



Analysis of Environmental-Friendly Aspects of Floating Nets (Bagan) in Batu Putih Atas Village, Bitung City Based on Responsible Fisheries Principles

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Abstract

To conserve fish resources, especially pelagic species, it is necessary to use environmentally friendly fishing gear according to the principles of responsible fisheries management. Bagan is a fishing gear that catches small pelagic fish as the primary target fish and is commonly found in Batu Putih Atas Village, Bitung City. This study analyzes the environmentally friendly aspects of Bagan, operated by local fishermen, based on CCRF principles. The research was conducted using a survey method using a questionnaire containing nine criteria with a weighted score of 1-4 for each criterion. Data analysis used descriptive quantitative. The results show that the type of Bagan used is floating Bagan, considered very environmentally friendly, with a weighted score of 30.2. This gear has a reasonably low selectivity but does not damage the habitat, is safe for fishers and consumers, and has minimal impact on biodiversity, low bycatch, and no protected fish. It is also socially acceptable and profitable for fishers.

Keywords: bagan, CCRF, environmental, responsible fisheries

1. INTRODUCTION

Batu Putih has an area of 1964 ha and is geographically located at 1°34'00"–1°35'42" LU dan 125°09'20"–125°09'39.40" BT. It is the northernmost sub-district of Bitung City and is located in the Ranowulu sub-district. Two villages in the sub-district are Batu Putih Bawah and Batu Putih Atas [1]. Batu Putih waters are rich in small pelagic fish resources that have the potential to be managed by local fishermen because the Batu Putih waters are protected from the entry of waves in the area [2]. Fishing gear that is commonly found in the Batu Putih area is Bagan. The construction of the bagan is made of a series of bamboo in the center of the net [3]. It is passive and uses light aids [4]. Bagan is a fishing gear that catches small pelagic fish, which are the main fishing target. To conserve fish resources, especially pelagic, it is necessary to use environmentally friendly fishing gear that refers to the international guidelines of the Code of Conduct for Responsible Fisheries (CCRF) [5]. Some of the criteria that have been set by the Food and Agriculture Organization (FAO) include fishing gear that has high selectivity, does not damage fish habitat, produces quality fish, does not harm fishers, production does not harm consumers, low by-catch, minimal biodiversity impact, does not harm protected fish and is socially acceptable [6]. The CCRF provides direction and principles to ensure that fisheries activities are conducted in a way that does not harm the ecosystem, preserves fisheries resources, and provides sustainable economic and social benefits for fishing communities. Therefore, this research aims to analyze the environmental friendliness of the Bagan operated by Batu Putih Atas Village fishermen based on the principles of CCRF to realize sustainable fisheries activities.

2. METHODS

The implementation of the activity was carried out in Batu Putih Atas Village, Bitung City in November 2024 with the research subjects being active bagan fishermen. Determination of the number of samples using the Slovin formula [7]:

$$n = \frac{N}{1 + N e^2}$$

Description:

n = number of samples

N = total population

e = margin of error (0.2)

then the number of samples in this study are

$$n = \frac{20}{1 + 20 (0,2)^2}$$

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$$n = \frac{20}{1,8} = 11,1111.$$

This study used a survey method, with a questionnaire as the main instrument to collect data [8]. The questionnaire contains nine criteria for weighting environmentally friendly fishing gear, which refer to the Code of Conduct for Responsible Fisheries (CCRF) document [9]. Each criterion is given a score of 1-4. The criteria are presented in Table 1.

Table 1. Weighting Criteria for Eco-Friendly Fishing Gear

No.	Criteria	Sub Criteria	Score
1.	Has high selectivity	Tools catching more than three species of fish with vastly different sizes	1
		The device captures three species of vastly different sizes	2
		Tools catching less than three species of approximately the same size	3
		Tools that catch only one species of fish of approximately the same size	4
2.	Does not destroy fish habitat	Causes habitat destruction over large areas	1
		Causes habitat destruction in a small area	2
		Causes partial habitat destruction in a narrow area	3
		Safe for habitat (does not damage habitat)	4
3.	Produce quality fish	Dead and rotten fish	1
		Dead, fresh and physically deformed fish	2
		Fresh dead fish	3
4.	No harm to fishermen	Live fish	4
		Resulting in the death of fishermen	1
		Resulting in permanent disability of the fishermen	2
		Causes temporary health problems	3
5.	Production does not harm consumers	Safe for fishermen	4
		Has a chance of causing death to consumers	1
		Has a chance of causing health problems to consumers	2
		Has very little chance for consumer health	3
6.	<i>By catch</i> is low	Safe for consumers	4
		<i>By-catch</i> consists of several species that are not marketable.	1
		<i>By-catch</i> consists of several types and some are sold in the market.	2
		<i>By-catch</i> is less than three species and sells well in the market.	3
7.	Impact of minimal biodiversity	<i>By-catch</i> less than three species and high price in the market	4
		Causes the death of all living things and destroys habitats during operation	1
		Causing the death of some species and destroying habitats	2



		Causes mortality of some species but does not destroy habitat	3
		Safe for biodiversity	4
		Fish protected by law are often caught	1
8.	No harm to protected fish	Fish protected by law were caught several times	2
		Fish that are protected by law have been caught	3
		Protected fish are never caught	4
		Low investment cost	1
9.	Socially acceptable	Economically beneficial	2
		Does not conflict with local culture	3
		Does not conflict with existing regulations	4

After the scores are obtained, the ranking can be seen in the value range below, among others:

- 1-9 : Extremely environmentally unfriendly
- 10-18 : Not environmentally friendly
- 19-27 : Environmentally friendly
- 28-36 : Very environmentally friendly

The percentage of the results of the weighting value obtained using the formula:

$$X = \frac{\sum Xn}{N}$$

Description

X : Fishing gear environmental friendliness score

X : total score

N : Total respondents

The proportion (%) of indicators assessment of 9 criteria of the total respondents was obtained using the formula:

$$\text{Proportion of Respondents' Scores} = \frac{\sum \text{criteria score } x}{\text{Total number of respondents}} \times 100\%$$

Data analysis uses quantitative descriptive study, which analyzes data by describing or describing the data that has been collected as it is supported by data in the form of numbers generated from actual circumstances [10].

3. RESULTS AND DISCUSSION

The type of bagan operated by Batu Putih Atas Village fishermen, Bitung City, is a floating bagan. The Bagan is made of bamboo and wood; on the left and right sides, there are corks so that the Bagan can float. On the Bagan, there are two types of lights, namely spotlights and LED lights. The lamp serves as a tool to attract the fish's attention. There is a house building that functions as a protector and puts the generator (electricity source). The Bagan also has a roller that lowers and pulls the net during the setting and hauling process. The setting-hauling process can occur 2-6 times (depending on the number of fish). One of the Bagan found in the waters of Batu Putih Atas is presented in Figure 1.



Figure 1. Bagan of Batu Putih Atas

Overall, the calculation of the environmental friendliness weight of fishing gear obtained a value of 30.2. This value is included in the environmentally friendly category using nine criteria for fishing gear environmental friendliness based on CCRF (FAO) 1995. The assessment of criterion 1 (high selectivity) is presented in Figure 2.

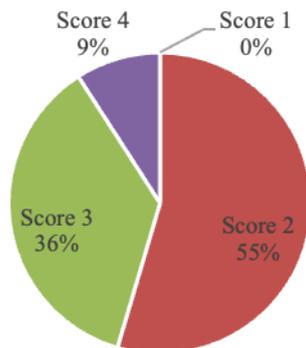


Figure 2 . Proportion of Respondents' Score on Criterion 1

Based on the figure above, most respondents chose sub-criterion 2: this fishing gear catches three species of fish with significantly different size variants. This shows that the level of selectivity of the Bagan is categorized as relatively low. Observations in the field showed that the main fish caught were anchovies (*Stolephorus* sp.), tembang fish (*Sardinella fimbriata*), and malalugis/layang fish (*Decapterus* sp.) as well as squid, which were by-catches. The large number of fish species caught is due to the tiny mesh size used. The size of the driftnet mesh operated by Bagan fishers in Kupang Bay Waters is 0.5 inches (tiny) [11] and even as small as 0.2 cm [12], so many types of fish are caught, causing the results of criterion 1 assessment to be classified as very non-selective. According to [13], fishing gear with high selectivity, namely fishing gear that only catches fish, is the main target of its capture. One of the efforts that can be made to increase the selectivity of fishing gear is to improve the mesh size. This improvement can be done by applying a mesh size of 1 cm [14].

The assessment of criterion 2 (does not destroy habitat), criterion 5 (production does not harm consumers) and criterion 7 (minimum biodiversity impact) obtained the same results, namely choosing sub-criterion 4 and presented in Figure 3.

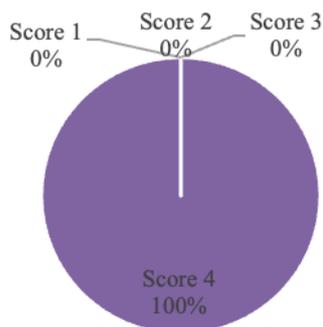


Figure 3. Proportion of Respondents' Score on Criterion 2, Criterion 5 and Criterion 7

This shows that bagan is a safe fishing gear for fish habitat. Bagan is a fishing gear that waits for fish to come to the center of the net with the help of light so that fish gather [4]. Passive fishing gear is one of the indicators that it does not damage the environment [15]. In addition, the operation of this fishing gear does not reach the bottom of the water. The operation of the Bagan is only at a net depth of 15 - 20 meters from the sea surface [16]. Thus, the biodiversity in these waters becomes prosperous and sustainable.

Assessment of criterion 3, the results obtained that the caught fish is dead and fresh. The proportion of respondents' score is presented in Figure 4.

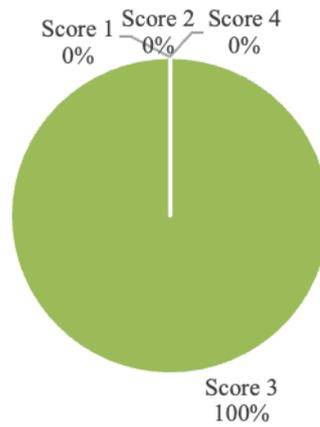


Figure 4 . Proportion of Respondents' Score on Criterion 3

Based on observations during the study, the fish caught were still alive after pulling the net. The fish are first collected in a collection net before being brought ashore. In the morning, the fish in the net is then transferred into a bucket and ready to be taken ashore to be sold to consumers. So that the catch can be said to be fresh. Fresh fish still have the same properties as live fish in appearance, odor, taste, and texture [17]. The fish's freshness will affect the fish's quality during handling and marketing [18]. The assessment on criterion 4 is presented in Figure 5.

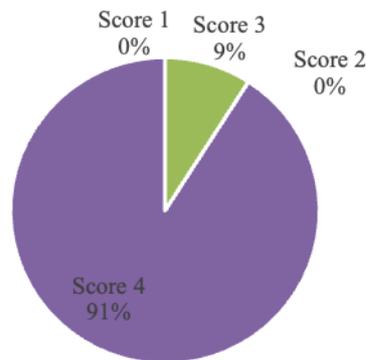


Figure 5 . Proportion of Respondents' Score on Criterion 4

Respondents mainly chose sub-criterion 4. Namely, this fishing gear is safe for fishermen. This is because the bagan is easy for fishermen to operate safely. Operating a floating bagan does not require or drain a lot of energy because its use is enough to lower the net. When lowered, floating bagan fishermen can rest in the available house buildings while waiting until it is time to raise the net, only staying up late when the fish are rising, so the risk of fatigue or illness is minimal [19]. The existence of respondents who still chose sub-criterion 3 indicates that this stage of fishing gear operation still has risks that can interfere with health. One of these risks is back pain and injured hands when using the roller in lowering and raising due to the large and heavy size of the roller, and the operation is carried out by only one person [20]. Operating a bag can sometimes cause wrist or leg injuries when lowering or pulling the net, but they are not permanent [21]. Based on observations during the study, began fishers did not bring safety equipment such as gloves. Using personal protective equipment (PPE) such as gloves can minimize the danger of injury [20]. The assessment of criterion 6 is presented in Figure 6.

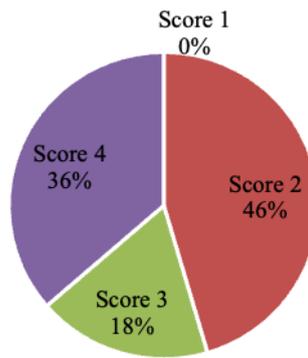


Figure 6. Proportion of Respondents' Score on Criterion 6

In criterion 6, most respondents said bycatch was low, and some were marketable, such as squid (*Loligo sp.*). Squid has phototaxis properties, which are close to light [22] and have high economic value [23]. This means that fishermen will get additional income in addition to the sale of fish from the main catch. The results of data processing show that in criterion 8, respondents chose sub-criterion 4, namely that protected fish are never caught (Figure 7).

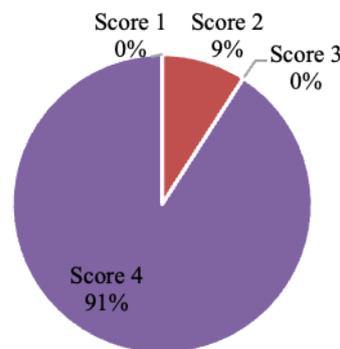


Figure 7. Proportion of Respondents' Score on Criterion 8

The legal basis is based on the Minister of Marine Affairs and Fisheries Regulation of the Republic of Indonesia Number 61/PERMEN-KP/2018. Protected fish species include sharks, stingrays, napoleon fish, kingfishers, dolphins, whales, dugongs, sea turtles, clams, and cucumbers [13]. anthozoans Based on the interview results, the capture of protected species is generally caused by accidental factors, which occur due to the attraction of fish to light. Respondents' assessment of criterion 9 can be seen in Figure 8.

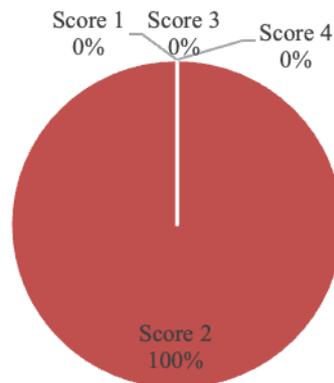


Figure 8 . Proportion of Respondents' Score on Criterion 9

The results show that respondents chose sub-criterion 2, namely that this fishing gear is profitable because it can meet the needs of daily life and when the fish season is very profitable. The needs in 1 fishing trip include 15 liters of fuel, one bottle of oil, and personal needs such as cigarettes and consumption. If

calculated, operational costs are approximately Rp.90,000 - Rp.100,000. The catch obtained is approximately one bucket (30 kg - 50 kg) with a selling price of Rp. 300,000 - Rp. 500,000 per bucket, depending on the type of fish. So local bagan fishermen say this fishing gear is profitable.

4. CONCLUSION

1. The floating chart operated by Batu Putih Atas Village fishermen is considered very environmentally friendly, with a weight value of 30.2.
2. Based on the results of the proportion of respondents' assessments, it is known that the selectivity of this fishing gear is relatively low. Nevertheless, this fishing gear does not damage the habitat; production is safe for consumers and has minimal impact on biodiversity. The caught fish is obtained dead, fresh, and safe for the fishermen. Bycatch is also low, with no protected fish caught. The gear is socially acceptable and profitable for the fishers. Further improvements are needed in the selectivity of fishing gear, so further research is needed on ideal mesh size optimization to support more sustainable fisheries management.

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