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Potential and Challenges of Using Sensing Technology to Support the Eradication of Armed Criminal Groups in Papua

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Abstract

Papua, a resource-rich region in Indonesia, faces significant security challenges due to the presence of armed criminal groups (KKB). The eradication of KKB in this area requires advanced tools, among which sensing technology shows considerable promise. Sensing technologies, including satellites and drones, can offer precise and real-time data crucial for monitoring and responding to KKB activities. However, the effective deployment of these technologies is impeded by Papua's complex geographical terrain, extreme weather conditions, and inadequate infrastructure. This study aims to explore the potential of sensing technology in combating KKB by addressing these specific challenges and proposing strategies to optimize its use. Through a systematic literature review, the research identifies effective sensing methods and highlights the obstacles encountered in similar contexts. Findings suggest that adaptive technology development, increased resilience to weather conditions, and improvements in infrastructure are essential for maximizing the benefits of sensing technology. This research contributes to the development of effective strategies for eradicating KKB and enhancing security in Papua, emphasizing the need for coordinated efforts between government, research institutions, and the private sector to address the region's unique challenges.

Keywords: Papua, Armed Criminal Groups, Sensing Technology, KKB Eradication

INTRODUCTION

Papua, as one of Indonesia's resource-rich regions, has been faced with complex challenges involving armed criminal groups. The existence of these groups not only threatens community security, but also challenges the stability of the region. (Rinasti et al., 2022).. Therefore, serious efforts are needed to eradicate armed criminal groups (KKB) in Papua. One of the tools that can be used to support KKB eradication efforts is sensing technology. This technology has proven its potential in providing accurate and real-time information, so it can be an effective instrument in security operational activities. By utilizing sensing technology, it is hoped that a deeper understanding of the dynamics and location of KKB activities can be obtained, so that preventive and enforcement actions can be carried out more precisely and efficiently.

The deployment of sensing technology to counter KKB (Armed Criminal Groups) in Papua faces several significant challenges due to the region's unique conditions. These challenges include complex geographical terrain, extreme weather conditions, and limited infrastructure, which collectively hinder the effectiveness of sensing technologies (Zhu et al., 2018). For instance, the rugged landscape and dense forests can obstruct satellite and drone signals, impacting real-time monitoring and data transmission (Mao et al., 2020). Additionally, severe weather conditions can impair the functionality and durability of sensing equipment (Enam et al., 2021). Despite these obstacles, various studies have demonstrated the effectiveness of sensing technologies in similar contexts. For example, UAVs and remote sensing have been

successfully employed in other conflict zones to enhance intelligence gathering and situational awareness (Munir et al., 2022). These technologies have shown potential in improving border surveillance and providing actionable intelligence, even in challenging environments.

This study aims to explore the potential of sensing technology in combating KKB in Papua by identifying and addressing the specific challenges of its implementation. It will examine how these technologies can be adapted to overcome geographical and environmental obstacles, and how they can be integrated with existing security and law enforcement strategies. The research will also focus on developing policy recommendations to maximize the benefits of sensing technology, emphasizing the need for adapting technological solutions to local conditions and ensuring effective coordination with local communities. By providing a comprehensive analysis of the potential and challenges of using sensing technology, this study seeks to contribute significantly to the development of effective strategies for combating KKB and enhancing security in Papua.

RESEARCH METHODS

The research method applied in this study uses the Systematic Literature Review (SLR) approach, a systematic and structured method for collecting and analyzing literature related to the application of sensing technology in efforts to eradicate Armed Criminal Groups (KKB) in Papua. This SLR method is designed to provide a comprehensive and objective overview of the existing literature, adhering to strict research standards (Szvetits & Zdun, 2016).

In conducting the literature search, the keywords used were related to the topic of combating KKB in Papua. The search was conducted in Indonesian and used data sources from journals and research articles published between 2013 and 2023. The search process was conducted through several databases, including Google Scholar and Sciencedirect, to ensure the completeness and credibility of the data obtained.

The SLR method forms a solid basis for examining and exploring relevant literature, which forms the basis for understanding the potential and challenges of using sensing technology in supporting efforts to eradicate KKB in Papua. With this approach, it is hoped that the results of the research can contribute to further understanding of how sensing technology can be optimized in maintaining security in Papua which is faced with a complexity of geographical challenges, extreme weather conditions, and limited infrastructure.

RESULT AND DISCUSSION

Research Results Scheme or Diagram (PRISMA)

Diagram 1. Describes the article selection process using the Preferred Reporting Systematic Reviews and Meta-analysis (PRISMA) guidelines. A total of 80 articles were found in the initial search stage covering the period 2013-2023. After the screening process, 7 articles were selected, then evaluated and synthesized for inclusion in the final literature review report.

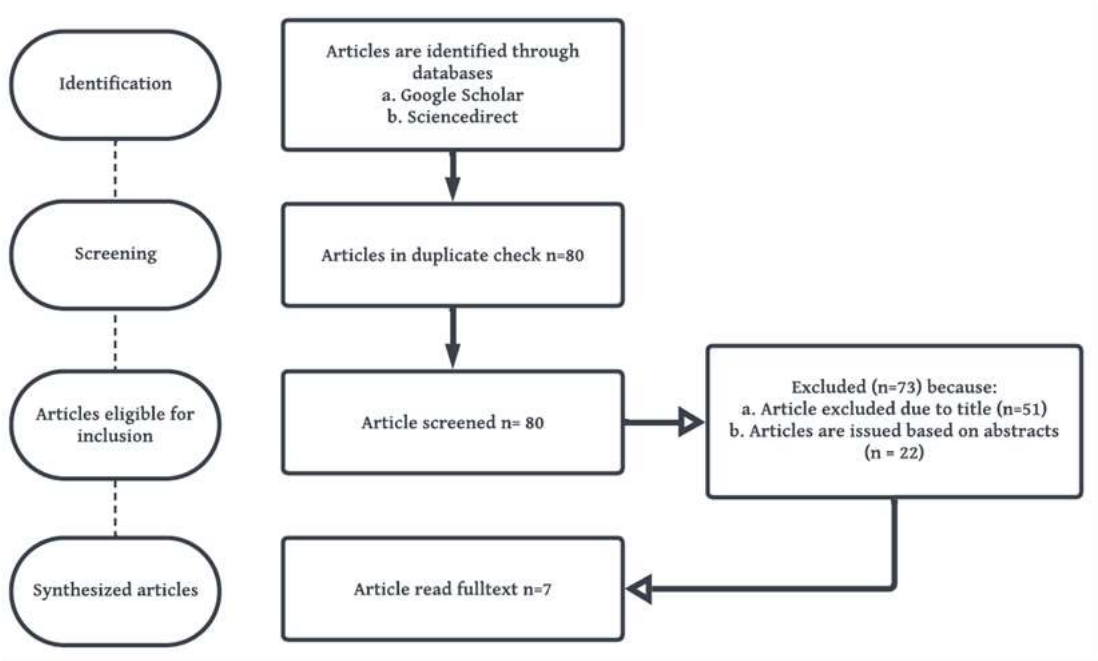

Chart 1. PRISMA Diagram

Researchers selected articles obtained and extracted data from each article obtained from each database. The results of the article were reviewed regarding the potential and challenges of applying Sensing Technology in the eradication of armed criminal groups in Papua.

Table 1. Articles Related to the potential and challenges of applying Sensing Technology in the eradication of armed criminal groups in Papua

Title and Researchers	Purpose	Result
The Widespread Use of Remote Sensing in Asbestos, Vegetation, Oil and Gas, and Geology Applications (Torres Gil et al., 2023)	The purpose of this journal is to provide an in-depth literature review of common and promising disciplines in remote sensing, such as asbestos cement roof identification, vegetation identification, oil and gas industry, and geology.	This study found that remote sensing is widely used for the identification of vegetation, minerals, and oil spills, but there is limited research on the identification of asbestos cement tiles. The results suggest that remote sensing should be considered as a key tool for comprehensive development strategies and multitemporal analysis of field parameters in sectors such as urban planning, mining, and oil and gas companies.
Demotivating Adversarial Defense in Remote Sensing (Chan-Hon-Tong et al., 2021)	This study aims to investigate whether increasing CNN's resilience to hostile attacks can also improve their ability to handle over-fitting and diverse remote sensing data.	This study finds that hardening convolutional neural networks (CNNs) against adversarial attacks does not necessarily improve their robustness against overfitting and their ability to handle diverse remote sensing data. Adversarial robustness was found to be uncorrelated with geographic robustness and over-fitting in several experiments conducted on public remote sensing datasets.

Perturbation-Seeking Generative Adversarial Networks: A Defense Framework for Remote Sensing Image Scene Classification (Cheng et al., 2022)	To propose a defense framework called perturbation-seeker generative adversarial networks (PSGAN) for scene classification of remote sensing images (RSI).	PSGAN shows great effectiveness in defending against known and unknown attacks, as demonstrated through comprehensive and extensive experimental results on three widely used benchmarks for RSI scene classification. The research shows that PSGAN is effective in defending against both known and unknown attacks, making it a promising defense method for RSI scene classification.
Design Of Remote Sensing-Based Geographic Information System (Yang, 2022)	To collect electromagnetic waves emitted and reflected by a remote target, which are then analyzed and processed to form an image...	The experimental results show the excellent practical experience of the system, with clear geographic information images and visible edge details. The system provides users with effective geographic information data and has a wide range of applications.
Conflict Resolution of Papuan Armed Criminal Groups (Amanda & Pramono, 2023)	The purpose of this research is to provide solutions to legal issues arising from the conflict with the Papuan Armed Criminal Group (KKB) and to propose a dispute resolution strategy.	Research shows that resolving the conflict with the Papuan Armed Criminal Group involves taking preventative measures, such as military operations and infrastructure development, while also considering alternative approaches such as mediation and international arbitration. The focus is on addressing the KKB's goal of gaining international attention and seeking Papuan sovereignty, rather than categorizing them as terrorists.
Propaganda Analysis of Independent Papuan Organizations: Preventive Efforts for Nation Disintegration (Leszek. 2023)	The purpose of this research is to conduct a propaganda analysis of Papuan independent organizations, especially the Armed Criminal Group (KKB), to prevent efforts that could lead to national disintegration.	This research conducts a critical discourse analysis of propaganda for Free Papua collected from Facebook posts by the Armed Criminal Group (KKB) in Papua and its sympathizers. The propaganda claims that the Indonesian military (TNI) and police (Polri) conduct open operations, form militias, commit violence and torture against the Papuan people.
The Role of the National Counterterrorism Agency (BNPT) in Efforts to Counter Armed Criminal Groups (KKB) as Terrorism Crimes (Study at the National	The purpose of this study is to determine the countermeasures taken by the National Counterterrorism Agency (BNPT) in dealing with the Armed Criminal Group (KKB)	This research discusses the countermeasures taken by the National Counterterrorism Agency (BNPT) in dealing with the Armed Criminal Group (KKB) in Papua as a crime of terrorism. BNPT uses soft and hard approaches in their efforts to overcome the KKB as a terrorism group.

Counterterrorism Agency) (Aryeno et al., 2022)	in Papua as a crime of terrorism...	

Source: Data Processed by Researchers, 2023

History of Armed Criminal Groups in Papua

Armed criminal groups (ICCs) in Papua have complex and multifaceted historical roots. Their history can be traced back to Papua's early days as part of the Dutch East Indies, where conflicts between indigenous tribes and the colonial Dutch gave rise to a number of tensions. Post-Proclamation of Indonesian Independence, parts of West Papua became part of Indonesia, and this was the beginning of political and identity conflicts among ethnic groups in Papua. (Effendi & Panjaitan, 2021).. Terrorist separatist groups were once an organization called Papua Merdeka, which stood for the liberation of West Papua. On July 1, 1971, the three major leaders of the Free Papua Organization, Yusuf Krai, Nicolas Youwe and Zet Javet Rumkorem, did not accept the surrender of Papua by the Netherlands to its former Indonesian colony in 1969. Thus, the three raised the Morning Star Flag and announced the establishment of the Republic of West Papua. (M. Yusuf Samad & Poppy Setiawati Nurisnaeny, 2022). Under the orders of President Soeharto, the Republic of West Papua was destroyed by the Indonesian military, but the Free Papua Movement continues to this day.

In 2018 the Government passed Law No. 5/2018 on terrorism (Terrorism is a serious crime that can endanger the state, ideology, state sovereignty, state security and human values in the aspects of society and the state. Terrorism is the involvement of groups or people in an organization both inside and outside the country with the aim of committing crimes that have the potential to threaten the welfare and security of society, nation and state).

The security situation in Papua has recently shown another escalation and tends to heat up. Various demonstrations rejecting the status of special autonomy (Otsus) to various shooting incidents due to armed conflict continue to claim lives, reported from the Kompas.com page summarized from January to September 2021 there were several attacks carried out by terrorist separatist groups in Papua:

- January 2021, attack on military post in Sugapa, 1 TNI killed.
- April 2021, shooting in Pegubin, Brigadier General I Gusti Putu Danny Karya Nugraha was killed, 1 TNI was killed.
- September 2021, attack on military post, 2 TNI injured and 4 killed.
- September 2021, an attack in the mountains of Bintan, 1 Indonesian was killed, 5 TNI were injured, and several public facilities in Bintan sub-district were damaged by fire.
- September 2021, gunfire in Kiwirok, 2 police officers injured)

Beyond that, victims continue to fall from civilians, community leaders and security forces.

Sensing Technology in National Defense System

Sensing Technology has a central role in strengthening the National Defense System, becoming a key element in efforts to maintain the security and sovereignty of a country. (Chan-Hon-Tong et al., 2021). In this context, sensing technology involves the use of various types of advanced sensors and devices, such as satellites, surveillance aircraft, and ground sensors, to monitor, collect data, and analyze information crucial to defense interests. The use of sensing satellites allows countries to have a broad and accurate understanding of geographical conditions, military activities and strategic changes in different regions. Reconnaissance aircraft and ground sensors, on the other hand, provide more detailed and real-time observation capabilities, enabling early detection of potential threats.

By leveraging sensing technology, countries can improve border monitoring capabilities, identify potential threats, and formulate responsive defense strategies. However, challenges such

as the high cost and complexity of sensing technology demand careful planning and management. Therefore, investment in research and development of this technology needs to continue to maintain and improve the competitiveness and effectiveness of the National Defense System in the face of various evolving security threats.

Potential of Sensing Technology in Eradication efforts in Papua

The potential of sensing technology in eradication efforts in Papua is enormous. Through its ability to collect accurate and real-time data, this technology can be a very effective tool in monitoring and identifying the activities of the Armed Criminal Group (KKB). The use of advanced sensors, such as satellites and drones, enables the mapping of Papua's territory with a high level of detail, providing an in-depth understanding of the dynamics of KKB movements and locations. (Hafizt et al., 2017).. With this technology, it is also possible to monitor the logistical movements and resources of the KKB, providing strategic insights that are crucial in planning eradication operations.

The potential of sensing technology also lies in its ability to provide quick and precise information to security forces. (Fazio et al., 2011).. The data obtained can be processed quickly, enabling a more efficient response to the KKB threat. The use of sensing technologies can create tactical advantages, speed up detection and minimize risks in security measures. With a focus on optimizing the potential of these technologies, smarter and more responsive eradication strategies can be generated, which in turn will support efforts to achieve security and stability in Papua.

Challenges in Applying Sensing Technology for Eradication in Papua

In the effort to eradicate the Armed Criminal Group (KKB) in Papua, the application of sensing technology is one approach that is expected to make a significant contribution. However, as with the implementation of technology in areas that have unique characteristics such as Papua, various challenges need to be considered. Complex geographical factors, extreme weather conditions, and limited infrastructure are obstacles that need to be overcome so that sensing technology can operate optimally and effectively. The following is a description

1. Complex Geographical Factors

Complex geographical factors in Papua pose significant challenges in the application of sensing technology to support efforts to eradicate armed criminal groups (KKB). Papua's mountainous terrain, wilderness, and wide rivers make accessibility to various locations difficult. (Nababan et al., 2022).. These hard-to-reach geographical conditions are a major obstacle in deploying and operating sensing devices in the field. With rugged and difficult terrain, the use of conventional equipment can be impractical and requires innovative solutions. Therefore, the main challenge is how to develop sensing technologies that can adapt to these complex geographical circumstances, so as to provide accurate and real-time information amidst such complex accessibility challenges. An in-depth understanding of Papua's geographical characteristics is key to overcoming these obstacles, ensuring that sensing technologies can be effectively and optimally integrated in efforts to eradicate KKB in the region.

2. Extreme Weather Condition Factors

Papua is known for its unpredictable weather conditions, including heavy rain, strong winds and dense fog. A major challenge lies in the ability of sensing technologies to operate optimally under these extreme weather conditions. Limited visibility due to heavy rain or fog can affect the accuracy of information obtained through sensing technology. Strong winds can also affect the stability of unmanned aircraft or drones used in aerial surveys, making it difficult to collect accurate data.

In addition, unpredictable weather conditions are an obstacle to operational planning and implementation. (Izza et al., 2023).. The use of sensing technologies that require high visibility can be hampered by the presence of dense fog or heavy rainfall. Therefore, the main challenge

is how to overcome weather uncertainty to ensure the sustainability and consistency of sensing technology operations in supporting efforts to eradicate KKB in Papua.

3. Infrastructure limitation factor

Lack of adequate transportation facilities hinders the distribution of technological devices to remote areas (Izza et al., 2023).. This not only slows down the implementation process, but can also delay rapid response to MPA activities that often occur in hard-to-reach locations. In addition, electricity and communication limitations are critical factors that affect the operation of sensing technology devices. Unstable electricity infrastructure can hamper device durability, while limited communication networks can reduce connectivity between devices, control centers and field teams.

Efforts to Handle KKB in Papua with Sensing Technology

In the context of combating armed criminal groups (KKB) in Papua, an effective response requires an integrated strategy utilizing sensing technology. To overcome challenges arising from complex geographical factors, extreme weather conditions, and limited infrastructure, several countermeasures can be implemented:

1. Adaptive Technology Development:

To overcome complex geographical challenges, it is necessary to develop sensing technologies that can adapt to the topography of Papua. (Hafizt et al., 2017).. Drone technology or unmanned aircraft equipped with advanced sensors can be used to conduct monitoring in hard-to-reach areas. In addition, in-depth research is needed to optimize the design of sensing devices to operate effectively in the wilderness and mountains of Papua.

2. Increased Resilience to Extreme Weather:

Extreme weather conditions in Papua pose a serious challenge, but efforts can be made by integrating sensing technologies that are resilient to adverse weather conditions. (Rosalez et al., 2022).. The use of sensors that can function optimally under heavy rain, strong winds and dense fog is key. In addition, the provision of real-time weather data can also assist field team operations in anticipating weather changes and dynamically adjusting strategies to eradicate KKB.

3. Optimal Supporting Infrastructure:

Overcoming infrastructure limitations requires focused efforts on basic infrastructure development in Papua. (Nababan et al., 2022).. Investment needs to be increased to improve transportation, electricity and communication networks. The selection of sensing technology installation locations also needs to consider the availability of supporting infrastructure. In addition, the use of renewable energy technology can be a solution to overcome electricity limitations in remote areas.

Through the implementation of these countermeasures, it is hoped that sensing technology can become an effective tool in supporting operations to eradicate KKB in Papua. Collaboration between the government, research institutions and the private sector is key in designing holistic and sustainable solutions to achieve security and stability in the region.

CONCLUSION

Papua, as a resource-rich region of Indonesia, faces complex challenges from armed criminal groups (KKB). Combating KKB requires serious efforts, and sensing technology is emerging as a potential tool. These technologies can provide accurate and real-time information, enabling appropriate responses in security operations. However, its application in Papua is not free from challenges, such as complex geography, extreme weather conditions, and limited infrastructure. Complex geographical factors, such as mountains and wilderness, pose obstacles

to the distribution and operation of sensing technology. Extreme weather conditions, such as heavy rain and fog, can hinder technology performance. Infrastructure limitations, including transportation and electricity, also affect the distribution and operation of sensing technology devices.

Remedies include developing adaptive technologies, increasing resilience to extreme weather and improving basic infrastructure. Drones with advanced sensors can be used for monitoring, while weather-resistant technologies can minimize the impact of extreme conditions. Investments in basic infrastructure, such as transportation and electricity, are key to supporting the implementation of sensing technologies. With an in-depth understanding of the potential and challenges of using sensing technology, it is hoped that a strategy to eradicate KKB in Papua can be developed effectively. Collaboration between stakeholders is important in designing holistic solutions to achieve security and stability in the region.

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