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The Utilization of Technology in Law Enforcement Addressing IUU Fishing for Sustainable Governance in The Fisheries Sector

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Abstract:
The role of technology in supporting sustainable fisheries governance in Indonesia, particularly in addressing the issues of Illegal, Unreported, and Unregulated (IUU) fishing, is crucial. This study emphasizes the main technological aspects: Vessel Monitoring System (VMS) and the usage of big data. It will indicate how integrating these technologies can strengthen law enforcement and support the sustainability of the fishery sector. VMS enables authorities to monitor the movement of ships in real time, enhancing the detection of illegal fishing activities. Meanwhile, big data analysis plays a significant role in identifying patterns and trends of IUU fishing through processing data related to ships, catches, and fish movements. Additionally, using the internet for socializing sanctions and regulations to the public raises awareness about the impacts of IUU fishing and the legal consequences faced. This study demonstrates that collaboration between technology and public policy can be the key to more effective and sustainable fisheries law enforcement efforts.

Keywords: *Technology, law enforcement, IUU fishing, socialization, sustainability*

A. Introduction

Indonesia has 5.9 million square kilometers of water area and is the world's largest archipelago, boasting one of the most abundant potential fisheries resources. (Mineral, 2009) This potential makes the fisheries sector a crucial pillar of the country's economy and a source of livelihood for millions of people living along its coasts. However, the increasing threat of Illegal, Unreported, and Unregulated (IUU) fishing practices jeopardizes the sustainability of the fisheries sector. IUU fishing not only harms Indonesia's economy but also has a detrimental impact on marine ecosystems, making it difficult to manage fisheries resources sustainably.

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Indonesia loses around 30 trillion in economic potential in the fisheries sector every year due to IUU fishing. (Jatim, 2024) This activity is carried out by domestic and foreign ships, which are often unlicensed, use prohibited fishing gear, or exceed catch quotas. Additionally, non-compliance with catch reporting makes it difficult for authorities to monitor fish stocks and implement effective conservation policies. In the long run, IUU fishing threatens the availability of fish and can affect the stability of marine ecosystems. Ultimately, this will harm coastal communities that depend on fisheries for their livelihoods. (Putranti, 2016)

To support supervision and law enforcement in the fisheries sector, the government can use modern technologies that already exist, including Radar, Optical, Infrared, VMS, and AIS

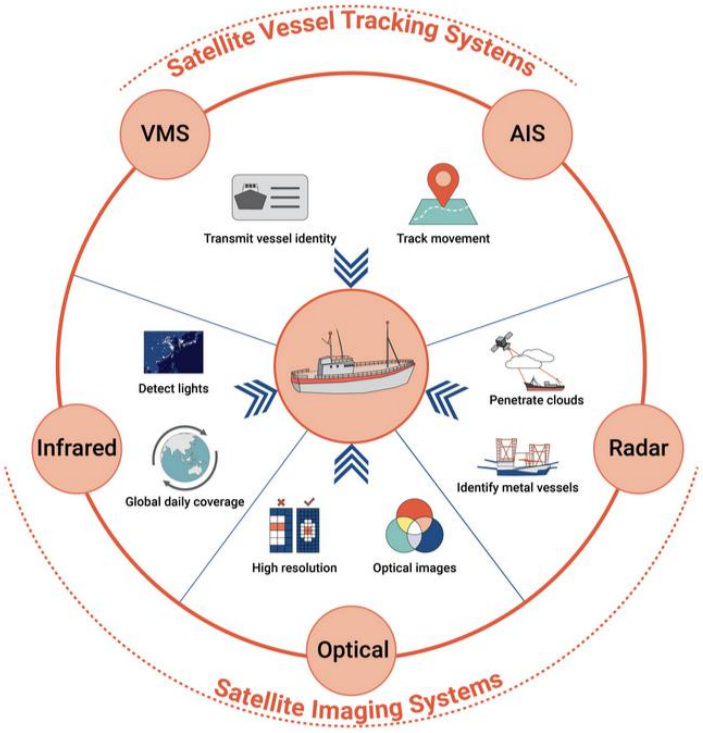

Image 1. Ship tracking technologies Source: https://globalfishingwatch.org/?s=VMS

Radar (Radio Detection and Ranging) is a system that uses radio waves to detect objects above sea level. It emits electromagnetic waves, which are then reflected to the radar when encountering an object like a ship. By measuring the time it takes for the signal to return, radar can determine the detected object's location, speed, and direction. Radar is highly effective in identifying ships from long distances. (Arleiny, Sartoto, Parerungan, & Nurjana, 2018) However, in recent years, many nations, including Indonesia, have developed ships undetectable by radar. (Kementrian Pertahanan Repulik Indonesia, 2018)

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Optical technology utilizes cameras or visual sensors to capture images or videos of a specific area, aiding in the identification of ships, their types, and their activities. Optical imaging captures visible light reflected by objects, providing detailed and clear images in bright conditions. This technology is also effective for close-range monitoring and visual identification but relies heavily on adequate lighting. (Şengül, Yılmaz, & Uğurlu, 2023) However, it has limitations due to its strong dependence on lighting conditions.

Infrared technology effectively detects infrared radiation or heat emitted by an object. This system enables surveillance in low-light conditions or limited visibility, such as at night or in dense fog. Infrared can identify objects that emit heat from human activity or ship engines. Since it does not depend on visible light, this technology is commonly used in nighttime patrols. However, infrared imaging is not well-suited for detailed identification or remote monitoring due to limitations in range and resolution. (Lumban-Gaol, et al., 2019)

To reduce the number of IUU fishing violations, Indonesia's Ministry of Maritime Affairs and Fisheries (KKP) has implemented a Vessel Monitoring System (VMS) and Automatic Identification System (AIS). A satellite-based monitoring tool, VMS, must be installed on fishing ships of 30 GT or more. This technology allows for remote monitoring of ship movements and other activities such as transshipment. Position information is sent in real-time for 24 hours to the KKP command center. Since turning off the VMS can indicate unlawful activity, it can also be seen as fulfilling the mens rea element in criminal acts. The VMS can detect instances such as ships entering conservation areas or fishing in restricted zones, allowing the KKP system to identify these anomalies and confirm the ship's status quickly. (Koral, 2023)

Meanwhile, AIS is a radio signal-based system typically used by larger ships, usually above 100 GT. Its primary function is to ensure shipping safety by allowing each ship to identify the other's position, direction, and speed. While the original purpose of AIS was to prevent collisions at sea, AIS data is also valuable for monitoring fisheries. However, AIS has some limitations, as its signals can be turned off, mainly by ships that wish to avoid detection for illegal fishing activities.

The combined use of VMS and AIS provides the KKP with two complementary layers of monitoring. AIS signals facilitate monitoring larger ships and are not necessarily restricted to fishing operations, while VMS is primarily focused on monitoring fishing activities. Data from VMS and AIS can be accessed through the Global Fishing Watch platform, allowing the public to monitor ship activity, increasing transparency, and encouraging citizens to identify suspicious behavior. This platform also helps preserve Indonesia's fisheries resources.

VMS and AIS also enable fisheries authorities to track the movements of ships operating in Indonesian waters in real time. This technology provides accurate data on ship position and activity, allowing authorities to detect ships that are out of compliance or fishing in restricted zones. This technology helps fisheries authorities prevent and address IUU fishing violations, which would be very challenging to identify using conventional surveillance methods such as sea patrols. (Soemarmi, Indarti, Pujiyono, Azhar, & Wijayanto, 2020)

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Considering the context, this study aims to address the following key questions: how is technology utilized in handling Illegal, Unreported, and Unregulated (IUU) fishing in Indonesia? Also, how can the integration between technology and fisheries policy support sustainable governance of fisheries resources?

B. Literatur Review

Illegal, Unreported, and Unregulated (IUU) fishing is a global issue that harms marine ecosystems, threatens the sustainability of fish stocks, and negatively impacts national economies. Precautionary measures, IUU fishing requires effective strategies, including strong law enforcement measures. Over the past two decades, modern technology has been crucial in addressing IUU fishing.

In its application, VMS supports the ultimum remedial principle outlined in Article 66A of the Job Creation Law No. 6 of 2022, which prioritizes administrative sanctions before criminal law enforcement. (Undang-Undang Cipta Kerja No. 6 Tahun 2022, 2022) VMS enables the accurate and efficient collection of evidence on violations committed by ships in Indonesian waters, allowing for appropriate sanctions to be imposed without necessitating a more severe law enforcement process, except in some instances. Therefore, VMS is essential for enhancing surveillance efficiency and promoting a better data-driven approach to law enforcement. Additionally, VMS aligns with the principles of sustainability and the protection of Indonesia's marine resources.

The criminal law enforcement mentioned is outlined in Article 7, paragraph (2) of Law No. 45/2009, which addresses determining fishing areas, Total Allowable Catch (TAC), and permitted fishing gear. This policy is crucial for stopping and addressing IUU fishing in Indonesia. (Undang-Undang No 45. Tahun 2009 tentang Perubahan Atas Undang-Undang No.31 Tahun 2004, 2009) This article serves as the legal foundation for monitoring and sanctioning IUU fishing violations, ensuring the sustainability of Indonesia's marine resources and aquatic ecosystems.

Moreover, VMS tracks ship movements and is essential for developing more sophisticated data systems. For example, fisheries authorities can analyze the data collected from these systems to identify patterns associated with illegal fishing practices. This analysis enables them to pinpoint areas frequently targeted of unlawful fishing, allowing authorities to focus their attention and increase surveillance in those regions. This data-driven approach is often referred to as "big data." Big data offers advantages over conventional law enforcement methods by facilitating faster and more targeted actions.

Furthermore, the capacity of authorized institutions to combat IUU fishing in these waters is significantly enhanced by the use of big data. In this context, "big data" refers to the processing and analysis of vast amounts of information from various sources, including catch reports, fish movement data, and VMS. (Darmica, 2023) Through big data processing, authorities can identify suspicious patterns indicative of illegal activities, such as ships operating outside designated borders or those failing to report their catches under regulations. Additionally, big data analysis aids fisheries authorities in predicting the likelihood of IUU fishing, enabling

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them to allocate surveillance resources more effectively and anticipate where and when illegal fishing may occur.

However, while technology can aid in the fight against IUU fishing, it is essential to remember that technology is merely a tool. Proper law implementation and raising public awareness also play crucial parts in the battle against illegal fishing. Even the most advanced technology will not succeed in stopping unlawful fishing without appropriate action and heightened public consciousness. The public must be informed and actively participate by reporting suspicious activities to support these efforts.

This research will exclusively focus on VMS and big data technologies that can enhance law enforcement and sustainable governance in Indonesia's fisheries sector. It will explore how these technologies can work together to improve the sustainability of fisheries resources and reduce IUU fishing. The findings are hoped to contribute to the development of more innovative and responsive public policies aimed at addressing the existing challenges in managing Indonesia's marine resources.

C. Methods

This research will be using a qualitative method with a descriptive-analytical approach. Data will be collected through document studies, including government policies and official reports on implementing VMS technology, big data, and internet-based outreach. Additionally, field observations of technology implementation will be conducted to understand its application comprehensively. Thematic analysis will be utilized to evaluate the effectiveness of these technologies in supporting law enforcement and the sustainability of the fisheries sector and the level of public compliance with regulations.

D. Result And Discussion

Utilization of Technology in Handling Illegal, Unreported, and Unregulated (IUU) Fishing in Indonesia

Indonesia undergoes significant economic losses each year due to IUU fishing, prompting the government to prevent this issue further and ensure the sustainability of fisheries resources in its waters. As a result, the government has developed technologies to combat IUU fishing. In 2003, Indonesia began collaborating with France to implement satellite-based monitoring technology, installing 1,500 VMS transmitters on large fishing ships. The primary purpose of this technology is to enable real-time remote monitoring of ship activities, allowing authorities to track vessels operating in Indonesian waters and identify potential violations, such as fishing in restricted areas. (Izzah, 2023) Regulation of the Minister of Marine Affairs and Fisheries Number 10 of 2019 formalizes VMS as an official regulation, mandating that fishing ships over 30 GT must install VMS to operate both on the high seas and within the Republic of Indonesia Fisheries Management Area (WPP-NRI).

VMS has become more innovative by opening up the VMS service provider system and integrating supporting technologies such as automatic alert systems and satellite radar data exchange. These advancements enhance the accuracy and precision of identifying illegal

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activities in Indonesian marine ecosystems. In 2022, KKP launched a command center based on the Integrated Maritime Intelligent Platform (IMIP). This command center collaborates with satellite surveillance systems to monitor ship movements and ensure real-time enforcement. If a ship turns off or evades the VMS, the system can send an immediate warning signal and mobilize officers to take action against the boat.

In addition to benefiting government surveillance, VMS also provides advantages for fishing ship owners, who can utilize the data generated by VMS to ensure compliance and enhance the safety of their operations. While VMS has become a crucial component of the fisheries surveillance system, challenges remain in fisheries law enforcement. According to Greenpeace Indonesia, thousands of ships continue to engage in illegal fishing in Indonesian waters, leading to significant economic losses and threatening marine ecosystems. Currently, VMS is enforced only for ships over 30 GT, meaning smaller ships below this threshold are not subject to this monitoring system. This highlights the need for a more inclusive approach that incorporates small ships into the monitoring framework alongside VMS and command centers.

To address the issue of IUU fishing violations in Indonesia's marine and fisheries areas, KKP has reportedly prepared several ships to conduct marine surveillance. However, the number of vessels deployed is minimal compared to the number of ships operating in the waters. According to KKP data from 2024, there are only 34 Marine and Fisheries Supervisory ships, (DJPSDKP, 2024) This immensely contrasts the roughly 23,548 fishing boats measuring 30 Gross Tonnage (GT) or more. (Indonesia, 2024) This significant disparity poses challenges for manual surveillance, which requires the physical presence of supervisory ships at sea. This issue is especially critical given the vast expanse of Indonesia's waters, where IUU fishing can quickly occur.

These limitations highlight the critical importance of technology such as VMS. However, it should be complemented by policy adjustments that encompass all types of ships, enhance surveillance capacity and infrastructure at the provincial level, and implement other necessary policy changes. The deployment of VMS represents a significant advancement in Indonesia's fisheries management. To fully optimize this technology, developing a surveillance system that is evenly distributed across all ships is essential. Moreover, the effectiveness of this technology relies on appropriate policies and active participation from the wider community and fisheries industry stakeholders in reporting illegal activities and supporting the sustainability of marine resources.

Integration Between Technology and Fisheries Policy to Support Sustainable Governance of Fisheries Resources in Indonesia

One key to sustainable governance in Indonesia's fisheries sector is the integration of fisheries policy with technology. Various technologies, particularly VMS and big data, are crucial in optimizing surveillance and law enforcement against IUU fishing. As mentioned in the Job Creation Law and other related regulations, administrative sanctions are established as precautionary measures before pursuing criminal legal action. This approach enables more effective and data-driven law enforcement and contributes to the conservation of marine resources by penalizing violators.

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Before criminal sanctions are applied, administrative sanctions under the Job Creation Law are utilized to maintain security and control illegal fishing. Administrative sanctions, such as fines or the revocation of operating licenses, are imposed directly for violations detected by VMS. This approach allows businesses the opportunity to rectify actions that breach regulations. This method aligns with the principle of *ultimatum remedial*, emphasizing the use of administrative measures as they are typically faster and more effective than legal proceedings, which can be lengthy. The ultimate goal is to support the sustainability of fisheries. Criminal action is considered a last resort, applied only if the perpetrator repeatedly commits the offense or if the violation is deemed serious.

Processing and analyzing large-scale data from VMS, catch reports, and fish movement can be enhanced using big data technology, significantly improving monitoring effectiveness. Big data enables authorities to identify patterns of suspicious ship activity, pinpoint areas prone to IUU fishing violations in Indonesian marine ecosystems, and predict when and where these violations might occur. This capability allows the government to allocate resources more effectively for surveillance in specific locations and times where illegal activities are most likely. Additionally, big data analysis assists the government in setting fairer and more sustainable catch quotas, adjusting regulations based on the status of fish stocks, and optimizing ship distribution according to current water conditions.

This technology enhances law enforcement and increases transparency in the fishing industry. Platforms like Global Fishing Watch enable the public to monitor ship activity, raising awareness about the importance of marine resource conservation. Ship owners also benefit from VMS, which provides tracking data supporting legal compliance and enhancing operational safety.

However, despite strong regulations, the installation of VMS is still largely limited to large vessels. Smaller vessels, those under 30 GT, are not required to install VMS and may still engage in violations. A more comprehensive approach is necessary to reach these smaller vessels, as they can easily evade surveillance. To effectively address these surveillance challenges, adequate infrastructure is essential at both central and regional levels, which includes a sufficient fleet of inspectors and readiness of human resources for effective surveillance to support enforcement efforts. (Cutlip, 2017)

The foundation for more efficient, responsive, and data-driven fisheries governance is established through integrating policies enshrined in law, big data, and VMS technology. This system ensures that IUU fishing violations can be detected and addressed more swiftly through preventive administrative sanctions, ultimately aiding in preserving fisheries resources. Additionally, this approach fosters more accountable and sustainable fisheries governance for the future, allowing current and future generations to reap the economic benefits of the fisheries sector without compromising the marine ecosystem.

E.Conclusion

In conclusion, using technology in Indonesia's fisheries policy has dramatically improved how the sector is managed and monitored, especially in combating IUU fishing. The government uses VMS and big data to watch ships in real time, making it easier to find suspicious activities.

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To protect fishery resources, important steps have been taken, such as requiring ships over 30 GT to use VMS since 2003, along with building command centers and satellite systems for better surveillance.

Additionally, the administrative sanctions policy mentioned in the Job Creation Law is an initial step before pursuing criminal action, aligning with the *ultimum remedium* principle. This approach prioritizes administrative measures for addressing violations, allowing quicker and more targeted enforcement without immediately resorting to criminal proceedings. This strategy not only decreases illegal fishing but also contributes to the preservation of marine ecosystems.

Big data technology plays a key role in identifying patterns of violations, managing fish stocks, and allocating surveillance resources to areas at high risk of IUU fishing. However, challenges remain, particularly with smaller vessels under 30 GT not yet required to install VMS. It is hoped that a more comprehensive approach and improvements in local surveillance infrastructure will enhance the efficiency of fisheries management.

By integrating technology, policy, and public participation, fisheries governance systems become more transparent, accountable, and sustainable. This approach allows Indonesia to preserve marine resources better and support the fisheries sector, ultimately benefiting coastal communities and ensuring resources for future generations.

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