

Forest and Land Fire Management Strategy in East Kotawaringin, Central Kalimantan, with Pentahelix Approach

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Abstract. Forest fires in East Kotawaringin, Indonesia, pose a significant environmental and socio-economic challenge, primarily driven by illegal land clearing practices for agricultural expansion, particularly oil palm and rubber plantations. These practices, often employed by both smallholders and large corporations, are exacerbated by natural factors such as seasonal drought and exacerbated by a lack of sustainable land management practices and inadequate training for local communities. This research utilizes the Pentahelix model (government, academia, business, community, and media) to investigate effective strategies for mitigating these fires. Employing Qualitative Comparative Analysis (QCA), the study examines diverse configurations of collaboration among these actors to identify critical success factors. Data was collected through in-depth interviews, observations, and document analysis. Findings highlight the crucial role of the business sector beyond its industrial function. Active engagement in promoting green technologies, providing training programs for farmers on sustainable land-clearing techniques, and supporting community-based fire prevention initiatives emerges as essential. Furthermore, the media's role extends beyond information dissemination; it encompasses active public awareness campaigns, real-time monitoring and reporting of fire incidents, and fostering public pressure for improved policy implementation. Successful fire management necessitates a robust framework of collaboration, including strengthened policies and law enforcement, effective community empowerment programs, strategic utilization of technology for early detection and response, and open communication channels among all pentahelix actors to facilitate rapid response, policy refinement, and behavioral change within the community.

Keywords: Forest Fire, Collaborative Governance, Penta helix

1 Introduction

Forest and land fires in Indonesia, especially in Kalimantan, are still a serious problem that cannot be handled properly [1]. Every year, fires are often caused by the practice of illegal land clearing using fire, which is carried out by individuals who want to use land for agriculture or plantations. Although the government has issued various regulations and policies to reduce fires, such as a moratorium on land clearing and the use of monitoring technology, implementation on the ground is still weak [2]. Inadequate supervision, as well as a lack of strict law enforcement against arsonists, further exacerbated the situation [3]. This causes fires to occur repeatedly, with huge impacts of ecosystem damage, such as biodiversity loss and disturbed air quality [4].

In addition, social and economic factors also play a role in worsening the handling of forest and land fires. In many areas of Kalimantan, people who depend on agriculture for their livelihoods often choose a quick and cheap way to clear land by burning, even though this

method is illegal and dangerous. Inadequate approaches to replace old practices with greener alternatives, as well as low levels of public awareness about the long-term impact of fires, make this problem even more difficult to overcome. Coupled with the haze disaster that harms the health and economy of communities in the wider region, forest and land fire management in Kalimantan requires better coordination between the government, communities, and the private sector, as well as more sustainable and comprehensive solutions.

Forest fires in East Kotawaringin, Central Kalimantan, occur every year, with the peak usually occurring in the dry season, which is around June to October. In 2021, major fires occurred in July and August [5]. Meanwhile, in 2022, forest fires increased again from July to September. In 2023, despite more intensive countermeasures, forest fires were still detected in August and September, causing widespread haze. Forest fires in East Kotawaringin are mostly caused by illegal land clearing using fire for plantations, especially for oil palm and rubber. This practice is often carried out by farmers or plantation companies who want to expand their agricultural area in a faster and cheaper way.

In 2023, despite more intensive countermeasures, forest fires were still detected in August and September, causing widespread haze. Forest fires in East Kotawaringin are mostly caused by illegal land clearing using fire for plantations, especially for oil palm and rubber [6]. This practice is often carried out by farmers or plantation companies who want to expand their agricultural area in a faster and cheaper way. In addition, natural factors such as hot weather and low rainfall during the dry season also worsen conditions and trigger forest fires that spread faster. In addition, the fires are also triggered by a lack of environmentally friendly land management systems and a lack of training for smallholders to use more sustainable methods.

Forest fire management efforts in East Kotawaringin and its surroundings are often ineffective due to a number of factors. First, weak supervision on the ground, as well as a lack of law enforcement against illegal arsonists, make forest fires often difficult to stop. Local and central governments sometimes only provide emergency responses, such as dispatching fire brigades, but long-term solutions and more comprehensive prevention have not been sufficiently implemented. In addition, coordination between local governments, plantation companies, and local communities is also poorly established, so efforts to educate the community and replace the habit of clearing land with burning are very limited. Lack of funding for wildfire management, as well as conflicts of interest between the short-term economy and environmental protection, have exacerbated this situation.

The importance of the involvement of the government, the private sector, and the media in tackling forest fires in East Kotawaringin, Central Kalimantan, cannot be underestimated, as this problem requires collaborative efforts involving all stakeholders. Governments must play a leading role in designing decisive and data-driven policies to prevent fires, by ensuring clear regulations and effective oversight on the ground. The private sector, especially plantation companies, needs to be responsible in implementing environmentally friendly land clearing practices and not using fire as a means of land clearing [7]. The role of the media, the media serves as a liaison between the government and the community in conveying information related to forest fires [8]. The media also raises public awareness, by disseminating information about the impact of forest fires and the importance of mitigation efforts.

One effective way to analyze the problem of forest fires is to use the Pentahelix approach, which involves five main elements: government, society, business, academia, and the media. This approach provides a thorough analysis of how each party can play a role in the prevention and management of forest and land fires in an integrated manner. The government is responsible for designing policies, regulations, and law enforcement, while the public must be involved in monitoring and educating about fire hazards and environmentally friendly land clearing

alternatives. The business world, especially plantation companies, must commit to using environmentally friendly technology in their operations and stop the practice of illegal burning. Academics play a role in providing data and research related to the impact of fires and science-based solutions that can be applied in the field, while the media has an important role in disseminating information and increasing public awareness about forest fires. By involving these five elements, the Pentahelix approach can create a more comprehensive, integrated, and sustainable solution to overcome forest fires, which does not rely only on one party, but the synergy of all elements of society.

Research written by a researcher raises the topic of the application of the Pentahelix approach in analyzing flood disaster prevention and management in Central Java [9]. In his dissertation, the researcher explored how the five elements, namely the government, society, the business world, academics, and the media, played a synergistic role in dealing with flood disasters that often hit the region [10]. The results of the study show that the Pentahelix approach is able to create more effective collaboration between various stakeholders. The government has succeeded in designing more inclusive mitigation policies, while communities participate in disaster preparedness and risk reduction programs. The business world, for example companies in the infrastructure sector, also contributes to the development of drainage and flood control infrastructure. Academics provide research-based solutions for flood prevention, while the media plays a role in disseminating information that raises public awareness about flood hazards and mitigation measures [11]. This study also emphasizes the importance of periodic evaluation and data-based policy improvement to ensure that this collaboration continues to be effective and has a positive impact on flood risk reduction in Central Java. This study has similarities in the approach used, namely pentahelix [12].

A dissertation study written by a researcher explores the application of the pentahelix approach in analyzing the prevention and management of forest fires in Sumatra [13]. This research aims to understand how the involvement of five elements: government, society, business, academia, and the media can create a more holistic and sustainable solution to the problem of forest fires that often occur in the region. The results show that collaboration between these stakeholders strengthens fire prevention efforts, with governments taking a leading role in formulating more assertive and data-driven policies, while communities are actively involved in prevention efforts at the local level, such as fire patrols and environmental education.

The business world, especially plantation companies, is committed to reducing land burning practices, as well as investing in environmentally friendly technologies. Academics contribute research related to ecosystem restoration and sustainable land management, while the media plays a major role in raising public awareness about the impact of forest fires and the importance of natural resource management. The study concludes that the pentahelix approach can strengthen coordination between all parties and result in more effective strategies in reducing the frequency and impact of forest fires in Sumatra. This research also has similarities in the objects and approaches used.

Based on the above, this article contains the results of research conducted related to forest and land fire management in East Kotawaringin, Central Kalimantan using the Pentahelix approach. This study analyzes the involvement of the government, the private sector and the media in the prevention and management of forest and land fire disasters.

2 Literature Review

In this scientific work, there are several articles that are used as a benchmark for comparative authorship. The scientific work is reviewed and analyzed where the similarities and differences arise so that differences arise in the research. The scientific works are:

1. An article written by Agung Subagyo entitled, *"Pentahelix Policy Management Paradigm as a Model for Disaster Management in Bojonegoro Regency East Java"* [14]. This study states that pentahelic policy management has not been carried out optimally. This study uses the pentahelix model as the object of study, while the research to be carried out is to make the pentahelix model as an analysis design. The similarity of this research is to discuss disasters and use qualitative research methods. This research focuses on the object of disaster management study, while the research to be conducted focuses on forest and land fire disaster management strategies.
2. An article written by Kushartati Budiningsih entitled, *"Implementation of Forest and Land Fire Control Policies in South Sumatra Province"* [15]. This article discusses the involvement of the Government sector in forest fire management. The countermeasures are in the form of actions when a fire occurs, namely quick response actions to extinguish the fire. The research to be carried out is to focus more on early prevention strategies for forest and land fires. The similarity of this research is on the object, namely forest fire management and the pentahelix approach.
3. An article written by Achmand Fathoni entitled, *"Pentahelix Analysis in Disaster Mitigation Efforts in Selok Anyar Village, Pasirian District, Lumajang Regency"* [16]. This article discusses disaster mitigation carried out by five parties in the pentahelix theory, namely the role of the government, the role of academics, the role of business people, the role of the media, and the role of the community. This article has the same discussion as the article being written, namely the pentahelic discussion, but only contains three elements, namely the role of the government, the role of the business sector, and the role of the media.

3 Method

This study uses the Qualitative Comparative Analysis (QCA) method. This method allows researchers to identify diverse condition configurations in the context of pentahelix collaboration, so as to understand the effectiveness of each actor in the forest and land fire management process. Data collection techniques, data are collected through in-depth direct observation, and document analysis. The informants in this study include representatives from five elements of pentahelix, namely government, community, business, academia, and the media. Direct observation in the field helps to understand the local context relevant to forest fires. The focus of the research is to identify the roles and contributions of actors in the pentahelix model, as well as observe the dynamics of the collaborations that are formed. This focus limits the scope of the research so that only relevant data is analyzed to achieve the research objectives. Data analysis uses the Qualitative Corporate Analysis approach to evaluate the complexity of cause and effect in multi-actor collaboration. This technique allows researchers to extract patterns of interaction between actors and identify conditions that support or hinder the collaboration process. To ensure the validity of the research results, the triangulation method from various sources of information is used. This is done through comparing data from interviews, documents, and direct observations, in order to improve the reliability of research findings.

4 Result

In the context of the pentahelix model, which involves five elements, namely the government, the business sector, the community, academics, and the media, here are three strategies that can be taken to overcome forest and land fires in East Kotawaringin, Central Kalimantan:

1. Policy Strengthening and Law Enforcement

The government, as the party that formulates the policy, can strengthen regulations related to forest and land fire prevention by involving the business sector and the media in the implementation of the policy. The government must increase supervision and law enforcement against the practice of land clearing by burning, as well as give strict sanctions to violators. The business sector, especially plantation and forestry companies, has an obligation to comply with these regulations and implement greener land clearing practices. The media, as a channel of information, plays a role in educating the wider community about the importance of the policy and the negative impact of forest fires, while monitoring and reporting on violations that occur. The collaboration between these three elements ensures that policies are not only on paper, but can be implemented effectively on the ground.

2. Local Community Education and Empowerment Program

To change the habits of people who often clear land by burning, the government, the business sector, and the media need to work together in implementing education and community empowerment programs. The government can work with academics to develop research-based educational materials that explain the dangers of forest and land fires and alternatives to land clearing that are more environmentally friendly. The business sector, especially companies involved in agriculture or plantations, can provide training or facilities to local farmers to adopt more sustainable agricultural techniques (Andi, 2024). The media has an important role in disseminating this information through public campaigns and news reports, to increase public awareness throughout the East Kotawaringin region on the importance of forest fire prevention.

3. Utilization of Technology for Monitoring and Early Response

In order to optimize forest fire prevention, the government can collaborate with the business sector to develop and implement satellite-based fire monitoring technology, drones, and other mapping systems. This technology allows for early detection of fire and fire, as well as faster response in containment. The business sector, especially companies that own concession land, can support the use of this technology to accelerate fire suppression in their operational areas. The media has an important role in disseminating real-time information to the public about fire incidents, steps taken to overcome fires, and the need for community participation in prevention efforts [17]. Collaboration between these three elements in utilizing monitoring technology can minimize the potential for fires and their impact in East Kotawaringin.

Table 1 presents the details related to the strategy of the government, business sector, and media sectors, as well as the synergy between the three in forest and land fire management in East Kotawaringin, Central Kalimantan, with the Pentahelix approach, can be seen in the following table:

Table 1. The strategy of and synergy between the government, business sector, and media sectors in forest and land fire management in East Kotawaringin, Central Kalimantan

Collaboration Aspects	Government	Business Sector	Media	Synergy Between the Three
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Collaboration Objectives	Establish policies for the prevention and suppression of forest and land fires	Provide environmentally friendly technology and funding for fire prevention.	Raising public awareness of fire hazards and how to prevent them	Collaboration to optimize policy, technology, and communication in reducing fires.
Role in Fire Prevention	Create regulations and policies that support fire control.	Implementing environmentally friendly methods and sustainable business practices.	Disseminate information related to fire prevention policies and campaigns	Governments, businesses, and the media align messages and actions to prevent fires.
Role in Emergency Response	Coordinating blackout efforts and arranging emergency fund allocation	Provide logistics, extinguishing tools, and experts if needed	Provide reports and live updates related to the fire situation	Synergy between the three parties allows for a quick and coordinated response.
Role in Rehabilitation	Develop policies and budgets for post-fire land rehabilitation.	Conducting Corporate Social Responsibility (CSR) for forest and land restoration	Disseminate information about rehabilitation programs and the importance of ecosystem restoration.	The government, the business sector, and the media are working together to ensure rehabilitation programs are on target and receive public support.
Communication Strategy	Use official government channels to convey fire-related policies and information.	Collaborate with the media for corporate campaigns on environmental sustainability.	Conveying a positive message about the importance of fire prevention and environmental awareness.	Collaboration between the government, the business sector, and the media results in unified communication, increasing the effectiveness of the message conveyed.
Capacity Building	Conducting training and socialization for state apparatus and local communities.	Provide resources for community training related to environmental management.	Educating the wider community on fire prevention practices and the importance of sustainability	All parties work together to increase public capacity and awareness in forest fire prevention.
Sustainability of Collaboration	Develop long-term policies and funding for fire management.	Develop environmentally friendly products and services and support government policies	Sustain an education campaign about fire hazards and the need for cooperation.	Continuous cooperation between the three sectors strengthens the commitment to

				comprehensive fire management.
Challenges and Obstacles	Limited resources, weak supervision, and lack of coordination between institutions.	Difficulties in changing the mindset and corporate responsibility related to the environment.	Difficulties in conveying a clear message to people who do not care.	Poorly coordinated synergy can hinder the effectiveness of fire management.
Success Indicators	Decrease in the number of fires and the area burned as well as increase public awareness.	Reducing the use of land burning methods, as well as increasing CSR for environmental restoration.	Timely and targeted dissemination of information as well as increasing public awareness.	Keberhasilan diukur dari berkurangnya kebakaran, meningkatnya partisipasi masyarakat, dan tercapainya kebijakan yang efektif.

5 Discussion

The forest and land fire management strategy in East Kotawaringin, Central Kalimantan, involving the government as the main policy maker, the business sector, and the media, can be analyzed using pentahelix theory to see how coordination between these three sectors works on the ground. Governments at the central and local levels have tried to introduce regulations that prohibit land clearing by burning, such as the Presidential Regulation on the Moratorium on Land Clearing, as well as increasing supervision and law enforcement against illegal burning perpetrators.

However, in the field, law enforcement is often constrained by a lack of resources, limited supervision, and the presence of irresponsible individuals. In the context of pentahelix, collaboration between the government sector and the business sector is essential to ensure plantation companies or other industrial sectors comply with these rules. Unfortunately, the implementation of this policy is still not fully effective because some large companies tend to focus more on land expansion in a fast and cheap way, without paying attention to the long-term environmental impact. The media plays an important role in exerting public pressure and raising awareness of violations that occur, but the media must also educate the public and build a positive image related to existing fire prevention policies.

The business sector, particularly oil palm, rubber and other agricultural plantation companies, plays a key role in forest fire management in East Kotawaringin. In pentahelix theory, the business sector is expected not only to focus on profit, but also to be responsible for environmental and social sustainability. Several large companies have begun to adopt green practices, such as the use of technology to clear land without burning, but there are still many companies that have not fully committed to the change. In the field, there is still the practice of clearing land with fire, especially in companies that are less supervised or have short-term interests. In this case, collaboration between the business sector and the government is crucial to strengthen policies and maximize supervision. In addition, the media can play an important role in highlighting companies that violate regulations and publicizing good practices from companies that have implemented environmentally friendly land clearing systems. This will

provide incentives for other business sectors to follow in the same footsteps, while increasing pressure from the public.

The media has a very important role in forest and land fire management strategies in East Kotawaringin, especially in terms of counseling, monitoring, and supervision. Within the framework of pentahelix theory, the media acts as a bridge of communication between the government, the business sector, and society [18]. In the field, the media is often a tool to disseminate information related to government policies on forest fires, as well as to educate the public about the dangers and impacts of forest fires on the environment and health. However, the challenge is that the media does not always have adequate access to provide timely and accurate information about fire events, especially in remote areas.

In addition, the media is also often caught up in sensational news, which can actually obscure the educational message that they want to convey. For this reason, it is important for the government and the business sector to establish closer cooperation with the media in building a more constructive and educational narrative. With this collaboration, the media not only functions as a channel of information, but also as an agent of change that can encourage more responsible behavior both among the community and business people in preserving forests and land.

6 Conclusion

The importance of close collaboration between the government, business, and media sectors in addressing these increasingly complex environmental issues. The government plays an important role in formulating strict policies and regulations, as well as supervising the implementation of fire management programs through synergy between related agencies. The business sector, especially companies operating around fire-prone areas, needs to be responsible in implementing environmentally friendly land management practices, such as reducing land clearing by burning and implementing environmentally friendly technologies. The media has a strategic role in disseminating information to the wider community, raising awareness about the dangers of forest fires, and encouraging public participation in prevention efforts. The collaboration of these three sectors is very important, because the three support each other in creating comprehensive policies, actively engaging the community, and educating the public to prevent forest and land fires more effectively and sustainably. With an integrated strategy and commitment from each party, forest and land fire management in East Kotawaringin can be more effective and have a wider positive impact on environmental sustainability and the welfare of local communities.

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