

Strategies of Optimizing VMS to preventing IUU fishing by Indonesian fishermen in Papua New Guinea

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Abstract

Illegal, unreported, and unregulated (IUU) fishing presents a substantial obstacle to the effective administration of maritime affairs, specifically in areas such as Papua New Guinea, where Indonesian fishermen partake in unlawful operations within the Exclusive Economic Zone. The primary objective of this research endeavor is to assess the effectiveness of policy interventions that target IUU fishing by Indonesian seafarers in Papua New Guinea, with a specific emphasis on the deployment of vessel monitoring systems (VMS). This research identifies significant challenges and assesses alternative approaches for improving VMS policies by employing the Analytical Hierarchy Process (AHP). The findings underscore the significance of involving stakeholders, adhering to legal and regulatory requirements, and the consequences for maritime security. Identifying education and training as the most crucial options emphasizes the importance of equipping stakeholders with the essential knowledge and abilities to efficiently utilize VMS technology. The study also stresses how important it is for agencies to work together, for VMS coverage to grow, and for infrastructure to be improved in order to make policies more effective. The Indonesian Government can enhance its regulatory capabilities regarding illegal, unregulated, and unreported (IUU) fishing, thereby promoting maritime security and sustainable fisheries management in the region, by placing an equal emphasis on education and training in conjunction with these supplementary measures.

Keywords: IUU Fishing, Vessel Monitoring System (VMS), Maritime Security, Indonesian Fishermen

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A. INTRODUCTION

Indonesian fishermen's engagement in illegal, Unreported, and Unregulated (IUU) fishing in Papua New Guinea represents a substantial obstacle for the Indonesian government in its efforts to combat unlawful fisheries. Monitoring fishing vessel movement in east Indonesia has revealed an increase in the number of Indonesian vessels entering the Exclusive Economic Zone of Papua New Guinea, where they may be engaging in illegal fishing. Between 2019 and 2023, Papua New Guinea authorities apprehended Indonesian seafarers in seventeen instances of illegal fishing. In these cases, Papua New Guinea security forces arrested 92 Indonesian fishermen; among them were actors from the fisheries sectors of Papua, Southeast Sulawesi, and South Sulawesi. Improving oversight and law enforcement is crucial to preventing illegal fishing practices (Kedutaan Besar Republik Indonesia di Port Moresby Papua Nugini, 2023a; Konsulat RI di Vanimo, 2023). There has been an observed increase in the number of boaters moving from Indonesian waters to Papua New Guinea since 2018. Overexploitation in fishing management areas (WPP) 717 and

718 has led to a decline in seafood production, including shellfish and prawns (Indonesia Ocean Justice Initiative, 2022a, 2022b). Authorities have apprehended vessels carrying fishing gear and shells in an illicit manner, providing evidence of this condition. Additionally, the abundance of high-value marine products in the waters of Papua New Guinea, including white kappa, Chinese catfish, and shrimp, encourages Indonesian fishermen to endeavor to capture fish there (Direktorat Jendral Pengelolaan Ruang Laut, 2018; Konsulat RI di Vanimo, 2023). The limitations of Papua New Guinea with regard to law enforcement and monitoring the marching country's territory do not significantly contribute to this situation (Atase Pertahanan Indonesia di Port Moresby Papua Nugini, 2023; Konsulat RI di Vanimo, 2023).

Indonesian fishermen conducting illegal fishing demonstrate the need for the Indonesian government to oversee and regulate the national fisheries sector. The government has strategically implemented a joint task force to address the issue of illicit fishing in this particular context as part of its broader endeavors to monitor and combat transgressions in the maritime domain. Enforcement measures against illicit fishing rely on the execution of efficient surveillance or monitoring systems, specifically involving patrols, deterrence, and the surveillance of fishing vessels. Act No. 31 of 2004 regulates the utilization of vessel monitoring systems through the fisheries monitoring system as one aspect of fisheries surveillance (Bachtiar, 2022; Soemarmi et al., 2020; Tawaqal et al., 2020). The Vessel Monitoring System (VMS) technology plays a critical role in overseeing the whereabouts and operations of fishing vessels, including both Indonesian and foreign vessels that enter Indonesian territorial waters. The VMS monitoring system operates by receiving a signal from the ship's transmitter. The monitoring center at the Ministry of Maritime Affairs and Fisheries relays the signal via satellite.

The data generated by VMS is used to address Illegal, Unreported, and Unregulated (IUU) fishing by identifying irregularities or suspicious activities conducted by fishing vessels. The activity data of these vessels can help determine targets and operational areas, in addition to providing evidence of violations committed by fishing ships (Bachtiar, 2022; Soemarmi et al., 2020; Tawaqal et al., 2020). Restrictions and limitations significantly impact the implementation of the Vessel Monitoring System (VMS) policy, hindering efforts to prevent illegal fishing. Small vessels, defined as those below 30 GT, frequently engage in maritime-territorial violations. This category encompasses 99.9% of all fishing ships operating within Fisheries Management Territory (WPP) 717 and 718. Since these vessels are not required to implement VMS, their potentially dubious activities may go unmonitored. Manipulating the VMS transmitter on the vessel poses an additional challenge because it compromises the precision of the data obtained from maritime operations surveillance. In situations where the maritime security authority's capabilities fall short of the extent of Indonesia's maritime operating territory, the competent maritime safety authority cannot be exempt from the responsibility of addressing illicit fishing. The June 2023 apprehension of the KMN Sanjaya 108, which comprised 28 crew members, demonstrates that Indonesia's national fishing vessel surveillance

capabilities remain deficient. With a 49-ton yield, this is one of the highest incidences of illicit fishing in Papua New Guinea, committed by a 150 GT vessel (Kedutaan Besar Republik Indonesia di Port Moresby Papua Nugini, 2023b).

The purpose of this research is to optimize the policy governing the Vessel Monitoring System (VMS) as part of an initiative to prevent Illegal, Unreported, and Unregulated (IUU) fishing in Papua New Guinea by Indonesian fishermen. By considering the challenges and constraints associated with the deployment of VMS, this research aims to assess and enhance the efficacy of law enforcement and surveillance systems in the fisheries industry. Furthermore, the research aims to identify and rectify deficiencies in Indonesian national fishing vessels' surveillance capabilities, as exemplified by the detention of Indonesian fishermen by Papua New Guinea authorities.

The research inquiry is: "What the extent strategy does improved implementation of VMS strategies contribute to the eradication of IUU fishing?" centered on the identification and development of strategies to enhance the efficacy of Vessel Monitoring System (VMS) implementation in the prevention and management of Illegal, Unreported, and Unregulated (IUU) fishing. We conduct an assessment of existing policies and practices, recognize deficiencies and limitations in the system, and formulate suggestions for enhancement. Potential strategies may include improved interagency collaboration, enhanced technical capabilities and personnel, and the development of new monitoring and law enforcement technologies and methodologies. In conjunction with expert opinions in the domains of fisheries and maritime security, the research will employ empirical data, qualitative and quantitative analysis, and expert opinions.

B. METHODOLOGY

This research examines alternative approaches to the policy of managing IUU fishing by Indonesian seafarers in Papua New Guinea. Interviews and questionnaires were administered to relevant sources in order to acquire data. The research employed the Analytical Hierarchy Process (AHP) as its analytical method to ascertain the relative importance of strategies in tackling the given issue. In the initial phase of the AHP analysis procedure, criteria are established in accordance with the research problem and objectives, variables as defined in the Public Policy Implementation theory of Mazmanian and Sabatier, and data obtained from research interviews. Based on the analysis of the interview results, the second phase entails the development of alternative policy strategies. In the third phase, evaluation data is gathered from pertinent sources via pairwise comparison questionnaires. Utilizing Business Performance Management Singapore's Analytical Hierarchy Process—Operating System instrument, the final phase consists of calculating the outcomes of the evaluation of alternatives and criteria.

C. RESULT AND DISCUSSION

Implementation of combating Illegal, Unreported and Unregistered Fishing

In essence, IUU fishing refers to the act of engaging in fishing activities without proper authorization, without reporting, or without complying with applicable regulations. In addition, the FAO (2022) defines IUU fishing as "fishing activities that are illegal, unreported, and unregulated, and which damage marine habitats, contribute to unfair competition, and endanger the livelihoods of legitimate fishermen". In accordance with this viewpoint, IUU fishing is an extremely hazardous fishing practice that threatens sustainable fisheries management. Various sectors, including the economy, society, welfare, and security, classify Illicit by Way of Life (IUU) fishing as a prohibited activity (Agastia, 2021; Song et al., 2019).

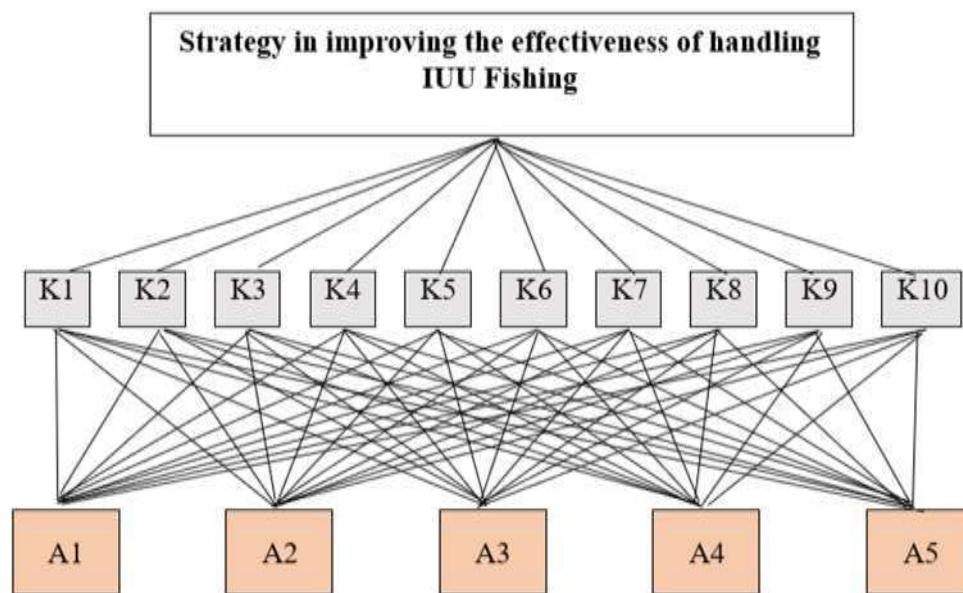
The issue of IUU fishing has prompted Indonesian and Papua New Guinean governments to take various measures in an effort to address the problem. The bilateral maritime border agreement and cooperation constitute one of the most consequential undertakings. This agreement governs the rights and responsibilities pertaining to fisheries resource management in the border region. Representatives of both nations also attend regional forums dedicated to promoting sustainable fisheries management in the Arafura and Timor regions.

Despite several attempts, there are still some challenges to be addressed about IUU Fishing. The implementation of VMS to combat IUU fishing can have social and economic repercussions, particularly if legitimate fishermen incur increased costs or face access restrictions, which is one of the primary obstacles. Furthermore, VMS policies often overlook vessels weighing less than 30 GT. The extensive and remote geographical sea area separating Indonesia and Papua New Guinea presents a challenge in monitoring illicit fishing operations, in addition to challenges within the policy sector. Prohibitive human and financial resources could potentially impede the efficient execution of law enforcement patrols and operations. Extra efforts may be necessary to ensure the efficacy of joint actions through interagency coordination, both domestically and internationally.

The security forces of Indonesia and Papua New Guinea have identified deficiencies in human resources, communication infrastructure, and marine patrol apparatus. Due to insufficient implementation of the VMS installation requirement, several fishing boats continue to breach the territorial line. Monitoring IUUF is challenging because of the extensive maritime territory and little cross-border connectivity. Inadequate maritime surveillance capabilities or systems hamper Papua New Guinea's marine surveillance activities.

Policy Strategy Analysis in AHP

The process of ascertaining priority policy alternatives using the AHP method involves a sequence of computations performed on the outcomes of pairwise evaluations carried out by authoritative sources. The manner in which policy alternatives are determined in this study is depicted hierarchically in the figure below.



The analysis model employed in this investigation possesses the subsequent hierarchical structure:

- a.Goal: This level denotes the research's objective, which is to ascertain the policy strategy for enhancing the efficacy of vessel monitoring system policy implementation in order to combat IUU fishing.
- b.Criteria (K): This constitutes a factor that is taken into account when determining the appropriate policy strategy. Based on problems and theoretical studies associated with the implementation of the Vessel Monitoring System policy and its effect on the management of IUU fishing, ten criteria are established in this research.
- c.Alternative (A): This comprises strategic recommendations and suggestions for enhancing the efficacy of policy implementation in support of Indonesian fishermen's management of IUU fishing, derived from a synthesis of data findings and assessional opinions of resource persons regarding the current state of affairs.

1. Calculation of Criteria from pairwise Comparison

The outcomes of the computation at the initial tier of hierarchical criteria applicable to decision-making in this research comprise the following:

LEVEL 1 (Criteria)		Indonesia Maritime Security Agency	Dispotmaral	Ministry of Maritime Affairs and Fisheries	Indonesia Defense Attache for Papua Nugini	Global Priorities
K1	Implementation Effectiveness	0,016	0,157	0,017	0,069	0,052
K2	Implementability	0,23	0,05	0,014	0,06	0,07
K3	Community Participation	0,016	0,062	0,128	0,092	0,074
K4	International Cooperation	0,035	0,157	0,021	0,132	0,077
K5	Communication and Consistency	0,032	0,083	0,081	0,101	0,084
K6	Compliance with Laws and Regulations	0,048	0,069	0,064	0,193	0,103
K7	Political Support	0,212	0,043	0,029	0,031	0,067
K8	Organizational Capacity	0,172	0,088	0,042	0,041	0,09
K9	Stakeholder Involvement	0,106	0,221	0,302	0,078	0,19
K10	Impact on Maritime Security	0,133	0,07	0,302	0,204	0,193
Consistency Ratio		0,099	0,088	0,096	0,099	0,032

The results of priority calculations for each resource individual exhibit a discernible pattern of variation, as shown in the table above. The pattern of variation in assessment results and results that are relatively homogeneous (79.2%), as determined by individual calculations, show that there is a high level of agreement among sources about how important criteria are depending on the circumstances and contexts being looked at. However, the consensus ratio stood at a mere 53.1%, suggesting a limited degree of concurrence among the interviewees regarding the comparative evaluation of criteria. The interviewees' varied perceptions or judgments contribute to this lack of agreement. Despite the lack of consensus, this does not imply that the assessment results are invalid. The consistency ratio for the group evaluation was 0.032 (<0.1), which provides evidence of the group's reliability when applied to alternative evaluations. The consensus results regarding the criteria indicate that impact on maritime security holds the highest priority at 19.3%. Stakeholder engagement follows at 19%, and compliance with laws and regulations is at 10.3%. This suggests that the evaluation of the alternative hierarchy places significant importance on factors such as stakeholder engagement, compliance with laws and regulations, and the impact on maritime security.

2. Calculation of Alternative from pairwise Comparison

According to Saaty (1980), the purpose of evaluating alternatives on each criterion is to guarantee a comprehensive examination of crucial elements in the decision-making process. This approach is implemented in order to account for the varying degrees of importance attributed to each criterion. The outcomes of the pairwise assessment in this study, which derive their results from the aforementioned explanation, comprise the following:

LEVEL 1 (Criteria)		Global Priority (Criteria)	Alternative (A)						
			Expansion of VMS Coverage	Infrastructure Improvement	Enhancement of Coordination and Integration	International Cooperation	Education and Training	Consistency Ratio	Group Consensus
K1	Implementation Effectiveness	0,052	0,118	0,188	0,226	0,127	0,341	0,023	71,30%
K2	Implementability	0,07	0,162	0,146	0,19	0,143	0,358	0,031	66,10%
K3	Community Participation	0,074	0,101	0,227	0,186	0,107	0,379	0,026	77,80%
K4	International Cooperation	0,077	0,134	0,215	0,216	0,22	0,215	0,003	64,50%
K5	Communication and Consistency	0,084	0,139	0,152	0,247	0,191	0,271	0,02	63,20%
K6	Compliance with Laws and Regulations	0,103	0,121	0,208	0,271	0,139	0,261	0,031	68,10%
K7	Political Support	0,067	0,1	0,154	0,204	0,259	0,283	0,014	73,50%
K8	Organizational Capacity	0,09	0,165	0,197	0,194	0,149	0,294	0,017	71,70%
K9	Stakeholder Involvement	0,19	0,173	0,214	0,231	0,125	0,258	0,026	75,30%
K10	Impact on Maritime Security	0,193	0,178	0,176	0,191	0,266	0,19	1,8	63,30%
Consistency Ratio		0,032	0,148	0,19	0,216	0,178	0,268	0,031	69,30%
Prioritas Global Alternatif									

The findings pertaining to the evaluation and prioritization of each alternative across all criteria exhibit a notable degree of concordance, as evidenced by the relative homogeneity of 90.3% in the results. As determined by the aggregation of group assessments, the level of consensus regarding alternative evaluation is 69.3% (medium), indicating a notable degree of concurrence regarding the evaluation of each alternative. Based on the consistency ratio of 0.031 (<0.1) in the aggregation of group assessments, it can be concluded that the alternative assessment maintains consistency and yields dependable results. The following is the priority ranking of alternatives in accordance with the final evaluation:

- a. Education and Training (0.268)
- b. Enhancement on Organizational Coordination and Integration (0.216)
- c. Infrastructure Development (0.19)
- d. International Cooperation (0.178)
- e. Expansion on VMS Coverage (0.148)

Each of these alternatives offers actionable plans and strategies to enhance the efficacy of IUU fishing management. In light of the preceding alternatives in the specified sequence, it can be deduced that the Education and Training alternative is regarded as the most crucial in terms of policy implementation. It is nevertheless essential to say that every alternative possesses distinct significance and applicability within various contexts.

The subsequent section provides descriptions of the actionable planning that may be executed for each alternative.

1. Education and Training

- a. Training and developing the skills of appropriate staff is crucial for carrying out and overseeing VMS effectively. This includes skill development in technology and system administration, as well as instruction on the proper utilization and surveillance of the VMS system.
- b. Ensuring human resource capacity building and implementing technological updates are imperatives for operating the VMS technology. This includes financial assistance for the modernization of monitoring equipment, as well as instruction on the most recent technological developments and their proper application.
- c. Increase awareness and comprehension of the significance of surveillance and monitoring among fishers and relevant stakeholders by providing them with training on the benefits and application of VMS.
- d. Organizing awareness campaigns can enhance community and fisher comprehension of the advantages of VMS and the criticality of combating IUU fishing. This may encompass workshops, seminars, and media campaigns.
- e. Government support or subsidies for the acquisition of VMS equipment for fishing vessels have the potential to alleviate financial strain and enhance the advantages associated with VMS utilization. Financial aid, subsidies, and other assistance programs are some examples.
- f. One way to promote adherence to regulations and utilization of VMS among fishermen is to establish a reporting incentive system. This involves offering incentives or prizes to fishermen who adhere to the regulations.

2. Improving Organizational Coordination and Integration

- a. Additional agencies, including Indonesian Navy (TNI AL) and Indonesian Coast Guard (Bakamla RI), play a crucial role in providing support for surveillance and control operations in maritime domains that the Indonesian Ministry of Maritime Affairs and Fisheries is unable to adequately access. Collaboration among these entities may enhance the efficacy of VMS deployment.
- b. In order to preserve the efficacy and sustainability of the VMS system, the Indonesian Ministry of Maritime Affairs and Fisheries and its affiliated agencies

must exhibit a steadfast dedication to embracing and modifying the most recent technological advancements. Adapting to changes in the technological environment and comprehending and implementing novel technologies are both aspects of this.

- c. An increasing emphasis on strengthening collaboration with local governing bodies and authorities. This collaborative effort may encompass the harmonization of oversight, law enforcement, and information sharing.
- d. An additional consideration is the creation of coordination forums and cooperative working groups to facilitate information exchange and ensure coherence between VMS and the broader fisheries management system.
- e. In order to facilitate efficient law enforcement and cooperative management of VMS violations, the Indonesian Ministry of Maritime Affairs and Fisheries has established coordination with pertinent agencies. This involves coordinating the legal procedures and promptly responding to any infractions identified by VMS.
- f. Information exchange between institutions and data integration between the private sector and government agencies are made possible through the use of VMS and effective and efficient communication. To ensure effective information exchange and coherence, joint working groups and coordinated forums must be formed.
- g. By engaging stakeholders, such as fisheries organizations, in the policy-making process, it is possible to guarantee that the policy accurately represents the requirements and conditions of these groups. It may also improve support and adherence to the policy.
- h. To facilitate the integration of VMS, governmental organizations collaborate with private sector entities, including fishery enterprises and technology suppliers. This may include working together to obtain and use technology, as well as sharing information and data.

3. Infrastructure Development

- a. Government funding is indispensable for the effective implementation of the VMS. Budgetary provisions for infrastructure, hardware, and training may be a component of the financial support. This assistance can help fishing communities acquire, install, and understand VMS equipment.
- b. Private sector participation can help to improve VMS infrastructure. VMS implementation may require private corporations' technological resources and specialized knowledge. Government efforts to foster collaboration with the private sector may involve the implementation of assistance or incentive programs.
- c. Cutting-edge technologies such as miniaturized satellites, sophisticated sensors, and high-level data analysis can enhance the efficacy of vessel monitoring. These technologies can aid in the detection and monitoring of unlawful activities, in addition to guaranteeing adherence to regulatory standards.

4. International Cooperation

- a. Cross-border collaboration with neighboring countries (Indonesia-Papua New Guinea) can facilitate addressing the issue of illicit boat movements between regions, particularly in the areas of information exchange and law enforcement coordination. Collaboration encompasses law enforcement, information exchange, and surveillance.
 - b. Collaborating with other organizations and nations that share similar interests in maritime security can enhance VMS effectiveness in combating IUU fishing, especially in border regions. This entails sharing information across borders and coordinating operations.
 - c. Policies enhancement in the efficacy of VMS in combating IUU fishing, particularly in border regions, may result from policies that encourage cross-border coordination among neighboring nations. This involves collaboration in monitoring, law enforcement, and the sharing of information.
 - d. The efficacy of VMS in waters contested by multiple nations can be enhanced through political support for regional and international cooperation, as exemplified by regional fisheries forums. This involves collaboration in monitoring, law enforcement, and the sharing of information.
5. Expansion of VMS Coverage
- a. Significant alterations in fishing community behavior will be necessary to increase VMS coverage, particularly on vessels exceeding 30 GT. This may necessitate the implementation of new regulations, capital expenditures for technological advancements, and VMS training.
 - b. Expanding the required vessel weight range for VMS installation, especially below 30 GT, could potentially enhance the efficacy of monitoring fishing vessel activities at sea. Nevertheless, this might potentially increase the workload for fishermen, particularly those operating smaller boats.
 - c. Better access to the global market may be advantageous for fishing communities that employ VMS correctly. This may promote the adoption of VMS and the intended modifications in behavior. Nevertheless, this necessitates knowledge and training on how to effectively exploit these advantages.
 - d. Ongoing improvements and enhancements can effectively enforce stricter regulations regarding IUU fishing and VMS implementation. However, this also necessitates that fishermen receive assistance in adjusting to regulatory changes and that such changes be effectively communicated.
 - e. Implementing VMS policies with periodic audit and evaluation mechanisms can guarantee the attainment of goals and objectives, adherence to legal requirements, and the long-term viability and efficacy of the policies. It can encourage desired behavioral changes and provide feedback that is beneficial to policymakers and implementers.

D. CONCLUSION

Indonesian fishermen in Papua New Guinea are subject to a policy implemented by the Indonesian Government to manage IUU fishing. This policy

primarily involves the utilization of the Vessel Monitoring System (VMS) to oversee fishing operations. Despite this, the research identified technical limitations that complicate the extent to which policies can regulate the required level of behavior. These limitations include funding constraints, technological depletion, compliance by fishermen's groups, and infrastructure deficiencies, among others. Such constraints indicate a very high degree of variation in the behaviors that require regulation, reducing the effectiveness and extent of policies to control them. Furthermore, the technical dimensions of the policy have an impact on policy execution, the agency's capacity to uphold maritime security, transgressions of territorial boundaries, and unidentified illicit fishing practices that constitute unillicit underwater usage. Improving implementation in a precise and quantifiable manner, therefore, necessitates a policy that places considerable emphasis on behavior associated with minor issues.

An analysis of the evaluation of criteria and policy alternatives in implementing VMS policies to stop IUU fishing showed that there are five other sectors that can make VMS policies work better. In addition to education and training, these alternatives consist of interagency coordination and integration enhancements, VMS coverage expansion, and infrastructure improvement. Education and training take precedence over the remaining five alternatives. A series of actions, including public education and awareness campaigns regarding the VMS policy, initiatives to educate fishermen about the advantages of the VMS technology, incentive programs to encourage seafood participation, capacity building for relevant agencies, and comprehensive knowledge of the technology presently employed in Indonesia, can be employed to implement these alternative policy options.

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