InJAST
Volume 7, Number 2, October 2026
Pages: 127-133

P - ISSN: 2722 - 0133
E - ISSN: 2722 - 0141
DOI: https://doi.org/10.33751/injast.v7i2.63

Strategy for Improving Infrastructure and Supervision Facilities to Maintain Sustainable Marine and Fisheries Resources in the Indonesian Fisheries Management Area (WPP) 711 Natuna Sea

WENDY REYNOLD KUNIO ROMPAS*, SATA YOSHIDA SRIE RAHAYU, ANI IRYANI

Graduate School of Environmental Management, Pakuan University, Bogor, Indonesia

*Corresponding author: *kuniowendy@gmail.com*

Submitted 30 April 2026; Accepted 16 October 2026; Published 30 October 2026

ABSTRACT

The Fisheries Management Area of the Republic of Indonesia (WPP-RI) 711 in the Natuna Sea has significant marine and fisheries resource potential, but faces challenges such as illegal, unreported, and unregulated (IUU) fishing, limited surveillance infrastructure, and low integration of monitoring technology. This study aims to analyze the condition of monitoring infrastructure and facilities, determine priority factors, and formulate strategies to improve surveillance infrastructure and facilities to maintain sustainable marine and fisheries resources in WPP-RI 711 Natuna Sea. The study employed the Analytical Hierarchy Process (AHP) method involving multidisciplinary experts through pairwise comparisons to determine the weights of criteria and alternative strategies. The results show that the priority factors in improving surveillance infrastructure and facilities are regulation and financing, followed by technology and information system integration, availability of monitoring facilities, infrastructure conditions, and institutional and human resource capacity. The main recommended strategy is the development of a technology-based surveillance system (36.58%), followed by modernization of infrastructure and monitoring facilities (33.88%), strengthening regulations and financing schemes (17.01%), and enhancing human resource and institutional capacity (12.52%). The implementation of these strategies is expected to improve monitoring effectiveness, expand surveillance coverage, accelerate response to violations, and support sustainable management of marine and fisheries resources in the Natuna Sea.

Keywords: *AHP; fisheries surveillance; infrastructure and facilities; Natuna Sea; WPP-RI 711*

INTRODUCTION

The sea is one of the largest natural resources that has extraordinary economic and ecological potential for the welfare of the Indonesian people. With an area of around 6.4 million km², Indonesia is known as an archipelagic country with the largest marine biodiversity in the world (Basrial & Yandi, 2019). This potential is not only in the form of capture fisheries, but also includes environmental services, marine tourism, and non-biological resources such as oil and gas (World Bank, 2021). However, behind this abundant potential, the use of marine resources is often not accompanied by effective and sustainable management. As a result, various problems arise such as overexploitation, marine pollution, and illegal fishing practices that threaten the sustainability of marine ecosystems (Gou & Yang, 2023).

In the context of the blue economy, marine resource management is not only oriented towards increasing production yields, but also maintaining ecological balance for future generations (World Bank, 2021). This approach emphasizes that the sustainability of marine resources can only be realized if the supervisory system, infrastructure, and legal policies are integrated. The main challenges in many Indonesian waters are weak monitoring capacity, limited infrastructure and means of controlling fishery activities, and low coordination between relevant agencies (Hafsaridewi et al., 2018). This condition leads to vulnerability to Illegal, Unreported, and Unregulated (IUU) fishing practices, resulting in large economic losses and declining fish populations in national waters (Gou & Yang, 2023). From October 2024 to October 2025, the Ministry of Maritime Affairs and Fisheries through the Directorate General of Marine Resources and Fisheries Supervision managed to arrest as many as 326 units of illegal fishing vessels, consisting of 297 units of Indonesian fishing vessels (KII) and 29 units of foreign fishing vessels (KIA). From this performance, the valuation of potential state losses that have been saved is IDR 3.59 trillion.

One of the areas that has strategic significance in the management and supervision of Indonesia's marine resources is the Fisheries Management Area of the Republic of Indonesia (WPP-RI) 711, which includes the waters of the Natuna Sea and its surroundings. This area is directly adjacent to other countries and is an important route for industrial and traditional fisheries activities (Krisnafi et al., 2017). Due to its strategic position, the Natuna Sea is an area with high potential for pelagic fish, demersal, reef fish (grouper, napoleon), and the leading commodity of squid, but is also vulnerable to illegal fishing activities by foreign ships.

The Government of Indonesia through the Ministry of Maritime Affairs and Fisheries (KKP), especially the Directorate General of Marine Resources and Fisheries

Supervision (PSDKP), has operated a fleet of Fisheries Surveillance Vessels tasked with supervising and enforcing fisheries regulations in all Indonesian waters. These patrol vessels play an important role in preventing and cracking down on IUU fishing activities and ensuring that fishing activities are carried out in accordance with applicable regulations.

Although patrol boat operations have been intensified, their effectiveness in protecting and managing fishery natural resources in the Natuna Sea is still a question. Several studies have shown that increased patrols can reduce IUU fishing activities and help fish stock recovery (Agnew et al., 2009). However, other studies have stated that the success of patrol operations is highly dependent on the frequency and duration of patrols, as well as the support of advanced monitoring technology (Hastings et al., 2015). For this reason, the existence of adequate surveillance infrastructure and facilities is key to maintaining the sovereignty and sustainability of fish resources in the region (Abdullah & Pandamdari, 2023).

Weaknesses in the marine surveillance system not only have an impact on economic losses due to fish theft, but also pose a threat to the sustainability of Indonesia's marine ecosystem (Hafsaridewi et al., 2018). Immeasurable fishing activities result in the degradation of fish stocks and an imbalance in aquatic ecosystems. Therefore, strengthening aspects of data-based supervision and management is very important to maintain the stability of national marine resources (Trenggono, 2023). Strategies to improve infrastructure and appropriate monitoring facilities can strengthen the performance of fisheries monitoring institutions and increase the effectiveness of government policy implementation in the field (Krisnafi et al., 2017).

The phenomenon that occurs in the field shows that IUU fishing activities are still rampant in the Natuna Sea area. Foreign ships often enter Indonesian waters without a permit, especially around WPP-RI 711, causing economic losses of up to trillions of rupiah every year (Abdullah & Pandamdari, 2023). In addition, limited facilities such as base ports, communication equipment, and inadequate patrol fleets cause the implementation of supervision to be not optimal (Krisnafi et al., 2017). In fact, this area is one of the national strategic priority areas that must be maintained in terms of its sustainability considering the high potential for marine products and its proximity to the Exclusive Economic Zones (EEZs) of other countries (World Bank, 2021).

Based on previous phenomena and studies, there is a research gap that shows that previous studies still focused on the aspects of determining work areas and legal frameworks without elaborating on a comprehensive strategy to improve infrastructure and monitoring facilities in the WPP-RI 711 area, even though the integration of technical, managerial, and policy approaches is the key to the success of effective marine surveillance (Hafsaridewi et al., 2018). This research offers novelty by formulating strategies to strengthen infrastructure and monitoring facilities systematically to support the implementation of measured fishing in the Natuna Sea, which is based on the synergy between strengthening physical infrastructure, institutional capacity, and optimizing regulations based on scientific data.

Taking into account this background, it is necessary to conduct research on "Strategies for Improving Infrastructure and Monitoring Facilities to Maintain Sustainable Marine Resources and Fisheries in WPP-RI 711 in the Natuna Sea." This research was conducted to answer the strategic need to strengthen Indonesia's marine surveillance in an integrated and sustainable manner, in order to maintain the sovereignty and resilience of national fishery resources.

The Analytical Hierarchy Process (AHP) approach is used in this study as a multicriteria decision-making tool, which allows researchers to develop strategies based on priorities and weights of various stakeholders. With this approach, it is hoped that the results of the research will be able to provide applicable and relevant policy recommendations in facing the challenges of managing fishery resources in the waters of the Natuna Sea.

METHODS

Obtained from the research will be analyzed using the AHP method which is a method that can be used in various qualitative studies, such as decision-making (Rusydiana and Jarkasih, 2010). In the model proposed in this study, there are at least 3 levels of hierarchy as follows (Figure 1).

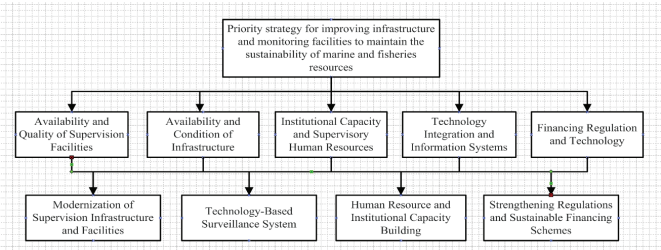


Figure 1. Hierarchical structure of alternative selection of policy strategies.

The questions in the AHP questionnaire are in the form of pairwise comparison between elements in the cluster to be able to find out which of the two elements has greater influence and is more dominant and how big the difference is when viewed from one side (Rusydiana and Jarkasih, 2010). The numerical scale of 1 - 9 is used, which is a translation of the verbal assessment. The filling out of the questionnaire by the respondents must be accompanied by the researcher to maintain the consistency of the answers given. In general, the questions on the AHP questionnaire are very numerous.

© Pakuan University

So that non-technical factors can cause a high level of inconsistency.

Graphically, the problem of AHP decisions can be constructed as a tiered diagram (hierarchy). The steps in the AHP method include:

1. Organize the hierarchy
   The first stage in the AHP method is to identify the factors that cause the problem. The causative factors can be expanded into criteria in decision-making. Defining the problem and determining the desired solution, then arranging a hierarchy of the problems faced. Hierarchical arrangement is setting goals that are the goals of the system as a whole at the top level. Hierarchical preparation by determining what is faced which is the goal of the system as a whole. The problem is solved, described into its elements, namely goals, criteria and alternatives, then arranged into a hierarchical structure.
2. Evaluation of criteria and alternative strategies
   Assessment of criteria and alternative strategies through paired comparison. According to Saaty (2016), for various problems, scales 1 to 9 are the best scale in expressing opinions. The value and definition of qualitative opinions from the comparative assessment scale. The criteria comparison assessment scale is based on expert assessment using the pairwise comparison method. The pairwise comparison assessment scale is as follows (Table 1).

Table 1. Paired comparison assessment scale (Saaty, 2016).

Intensity Importance	Remarks	Explanation
1	Both elements are equally important	Two elements have an equally great influence on the purpose
3	One element is a little more important than the other	Experience and judgment favor one element more than the other
5	One element is more important than the other	Experience and judgment are very strong in favor of one element over the other
7	One element is clearly more important than the other	A strong supported and dominant element is seen in practice
9	One element is absolutely essential to the other	Evidence in favor of one element against another has the highest level of affirmation that is likely to corroborate
2,4,6,8	Values between two adjacent considerations	This value is given when there are two compromises between two options
The Opposite	If for activity i gets one number compared to activity j, then j has the opposite value compared to i	

3. Prioritization
   Each level of the hierarchy needs to be compared in pairs to determine priorities by comparing one element with another against a specified criterion (Priandika, 2016). Priority determination is carried out by the subjectivity of experts who have understood the problem or have an interest in the problem. Then by giving weight to each element according to its nature priority. The relative comparison value is then processed to determine the relative ranking of all alternatives. Weight or priority is calculated through mathematical equations (Rahadian, 2016).
4. Consistency validation
   Basically, AHP can be used to process data from one expert respondent. However, in its application, the assessment of criteria and alternatives is carried out by several multidisciplinary experts. Consequently, the opinions of several experts need to be checked for consistency one by one.

   Consistent opinions are then combined using geometric averages (Malik & Haryanti, 2018). The formula for index consistency is:

$$CI = \frac{\lambda - n}{n-1}$$

   CI = Consistency Index
   λ = rage score of the overall criteria
   N = Number of comparison matrices according to criteria
5. Calculation Consistence Ratio (CR)
   CR is consistent if the assessment results are ≤10%, if the Consistent Ratio (CR) is > 10% of the consideration must be corrected.

$$CR = \frac{CI}{RI}$$

   CR = Consistency Ratio
   CI = Consistency Index
   RI = Random Index

   The RI value is a value issued by Oarkridge Laboratory in the form of a matrix size table along with its random index (Saaty, 1990).

In preparing the implementation of a monitoring and control policy strategy to maintain the sustainability of fishery resources, it requires a tactical, efficient and effective approach in determining priority policies through the Analytical Hierarchy Process (AHP) approach which is formulated through consideration of the attributes that are influential for the determination of policy strategies based on experience, expertise, field data, and literature studies that are considered by stakeholder assessments.

RESULT AND DISCUSSION

Consistency Ratio

Consistency Ratio (CR) in AHP is very important, because CR shows the consistency of the expert in answering the questionnaire. The maximum limit for an expert to consistently answer the questionnaire question is indicated by a CR value below 10%. If the CR of the prospective expert exceeds 10%, it will be replaced. The results of the individual assessment of 4 experts show that the highest CR is found in 4 experts with a CR value of 10.72%, while the lowest CR is in expert 2 and expert 3. The results of the CR show that all experts are still in a consistent range in answering questions from the paired comparison questionnaire can be seen in Table 2.

Table 2. Consistency Ratio of each expert's assessment.

No	Responden (Experts)	Strategies for Improving Infrastructure and Monitoring Facilities (%)	Availability and Quality of Monitoring Facilities (%)	Availability and Infrastructure Conditions (%)	Institutional Capacity and Human Resources of Supervisors (%)	Technology Integration and Information Systems (%)	Regulation and Financing Technology (%)
1	1	9,59	4,12	3,95	8,32	4,12	6,71
2	2	2,99	0,00	9,00	8,32	4,12	6,71
3	3	5,38	0,28	0,28	4,12	0,00	5,69
4	4	9,62	5,02	9,00	8,32	4,12	10,72

Prioritizing Criteria

Based on the results of the expert assessment of the level of criteria, it was found that the regulatory criteria and financing technology have a higher priority weight than the other 4 criteria of 31.97%, which can be seen in Table 3. Regulation and financing technology are the main criteria and as a priority criterion in the strategy to improve infrastructure and monitoring facilities. Criteria Regulation and financing technology indicate the importance of maintaining sustainable marine and fisheries resources.

Table 3. Weighting of Criteria for Infrastructure and Monitoring Facilities Improvement Strategy.

Criteria	Weight (%)
Availability and Quality of Monitoring Facilities	20,08
Availability and Infrastructure Conditions	17,47
Institutional Capacity and Human Resources of Supervisors	8,81
Integration of Technology and Information Systems	21,68
Regulation and Financing Technology	**31,97**

Table 3 shows the priority criteria in determining the strategy for improving infrastructure and surveillance facilities. The criteria with the highest weight after regulation and financing technology are the integration of technology and information systems, the availability and quality of supervision facilities, the availability and condition of infrastructure facilities, and the institutional capacity and supervisory human resources, with a weight of 21.68% each; 20,08%; 17,47%; and 8.81%. The results of the analysis used AHP from 5 criteria used as the basis for evaluating policy strategies, strategies for improving infrastructure and means of supervision.

Alternative Policy Strategies

Improving infrastructure and monitoring facilities is an important factor in supporting the sustainability of marine and fishery resources. The sustainability of marine resource management is not only determined by good policies, but also by the effectiveness of a monitoring system that is able to ensure compliance with resource utilization rules. Supervision is part of the management function that aims to ensure the implementation of activities in accordance with the plan and take corrective actions if deviations occur (Terry, 2013). In the context of fisheries management, supervision is an important instrument to prevent overexploitation and ensure the sustainability of resources.

Improving supervision infrastructure plays a role in strengthening the state's presence in fisheries management areas. The availability of monitoring posts, operational buildings, docks, and other supporting facilities allows officers to directly monitor marine and fishery resource utilization activities. Supervision infrastructure is a facility used to support the implementation of supervision consisting of land, monitoring posts, operator buildings, warehouses, and other supporting facilities that support monitoring activities effectively and sustainably (Kementerian Kelautan dan Perikanan, 2021). With adequate infrastructure, coordination between monitoring units can run more optimally and response to violations can be carried out faster.

On the other hand, the improvement of monitoring facilities has a significant impact on the ability to detect early detection of fishing activities that do not comply with the provisions. Monitoring facilities include patrol boats, vessel monitoring systems, radar, and communication devices used to support the effective implementation of monitoring, control, and surveillance. The Monitoring, Control, and Surveillance (MCS) approach is an integrated surveillance system that combines monitoring of fishery activities, licensing control, and field supervision to ensure compliance with fisheries regulations (Food and Agriculture Organization, 2017).

The results of previous research show that the improvement of monitoring facilities and infrastructure has a significant effect on the effectiveness of fisheries resource management. Research conducted by Pomeroy and Andrew (2011) states that the success of small-scale fisheries management is largely determined by the availability of monitoring infrastructure and adequate operational capacity. Good monitoring infrastructure allows for increased fishermen's compliance with

© Pakuan University

regulations and reduces the rate of resource utilization violations.

In addition, research by Kurniawan (2020) shows that the limitations of patrol facilities and monitoring technology cause the supervision of marine resources to be suboptimal, thereby increasing the risk of illegal fishing practices. Therefore, the improvement of surveillance facilities such as patrol boats, VMS systems, and integrated command centers is a major need to support effective supervision.

Another study conducted by Agnew et al. (2009) also showed that weak monitoring facilities are one of the main factors in the occurrence of IUU fishing practices in various fisheries regions around the world. The study confirms that countries that have a strong surveillance system with the support of monitoring technology and an adequate patrol fleet tend to have lower violation rates and more sustainable resource management. Thus, the improvement of monitoring facilities not only has an impact on law enforcement aspects, but also on the sustainability of fish resource stocks.

Furthermore, improving infrastructure and monitoring facilities supports the implementation of sustainable fisheries management principles. The existence of an effective monitoring system allows the government to obtain more accurate data on fishing activities, distribution of fishery businesses, and the level of resource utilization. This data is the basis for the formulation of science-based fisheries management policies, such as modernization of infrastructure and monitoring facilities, technology-based monitoring systems, human resource and institutional capacity building, and strengthening regulations and financing schemes. Thus, improving infrastructure and monitoring facilities not only serves as a tool for law enforcement, but also as an important instrument in maintaining a balance between economic utilization and sustainable sustainability of marine and fishery resources (Food and Agriculture Organization, 2020).

The results of the calculation of alternative priorities for infrastructure improvement strategies and monitoring facilities from AHP show that the alternative technology-based surveillance system strategy is the alternative with the highest weight compared to the other 3 alternatives can be seen in Table 4.

Table 4. Hierarchy and priorities of sustainable fisheries resources surveillance policy strategy.

Goal	Alternative Strategies	Priorities (%)
Strategy to Improve Infrastructure and Monitoring Facilities to Maintain the Sustainability of Fishery Resources	Modernization of infrastructure and means of supervision	33.88
	Technology-based surveillance system	36.58
	Increasing the capacity of human resources and institutions	12.52
	Strengthening of regulations and financing schemes	1701

Policies to improve infrastructure and monitoring facilities to maintain the sustainability of fishery resources require synergy between state forces (regulations), local actors (fishers & business actors), academic communities (scientific databases & evaluations). Focus on modernizing infrastructure and monitoring facilities, technology-based supervision systems, increasing human resource and institutional capacity, and strengthening regulations and financing schemes.

Based on a combination of criteria, the priority order of policies for improving infrastructure and monitoring facilities to maintain the sustainability of fishery resources is obtained as follows: (1) a technology-based supervision system with a priority weight of 36.58%, followed by the second priority, namely the modernization of infrastructure and monitoring facilities with a priority weight of 33.58%. The next alternative strategy is strengthening regulations and financing schemes, and regulatory enforcement, and increasing human resource and institutional capacity with priority weights of 17.01%, and 12.52%, respectively.

Based on the results of the analysis using the Analytical Hierarchy Process (AHP) method, the priority strategy in improving infrastructure and monitoring facilities to maintain the sustainability of marine and fishery resources in WPP-RI 711 Laut Natuna shows that a technology-based supervision system is an alternative strategy with the highest weight of 36.58%. The next priority is the modernization of infrastructure and monitoring facilities by 33.88%, then the strengthening of regulations and financing schemes by 17.01%, and the increase in human resource and institutional capacity by 12.52%. These results show that increasing technology-based supervision is the main strategy in maintaining the sustainability of fishery resources in the Natuna Sea area which has the characteristics of large waters, is directly adjacent to other countries, and is prone to IUU fishing activities (Saaty, 2008; Food and Agriculture Organization, 2017).

The first priority in the form of a technology-based surveillance system reflects the urgent need for the use of technology to support the effectiveness of surveillance in WPP-RI 711. The use of technologies such as the Vessel Monitoring System (VMS), Automatic Identification System (AIS), coastal radar, and satellite-based remote sensing allows for real-time monitoring of ship activities. The geographical conditions of the Natuna Sea are vast and directly adjacent to international waters cause conventional patrol-based surveillance alone to be ineffective. Therefore, technology integration is the main strategy to increase the scope of surveillance, accelerate the detection of violations, and improve the operational efficiency of surveillance (Food and Agriculture Organization, 2017; Agnew et al., 2009).

The second priority, namely the modernization of infrastructure and monitoring facilities, shows the importance of improving physical facilities and operational tools in supporting supervision. The modernization includes the construction and improvement of surveillance posts in the strategic area of Natuna, strengthening surveillance piers, procuring fast patrol boats, and providing an integrated surveillance command center. The existence of modern infrastructure and facilities will increase the state's presence in border areas and accelerate responses to violations. In addition, modernization of surveillance facilities also supports the optimal implementation of technology-based surveillance systems through integration between command centers, patrol fleets, and digital monitoring systems (Kementrian Kelautan dan Perikanan, 2021; Pomeroy & Andrew, 2011).

The third priority, namely strengthening regulations and financing schemes, shows that the success of improving infrastructure and monitoring facilities is highly dependent on policy support and sustainable funding. Strengthening regulations is needed to ensure the implementation of the monitoring system runs effectively, including regulating the obligation to install ship monitoring devices, data exchange mechanisms between agencies, and law enforcement against violations. Meanwhile, innovative financing schemes such as collaboration between central and regional governments, international cooperation, and the use of performance-based financing schemes are important to support the sustainability of surveillance operations in the Natuna Sea region (Food and Agriculture Organization, 2020; Kurniawan, 2020).

The last priority is to increase the capacity of human resources and supervision institutions to remain an important factor in supporting the implementation of other strategies. Supervisory human resources who have competence in the operation of monitoring technology, analysis of surveillance data, and law enforcement at sea are very necessary. In addition, institutional strengthening through coordination between agencies such as the Indonesian Navy, Bakamla, and local governments is also the key to creating an integrated supervision system. With adequate human and institutional capacity, the implementation of technology-based supervision systems and infrastructure modernization can run optimally (Pomeroy & Andrew, 2011; Terry, 2013).

CONCLUSION

The condition of the infrastructure and monitoring facilities in WPP-RI 711 Natuna Sea is still not optimal in supporting the sustainable supervision of marine and fishery resources. The limitations of surveillance posts in strategic areas, the uneven distribution of surveillance dock facilities, the limitation of patrol fleets, and the lack of integration of technology-based surveillance systems are the main obstacles in the implementation of supervision. These conditions have an impact on the suboptimal scope of supervision in the vast Natuna Sea area and directly adjacent to international waters.

Based on the results of the analysis of the Analytical Hierarchy Process (AHP), the priority factors in improving infrastructure and supervision facilities consist of regulation and financing as the most dominant factors, followed by the integration of technology and information systems, the availability of supervision facilities, the availability of supervision infrastructure, and the capacity of human resources and institutions. These results show that increasing supervision does not only depend on the availability of physical facilities, but also requires policy support, sustainable funding, and integration of supervision technology.

The priority strategy for improving infrastructure and monitoring facilities in WPP-RI 711 Natuna Sea based on the results of the AHP analysis shows that a technology-based supervision system is the main strategy. This strategy is followed by modernization of infrastructure and supervision facilities, strengthening regulations and financing schemes, and increasing the capacity of human resources and supervision institutions. The implementation of this strategy is expected to increase the effectiveness of supervision, expand the scope of monitoring, accelerate the response to violations, and support the sustainable use of marine and fishery resources in the Natuna Sea.

Thus, the improvement of infrastructure and supervision facilities in WPP-RI 711 Natuna Sea needs to be carried out in an integrated manner through the development of a technology-based supervision system, modernization of supervision infrastructure, strengthening regulations and financing, and increasing the capacity of human resources and institutions to support the sustainable management of marine and fishery resources.

REFERENCES

Abdullah, R., & Pandamdari, E. (2023). Analisis yuridis penangkapan ikan oleh kapal asing yang menangkap ikan di Indonesia. Reformasi Hukum Trisakti, 5(3), 1–15.

Agnew, D. J., Pearce, J., Pramod, G., Peatman, T., Watson, R., Beddington, J. R., & Pitcher, T. J. (2009). Estimating the worldwide extent of illegal fishing. *PLOS ONE, 4(2)*, e4570.

Basrial, Z., & Yandi, R. (2019). Kepemilikan terhadap sumber daya alam. *Jurnal Istikhlaf, 1(1), 1–10*.

Food and Agriculture Organization. (2017). *Fisheries monitoring, control and surveillance (MCS).* FAO.

Food and Agriculture Organization. (2020). *The state of world fisheries and aquaculture 2020*. FAO.

© Pakuan University

Gou, Y., & Yang, C. (2023). Dilemmas and paths of international cooperation in China's fight against IUU fishing. *Marine Policy, 155, 104–112*.

Hafsaridewi, R., Sulistiono, Fahrudin, D., & Koeshendrajana, S. (2018). Resource management in the Karimunjawa Islands, Central Java of Indonesia, through DPSIR approach. *AES Bioflux, 10(1), 7–22*.

Hastings, A., Bailey, N., Bramley, G., Gannon, M., & Watkins, D. (2015). *The cost of the cuts: The impact on local government and poorer communities* (pp. 1–24). Joseph Rowntree Foundation.

Kementerian Kelautan dan Perikanan. (2021). Peraturan Menteri Kelautan dan Perikanan Nomor 17 Tahun 2021 tentang Pengawasan Sumber Daya Kelautan dan Perikanan. KKP.

Krisnafi, Y., Iskandar, B. H., Wisudo, S. H., & Haluan, J. (2017). Penentuan prioritas wilayah kerja untuk peningkatan pengawasan perikanan di WPP NRI 711. *Marine Fisheries, 8(2), 211–221*.

Kurniawan, B. (2020). Sistem pengawasan sumber daya kelautan dan perikanan di Indonesia. *Jurnal Kebijakan Perikanan Indonesia, 12(2), 85–96*.

Malik, A. Y., & Haryanti, T. (2018). Penerapan metode Analytical Hierarchy Process (AHP) untuk sistem pendukung keputusan pemilihan program keahlian pada SMK Daarul Ulum Jakarta. *Jurnal Pilar Nusa Mandiri, 14(1), 123–135*.

Pomeroy, R., & Andrew, N. (2011). *Small-scale fisheries management: Frameworks and approaches for the developing world*. CABI.

Priandika, A. T. (2016). Model penunjang keputusan penyeleksian pemberian beasiswa Bidikmisi menggunakan metode Analytical Hierarchy Process. *Jurnal Teknoinfo, 10(2), 26–31*.

Rahardian, R., Hidayat, N., & Dewi, R. K. (2018). Sistem pendukung keputusan penentuan penerima bantuan keluarga miskin menggunakan metode Analytical Hierarchy Process–PROMETHEE II. *JPTIIK, 2(5), 1980–1985*.

Rusydiana, A., & Jarkasih, M. (2010). Mengurai masalah pengembangan sukuk korporasi di Indonesia: Pendekatan metode Analytic Network Process (ANP). *Jurnal Sistem Informasi Bisnis, 2(1), 12–17*.

Saaty, T. L. (2008). Decision making with the analytic hierarchy process. *International Journal of Services Sciences, 1(1), 83–98*.

Saaty, T. L. (2016). *The analytic hierarchy and analytic network processes for the measurement of intangible criteria and for decision-making. In Multiple criteria decision analysis: State of the art surveys* (pp. 363–419).

Terry, G. R. (2013). *Principles of management*. Irwin.

Trenggono, S. W. (2023). Penangkapan ikan terukur berbasis kuota untuk keberlanjutan sumber daya perikanan di Indonesia. *Jurnal Kelautan dan Perikanan Terapan, 1, 1–10*.

World Bank. (2021). *Oceans for prosperity: Reforms for a blue economy in Indonesia* (pp. 1–80). The World Bank.