JURNAL PERIKANAN DAN KELAUTAN
Volume 29 No. 1, February 2024: 11-17

e-issn : 2721-8902
p-issn : 0853-7607

The Selection of Eco-Friendly Tuna Fishing Technology (*Euthynnus affinis*) at Fish Landing Bases (PPI) Kuala Langsa Aceh Province

Seleksi Teknologi Penangkapan Ikan Tongkol (Euthynnus affinis) yang Ramah Lingkungan di Pangkalan Pendaratan Ikan (PPI) Kuala Langsa Provinsi Aceh

Muhammad Zikri Imanullah[1*], Bustari[1], Arthur Brown[1]
[1]Department of Utilization of Fisheries Resources, Faculty of Fisheries and Marine, Universitas Riau, Pekanbaru 28293 Indonesia
**email:* zikriimanullah18.11@gmail.com

Received
December 2, 2023

Accepted
January 17, 2024

Abstract

This study aims to identify and determine environmentally friendly tuna fishing gear and the priority for developing fishing gear at PPI Kuala Langsa. The method used in this research is a survey method. Moreover, purposive sampling was chosen as a sampling technique in selecting respondents as the sample. The data obtained were processed using the scoring and analytical hierarchical processes (AHP) methods. Based on the eco-friendly level, the longline scored 82.71%, the surface gill net scored 79.38%, the bottom gill net scored 76.04%, and the purse seine scored 74.79%. Based on the results of the AHP analysis, the fishing gears that became the main priority were longline with a value of 0.311, purse seine with a value of 0.293, surface gill nets with a value of 0.220, and bottom gill net with a value of 0.176. The government must reoptimise the catch of tuna based on environmentally friendly criteria. Also, it is necessary to conduct further research related to environmentally friendly fishing gear for other types of fish, and it is necessary to apply regulations regarding environmentally friendly fishing gear.

Keywords: AHP, Environmentally friendly, Fishing gear.

Abstrak

Tujuan penelitian ini adalah mengetahui dan menentukan alat penangkapan ikan tongkol yang ramah lingkungan dan menentukan prioritas alat penangkapan untuk dapat dikembangkan di PPI Kuala Langsa. Metode yang digunakan adalah metode survey. Dalam pemilihan responden sebagai sampel dilakukan dengan cara *purposive sampling*. Data yang diperoleh diolah dengan metode skoring dan metode *Analytical Hierarchy Process* (AHP). Berdasarkan tingkat ramah lingkungan rawai memperoleh nilai 82,71%, jaring insang permukaan memperoleh nilai 79,38%, jaring insang dasar memperoleh nilai 76,04% dan pukat cincin memperoleh nilai 74,79%. Berdasarkan hasil analisis AHP alat tangkap yang menjadi prioritas utama adalah rawai dengan nilai 0,311, pukat cincin dengan nilai 0,293, jaring insang permukaan dengan nilai 0,220 dan jaring insang dasar dengan nilai 0,176. Pemerintah mesti mengoptimalkan kembali hasil tangkapan ikan tongkol terhadap pertimbangan dari kriteria ramah lingkungan dan perlu dilakukan penelitian lebih lanjut terkait alat penangkapan ikan ramah lingkungan untuk jenis ikan lainnya dan perlu diterapkan regulasi mengenai alat penangkapan ikan yang ramah lingkungan.

Kata kunci: AHP, Ramah lingkungan, Alat penangkapan

1. Introduction

Langsa City is located in Aceh, one of the centers of the fisheries sector in Aceh. Langsa waters are part of WPP-RI 571 of the Republic of Indonesia, with the Strait of Malacca (KKP, 2014). Its fisheries sector has multiplied since the 1900s (Wagiyo & Febrianti, 2015). The development of this fisheries sector has attracted the government's attention, especially about fishing activities. Fishing activities in Langsa still contribute significantly to distributing its capture fisheries products to various regions.

Since Langsa City is one of the cities whose population relatively consumes fish, the market demand for fish production is also increasing (Alamsyah and Musbir, 2014). Therefore, Langsa is one of the best fish-producing areas in Aceh. One of the city's main fish products is small pelagic fish such as skipjack (*Katsuwonus pelamis*) and tuna (*Euthynnus affinis*). The distribution of these pelagic fish extends to all Aceh waters and even to all Indonesian waters. Tuna is one of the most sought-after fish in the market, so the availability of resources must be considered (Chaliluddin et al., 2019). Wagiyo & Febrianti (2015) showed that the current decline in mackerel production in Langsa aligns with the decline in mackerel production in other neritic waters. Furthermore, the DPPKP (2020) explained that one of the causes of the lack of fish distribution in 2019 was the decline in the catch of primary commodities such as mackerel, which had an impact on the distribution of marine products that increased.

The decline in fish stocks cannot be separated from using environmentally friendly fishing gear because most people in the Kuala Langsa PPI area work as fishermen, which affects competition between fishermen. Some fishing gear that can catch tuna at PPI Kuala Langsa include purse seine, gill net, and longline. Atmajaya & Hisyam (2021) explain that choosing the prioritized fishing gear in fishing activities takes several aspects to obtain environmentally friendly and sustainable fishing gear and help fishermen protect underwater biota and economy and security.

Rusmilyansari & Irhamsyah (2020) added that global fishing is growing in several world waters, including Indonesia, which is approaching overfishing. Monitoring the availability of tuna stocks in the Langsa water area has not been optimally implemented due to the lack of data and information on environmentally friendly fishing gear in fisheries management. So, this research seeks to consider the level of environmentally friendly fishing gear that will be a priority for tuna fishing in PPI Kuala Langsa, Langsa City, Aceh.

2. Material and Method

2.1. Time and Place

This research was conducted from March 4 to April 14, 2020. The research site was at the Kuala Langsa Fish Landing Site (PPI) in Langsa, Aceh (Figure 1).

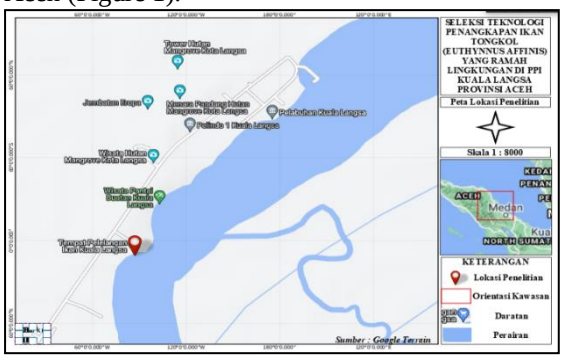

Figure 1. Research location

2.2. Methods

This research uses tools such as cameras, questionnaires, stationery, rulers, and data processing with Microsoft Excel software. The subject of this research is fishing gear that can catch tuna used by fishermen at PPI Kuala Langsa, namely purse seine, surface gill net, bottom gill net, and rawai. Data was collected through primary data from direct observation, secondary data sourced from PPI Kuala Langsa, DPPKP Kota Langsa, and citing literature from various sources.

2.3. Data Analysis

Data were analyzed to answer the research objectives. The criteria for the level of fish gear friendliness analyzed were based on the ethical principles of responsible fisheries (CCRF) elaborated by Mallawa et al. (2018).

To obtain the value of the environmental friendliness level, it will be summed up with the formula:

$$\text{Environmental Friendliness} = \frac{\text{Weight x Assess gains}}{\text{Full Value}} \text{ x } 100\%$$

After the score is obtained, the score is then calculated with a maximum of 100% with the following score range. Gain score = 86-100% high or very environmentally friendly; 66-85% moderate or environmentally friendly; 50-65 % low or less environmentally friendly, and ≤ 50%, very low or not environmentally friendly

Table 1. The weighting of environmental friendliness fishing gear criteria (Mallawa et al., 2018)

Criteria	Subcriteria	Weight	Subcriteria value
Size structure of captured fish	Small dominant fish	1.00	1
	Most fish are small and medium-sized.		2
	Most fish are medium-sized.		3
	Large dominant fish		4
Percentage of fish worth catching	≤ 10% of fish are fit to be caught	1.00	1
	10% - <20% fish fit to be caught		2
	20% - < 30% fish fit to be caught		3
	≥ 30% of fish are fit to be caught		4
Impact on habitat	Destruction of large areas	0.75	1
	Destruction of a narrow area		2
	Destruction of some narrow areas		3
	Safe for the habitat		4
Quality of catch	Fish die and start to rot	0.50	1
	Dead and deformed fish (physically deformed)		2
	Dead but still fresh fish		3
	Fish still alive		4
Impact of technology on fishermen	May cause death	0.50	1
	May result in disability		2
	It may interfere with the health.		3
	Safe for fishermen		4
Catch-to-consumer impact	The potential impact of death	0,50	1
	Potential health impacts		2
	It tends to be safe for consumers.		3
	Safe for consumers		4
By-catch	Some species do not sell well	0.50	1
	Some species of fish and some sell well		2
	By catch < 3 fish species and sellable		3
	By catching < 3 fish species and high value		4
Impact of technology on biodiversity	Frequent catch of conserved fish	0.75	1
	Several times, catching conserved fish		2
	Ever caught a conserved fish		3
	Never catch conserved fish		4
Use of fuel oil (BBM.)	Fuel consumption > IDR 2 million per trip	0.75	1
	Fuel consumption IDR 1 - 2 million per trip		2
	Fuel consumption IDR 0.5 - < 1 million per trip		3
	Fuel consumption < IDR 0.5 million per trip		4
Business investment costs	Business investment > IDR300 million per unit	0.75	1
	Business investment of IDR 200 - 300 million per unit		2
	Business investment of IDR 100 - 200 million per unit		3
	Business investment < IDR 100 million per unit		4
Labour absorption	Absorbs ≤ 5 workers	1.00	1
	Absorbs 5 - < 10 workers		2
	Absorbs 10 - < 15 workers		3
	Absorbs ≥ 15 workers		4
Profitability of the fishing business	Profit yield < IDR 100 million per year	1.00	1
	Profit yield of IDR 100 - < IDR 250 million per year		2
	Profit yield of IDR 250 - < IDR 500 million per year		3
	Profit yield ≥ IDR 500 million per year		4
Technology legality	Conflicts with > 2 regulations	0.50	1
	Conflict with two regulations		2
	Conflicts with one regulation		3
	Does not conflict with the rules		4
The link between technology and local customs and traditions	Completely opposite	0.50	1
	Opposite		2
	Slightly opposite		3
	Not opposite		4

The percentage of catchable tuna can be calculated using the method of Mallawa et al. (2018):

$$\text{Fish catching (\%)} = \frac{\sum \text{Fish catching}}{\sum \text{Catch}} \text{ x } 100\%$$

According to the reference, fish that are suitable for catching are at the level of mature gonads (TKG). According to Ardelia et al. (2016), the length of the first gonadally mature tuna is ≥ 40 cm. Fishing gear categorized as environmentally friendly is then prioritized using the Saaty (2008) method. The steps in the AHP method are as follows: 1) define the problem and look for the situation (Figure 2).

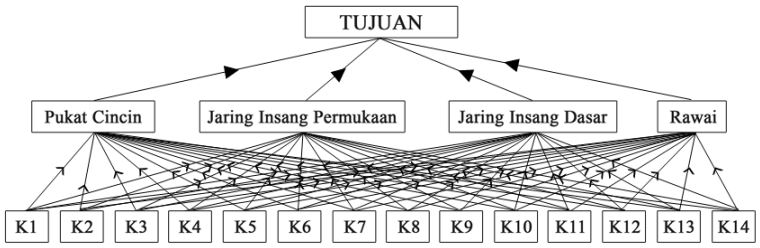

Figure 2. Hierarchical process of tuna fishing gear selection
Description: Level 1 = Objective (Environmentally friendly tuna fishing gear); Level 2 = Alternatives Level 3 = Criteria (14 criteria in Table 1)

2) prioritizing aspects. It determined the priority of aspects by making pairwise comparisons that compare aspects in pairs represented by the level of importance from 1 to 9, where the weighting of the given value is presented in Table 2.

Table 2. Comparison scale values (Saaty, 2008)

Level of importance	Definition
1	Both aspects are equally important
3	One aspect is slightly more important than the other.
5	One aspect is more important than the other.
7	One aspect is more important than the other.
9	One aspect is more important than the other.
2,4,6,8	If undecided between 2 adjacent values

3) calculate the consistency index with the formula: $CI = \frac{(\lambda \text{ maks-n})}{\text{n-1)}}$

Description:
CI = Consistency (consistency index)
ʎ max = Maximum eigenvalue
n = Number of elements/matrix size

4) calculate the consistency ratio with the formula: $CR = \frac{CI}{IR}$

Description =
CR = Consistency Ratio
CI = Consistency Index
IR = Index Random Consistency

3. Result and Discussion

3.1. Level of Fishing Gear Environment Friendliness

Based on the results of the analysis of the level of environmental friendliness of tuna fishing gear at PPI Kuala Langsa, which refers to 14 environmentally friendly criteria according to Mallawa et al. (2018), the results obtained are the four fishing gear included in the medium / environmentally friendly category which is presented in Figure 3. The analysis results in Figure 1 show that the longline scored 82.71%. According to Mallawa et al. (2018), this value falls into the medium or environmentally friendly category. Chaliluddin et al. (2019) stated that longline is an excellent fishing tool for environmental friendliness. Fishing gear has the advantage of being highly selective and has no significant impact on the environment or the surrounding habitat (Subehi et al., 2017).

Next in line was the second-place Gill net catcher, who scored 79.38%. As the name implies, gill nets are designed to catch pelagic fish such as tuna, mackerel, lemuru, and tembang. Surface gill nets are passive on the water surface and do not damage coral reef habitats (Soares, 2019). Rohadi et al. (2020) added that surface gillnet fishing does not violate existing regulations and is acceptable following prevailing practices. Then, the bottom gill net is ranked 3rd with a score of 76.04% and is classified as environmentally friendly. According to

KP Regulation No. 08 of 2008, gill nets and longlines are among the fishing gear that can be used, while arad and dogol are included in the category of prohibited fishing gear.

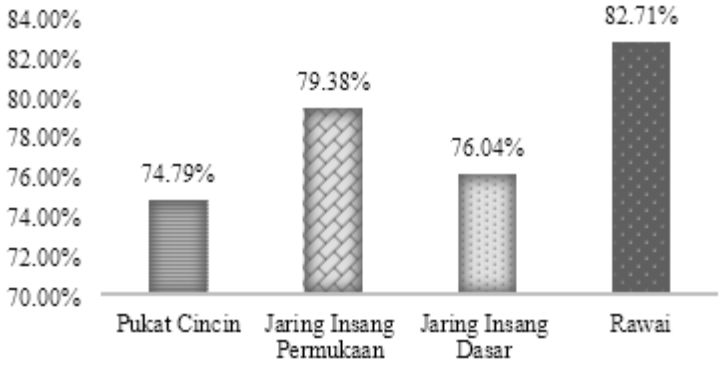

Figure 3. Analysis of environmental friendliness level

The last is purse seine, with a score of 74.79%. Tuasikal (2020) explains that purse seine is one of the most effective fishing gear for catching pelagic fish around the water surface. Purse seines can catch greater by-catch than main-catch. This is because the fish is attracted to good light (positive phototaxis). The mesh size of the purse seine is used as a mesh bag so that the fish are trapped in the net rather than entangled or spun.

3.2. Gear Comparison Against Eco-Friendly Criteria

The data were analyzed for environmental friendliness and then processed to determine the priority value of each fishing gear based on environmental friendliness criteria (Table 3). The results of the overall comparative analysis of environmentally friendly criteria with fishing gear are presented in Table 4.

Table 3. Comparative analysis of criteria for fishing gear

No.	Criteria	Fishing Gear			
		Purse seine	Surface gill net	Bottom gill net	Rawai
1.	Size structure of captured fish	0.214	0.209	0.106	0.472
2.	Percentage of fish worth catching	0.219	0.234	0.144	0.403
3.	Impact to habitat	0.343	0.195	0.122	0.340
4.	Quality of fish caught	0.341	0.215	0.173	0.270
5.	Impact of technology on fishermen	0.345	0.301	0.234	0.120
6.	Impact of technology on consumers	0.264	0.176	0.190	0.370
7.	By-catch	0.315	0.178	0.165	0.342
8.	Impact of technology on biodiversity	0.330	0.225	0.146	0.299
9.	Use of fuel oil	0.128	0.244	0.238	0.390
10.	Value of business investment costs	0.144	0.221	0.268	0.366
11.	Labour absorption	0.599	0.228	0.104	0.070
12.	Business profit	0.616	0.209	0.098	0.076
13.	Technology legality	0.267	0.256	0.224	0.253
14.	Technology's link to local customs and wisdom	0.207	0.271	0.238	0.284
	Priority	0.293	0.220	0.176	0.311

Table 4. Results of comparative analysis of overall criteria and fishing gear

Alternative	Priority Value	Priority Order
Rawai	0.311	1
Purse seine	0.293	2
Surface gill net	0.220	3
Bottom gill net	0.176	4

Based on the AHP analysis above, it is found that the priority value of fishing gear with the highest value is longline. Longline gear is an environmentally friendly fishing gear that is easy to use for tuna fishing. The analysis shows that longline gear fulfills almost all environmentally friendly criteria, including consistency in determining the size structure to be caught, not harmful to consumers, high-quality by-catch, small investment, and does not violate existing regulations. This is in line with previous studies such as Subehi et al. (2017); Chaliluddin et al. (2019), which proved that longline is a very environmentally friendly (responsible) fishing gear. Chodrijah (2017) stated that fish caught with longlines are fish with mouth openings more significant than the size of the hook, and fish with small mouth openings escape. According to Siregar et al. (2016), longlines have construction and operational techniques that do not harm species or the environment.

In the AHP analysis results, purse seine was ranked second. Because the main target of this fishing gear is pelagic fish, which is a collection of fish, based on the results of the AHP analysis, purse seine nets do not

destroy significant habitats, catch good quality fish, do not harm fishers, do not harm biodiversity, and can accommodate sufficient ABK, resulting in high profits. However, the investment value of purse seine nets is much higher than other fishing gear's. Nurdin & Budiarti (2017) stated that purse seine is one of the traits of active and aggressive fishing gear aimed at catching schools of pelagic fish. Malik (2018) added that a unified lifestyle causes the capture of small pelagic fish, and feels comfortable with floating objects in the marine environment such as FAD areas. However, the high value of purse seine fuel use is in the second position. This is due to the long distance between the fishing base and the fishing ground, which is 100 to 135 miles, requiring an average of 15 hours of operation (Safitri, 2018). Dollu & Bolang (2021) stated that using purse seine gear is feasible because it generates significant profits compared to fishing gear such as gill nets, fishing rods, and traps.

Surface gill nets rank third in determining environmentally friendly fishing gear. Surface gill nets are environmentally friendly fishing gear, and the size of fish caught by fishing gear can be determined based on the mesh size used. Surface gill nets are also minimal in fuel use, do not harm fishermen, and do not violate existing rules or practices. Chaliluddin et al. (2019), surface gill nets are environmentally friendly fishing gear and are passive in the aquatic environment, so they do not damage coral reefs.

Bottom gillnets ranked fourth in the determination of environmentally friendly tuna fishing gear. According to the findings, the simple gill net remains a lower priority than other fishing gears because it does not fulfill the environmentally friendly criteria clear from the pairwise comparative analysis of all criteria. Pramesthy et al. (2020) revealed that the disadvantage of using a basic gill net is a slight imperfection because it tends to physically damage (operculum) the quality of the fish caught. The by-catch that is still caught is quite large. Wahyuddin et al. (2013) added that there are concerns that bottom gill nets operated at the bottom of the waters can affect the damage and destruction of marine biota caused by the weight of the net in contact with the bottom.

4. Conclusions

Longline fishing gear scored 82.71% environmentally friendly; surface gill net scored 79.38%; bottom gill net scored 76.04%; and purse seine scored 74.79%. This shows that the four fishing gears above fall into the medium / environmentally friendly category. The results of AHP analysis using 14 criteria for environmentally friendly fishing gear show that the top priority is longline gear (mini longline) with a value of 0.311, followed by purse seine gear with a value of 0.293, then in third position is surface gillnet gear with a value of 0.220 and the fourth is bottom gillnet with a value of 0.176.

5. References

[DPPKP] Dinas Pangan, Pertanian, Kelautan dan Perikanan. (2020). *Rencana kerja Dinas Pangan, Pertanian, Kelautan dan Perikanan (DPPKP) Kota Langsa*. Aceh.

[KKP] Kementerian Kelautan dan Perikanan. (2014). Peraturan Menteri Kelautan dan Perikanan Republik Indonesia Nomor 18/PERMEN-KP/2014. Wilayah pengelolaan perikanan Negara Republik Indonesia.

Alamsyah, R., Musbir, F.A. (2014). Struktur ukuran dan ukuran layak tangkap ikan cakalang (*Katsuwonus pelamis*) di Perairan Teluk Bone. *Jurnal. Sains & Teknologi*, 14(1): 95-100.

Ardelia, V., Vitner, Y., Boer, M. 2016. Reproduction biology Eastern little tuna *Euthynnus affinis* is in the Sunda Strait. *Jurnal Ilmu dan Teknologi Kelautan Tropis*, *8*(2): 689-700.

Atmajaya, O.D.D., Hisyam, M. (2021). Penentuan Alternatif alat tangkap ramah lingkungan untuk keberlanjutan perikanan tangkap di Kabupaten Kubu Raya. *NEKTON: Jurnal Perikanan dan Ilmu Kelautan*, 1(2): 94-103.

Chaliluddin, M. A., Ikram, M., Rianjuanda, D. (2019). Identifikasi alat penangkapan ikan ramah lingkungan berbasis CCRF di Kabupaten Pidie, Aceh. *Jurnal Galung Tropika*, 8(3): 197-208.

Chodrijah, U. (2017). Struktur ukuran dan parameter populasi ikan lemadang (*Coryphaena hippurus* Linnaeus, 1758) di Laut Sulawesi. *BAWAL: Widya Riset Perikanan Tangkap*, 8(3): 147-158.

Dollu, E.A., Bolang, F.B. (2021). Analisis kelayakan usaha perikanan tangkap mini purse seine (pukat cincin) di perairan Kokar Kecamatan Alor Barat Laut, Kabupaten Alor, Provinsi Nusa Tenggara Timur. *Akuatika Indonesia*, 6(1): 1-7.

Malik, A.A. (2018). Ipteks bagi masyarakat (IbM) kelompok nelayan *purse seine* di Desa Siddo Kecamatan Soppengriaja Kabupaten Barru. *JATI EMAS (Jurnal Aplikasi Teknik dan Pengabdian Masyarakat)*, 2(2): 83-88.

Mallawa, A., Amir, F., Safruddin, S., Mallawa, E. (2018). Keberlanjutan teknologi penangkapan ikan cakalang (*Katsuwonus pelamis*) di perairan Teluk Bone, Sulawesi Selatan. *Marine Fisheries*, 9(1): 93-106.

Nurdin, E., Budiarti, T.W. (2017). Kapasitas penangkapan pukat cincin mini di Pemalang. *Jurnal Penelitian Perikanan Indonesia*, 15(2): 171-178

Pramesthy, T.D., Mardiah, R.S., Shalichaty, S.F., Arkham, MN, Haris, RBK, Kelana, P.P., Djunaidi, D. (2020). Analisis alat tangkap jaring insang (gill net) berdasarkan kode etik tatalaksana perikanan bertanggung jawab di perairan Kota Dumai. *Aurelia Journal*, 1(2): 103-112.

Rohadi, Y., Hertati, R., Kholis, M.N. (2020). Identifikasi alat tangkap ikan ramah lingkungan yang beroperasi di perairan Sungai Alai Kabupaten Tebo Provinsi Jambi. *SEMAH Jurnal Pengelolaan Sumberdaya Perairan*, *4*(2).

Rusmilyansari, R., Irhamsyah, I. (2020). *Teknologi trammel net dalam kajian selektivitas penangkapan ikan*. Universitas Lambung Mangkurat.

Saaty, T.L. (2008). Decision-making with the analytic hierarchy process. *International journal of services sciences*, 1(1): 83-98

Safitri, I. (2018). Perikanan tangkap purse seine di Pelabuhan Perikanan Nusantara (PPN) Pemangkat Kalimantan Barat. *Jurnal Laut Khatulistiwa*, 1(3): 89-96.

Siregar, A.A., Bustari, B., Brown, A. (2016). *Study technology of longline fishing gear in the Muara Sako Kampar Kiri Waters Langgam Village Pelalawan Regency*. Universitas Riau. Riau

Soares, J.M.S.D. (2019). *Pengaruh perbedaan ukuran lebar mata jaring gill net permukaan terhadap cara tertangkapnya ikan di Pelabuhan Perikanan Pantai (PPP) Kabupaten Pacitan, Jawa Timur*. Doctoral dissertation, Universitas Brawijaya.

Subehi, S., Boesono, S.H., Ayunita, D. (2017). Analisis alat penangkap ikan ramah lingkungan berbasis *Code of Conduct For Responsible Fisheries* (CCRF) di TPI Kedung Malang Jepara. *Jurnal Perikanan Tangkap*, 1(3).

Tuasikal, T. (2020). Inventarisasi alat tangkap ramah lingkungan di Desa Werinama. *Jurnal Agrohut*, 11(1): 19-24.

Wagiyo, K., Febrianti, E. (2015). Aspek biologi dan parameter populasi ikan tongkol abu-abu (*Thunnus Tonggol*) di Perairan Langsa dan sekitarnya. *BAWAL Widya Riset Perikanan Tangkap*, 7(2), 59-66.

Wahyuddin, A.E., Reppie, E., Paransa, I.J. (2013). Kajian fungsi bridle line pada jaring insang dasar. *Jurnal Ilmu dan Teknologi Perikanan Tangkap*, 1(4).