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Environmental Friendliness Level of Belat Fishing Gear in the Waters of Nipah Panjang II Tanjung Jabung Timur Regency

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ABSTRACT

Tanjung Jabung Timur Regency is a fairly extensive fishing ground, with fisheries production reaching 25,017.89 tons. Nipah Panjang II Sub-district is a coastal area where the majority of residents work as fishers. These fishers use various types of fishing gear, one of which is the belat. Belat is a passive fishing gear that relies on the tidal cycle. This study aimed to determine the level of environmental friendliness of the belat fishing gear operated in the waters of Nipah Panjang II, Tanjung Jabung Timur Regency. The research was conducted from February to March 2026 using an observational method, with samples selected through purposive sampling of 10 belat fisherman. The data collected concerned the environmental friendliness level of the belat fishing gear. Data were analyzed based on the nine criteria of the Code of Conduct for Responsible Fisheries (CCRF). The results showed that the belat fishing gear obtained an average score of 26.8, which falls into the environmentally friendly category. This fishing gear is considered reasonably consistent with the principles of sustainable fisheries, as it does not cause major habitat damage, safe for fisherman, produces catches that are safe for consumption, and is socially accepted by the fishing community. However, several aspects still require attention, particularly low selectivity, relatively high by-catch, and the possibility of catching protected fish species. Overall, the belat fishing gear can be categorized as environmentally friendly, although management improvements are still needed to better align it with the principles of sustainable fisheries.

INTRODUCTION

Tanjung Jabung Timur Regency has a fairly extensive fishing area, covering marine waters, swamps, and tidal zones, with a marine area of 77,752 hectares and fisheries production reaching 25,017.89 tons in 2018 (BPS of Jambi Province, 2020). One of the coastal areas in this regency is Nipah Panjang II Sub-district, where most residents work as fishers using various types of fishing gear, one of which is the belat. Belat is a passive fishing gear that relies on the influence of the tidal cycle, in which fish carried in during high tide become trapped as the water recedes because they are unable to escape (Siregar *et al*., 2015). This gear is relatively simple, requires no bait, and has low operational costs since it does not depend on fuel, unlike active fishing gear (Simanjuntak *et al*., 2025).

Although classified as a simple and low-cost fishing gear, the belat is capable of catching large quantities of fish and more than three species at once (Purnomo *et al*., 2023). According to the guidelines of the FAO's Code of Conduct for Responsible Fisheries (CCRF), environmentally friendly fishing gear must meet nine criteria, namely high selectivity, no habitat damage, high-quality catch, safety for fisherman, safety of the product for consumers, low by-catch, low impact on biodiversity, no harm to protected species, and social acceptability. Previous research findings indicate that the belat fishing gear scores lowest on the criteria of selectivity and by-catch. This is evident from the ability of the belat to catch more than three fish species of varying sizes. Research by Rosadi *et al*. (2022) in the waters of Tanjung Solok Sub-district, Tanjung Jabung Timur Regency, showed that belat catches included more than three species with a relatively high by-catch rate. In addition, although the resulting by-catch level is relatively high, this by-catch still holds economic value and can be sold at varying prices.

Based on these findings, it is necessary to apply the concept of sustainable capture fisheries management in according with the provisions of the Code of Conduct for Responsible Fisheries (CCRF) as a crucial effort to preserve and sustain fish resources in the future. Therefore, this study aimed to determine the level of environmental friendliness of the belat fishing gear operated in the waters of Nipah Panjang II, Tanjung Jabung Timur Regency.

METHODS

Location and Time

This research was conducted in the waters of Nipah Panjang II, Tanjung Jabung Timur Regency, from February until March 2026.

Tools and Materials

The materials and equipment used in this study included belat fishing gear with mesh sizes of 1 inch (2.54 cm) and 1¼ inch (3.175 cm), digital scale, stationery, a cutting mat, calipers, a smartphone and laptop, and questioners.

Research Procedure

Data on the environmental friendliness level of the belat fishing gear were collected through a combination of direct observation and interviews. Observation is a data collection technique involving the direct observation of the object to be studied (Sugiyono, 2020). Observations were made of the belat gear itself, including its length and mesh size. This was followed by recording the catches obtained, including the main catch, by-catch, and discards. Interviews were then conducted with gear owners to obtain additional information on construction, operating methods, and daily fishing practices. The gear was subsequently evaluated based on the nine criteria for environmentally friendly fishing gear according to the 1995 Code of Conduct for Responsible Fisheries (CCRF) guidelines.

Data Analysis

The environmental friendliness level of the belat fishing gear was analyzed using the nine criteria of the 1995 Code of Conduct for Responsible Fisheries (CCRF). Each criterion comprises four sub-criteria with scores ranging sequentially from 1 to 4, giving a maximum possible score of 36 points. The final weighted score was obtained by dividing the total weighted score by the total number of respondents, using the following formula (Sima *et al*., 2013):

$$X = \Sigma Xn / N$$

Where:
X = weighted score
ΣXn = total weighted score
N = total number of respondents

Based on the resulting score, the gear was classified into one of four categories of environmental friendliness: highly unfriendly (score 1–9), unfriendly (score 10–18), environmentally friendly (score 19–27), and highly environmentally friendly (score 28–36) (Sima *et al*., 2013).

RESULTS

The environmental friendliness of fishing gear is an important aspect of sustainable fisheries management. A fishing gear can be categorized as environmentally friendly if its operation does not cause negative impacts on the aquatic ecosystem, whether in terms of habitat damage, disturbance to biodiversity, or the sustainability of fish stocks. The environmental friendliness of the belat fishing gear was assessed to evaluate the extent to which this gear aligns with the principles of sustainable fishing, referring to the nine main criteria in the 1995 Code of Conduct for Responsible Fisheries (CCRF) guidelines. The assessment was carried out through questionnaires and direct interviews with 10 fishers using belat gear, with the complete evaluation results presented in Table 1.

Table 1. Environmental Friendliness Analysis

No	Criteria	Respondent										Score
		1	2	3	4	5	6	7	8	9	10	
1.	High selectivity	1	1	1	1	1	1	1	1	1	1	10
2.	Does not damage the habitat, living spaces, and breeding grounds of fish and other organisms	3	4	4	4	4	3	3	3	4	4	36
3.	Producing high-quality fish	3	2	3	3	3	3	3	3	2	3	28
4.	Does not endanger fishermen	3	4	3	3	3	3	4	4	3	3	33
5.	Products are safe for consumers	4	4	4	3	4	4	4	3	4	4	38
6.	Low bycatch	2	2	2	2	2	2	2	2	2	2	20
7.	Low impact on biodiversity	2	3	3	3	3	2	2	2	3	3	26
8.	Does not harm protected fish	4	4	4	3	3	4	4	3	4	4	37
9.	Socially Accepted	4	4	4	4	4	4	4	4	4	4	40
	Total Score											268
	Category Score											26.8

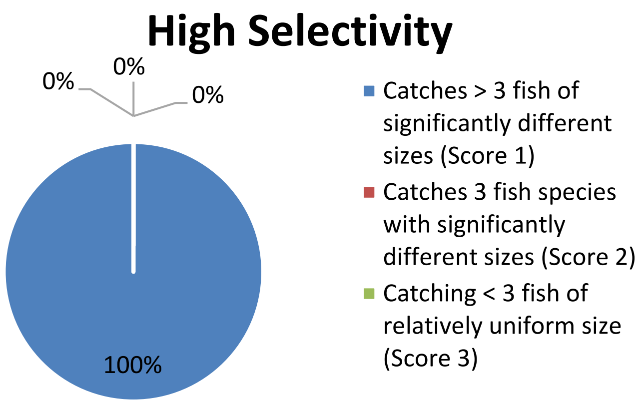

Figure 1. High Selectivity

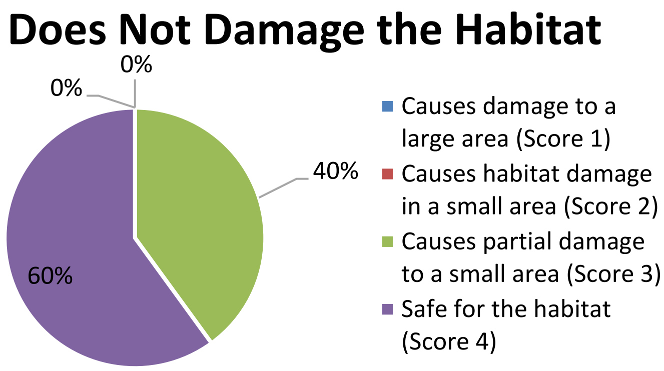

Figure 2. Does Not Damage the Habitat

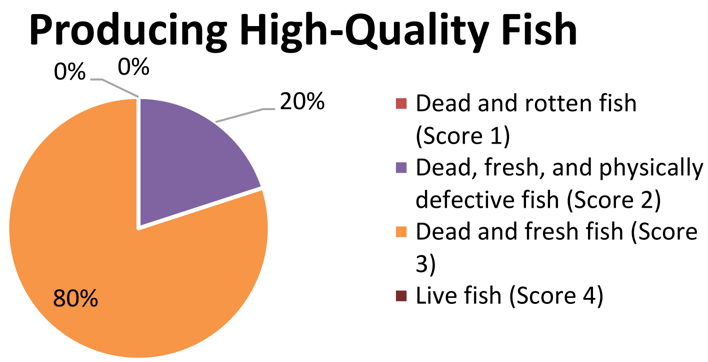

Figure 3. Producing High-Quality Fish

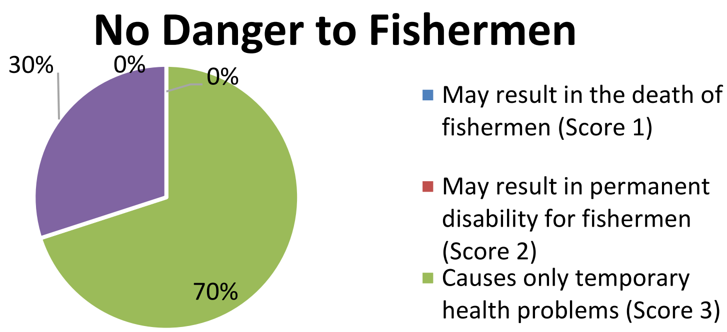

Figure 4. No Danger to Fishermen

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Rizki *et al*. (2026)
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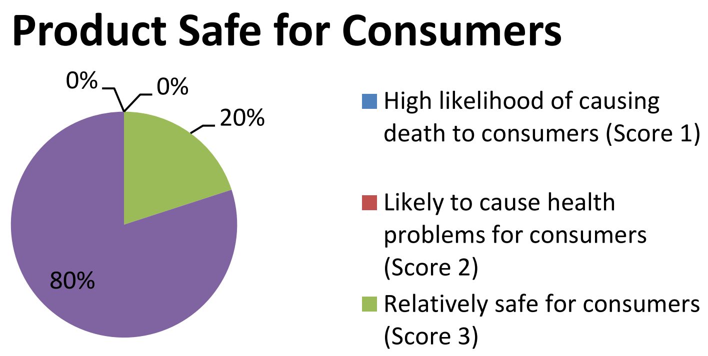

Figure 5. Products Safe for Consumers

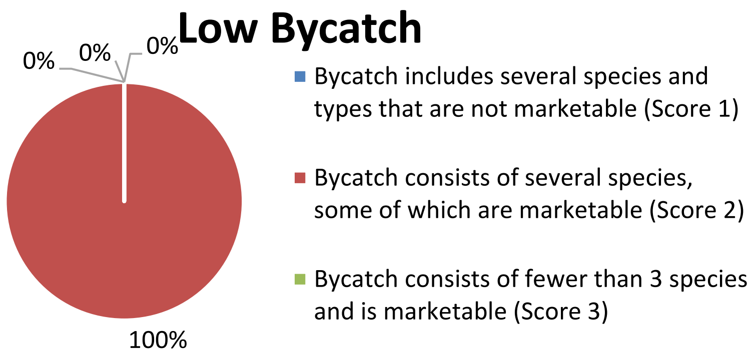

Figure 6. Low Bycatch

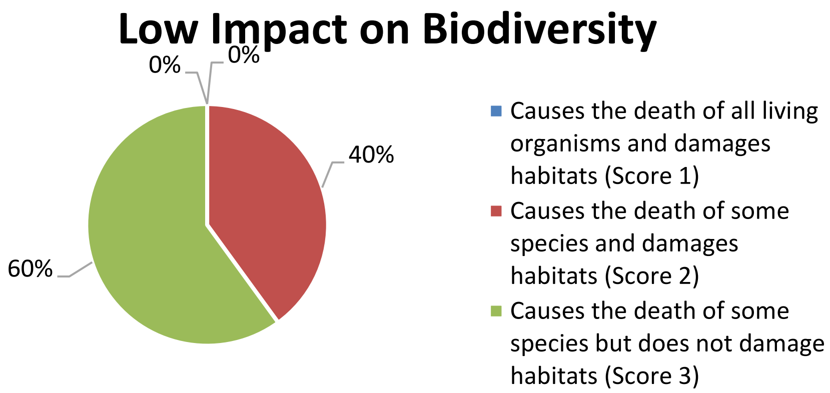

Figure 7. Low Impact on Biodiversity

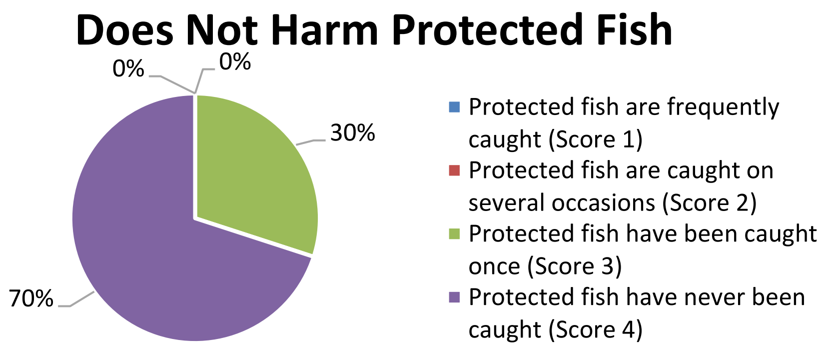

Figure 8. Does Not Harm Protected Fish

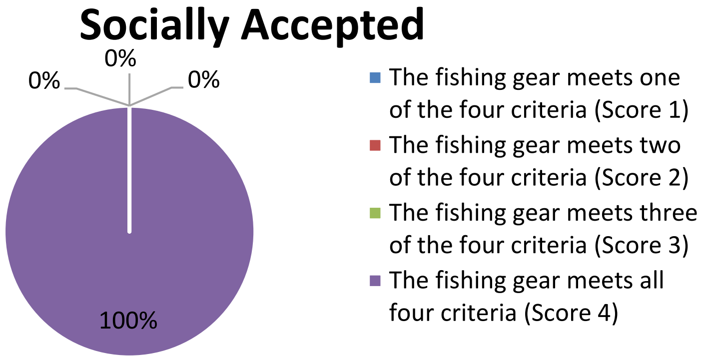

Figure 9. Socially Accepted

DISCUSSION

Based on the analysis of the nine CCRF (1995) criteria, the belat fishing gear operated in the waters of Nipah Panjang II obtained a score of 26.8, which, according to Sima *et al*. (2013), falls into the environmentally friendly category (score range 19–27). Meanwhile, according to Akbar *et al.* (2015), the belat fishing gear operated in the waters of Bunga Raya Village, Bunga Raya District, Siak Regency, Riau Province, was found to be a highly environmentally friendly fishing gear, with a score of 30.5.

1. High Selectivity

The selectivity of fishing gear plays a crucial role in sustainable fisheries resource management, alongside biological considerations (such as fish population size and structure), economic considerations (cost efficiency and added value), and resource sustainability considerations (including biodiversity conservation and prevention of overexploitation) (Warsa *et al*., 2021). The interview results showed that 100% of respondents stated that the belat gear could catch more than three widely varying size classes. Catch composition is an important indicator for assessing gear selectivity. According to Pramesthy *et al*. (2020), the selectivity level of fishing gear is determined by the number of species and sizes present in the catch. A fishing gear can be considered highly selective if it catches fewer than three species of relatively similar size. This low selectivity is attributed to the small mesh size of the gear. The mesh sizes used by fishers, 1 inch and 1¼ inch, allow small fish to enter and become trapped. Mesh size affects the resulting fish catch (Ramadhan *et al*., 2023). This is consistent with the findings of Akbar *et al*. (2015), who reported that the belat gear is capable of catching more than three species with widely varying sizes.

2. No Habitat Damage

The no habitat damage criterion is used to assess the potential disturbance caused by belat operations on the aquatic habitat. Environmentally friendly fishing gear is defined as gear that does not damage the bottom substrate of the waters (Kour and Hibata, 2019). The results showed that 40% of respondents stated that the belat gear caused partial damage within a limited area. This damage occurs due to the installation of stakes driven directly into the muddy bottom substrate, which serves as habitat for demersal fish, providing shelter and feeding grounds. Demersal fish are a group of fish that live in the lower water column to the seabed and tend to be solitary (Zahara *et al*., 2023), typically inhabiting sandy, rocky, or muddy substrates (Alatas *et al*., 2022). Meanwhile, 60% of respondents stated that the belat gear is safe for the habitat. This is consistent with the characteristics of belat as a passive fishing gear that does not damage the seabed. Respondents' statements were supported by interviews with fishers, who explained that although the belat gear comes into direct contact with the seabed, its impact is minimal compared to active fishing gear such as trawls. Trawls tend to drag or dig into the seabed, destroying both the biological and physical structure of the substrate.

3. High-Quality Catch

The quality of the catch plays an important role because it directly affects selling price, fisher income, and consumption safety. Post-harvest handling is one of the main factors influencing the freshness and quality of the catch. Improper handling can reduce catch quality (Hutapea *et al*., 2019). Fish quality can be assessed from its physical condition. The results of this study showed that 80% of respondents stated that the catch obtained using belat fishing gear consisted of dead fish that remained in fresh condition. Fish freshness plays a highly important role in determining the quality of fishery products (Wiranata *et al*., 2017). This freshness was maintained through the practice of one-day fishing trips and the use of ice as a cooling medium. However, 20% of respondents stated that some of the fish exhibited physical defects. These defects were caused by careless stacking of the catch, hasty sorting processes, and delayed handling. Physical damage in fish is generally caused by improper handling, which results in wounds or bruising on the fish's body and causes the flesh texture to become soft/mushy (Lestari *et al*., 2015).

4. Safety for Fishers

Work safety is a top priority in fishing operations. Good fishing gear is defined as gear that does not pose serious risks to fishers. Fishing is classified as a high-risk occupation. Compared to other professions, the rate of occupational accidents among fishers also tends to be higher (Basya *et al*., 2019). The results of this study showed that 70% of respondents stated that the operation of belat fishing gear did not pose any risk to fishers' safety. This finding forms the basis for categorizing belat as a safe fishing gear to operate. This risk reduction is relatively higher compared to active fishing gear. Meanwhile, 30% of respondents reported that belat fishing gear only caused temporary health disturbances. The disturbances experienced by fishers included back pain and minor injuries resulting from the installation or removal of stakes. Risk can be defined as the possibility of injury or adverse health effects (Wattimena *et al*., 2024). According to Radarwati *et al*. (2010), the level of occupational accident risk faced by fishers is strongly influenced by the type of fishing gear, technical ability, and the skills of the fishers themselves. In addition, a common risk faced by fishers generally comes from fish, such as being stung by the eeltail catfish (*Plotosus lineatus*).

5. Product Safety for Consumers

The product-safety-for-consumers criterion plays an important role in the suitability of the catch for public consumption. A product is considered safe if the fishing and post-harvest handling processes do not involve the use of hazardous substances. Such substances include poisons, oil, fuel, and formalin, which can cause health problems for consumers. Hazards may also arise from fish containing natural toxins. Based on the questionnaire results, 80% of respondents stated that the catch from the belat gear is safe for public consumption. This view is supported by evidence that the product does not pose a risk of acute poisoning, pathogenic contamination, or death for consumers, as demonstrated through direct consumer experience. This reflects a high level of confidence among most respondents in the food safety of catches produced by this gear. In contrast, 20% of respondents rated the belat catch as relatively safe, although mild allergic reactions characterized by itching and skin redness occurred after consuming shrimp. Consumers suspected these symptoms were related to individual sensitivity to the shrimp consumed. Scientifically, allergic reactions to shrimp are not caused by low product quality or safety, but rather by an individual's immune response to allergenic proteins present in shrimp. The main protein responsible as an allergen in shrimp is tropomyosin, which is also known to be the primary cause of cross-reactivity among various crustacean species (Chalid *et al*., 2015).

6. Low By-Catch

By-catch is defined as catch dominated by non-target fish species caught unintentionally. Environmentally friendly fishing gear is expected to produce low by-catch while still retaining high economic value. The low-by-catch criterion serves as an indicator of gear suitability. The results showed that 100% of respondents stated that the by-catch produced by the belat gear included several marketable species. The by-catch from the belat gear is not only diverse in species but also supports fishers' income. According to Rambun *et al*. (2016), habitat overlap between target and non-target fish contributes to the diversity of catch composition. Public interest in this by-catch is high because of its relatively affordable price, making it accessible to a wide range of consumers, from households to traders in traditional markets.

7. Low Impact on Biodiversity

The low-impact-on-biodiversity criterion is used to evaluate the effect of the fishing gear on the diversity of aquatic biota. Environmentally friendly fishing gear does not disturb aquatic biodiversity. The results showed that 60% of respondents stated that the belat gear caused mortality in several fish species but did not damage the habitat. This mortality generally occurred in fish that were not retrieved in time by fishers, leaving them stranded without water and exposed to heat until they died. Meanwhile, 40% of respondents stated that the belat gear caused both mortality in several species and habitat damage simultaneously. This mortality occurred in fish not retrieved in time, while habitat damage resulted from the installation of stakes driven directly into the bottom substrate. The utilization and development of fish resources require ongoing attention to environmental friendliness. The use of various types of fishing gear significantly affects the sustainability of fish catches (Nurhaeda *et al*., 2019). In practice, however, fishers in some areas tend to prioritize maximum catch without considering resource sustainability principles, which ultimately leads to a decline in marine biodiversity and habitat quality.

8. No Harm to Protected Species

The criterion of no harm to protected species serves as an important indicator in assessing the sustainability of fishing gear, aiming to protect species that are endangered or legally protected under national fisheries regulations. The results of this study showed that 70% of respondents stated that they had never caught protected fish species. In contrast, 30% of respondents admitted to having caught protected species using belat fishing gear. The protected species caught included the belida fish (*Chitala hypselonotus*) and the horseshoe crab (*Carcinoscorpius rotundicauda*). Based on the Regulation of the Minister of Environment and Forestry Number 2 of 2018, the belida fish (*Chitala hypselonotus*) and horseshoe crab (*Carcinoscorpius rotundicauda*) are classified as protected species. In Indonesia, the horseshoe crab is classified as a primitive marine animal in the vulnerable or rare category (Ubaidillah *et al*., 2013). Populations of horseshoe crabs in various regions, including Southeast Asia, have declined due to habitat degradation, environmental pollution, and overfishing (Wang et al., 2020). This decline occurs both from intentional capture and as bycatch from fisheries activities (John *et al*., 2018).

In this case, the belida fish (*Chitala hypselonotus*) was not released back into the water instead, fishers sold it due to its high market value. In contrast, the horseshoe crab (*Carcinoscorpius rotundicauda*) was released back into the water after being caught. This difference in practice reflects fishers' limited understanding of species protection status, indicating the need for stronger education and regulatory enforcement to prevent the exploitation of protected species. Improved management could enhance the sustainability of the belat gear with respect to biodiversity.

9. Social Acceptability

The social-acceptability criterion evaluates the level of acceptance of the belat gear among fishing communities and local society as an indicator of social sustainability in fisheries. Fishing gear is considered socially acceptable if it has low investment costs, is economically profitable, does not conflict with local culture, and does not conflict with existing regulations. The results showed that 100% of fisher respondents stated that the belat gear met all these criteria. These criteria include low investment cost, economic profitability, compatibility with local culture, and compliance with existing regulations. In terms of investment cost, the belat gear is relatively affordable, with a cost of around IDR 20,000,000 and a service life of up to 10 years, along with low maintenance costs since repairs can be carried out independently by fishers. The belat gear is economically profitable due to its low daily operational costs, combined with the marketable value of both the main catch and by-catch. The belat gear does not conflict with local culture, as it is a traditional fishing gear that has been used for generations without causing conflict among fishers. The use of belat gear does not conflict with existing regulations, although protected species have occasionally been caught unintentionally due to fishers' lack of awareness regarding the protection status of these species.

CONCLUSION

The belat fishing gear operated in the waters of Nipah Panjang II, Tanjung Jabung Timur Regency, obtained an environmental friendliness score of 26.8 based on the nine criteria of the Code of Conduct for Responsible Fisheries (CCRF), placing it in the environmentally friendly category. Of the nine criteria assessed, seven showed favorable results. However, two criteria showed relatively low performance, namely high selectivity and low by-catch.

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