habitat, 2 = moderately damaged habitat, 3 = still good habitat
Fishing technology	Destructive fishing gears	5	If the destructive fishing gears set 1=>5unit, 2=1-5unit, 3=None
	Environmental unfriendly fishing gears	1	If the fishing methods, 1=frequent, 2=rare, 3=none
	Fishing selectivity	3	CPUE: 1=declined, 2=stable, 3=inclined
	Fishing productivity	2	If the number of productive fishing gear: 1 > 50%; 2 = 10-50%; 3 = <10
	Modified fishing gears	4	1=present, negative impact, 2=absent, 3=present, positive impact
Social	Stakeholder participation	5	1=< 50%, 2=50-75%, 3=>75%
	Fishery conflict (per year)	4	1=>5 times, 2=2-5 times, 3=
	Adoption of local knowledge	3	1=none, 2=present, ineffective, 3=present, effective
	Figure representation	2	If the figure: 1=no figure; 2= have the figure but not dominant; 3=the figure is a dominant person
	Education level (dominant composition)	1	1=uneducated, 2=elementary and junior high school), 3=senior high school
Economy	Asset ownership	1	1=decreased, 2=stable, 3=increased
	Income (minimum regional wedge)	3	1=MRW, 2=equal MRW, 3=>MRW
	Consumption level	2	1=high, 2=fair, 3=low consumptive
	Economic dependence (from fishery resources)	4	1=independent, 2=fairly dependent, 3=highly dependent
Managed fish resources	Trend in catch production	5	1= ->25%, 2= -<25%, 3=stable/increased
	Changed in catch size	2	1=smaller, 2=stable, 3=larger
	Juvenile proportion	1	If the caught juvenile: 1= more than 50%; 2= 25%-50%; 3= less than 25%
	Catch composition	3	1=imbalance, 2=shifted, 3=unchanged
	Introduced species	4	1=dominant, 2=shifted, 3=unchanged
Governance	Compliance on sustainability (violation)	5	1=>5 times violation/year, 2=2-4 times violation/year, 3=<2 times violation/year
	Laws and regulations	4	1=none, 2=present, ineffective, 3=present, effective
	Local knowledge	3	1=not existed, 2=existed, ineffective, 3=existed, effective
	Decision making mechanism	2	1=none, 2=present, ineffective, 3=present, effective
	Fishery management plan	1	1=none, 2=present, ineffective, 3=present, effective
Stakeholders	Synergy in policy (among institutions)	3	1=institutional conflict, 2=ineffective comm., 3=effective communication
	Stakeholder capacity	1	1=no improvement, 2=slightly improved, 3=improved and functioned
	Sustainability policy support	2	1=absent, 2=present, unimplemented, 3=present, fully implemented

Table 2. Flag Status of EAFM.

Category	Flag status	Remarks
Bad		Fishery management in the local ecosystem <b>has not yet applied the principles of sustainable fisheries</b> , so it is necessary to establish a strategic plan to improve or improve the condition of the existing domains and indicators.
Moderate		Fishery management in the local ecosystem <b>has applied the principles of sustainable fisheries</b> . Still, it is not optimal, so it is necessary to set a strategic plan to optimize or improve the existing domains and indicators.
Good		Fisheries management in the local ecosystem <b>has applied the principles of sustainable fisheries optimally</b> , so it is necessary to set a strategic plan to maintain or improve the existing domains and indicators.

Table 3. Criteria conditions for each domain and complete figure of inland fishery management for Indonesia following the EAFM indicator testing.

No	Domain	Range of Composite Index		
		Poor	Fair	Good
1.	Habitat quality	498-830	831-1163	1164-1494
2.	Fishing technology	366-610	611-855	856-1098
3.	Social	366-610	611-855	856-1098
4.	Economy	300-500	501-700	701-900
5.	Fishery resource being managed	366-610	611-855	856-1098
6.	Governance	366-610	611-855	856-1098
7.	Stakeholders	233-389	390-546	547-700

Developing an inland fisheries management evaluation model means an ecosystem-based approach is a model of practice to comprehensively observe and effectively measure the management implementation by different authorities. Using this model, the existence management performance could be analyzed and produced the appropriate recommendation to improve fisheries management [16].

Following the criteria conditions for each domain and complete figure of inland fishery management for Indonesia, indicators adapted to EAFM are as follows:

#### Habitat

Five locations were assessed in the current work. Firstly, Cilacap District has a large fishery production of inland waters fisheries that comes from 24 sub-districts with a potential area of waters covering 1,593 hectares. The second one, Sukabumi District also has a large fishery commodity, where is popular with glass eel fishery.

The last three locations including Kampar, Kapuas, and South Barito, have the potential and large fisheries production from river and swamp areas. The vast flooded swampy area in these locations, varying number of fishing gear, and high fishing activities are some of the potential sources and supports of the economy.

The assessment for habitat quality showed that all locations were in the yellow zone (Table 4). It was indicated that, in general, the inland waters have good quality habitats to be managed properly due to observance of the principles of ecological sustainability.

Many factors in inland waters influenced the inland fishery activities as a productive fishing ground. Inland water areas are dependent on permanent, seasonal, or intermittent occurrence of flooded conditions [17], where inland capture fisheries and related activities could harvest high volumes of fish. Fishing activities in these areas usually start during the rainy season when fish migrate from the main river either for feeding or spawning and finish during the middle of the dry season when the fish are going back to the main river. Besides the water level condition, the water quality factors influence the number and biomass of fish for spawning success, growth, and great fluctuation. This condition is mentioned by [18] that water quality influences fish production.

#### Fishing Technology

In Sukabumi, traditional fishing gear is used for catching fish, especially glass eels. This include triangle scoop net and fyke net which is selective and environmentally friendly. Only a few small fish, such as anchovy, were caught as bycatch.

Table 4. Inland fishery management status in Indonesia evaluated by indicators adapted to EAFM.

No.	Domain	Composite domain				
		Kampar	South Barito	Kapuas	Cilacap	Sukabumi
1	Habitat quality	957	957	986	1150	861
2	Fishing technology	900	900	627	800	900
3	Social	973	973	1067	627	1007
4	Economy	440	440	440	470	850
5	Managed Fish Resources	1040	1040	880	1060	873
6	Governance	700	700	820	673	927
7	Stakeholders	333	333	333	533	700

Green zone also showed in Kampar and South Barito, the fishers used environmentally fishing gears which is selective and environmentally friendly. The use of fishing gear in South Barito has been developed according to the topography of the region, season, and target species [19]. In South Barito, although this area has the permitted and prohibited fishing gears such as Selambau (filtering device), some fishers still use the traditional gear.

In Kapuas, traditionally the fishers use the beje (trap) and nets to capture the fish. However, immigrant or temporary fishers use prohibited fishing gear such as stun or poison.

The results show that fishers the five locations practice good and moderate fishery management for sustainability. The sequence of fishing gears is operated according to water level fluctuation. The fishers select fishing gear according to the dynamic water level or water flow which influence the fish movement. During the initial flooding, the fish tend to migrate laterally from the river to the plain, and at the end of the rainy season, they move from flood plain to river [20]. Fishers traditionally use selective gears and target particular species and specific components of populations during some seasons in selected areas.

Fishing technology used in general still consider the selectivity and productivity of environmentally friendly fishing gear. This needs to be maintained for the sustainability of the resources in the waters. Fish populations exploited with passive gears will have consequences for the sustainability of the fishery activity [21]. [22] reported that for sustainable fish utilization, the selective fishing gears with larger mesh size is more selective to the fish size rather than species. So, to maintain the fish biodiversity and its population, regulation is required to manage the mesh size [23]. Simplicity in design, construction, operation, and investment costs make this fishing gear preferred by small-scale fishers. As a passive tool, a gillnet catch under certain conditions can be used to estimate the changes in fish quantity [24].

### Social

In term of social domain, the result showed that the observation area was in good fishery management for sustainability; only Cilacap was in moderate in the social aspect. Community participation in inland waters (the fishers) are very good in managing fish resources and certainly very good in minimizing conflicts.

Answering whether education is necessary or not, the people of Cilacap assume becoming a fisher does not require high education. Likewise, in Kampar District, the fishers, on average, have low education; they only have to take elementary and junior high school education. Thus, the fishers need education about the importance of sustainability of fisheries resources in order to remain sustainable. The fishers in Kapuas District dropped out at the senior high school level. While the fishers in South Barito are dominated by elementary and junior high school graduates. Despite that, most of the fishers can read well. Thus, it is not difficult to give understanding not to do the excessive exploitation activities in depleting the existing resources.

The destruction of fish resources is not only by exploitation but also by constructing shelter, electricity or energy, recreation destination, as well as dams. The development interest is more real-valued than the fisheries sector, so the well-being of the fishery resources tends to be overlooked [25]. Population growth impacts the environment, primarily through natural resources exploitation, water pollution, and pressure on agricultural land [26]. Furthermore, fishing communities often face unique social and economic stability challenges as they rely on a natural resource for income and employment; fishers are often characterized as economically impoverished and politically marginalized [27].

### Economy

In terms of economy, the result showed that Sukabumi was in good condition, while the rests were

in the bad category. This survey was conducted in 2018, and the data for the number of active fishery households in Cilacap was 4,072. However, fishing is only a side job for most people in Cilacap. Many of them also work as farmers, especially in time when it is difficult to catch the fish. This condition has an impact on the fisher's income which is only enough for their daily needs, and for some may be insufficient. The lack of role of social groups of fishers in Cilacap elevated many problems faced by the fishers, such as fishing boat theft, the use of poisons and stun to capture fish.

The people in Sukabumi take advantage of the glass eel fishery as a side job. There are about 100-200 fishers, but in the highest season of catching, October-April, the number of fishers can reach 300-400.

In Kampar, fishers were trained to develop fishery products, so the community's selling value of fishery products can increase. The community is equipped with making dried fish, salted fish, smoked fish, and other fishery products. A good product value can be used as an alternative income when the fish catches decrease. However, the awareness of the financial management of the fisher community is still lacking. The fish are used entirely for consumption on the same day, making the economy of the fishing community vulnerable. Other activities still maintain the viability of life as the main work, such as gardening and cutting wood. The training about saving systems for fishers is needed to increase community interest and manage their finances better.

In Kapuas, becoming a fisher is the main occupation. This has an impact on the income earned by fishers. Their income is only enough for their daily needs, and some may even be insufficient. In South Barito, fishers' average income is less than the minimum wage, and they have no savings because the income they got only runs out for consumption. Most fishers only rely on one job as a fisher, but some have side businesses such as trading or caretaker of goose cage.

The economic dependence of fishers on the catch has a huge effect in four locations. The huge negative effect is indicated by red color. It showed that the income of the fishers is highly dependent on the catch. Thus, introduction to fishery business is needed to improve the income of the fishers to a medium scale. It is important to establish a strategic plan to improve the condition of the existing domains and indicators.

Production of processed fishery products will enhance the fish product value, such as the anguillid eels [28]. However, the fishers have difficulty to market their product because of inadequate transportation and preservation procedure. Improving the product value and marketing technique can improve their socio-economic condition, and it could increase fishers' life up from the poverty line.

The survey by [29] showed that fish resources utilization in the Barito River could be categorized as small-scale fisheries. The average fisher's family

income of USD 4.27/day seems below the Indonesian welfare standard. Nevertheless, inland fishing in the Barito River contributed meaningfully to people's livelihoods.

### Managed Fish Resources

The inland fishery activities in five locations showed that the species were managed well for the sustainable fish resources. The catch composition or fish size will change when the fish population adjusts to new conditions that occur in the aquatic environment. Changes in species composition, fish abundance, and individual size of the target fish caught will encourage fishing methods and timing to be changed because the old methods are no longer suitable. These changes have an impact on small-scale fisheries within a region. The extinction of fish species or the reduction of fish biodiversity is caused by climate change and impacted by fishing activities. Distinguishing the effect of fishing with the effect of climate is not easy because, in the field, they go by simultaneously.

In South Barito, fisheries violations usually occur 2-4 times per year. The offense includes the use of poisons or electrical shock by fishers from other areas. In Cilacap, the community awareness to not throw garbage into the river is still very lack. The rubbish thrown into the river will be carried by the stream and washed away to the estuary, even to the sea. As a result, the catchment area for fishers is becoming narrower.

### Governance

Regulation needs to be established and implemented by local government at four locations so that inland water fishery management by considering the ecosystem can be realized. This regulation can be adjusted to the local wisdom in the area.

The results of the study show that only Sukabumi is in the green category. The local wisdom in Kapuas and South Barito is still followed by the fishers. For example, during the dry season, some small pools within the rice field areas are still inhabited by several species of fish that can be used as brood stock to supply young fish for the next wet season. Thus, the people living around the water body understand conservation and are planning for sustainable fisheries.

In Cilacap, the problem of waste needs to find a solution. This problem has only become an internal discussion among the fisher groups. This problem repeats itself every year without any real solution. In this case, an active role of community leaders is required to move the community.

In Kampar, community-based management assistance needs to be carried out by providing knowledge about management potential and utilization of fish resources that can improve the community's economic level. Besides that, fishing zoning regulation needs to be informed and socialized to fishers thus,

fishing activity will not interfere with the small fish. The fish nursery area could remain a conservation area that can support fish stocks in the Reservoir and the Kampar River.

There is a need for training in the utilization of water resources. Besides that, it needs to establish the fisheries groups that will be useful to communicate conflicts that occurred in fishers' communities. The participation of leaders also does not significantly play a role in fisheries management. Management is more oriented towards fisher's groups and community agreement on one water body, usually called *lubuk larangan*. *Lubuk larangan* is considered a form of local wisdom to ensure the utilization and protection of fish resources (especially fish resources in inland waters) [30]. Kampar District does not yet have specific local wisdom in utilizing the reservoir area. There is only an agreement among the fishers that a clown featherback (*Chitala lopis*) size of less than 2 kg must be released. It is needed to legitimate the unwritten regulation at the district level to become a joint agreement to maintain fish resources.

### Stakeholders

Stakeholders synergy is an important point in three locations, namely Kampar, South Barito, and Kapuas. Because the inland waters are an ecosystem whose utilization is multi-sectoral, the synergy among policies in these sectors are needed to support sustainable fisheries management. In South Barito, the participation of community figures is needed to encourage the formation of fisher groups and create fishery reserves planning. Fisheries conflicts in Kampar District are not significant, but there is infrequent theft potential by other fishers in the area.

Building partnerships between Government and fishers/Fishers' Groups as the stakeholders are needed to address the concerns on the sustainable utilization of the inland water resources [25]. The fishery management should involve the government and the community. The government role in management is more emphasized on coaching/counseling, while the role of the community in management is more emphasized on supervision in the field. The concept of natural resource management could accommodate many interested parties is an integrated concept or cooperative management [31].

The strengthened sub-regional cooperation with the development of joint or coordinated fisheries management plans should be promoted, including research and studies on the social, ecological, and economic importance of fisheries, and aquatic resources utilization [32]. The study reflects that very strong national and regional dependence on fish and fishery products for domestic food security, employment opportunities for millions of people, and support of the very profitable fish export industries.

### Future Inland Fisheries Management Strategic

Adopting an EAFM, the establishment of appropriate fisheries management mechanisms could be achieved by ensuring the sustainability of inland fishery resources and long-term food security. The ecological and human well-being aspects of fisheries in inland waters could also be improved. However, for an EAFM to be effective, inland fisheries management strategies must be considered. Transitioning toward an EAFM often involves fluctuating fisheries management, and there are various factors in which an EAFM can be applied depending on the goal and objectives of management, including governance, ecosystem, fishery, and human use.

Education for fishers is needed to increase their income. Some training can be carried out for fishers, such as financial management, knowledge on processed fish product such as salted fish, smoked fish, marketing the product. In addition, the training needs to include material on selective fishing gear and the importance of maintaining sustainable fisheries.

The main problems in Central Kalimantan Province (South Barito District and Kapuas District) are the unavailability of fishing season regulations and the type of fishing gear. They also did not have a Fisheries Management Plan as a planning document containing all the efforts to achieve sustainable productivity of aquatic resources and agreed goals. Meanwhile, in Riau Province (Kampar District) is starting a scarcity of fish with species such as Clown Featherback, Wallago, and Asian Arowana because there were no regulations or rules regarding fishing gear and size of fish that could be caught. Other problems are also not precisely the target of government assistance given to fishers, so it has not been used properly. The problems in West Java Province (Sukabumi District) and Central Java Province (Cilacap District) were about siltation due to the large amount of garbage in the waters around the river. Besides that, the waste heat discharged from the power plant indicated itching when local people use water around the waste disposal. Another problem is the coal spill around the estuary due to barges sailing to the water's edge.

### Conclusions

Inland waters in Indonesia are blessed with various types of rare fish and huge native fish. Unfortunately, unfriendly fishing gear causes fishermen's catches to decrease, and changes in the size of fish caught. It is necessary to establish sustainable management efforts and steps.

The concept of EAFM in inland fisheries has been considered a useful tool to provide a holistic framework in the fisheries management planning process. The results of the EAFM should be well communicated



among the relevant stakeholders to raise their awareness and for them to support and develop the activities.

There is no synergy between related stakeholders. Watershed management and the environment are the things that must be a common concern of all relevant stakeholders, the District and Provincial Levels. Good governance in its management is needed because, in essence, the natural resources damage that occurs due to bad government, the increasing potential for sectoral ego, and regional ego due to the use of natural resources in the watershed. Improved regulation is needed to sustain human life and life in general.

From the results of the EAFM analysis, the economy and stakeholder domains showed poor performances, indicated by a red flag. Nevertheless, in overall current fisheries management in Kampar, Kapuas, South Barito, Sukabumi, and Cilacap, especially for fishery resource being managed domain, were classified into a good category with values varying from 873 to 1060.

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### Conflict of Interest

Y.C.D., D.M., & N.N.W. drafted the manuscript; All authors contributed to the modification; All authors have read and approved the final manuscript. The authors declare no conflict of interest.

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