



Status of Skake Fishing Gear Technology in Cirebon Waters

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Abstract

This study aims to evaluate the status of the technology of the rake fishing gear used in Cirebon waters. This evaluation is important to understand the effectiveness and environmental impacts of the fishing gear in local fisheries activities. The research method used involves a descriptive approach with primary data collection through direct observation in the field and interviews with local fishermen. In addition, secondary data was obtained from literature and related reports relevant to the use of rake fishing gear. The results of the study indicate that the technology of the rake fishing gear in Cirebon waters has certain characteristics that affect the catch and sustainability of marine resources. This study also found that although this fishing gear is efficient in catching fish, its use requires better management to minimize negative impacts on the marine ecosystem.

Introduction

The fisheries resources include fish stock and the ecosystem of the coastal areas of the region correlate greatly with the fishing gears used by the people of the area. Losing biological and ecological complexity, the Cirebon marine ecosystem and its many inhabitants of fish are threatened by traditional fisheries using improper fishing tools such as rake fishing gear. These tools as efficient for some of the species like clam and crab, but they also causes negative effect like destruction of habitat and also catching other species which is considered undesirable (Nofrizal et al., 2018; Iskandar et al., 2014).

The rake fishing gear (locally known as garuk) work by dragging along the seabed, feeding on benthic resources particularly clams whilst disrupting the base of the seabed and other marine structures. This method leads to a high level of bycatch mortality and negatively impacts the biological diversity based on observations made by Rofiqo et al. (2019) and Tamarol et al. (2012) on the similar dredging apparatus. These problems are more profound in Cirebon since nearshore fisheries resources had been threatened by over fishing that caused fishermen to explore the intensity use of gears (Marine and Fisheries Service of Cirebon Regency, 2015).

Estimating the Eco-friendliness of fishing gears is paramount so as to address the economical needs and the conservation of environment. It is on these grounds that selectivity, habitat influence and bycatch involvements of tools such as rake gear must be assessed in accordance to the Code of Conduct for Responsible Fisheries (FAO, 1996). Other works by Sumardi et al. (2014) and Darmono et al. (2016) have established that sustainable fishing methodologies helps in reducing the negative impacts of the environment while increasing sustainable catchment in the future.

Therefore the objective of this study is to evaluate the current state of improvement in rake fishing gear technology in Cirebon waters. While doubtlessly valuable for enhancing knowledge of the environmental effects of fishing generally, such comparative analyses often do not address whether the fishing actually occurring is sustainable within a particular region.

The goal of this research is to refine understanding of fisheries' environmental impacts by first considering the stock's bycatch levels and the disturbance of its habitats and then determining whether it conforms to local law.

Methods

Study Area and Duration

Data for this study was collected in March 2020 among the coastal villages of Mundu and Citemu in Cirebon Regency. These sites were chosen because they employ rake fishing gear (garuk) and are contributors to food security of the fishing communities. It also has a variety of marine livelihood resources which are now threatened by destructive fishing activities.

Research Design

This research work adopted an inherent observational descriptive research design with a view to evaluating the environmental friendliness of rake fishing gear. This design allowed the researchers to document and systematically study the gear's properties, the ways it functioned, and its effects on the environment. Qualitative and quantitative data collection techniques were used and this offered an overall picture of the status of the fishing gear.

Data Collection

In order to achieve this, both primary and secondary research was undertaken in gathering data for the study.

Primary Data

Questionnaires: Based on this, a sare filled structured questionnaire was used and administered to fishermen that commonly use rake fishing gear. The questionnaire was developed to assess the gear according to nine attributes for sustainable fishing practices including selectivity, impact, and bycatch.

Field Observations: In methods used or fishing, environmental data and composition of catches, researchers made direct observations while following fishing operations. It also helped to check the results of the questionnaires and to maintain the necessary distance in the process.

Interviews: Qualitative interviews were held with fishermen to understand more comprehensively their concerns, their practices, and the perceived effects of rake fishing gear on the environment.

Secondary Data: The secondary data were obtained from published fisheries reports, regulations and the available literature. These data enriched the contextual background related to the ecological and related regulatory features of rake fishing gear in Cirebon and for more detailed understanding of the results of the primary data collection.

Sampling Method

Purposive sampling technique was used in the study in order to ensure that the selected participants as well as fishing units were comprehensive of the population of interest in relation to the objectives of the study. Purposive sampling allowed the researchers to focus on fishermen who met specific criteria, including: 1) Operation of Rake fishing gear in the coastal area 2) Owning small fishing boats which have a gross tonnage of 1-10; 3) Operating one day fishery.

This study targeted 12 fishing units out of 245 operational rake fishing units in the identified region. The sample size was arrived at using Suparmoko (2011) formula for sample size

whereby the acceptable margin of error is 10%. This approach applied reliability of the findings while at the same time being cost effective.

Data Analysis

In assessing rake fishing gear, the scoring method was applied that compared the effectiveness of the gear for environmentally friendly fishing practices to nine explicit indicators. The following are the criteria we derived from the FAO (1996) Code of Conduct for Responsible Fisheries:

Table 1. Evaluation Criteria for Fishing Gear Sustainability and Impact

Criterion	Key Indicators
Selectivity	Types and sizes of fish caught, with higher scores indicating greater selectivity.
Habitat Impact	Extent of habitat destruction caused by the fishing gear.
Quality of Catch	Condition of fish upon capture, with live fish scoring highest.
Fishermen's Safety	Risks associated with operating the fishing gear.
Consumer Health Safety	Likelihood of gear producing catch unsafe for consumption.
Bycatch Minimization	Proportion of bycatch relative to the main catch.
Biodiversity Preservation	Impact on marine biodiversity, including juvenile and non-target species.
Avoidance of Protected Species	Frequency of interactions with protected or endangered species.
Social Acceptance	Compatibility with local culture, regulations, and economic viability.

All the criterion were measured using 1- 4 scale, where the numbers indicated higher compatibility with the environment. Total score for each fishing unit was arrived at from a sum of the scores achieved in each of the criteria. These total scores were then categorized as follows: 1) First quarter: Highly negative for the environment; 2) Second quarter: Negative for the environment; 3) Third quarter: Neutral to the environment; 4) Fourth quarter: Positive for the environment.

The application of this scoring method brought a predicative value getting insight on the environmental status of rake fishing gear and giving insights on areas of improvement. As incorporating the field data and standard protocols facilitated in the analysis, the study provided recommendations for the appropriate ASM of the fishery resources of Cirebon.

The data obtained were analyzed quantitatively using a scoring technique to assess the environmental friendliness of rake fishing gear in Cirebon fishing grounds. The scoring criteria are as per the guideline of FAO (1996) selectivity, habitat impact, bycatch, and other pertinent issues are described under methods. Statistical techniques were also employed in the processing of the results in order to establish within and between group validity and reliability respectively.

Scoring Method

The responses as well as the observations made were rated with an overall score of 1-4 for every criterion identified. The scoring system provided more probabilities to show how the rake fishing gear was compliant with environment friendly practices. The total score for each fishing unit was calculated as:

$$\text{Total Score} = \sum_{i=1}^n S_i$$

Where:

S_i : Score for the i -th criterion.

Enduring and mana synchronous correlates In this work nine criteria are identified.

These results were then quantised into four levels as described in the methods to understand the environmental status of the gear.

Statistical Analysis

To ensure the robustness of the findings, the following statistical techniques were employed:

Descriptive Statistics

Descriptive measures and measures of variability such as the mean and standard deviation as well as the relative frequency distributions of the scores given to each criterion were determined. These measures offered the broad pattern by means of presenting the average and range of the data set.

For the purpose of the analysis, the percentage of respondents meeting specific score thresholds was calculated for every criterion.

Inferential Statistics

Analysis of Variance (ANOVA): In the analysis of variance ANOVA test was employed with the purpose to determine the differences in the mean scores between various fishing units. It also identified particular units with higher and lower green scores and make thus used to decide their outcomes as more or less environmentally friendly.

Correlation Analysis: Thus, Pearson correlation coefficients were used to assess relationships between specific criteria, for example selective or impact on habitats, identified in evaluating tradeoffs or interdependencies in gear performance.

Reliability Testing

A reliability test (e.g., Cronbach's alpha) was performed on the questionnaire responses to ensure internal consistency among the nine evaluation criteria.

Presentation of Results

The results were summarized in tables and graphs to facilitate interpretation. For example:

Table 2. Evaluation of Criteria Scores and Unit Distribution

Criterion	Mean Score	Standard Deviation	Percentage of Units Scoring ≥ 3
Selectivity	2.1	0.5	33%
Habitat Impact	1.8	0.7	20%
Biodiversity Preservation	2.0	0.6	25%

These results were further visualized using bar charts and scatter plots, highlighting key findings such as the distribution of environmentally friendly scores across the sample and correlations between criteria.

Interpretation of Findings

The statistical analyses provided critical insights into the performance of rake fishing gear in Cirebon waters. Units with higher scores were identified as models for sustainable practices, while those with lower scores indicated areas needing intervention. The ANOVA results demonstrated significant variability in performance, suggesting that factors such as operator expertise or fishing area characteristics could influence environmental friendliness.

Results and Discussion

Scratch

Arrest Unit Scratch

Scratch including into the tool catch *dredged net*. Scratch is tool operated catch in a way active at the base waters, with a catch target dryness. Boats used by fishermen size < 5 GT. Size boat namely (L x W x H) 7 m x 2.6 m x 0.9 m. in one time operation arrest fisherman using 3 – 4 scratches.

Group type tool fishing dredges are group tool framed fishing wood or serrated iron or hang on the part underneath, equipped or without net / material others, operated with method scratching at the base waters with or without boat For catch shellfish and sedentary biota

Scratch operated by 2 – 3 crew members. The fishing area is waters around Losari and Gebang . How to operate scratch that is *setting*, *dragging*, and *hauling*. Operating time start at 04.00 – 16.00 WIB. In one trip, 3 – 4 *haulings* are carried out. The system for results used If The number of ABK 2 people is: the number settlement reduced amount cost operational the result is profit. Profit the divided into five parts that is boat, engine, owner, and 2 crew members (the crew members including 1 owner ship). Same as results profit divided into two parts. One part For owner ship (maintenance ships, machines and tools catch), one part in the division number of crew members.

Scratch own construction that is rope main, *frame* (frame made from iron), and bags net.



Figure 1. Scratching in Cirebon Regency

Source: 2020 Research

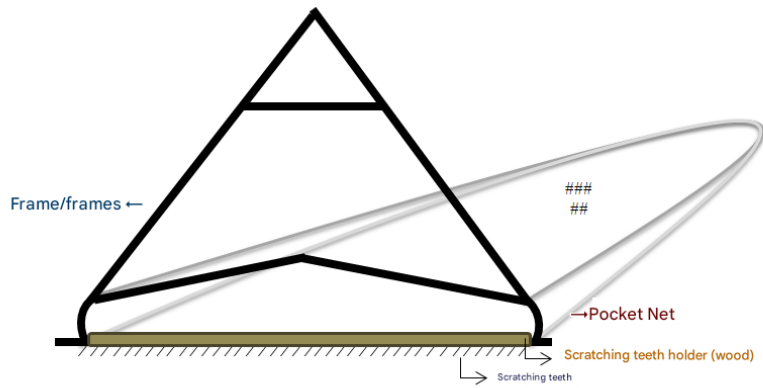


Figure 2. Construction Scratch

Source: 2020 research results

Parts tool catch scratching in Cirebon Regency is presented in the following table.

Table 3. Parts tool catch scratch in Cirebon Regency

No	Part	Material	Size
1	Bang or frame (triangle same foot)	Iron	Diameter: 1.5 cm Side length: 2 m Opening Length mouth: 2.5 m
2	Net pocket	PE	Diameter: 3 inches, 1 inch Length: 3 m
3	Pull rope scratch	PE	Diameter: 0.7 cm Twist direction: Z Length: 70 – 90 m
4	Seat tooth scratch	Wood	Length: 2 m
5	Tooth	Iron / Nail	Length: 15 cm Distance between teeth : 2.5 cm Total : 65
6	Ballast	Rock	-

Source: 2020 research results

Fishing Gear Status Scratch

Scratching in Cirebon including into the tool catch *dredged net* . Based on results research tool catch the scratch used Cirebon fishermen including into the category tool catch not enough friendly environment with amount score 22.75. This is because of scratch only fulfil a number of criteria tool catch friendly environment based on CCRF. Here is results evaluation score tool catch scratch:

Table 4. Assessment results scratch friendly environment

Criteria	Respondents												Score	
	1	2	3	4	5	6	7	8	9	10	11	12		
1	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00

2	1	1	1	1	1	1	1	1	1	1	1	1	1	1,00
3	2	3	3	3	4	4	3	3	4	4	4	4	4	3,42
4	4	4	3	3	1	1	3	3	3	3	4	4	4	3,00
5	3	3	3	3	4	4	3	3	4	4	4	4	4	3,50
6	2	2	2	2	2	2	2	2	2	2	2	2	2	2,00
7	2	2	2	2	2	2	2	2	2	2	2	2	2	2,00
8	4	4	4	4	4	3	3	4	4	4	4	4	4	3,83
9	3	3	3	3	3	3	3	3	3	3	3	3	3	3.00
Amount score category													22.75	

Table 5. Percentage results evaluation scratch friendly environment

No	Criteria	Score (%)			
		1	2	3	4
1	High selectivity	100	-	-	-
2	Does not damage the habitat, place live and thrive fish and organism breeding other	100	-	-	-
3	Produce quality fish Good .	-	8.3	41.7	50
4	No harm fisherman	16.7	-	50.0	33.3
5	Product No endanger health consumer	-	-	50.0	50
6	Minimum wasted catch	-	100	-	-
7	Minimum impact on diversity resource biodiversity	-	100	-	-
8	Didn't catch protected species	-	-	16.7	83.3
9	Accepted socially	-	-	100	-

Explanation about results evaluation scratch is as following:

Fishing gear must own high selectivity

Scratch own mark low selectivity that is with score 1. All tool the catch under investigation catch more from three species with different sizes far. The catch main scratch that is type shellfish. Type of shellfish caught dominated by shellfish blood (*Anadara granosa*). Shellfish others caught that is shell feathers (*Anadara pilula*), batik clams (*Paphia undulata*), and shellfish Putian. The catch side that is crab, shrimp white, ball sea cucumber or what is called ondol-ondol fishermen. According to Nofrizal et al. (2018)¹⁶, tools fishing that is not selective naturally influential to fish communities and populations in waters .

Fishing gear used No destroy habitat, place live and thrive fish and organism breeding other

Scratch is tool catch that destroys habitat, place live and thrive breed fish and other organisms with score 1. Scratch own iron frame construction, body/ bag, and teeth made from iron. scratch including into the tool catch *dredged net* operated on the bottom waters. In its operation tooth the will to stick into the base waters and plowing substrate waters. Substrate plowed waters will experience upheaval so that can destroying the habitat of the biota that live there immerse self in substrate waters and habitat for demersal fish and coral. In addition waters will become cloudy. According to Iskandar et al. (2014), way operation scratch give disturbance which

result in decrease abundance, diversity, biomass and loss place spawning and area nursery as consequence ongoing raking in a way continuously.

Produce quality fish Good

Based on results research 8.3% results catch in condition dead, fresh and disabled physical. 41.7% results catch in condition dead and fresh. As much as 50% of the results catch in condition alive. Fishing gear produce quality fish Good with score 3.42.

Condition results diverse catch because of a number of matter namely; duration of operation arrest, and form the body of the fish. Usually shellfish and crab in condition alive. There are also results dead and disabled catch because of withdrawal net by ship for 1 - 2 hours. The fish that are first formerly caught will squeezed and rubbed with net, so that potential experience disability even dead Because fatigue.

No harm fisherman

As many as 16.7% of fishermen state Usage tool catch potential result in death. 50% of fishermen state Usage tool catch potential result in disabled physical in nature Meanwhile. 33.3% of fishermen other state tool capture and use safe for fishermen. Operation scratch No endanger fisherman with score 3.00. Fisherman state that there is case upside down ship at the time operation arrests resulting in sinking fishermen. This is can cause death. Accident other happen consequence fishermen's feet get entangled in the rope main moment withdrawal net. And stepped on tooth scratching by fishermen which resulted in wound in the leg section.

According to Putra et al. (2017), the factors safety boat and also fisherman is things to do attention for success a operation fishing. Accidents that occur among them is boat sinking, ship stranded, ship fire, ship collision, and the ship backwards.

Product No endanger health consumer

Based on results research 50% results catch can very small chance for disturbance consumers. And 50% of the results catch other safe for consumers.

All over fisherman state No use material preservative dangerous For preserving fish. The catch washed by sea water and separated from rubbish Then stored in hatch. Some fisherman give ice to guard freshness of fish. There are dead and disabled fish will very small chance for disturbance consumers.

Minimum wasted catch

Catch side more of 3 species and behavior in the market as well as utilized by fishermen so that score For results The minimum discarded catch is 2. Percentage results catch side bigger in comparison results catch main. Fisherman to express that in one time at sea Can get shellfish as much as 2 – 3 quintals, and the results catch other as much as 20 – 30 kg. The catch shell dominated by shellfish blood with price sell Rp. 4000, -/kg in condition raw, and Rp. 35,000, -kg already boiled. While price results catch side ranging from Rp. 40,000, - - Rp. 50,000, - /kg.

Fishing gear used must give minimum impact on diversity resource biodiversity

Fishing gear used give minimum impact on diversity resource biodiversity with score 2. Fishing gear and methods its operation cause death a number of species and destroy habitats. Fishing gear scratch can give impact to resource biological Because construction a tool that has teeth. iron teeth the will to stick and poke base waters. Tooth length which is 15 cm with distance between tooth which is 2.5 cm. Shells size Not yet mature gonads and fish seeds caught

Based on results research by Iskandar et al. (2014), results catch scratch obtained part big is in the range of 13.23 - 21.20 mm. When seen from size shellfish at the time First gonads mature then in a way dominant tool catch scratch Lots catch under size worthy catch shellfish first mature gonads at size long shell about 18mm - 20mm

Didn't catch protected species Constitution or threatened extinct

Based on results research 16.7% of fishermen declared protected fish Once caught, as many as 83.3% others declared protected fish No Once caught.

Cases of protected biota being caught are very rare. happen even there is fishermen who don't Once find protected biota caught. Some tool catch Once catch turtle and shark However released return so that the score obtained which is 3.83.

Accepted in a way social

Fishing gear This accepted in a way social with score 3 because covers sub criteria cost investment cheap, profitable in a way economy, and not contradictory with existing culture. Fishing gear used for Rp. 300,000 per unit. In one capture usually fisherman using 3 units, so that costs incurred For tool catch which is Rp. 900,000, -. The cost the cheaper when in comparison with price tool catch others. Income earned fisherman in one trip around between Rp. 1,000,000 - Rp. 2,000,000.

Fishing gear No contradictory with existing culture, but contradictory with applicable regulation. Based on results study fisherman use means fishing (ships) measuring 2 and 3 GT. Based on Regulation of the Minister of Maritime Affairs and Fisheries Republic of Indonesia (2016), tools catch rake forbidden operated on the track I (A) arrest (0-2 nautical miles). In addition there is conflict with fisherman net Because equality area operation tool catch namely at the base waters. Fishing gear scratch often crash net and or net shrimp. Some fisherman state that scratch that is carried net replaced by the boss.

Conclusion

Based on the research results, it can be concluded that the Garuk fishing gear is included in the category of less environmentally friendly fishing gear. This is because it does not meet several criteria for environmentally friendly fishing gear such as: low level of selectivity and has a broad impact on fishery resources and natural resources.

References

- Abdulaziz, M. H., Aziz, N. B., & Aristi, D. P. F. (2018). Analisis keramahan lingkungan alat tangkap di Kabupaten Demak. *Journal of Fisheries Resources Utilization Management and Technology*, 7(2), 89–95.
- Darmono, O. P., Sondita, M. F., & Martasuganda, S. (2016). Teknologi penangkapan ikan baronang (*Siganus* sp.) ramah lingkungan di perairan Kepulauan Seribu [Tesis]. Bogor: Institut Pertanian Bogor.
- Deni, S. (2015). Karakteristik mutu ikan selama penanganan pada kapal KM. Cakalang. *Jurnal Ilmiah Agribisnis dan Perikanan (Agrikan Ummu-Ternate)*, 8(2), 72–80. <https://doi.org/10.29239/j.agrikan.8.2.72-80>
- Dinas Kelautan dan Perikanan Kabupaten Cirebon. (2015). *Laporan Dinas Kelautan dan Perikanan Kabupaten Cirebon*.
- FAO. (1996). *Code of conduct for responsible fisheries*. FAO Fisheries.

- Firdaus, I., Aristi, D. P. F., Sardiyatmo, & Faik, K. (2017). Analisis alat penangkap ikan berbasis Code of Conduct for Responsible Fisheries (CCRF) di Tempat Pelelangan Ikan (TPI) Tawang, Kendal. *Saintek Perikanan*, 13(1), 65–74. <https://doi.org/10.14710/ijfst.13.1.65-74>
- Indrawasih, R., & Wahyono, A. (2009). Pengoperasian jaring arad di perairan Pantai Utara Jawa: Masalah dan penyelesaiannya. *Jurnal Kebijakan dan Riset Sosial Ekonomi Kelautan dan Perikanan*, 4(1). <http://dx.doi.org/10.15578/jsekp.v4i1.5821>
- Iskandar, D., & Ade, G. (2014). Efisiensi teknis dan ekonomi alat tangkap garuk dan peluang pengembangannya di Desa Rawameneng, Kabupaten Subang. *Maspari Journal*, 6(2).
- Kartawijaya, T., Ardani, Eddy, H., Didin, K., Arinto, K. J., Imanuel, M. T., Suri, P. F., Iwan, D., Soraya, G., Styliia, J. J., & Kaharuddin, S. (2011). Analisis tingkat keramahan lingkungan alat tangkap trammel net di Teluk Palabuhanratu. *Buletin PSP*, 19(3), 253–266.
- Keputusan Menteri Kelautan dan Perikanan Republik Indonesia Nomor Kep.06/Men/2010 tentang alat penangkapan ikan di wilayah pengelolaan perikanan negara Republik Indonesia.
- Kurniawan, W., Agus, R., & Amani, E. S. (2017). Uji operasional alat tangkap ramah lingkungan jaring ciker (jaring tiga lapis atau trammel net). *Buletin Teknik Litkayasa*, 15(1), 47–55. <http://dx.doi.org/10.15578/btl.15.1.2017.47-55>
- Kurohman, F., Shasa, C., & Azis, N. B. (2018). Studi kasus penangkapan ikan yang ramah lingkungan di pangkalan pendaratan ikan (PPI) Celong, Kabupaten Batang. *Indonesian Journal of Fisheries Science and Technology (IJFST)*, 14(1), 63–69. <https://doi.org/10.14710/ijfst.14.1.63-69>
- Limbong, I., Ariani, F., & Heriyanto, T. (2019). The Composition of Fish Capture and Level of Environmental Gill Net in Kuallo Sokkam North Sumatera. *Jurnal Sumberdaya Akuatik Indopasifik*, 3(2), 75-80. <https://doi.org/10.46252/jsai-fpik-unipa.2019.Vol.3.No.2.70>
- Mahendra, F., Aristi, D. P. F., & Arisyanto. (2015). Analisis hasil tangkapan arad modifikasi (modified small bottom trawl) di perairan PPP Tawang Kendal, Jawa Tengah. *Journal of Fisheries Resources Utilization Management and Technology*, 4(1), 60–69.
- Menteri Kelautan dan Perikanan Republik Indonesia. (2015). *Peraturan Menteri Kelautan dan Perikanan Republik Indonesia Nomor 2/PERMEN-KP/2015 tentang Larangan Penggunaan Alat Penangkapan Ikan Pukat Hela (Trawls) dan Pukat Tarik (Seine Nets) di Wilayah Pengelolaan Perikanan Negara Republik Indonesia*.
- Menteri Kelautan dan Perikanan Republik Indonesia. (2016). *Peraturan Menteri Kelautan dan Perikanan Republik Indonesia Nomor 71/PERMEN-KP/2016 tentang Jalur Penangkapan Ikan dan Penempatan Alat Penangkapan Ikan di Wilayah Pengelolaan Perikanan Negara Republik Indonesia*
- Menteri Lingkungan Hidup dan Kehutanan. (2018). *Peraturan Menteri Lingkungan Hidup dan Kehutanan Republik Indonesia Nomor P.20/Menlhk/Setjen/Kum.1/6/2018 tentang Jenis Tumbuhan dan Satwa yang Dilindungi*.
- Nababan, B. O., Tridoyo, K., Luky, A., & Achmad, F. (2020). Analisis ekonomi alat penangkapan ikan arad di Pantai Utara Provinsi Jawa Tengah. *Jurnal Sosek KP*, 15(1), 1–14. <http://dx.doi.org/10.15578/jsekp.v1i1.8492>

- Nofrizal, R., Romie, J., Alit, H. Y., & Alfin. (2018). Hasil tangkapan sampingan (bycatch dan discard) pada alat tangkap gombang (filter net) sebagai ancaman bagi kelestarian sumberdaya perikanan. *Marine Fisheries*, 9(2), 221–233.
- Noviyanti, R. (2017). Adaptasi alat tangkap ramah lingkungan oleh kelompok nelayan di kawasan PPN Karangantu, Teluk Banten. Makalah seminar nasional perikanan tangkap, IPB.
- Putra, R. S., Fis, P., & Budhi, H. I. (2017). Pengelolaan keselamatan kerja nelayan di PPI Batukaras Kabupaten Pangandaran. *Albacore*, 1(1), 37–46.
- Rofiqo, I. S., Zahidah, N., Nia, K., & Lantun, P. D. (2019). Tingkat keramahan lingkungan alat tangkap jaring insang (gillnet) terhadap hasil tangkapan ikan tongkol (*Ethynnus sp.*) di perairan Pekalongan. *Jurnal Perikanan dan Kelautan*, 10(1), 64–69.
- Sumardi, Z., Ali, S. M., & Nasir, M. (2014). Alat penangkapan ikan yang ramah lingkungan berbasis *Code of Conduct for Responsible Fisheries* di Kota Banda Aceh. *Agriseip*, 15(2), 10–18. <https://doi.org/10.24815/agriseip.v15i2.2094>
- Suparmoko. (2003). *Penilaian ekonomi sumberdaya alam dan lingkungan: Konsep dan metode perhitungan*. LPPEM Wacana Media.
- Supriadi, D., Ega, F. P., & Restu, W. (2020). Pengaruh berbagai faktor produksi terhadap hasil tangkapan jaring kejer (Bottom Gillnet) di perairan Kabupaten Cirebon. *Jurnal Akuatek*, 1(1), 18–26.
- Tamarol, J., Alfret, L., & Johnny, B. (2012). Dampak perikanan tangkap terhadap sumberdaya ikan dan habitat di perairan pantai Tabukan Tengah, Kepulauan Sangihe. *Jurnal Perikanan dan Kelautan Tropis*, 8(1), 12–16. <https://doi.org/10.35800/jpkt.8.1.2012.387>
- Wijaya, D. P., Emil, R., Lefrand, M., & Telleng, A. T. R. (2016). Ghost fishing pada perikanan bubu di perairan Sario Tumpaan Teluk Manado, Provinsi Sulawesi Utara. *Jurnal Ilmu dan Teknologi Perikanan Tangkap*, 2(3), 109–112. <https://doi.org/10.35800/jitpt.2.3.2016.11447>
- Zulkhairiansyah. (2013). Studi ramah lingkungan alat tangkap trammel net di perairan Suak Seumaseh Kecamatan Samatiga Kabupaten Aceh Barat [Skripsi, Universitas Teuku Umar].