Environmental Crime Prevention: Understanding Digital Transformation and Actors in Preventing Land and Forest Fires in Indonesia

Syahrul Akmal Latief[1], Alfajri[2*], Riky Novarizal[3]
[1,3] Department of Criminology, Universitas Islam Riau, Indonesia
[2]Department of International Relations, Universitas Islam Riau, Indonesia

Correspondence: alfajri@soc.uir.ac.id

Abstract: *The crime of burning land and forests in Indonesia has caused transboundary haze, sparking diplomatic disputes between Indonesia and its neighboring countries in recent years. The Indonesian government remains committed to achieving the Southeast Asia regional goal of having a haze-free ASEAN. Despite implementing several policy measures, the incidence of crime persists. This paper discusses the need to understand the digital transformation and challenges of ground-level actors who deal with Indonesia's land and forest fires to prevent environmental crimes. This research uses descriptive qualitative methods, and the data collection techniques vary, including field observation, documentation, and semi-structured interviews. The research uses the theory of Actor Network Theory (ANT). The research findings indicate that promoting a better digital transformation and understanding the challenges faced by ground-level actors in Indonesia's land and forest fire prevention governance is crucial. Relevant actors must continuously improve digital technology to prevent fire occurrences, including the use of Sipongi, a web-based information system, and a mobile application for early detection and control of land and forest fires. At the same time, defusing power struggles and promoting strong collaboration among prevention actors in Indonesia's land and forest fire control are keys to better prevention measures.*

Keywords: *actors, digital transformation, environmental crime, governance, prevention*

1. INTRODUCTION

Indonesia owns the vast majority of the peatland in Southeast Asia (Purnomo et al., 2024). Land and forest fires, particularly on peatland, cause the transboundary haze. Prior to the diplomatic protest by Malaysia in 2023 in relation to Indonesia's transboundary haze (Aprilia, 2023), Malaysia had far worse exposure to transboundary haze than Singapore did during the 2019 haze crisis, causing a diplomatic uproar between top government officials (Afajri et al., 2021). The former Malaysian Minister for Energy, Science, Technology, Environment, and Climate Change, Yeo Bee Yin, and former Indonesian Forest and Environmental Minister Siti Nurbaya engaged in intense megaphone diplomacy as a result of this circumstance. Siti Nurbaya disagreed with her Malaysian counterpart's assertion that Indonesia's transboundary haze encompassed the Malaysian Peninsula and Malaysia Borneo. Instead, former Minister Siti asserted that Malaysian forest fires "may have been the cause of the haze" (Sagita, 2019).

According to former Minister Yeo Bee Yin's Facebook post, "Let the data speak for itself," the haze originated in Indonesia's Kalimantan and Sumatera Islands, citing Asean specialized meteorological data from Malaysia's Energy, Science, Technology, Environment, and Climate Change at the time (Sagita, 2019). A number of diplomatic disputes that persisted throughout President Joko Widodo's (Jokowi) administration were a continuation of the previous Indonesian government's failure to engage in environmental diplomacy with Singapore and Malaysia, its two neighbors in Southeast Asia.

Former President Jokowi's administration used a different strategy to deal with transboundary haze crime, taking into account the diplomatic context of the haze and the lessons learned from the Susilo Bambang Yudhoyono leadership. Jokowi favors result-driven diplomacy (Qin, 2015) and an inward-looking foreign policy (Situmorang, 2015). It was understandable that he favors internal consolidation in environmental diplomacy to influence bilateral and international negotiations, given his increased focus on domestic objectives (Rosyidin, 2017). The former president implemented several domestic policy innovations to address land and forest fires. These included merging the Ministry of Forestry and the Ministry of Environment to form the Ministry of Forestry and Environment, establishing the Peat Restoration Agency (Astuti, 2021), launching a social forestry program (Moeliono et al., 2017), and issuing a permanent moratorium on new forest clearance (Groom et al., 2022; Leijten et al., 2021). The previous ministry of Environment and Forestry introduced Sipongi, a digital system for early fire hot spot detection, and strengthened ground-level actors' efforts to prevent fires through Manggala Agni and the Fire Awareness Community (Nurhidayah et al., 2023; Arisanty et al., 2023), among other innovations.

Notwithstanding the previously indicated policy improvements, land and forest fires persist in the region, albeit at a significantly reduced size compared to the 2015 fire disaster.
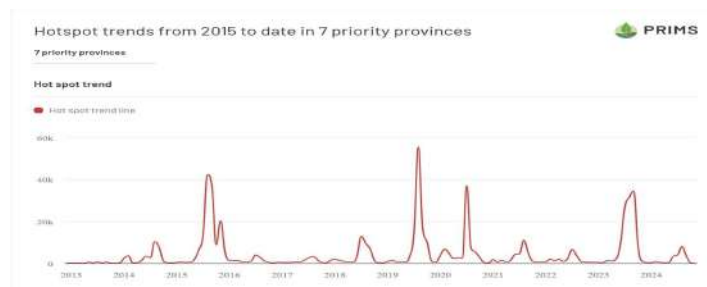

Figure 1: Hotspot trends from 2013-2024 in 7 priority province in Indonesia.

Source: NASA, accessed via Indonesia National Research and Innovation, Ministry of Environment and Forestry of the Republic of Indonesia by BRGM, 2024. Accessed 10 October, 2024, https://en.prims.brgm.go.id/dashboard/hotspot

Nevertheless, these occurrences ignited international turmoil during the 2019 and 2023 fires, leading to transboundary haze outbreaks. This study solely focuses on the research topic of digital transformation and the challenges faced by frontline fire prevention personnel. This study investigates the role of digital transformation, particularly Sipongi, in fire prevention and aims to elucidate the issues encountered by frontline actors in managing fire incidents through the lens of Actor-Network Theory. This study examines two grassroots organizations, Manggala Agni and the Fire Awareness Community.

Theoretical Framework (Literature Review)

Actor-Network Theory (ANT) offers a framework for analyzing the complexity of interactions among various actors, both human and non-human. In order to understand how such sociotechnical networks result in change, ANT (Callon, 1984, 1989; Latour, 2005) conceptualized network action as a process of assembling human (social actors) and non-human actors such as knowledge, objects, technologies, facts, laws, programs, etc., linked by a given situation. Sociotechnical networks construct, reconfigure, and expand to develop new solutions to identified problems (Bilodeau and Potvin, 2018). Actor-network theory centers on the following ideas: actors, networks, and translation. The actors encompass both human and non- human actors, while the network denotes the interdependent and dynamic actor-grids formed through interactive practices between these actors. Convergence interconnects the actors, establishing channels with other domains and translating connections and networks of interests and issues into the vernacular of the primary actors. This perspective aligns with the rational ontological theories discussed by scholars such as Couldry (2008), Latour (1996), and Yao and Liu (2022).

Actor-Network Theory (ANT) is a valuable framework for understanding the complexities of the Indonesia land and forest fires issue, particularly in the context of low coordination and power struggles among various involved actors. ANT emphasizes the interconnectedness of human and non-human actors in shaping socio-technical networks. In the case of Indonesia's land and forest fires, multiple actors—government agencies,

corporations, local communities, and environmental NGOs—are involved in the management and prevention of fires. However, power struggles and the lack of coordination among these actors often lead to ineffective policies and actions, exacerbating the problem and creating challenges, particularly for those ground-level actors discussed in research.

This research uses ANT to analyze the impact of various actors and their interactions on efforts to address the issue of land and forest fires at the site level. By mapping out the networks of actors involved and tracing the flow of power and influence, this research provides an opportunity to understand the challenges of effective governance in forest fires in Indonesia. By identifying and analyzing the actors, their relations, and power struggles, this research offers more effective strategies for preventing future land forest fires.

2. RESEARCH METHODS

This research employs a qualitative method. Sociology, anthropology, and international relations, among other social and political sciences, frequently utilize this method (Creswell, 2009). The ethnographic data collection technique involved close observation and documentation of land and forest fires, as well as efforts to prevent them. This research also conducted semi- structured interviews with 13 relevant stakeholders using snowball sampling during the period of 2022-2024. The interviewees have at least five years of knowledge, exposure, and experience regarding land and forest fires in Indonesia. We selected participants for this semi-structured interview from a range of related sectors, including government officials, environmental NGOs activists, Manggala Agni officers, and Fire Awareness Community officers, using both purposive sampling and snowball sampling, which involves recruiting respondents recommended by the interviewees themselves. Due to the sensitive nature of this research, we choose to anonymize the interviews unless the interviewees express a desire to remain anonymous. This research collects the data in four regencies and one city in Riau Province.
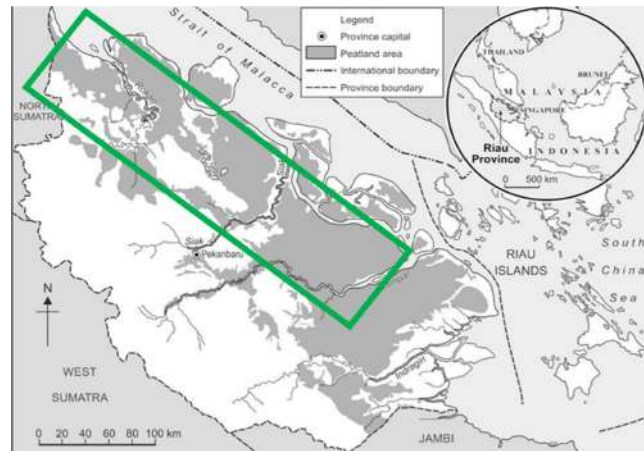
Figure 2: Location of Research: Rokan Hilir, Bengkalis, Siak, Pelalawan Regencies and Dumai city in Riau Province. Source: Adapted from (Miller et al., 2021)

We collected the data in five locations: Rokan Hilir, Bengkalis, Siak, Pelalawan, and Dumai regencies. We selected these regencies because of their proximity to neighboring countries and their susceptibility to frequent fires (Alfajri et al., 2019). The research uses Miles and Huberman's interactive analysis model to analyze the data (Miles and Huberman, 1994).

3. FINDINGS AND DISCUSSIONS

Understanding Digital Transformation: Sipongi

Sipongi is a web-based information system for the early detection and control of land and forest fires. The Directorate General of Climate Change, Ministry of Environment and Forestry, developed it during Jokowi's first term as president, following the 2015 fire occurrence (Sitanggang et al., 2022). The government asserted that Sipongi serves as the most reliable source of information for the general public, offering real-time data, hotspot data, weather data, satellite image calculation, identification of fire-prone areas, and ground check facilities up to the village level (Kementrian Lingkungan Hidup dan Kehutanan, 2020). In the context of Actor Network Theory, the presence of Sipongi as a non-human actor is a game changer in helping human actors to prevent land and forest fires in recent years, especially after the 2015 fire incident.

Figure 3. Hotspot distribution in Indonesia on 23 August 2019 with confidence levels high (red), medium (yellow), and low (green), reported by the SiPongi (**https://sipongi.menlhk.go.id/**) (Accessed on 7 Oct 2024).

Sipongi's monitoring system has provided warnings to local governments about land and forest fire threats, enabling them to determine emergency preparedness and responses. The system, accessible through its user-friendly Android mobile apps, allows local governments at the regency level to monitor fires in their areas. Provincial-level governments rely on regency- level results to determine emergency preparedness or response status (Interview, 13). Establishing an emergency preparedness status will intensify efforts to prevent fires by mobilizing local actors such as the police, army, Manggala Angni, Fire Awareness Community, and fire brigade from large corporations in the surrounding area. If the provincial government raises its status from emergency preparedness to emergency response, the central government will mobilize resources to prevent and stop fires in the local area (Interview, 13)

The monitoring data supplied by Sipongi is advantageous for ground-level actors, such as Manggala Agni and the Fire Awareness Community, since it facilitates the acquisition of preliminary information regarding the potential risks of land and forest fires. Despite facilitating early identification, their work on the ground continues to encounter challenges, as expressed throughout the interview. The limitations stem from inadequate supporting facilities, operational funding (Aryani and Mashur, 2024; Interviews, 5, 7), and the scope of their work area (Interviews, 1,2,3), all of which involve non-human actors in the context of land and forest fires across the four regencies and a city selected for the study
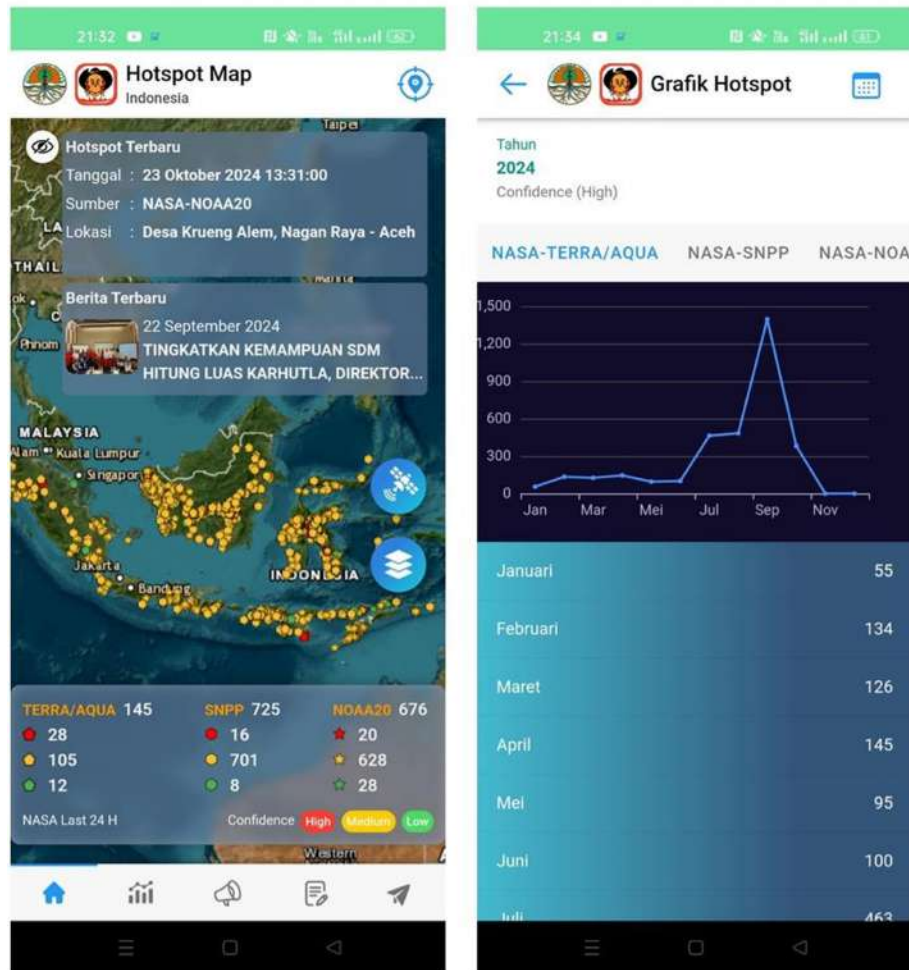
Figure 4. Sipongi, Mobile Apps Version. Source: Sipongi Apps (2024)

The government, through the Ministry of Environment and Forestry during Jokowi's presidential period, has appreciated Sipongi's presence in helping human actors to prevent land and forest fires. The government asserts an 80% reduction in land and forest fires compared to 2015, citing Sipongi's significant contribution to this success (reference). Sipongi's contribution led to the inclusion of the Sipongi Application in the Ministry of State Apparatus Empowerment and Bureaucratic Reform's Top 99 Public Service Innovations, which subsequently earned the Top 45 award in 2019 (Kementrian Lingkungan Hidup dan Kehutanan, 2024)

The government's commendation of Sipongi as a pivotal instrument in digital innovation for preventing land and forest fire crimes in Indonesia seems justified considering the reduction in hot spot trends over the past eight to nine years in these

research areas, especially after the 2015 fire incident, as depicted in Figure 4 below.
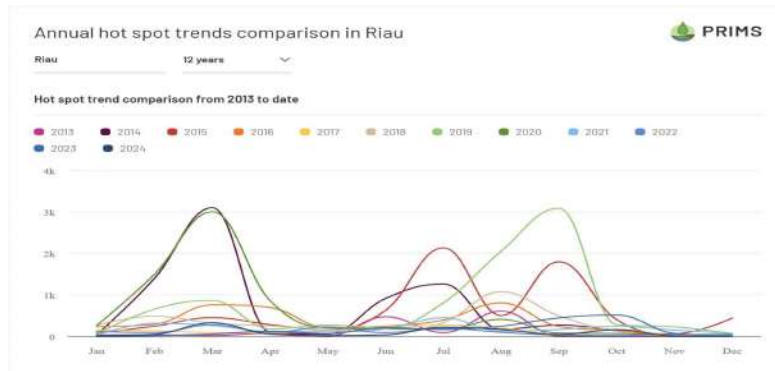

Figure 5: Hotspot trends comparison from 2013-2024 in Riau province.

Source: NASA, accessed via Indonesia National Research and Innovation, Ministry of Environment and Forestry of the Republic of Indonesia by BRGM, 2024. Accessed 10 October, 2024, https://en.prims.brgm.go.id/dashboard/hotspot

However, since the 2019 El Niño event that caused transboundary haze, which instigated a diplomatic row with Malaysia, Indonesia has undergone La Niña rather than El Niño from 2020 to 2022 (Jong, 2022), complicating the evaluation of the government's assertions of success in the government report (Bakar et al., 2021). Greenpeace, Walhi, and Pantau Gambut, along with other reputable environmental NGOs, scrutinized and challenged the government's successful claim (Herlina, 2022). The interviewees assert that the government's claimed success is unmeasurable, as there were more La Niñas than El Niños (Jong, 2022) during the reduction of fire hotspots (Interviews, 5, 7).
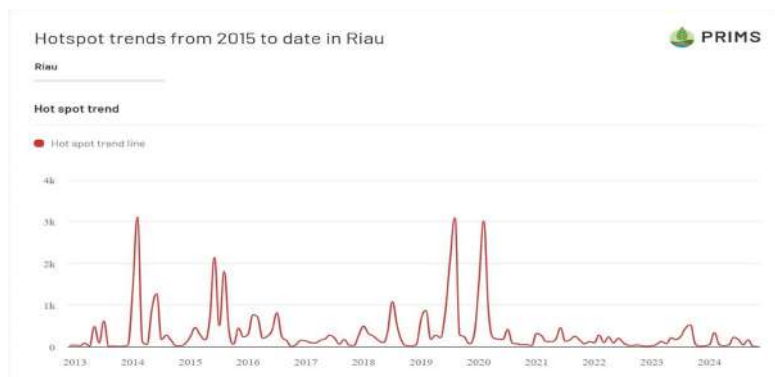

Figure 6: Hotspot trends from 2015-2025 in Riau province.

Source: NASA, accessed via Indonesia National Research and Innovation, Ministry of Environment and Forestry of the Republic of Indonesia by BRGM, 2024. Accessed 10 October, 2024, https://en.prims.brgm.go.id/dashboard/hotspot

Understanding Prevention Actors of Land and Forest Fires

Land and forest fires are among the environmental concerns that Indonesia must address concurrently with a multi-level strategy involving many actors (Interviews, 11, 12, 13). The Ministry of Environment and Forestry's Regulation Number P.32/Menlhk/Setjen/Kum.1/3/2016 outlines the necessary actions to control land and forest fires. The Ministry of Environment and Forestry, the Ministry of Agriculture, the Ministry of Health, the National Police, the National Army, and BMKG are among the central government actors that must be involved. Parties involved at the province level include the Manggala Agni, the provincial army, the provincial police, and provincial-level government actors. Similarly, the involvement of actors at the regency level mirrors that of those at the provincial level. At the village/site level, government fire brigades and big corporation fire brigades are involved. At the site level, there are also volunteers known as the Fire Awareness Community. All of these stakeholders must work together to control land and forest fire crimes in Indonesia (Interviews, 6, 8, 9, 10, 11, 12).

The research explores the challenges faced by actors at the site level, such as Manggala Agni and the Fire Awareness Community. Based on the 2009 Minister of Forestry Regulation Number: P. 12/Menhut-II/2009, Manggala Agni is a forest fire control team under the Ministry of Environment and Forestry, consisting of civil personnel and community members trained in fire management. Fire Awareness Community is a community that voluntarily engages in fire management and has received training (Ministry of Forestry Laws, 2009). These actors, within the Actor-Network Theory (ANT), have the least influence in policymaking and decision-making processes but are leading efforts to avoid land and forest fires. The individuals with the lowest rank encounter the most significant challenges, which often result in them lamenting their difficulties (Interview, 5, 7).

Figure 7. Manggala Agni (Dumai Operational Area, Covering 2 Regencies: Bengkalis and Rokan Hilir and Dumai City. Source: Ministry of Environment and Forestry, https://ppid.menlhk.go.id/berita/siaran-pers/5914/kunjungi- daops-manggala-agni-dumai-menteri-lhk-jangan-sampai-terjadi-duet-bencana. Accessed 7 October, 2024

According to Manggala Agni of the city of Dumai, their first challenge was the extent of their work area, which encompasses three regencies: Dumai, Bengkalis, and Rokan Hilir (Interview, 1). Despite Sipongi's warnings about land and forest fires, the size of their work area prevents them from arriving in time to stop the fire from spreading (Interview, 2). Additionally, they request that the government, which holds decision-making authority, deploy Manggala Agni in every regency of Riau Province, ensuring that each regency has a Manggala Agni team in case of a fire in a deep peat area (Interview, 3). This large extent of coverage area often caused poor coordination to extinguish the fire timely which reflects low coordination in general in peatland, land and forest fires governance (Martin et al, 2020).

A shortage of personnel is the second challenge Dumai's Manggala Agni faces. They hope to expand their workforce due to the importance of their work and operational area. Members of Manggala Agni underscored that extinguishing fires in the field necessitates superior physical and emotional well-being (Interviews, 1, 2). Poor health and inadequate physical fitness may hinder an individual's ability to combat land and forest fires (Interview, 3). Age also affects the availability of Manggala Agni personnel prepared to engage in firefighting operations. The optimal age for suppressing land and forest fires is under 50 years, but individuals over this age may struggle to perform their field responsibilities effectively (Interview, 3)

The third challenge from Manggala Agni in the Dumai operational area, which is related to the power struggle mentioned in Actor Network Theory, is securing additional funding. They hope to continue receiving additional budget support to expedite field operational work. They hope that this budget support will help improve facilities and infrastructure, such as cars and motorcycles for carrying out patrols. In addition, they anticipate having sufficient water pumps to effectively combat fires in the field (Interviews, 1). However, these facilities and infrastructure are still in short supply considering the large area of work they handle (Interviews, 2, 3).

Like Manggala Agni, the Fire Awareness Community encounters considerable challenges, such as insufficient funding, personnel, and supporting facilities (Interviews, 5, 7). Per actor-network theory, the Fire Awareness Community constitutes the least powerful human actor network among the land and forest fire protection networks. The Fire Awareness Community enlists all its personnel from the general populace, and this is not their permanent or full-time occupation. Despite their collaboration with Manggala Agni to extinguish field fires, the Fire Awareness Community does not receive the

minimum regency income (Interviews 5, 7).

The Fire Awareness Community in Pelalawan receives a monthly compensation of Rp. 500,000 (Interview, 5) from the village government, while those other researched regencies receive similar allowances. This insufficient compensation hinders the community's effectiveness, as they must seek alternative sources of income to support their families (Aryani and Mashur, 2024; Interview, 5). Interviewees show that all communities strive for a more equitable salary, ideally equal to the regency's minimum wage (Interviews, 5, 7). Although their funding could derive from the central government, province, or regency budgets, as well as other non-binding budgets that may provide compensation, there is no standardized framework for remuneration. This lack of accountability hinders the Fire Awareness Community's effectiveness.

Figure 8. A military personnel and 3 members of Fire Awareness Community conducting patrol to prevent land and forest fires in Teluk Makmur urban village, Dumai, 19 May 2024, https://monitorriau.com/news/detail/29225/cegah- karlahut-babinsa-dan-mpa-kelurahan-teluk-makmur-adakan-patroli. Accessed 7 October 2024

The limited number of personnel available to work in the field presents another challenge for the Fire Awareness Community. When initial information, whether from Sipongi or other sources, indicates a potential fire hot spot threat, the Fire Awareness Community often lacks sufficient personnel to respond promptly (Interview, 7). In fact, the Fire Awareness Community is the leading actor of all existing actor networks because they are in the lowest level of governance, at the villages, while other actors, such as Manggala Agni, have their offices in the center of the regency or municipality city. The presence of the Fire Awareness Community at the fire location is crucial for providing information to Manggala Agni, the police, and the army.

An additional challenge arising from the Fire Awareness Community's restricted power to make decisions is the lack of sufficient facilities and equipment (Hermanto and Yuliani, 2021 Sayendri and Anwar, 2016; Interview, 4). During the field observations and interviews, the Fire Awareness Community organizations in those regencies and

municipalities articulated their desire for sufficient resources to enhance their patrols. They frequently perform patrols utilizing their own vehicles, as the government-issued vehicles are inadequate and no longer serviceable. The problem arises when they attempt to use their own motorcycle, as they do not have the necessary funds to purchase gasoline (Interview, 5). They indicated that they did not expect to receive a patrol car, but they sincerely want a motorcycle suitable for police duties, supported by adequate operational funding (Interview, 7)

Therefore, this research has found that, although Sipongi plays a role in providing initial information regarding the threat of hot spots, this has not yet resolved the serious challenges they face in the field. Therefore, it is crucial to allocate sufficient space and authority to field-level actors, enabling them to actively participate in determining an appropriate budget for their field work. Additionally, it is crucial to give them a sufficient role and authority to decide, or at least accommodate, the facilities they require and the number of personnel they desire based on their long on-field operational experiences (Interviews, 4, 6, 8, 9, 10).

4. CONCLUSION

Even though land and forest fires have decreased significantly in recent years, land and forest fires continue to occur. The government of the Republic of Indonesia, as the leading actor, continues to strive to reduce the number of hotspots that cause fires, one of which is through a digital technology approach by introducing SiPongi, both web-based and mobile phone applications. The government claims that the significant reduction in forest fires to 80% since the 2015 fire incident was the contribution of all actors involved, including using SiPongi digital technology as an early detection tool for fire hot spots. Field observation and interview show that although there has been a decrease in the number of hot spots, interviewees believe this is also due to the absence of the El Nino factor—actors who work at the site level experience the most difficulties in fire prevention efforts. For example, Manggala Agni's Dumai Operational Area, which covers 3 regencies, has problems in terms of operational budget, limited personnel, and wide-stretch area. Meanwhile, Community Fire Awareness (MPA) experienced obstacles and difficulties regarding operational budget, limited personnel, minimum equipment and supporting facilities. Thus, engaging closely with actors who work daily at the site level, such as Manggala Agni and the Fire Awareness Community, by ensuring best governance practices at the site level would be vital to preventing the crime of burning the land and forests in Indonesia.

REFERENCES

Afajri, A., Wahyudi, H., & Setiawan, A. (2021). The post–ASEAN's haze-free roadmap 2020 and implementation of precautionary principle in Indonesia's environmental diplomacy: Riau's perspective. Berumpun: International Journal of Social, Politics, and Humanities, 4(1), 15-39.

Alfajri, A., Setiawan, A., & Wahyudi, H. (2019). Civil society organizations (CSOs) perspective and haze-free ASEAN 2020: Evidences from Riau. MJIR | Malaysian Journal of International Relations, 7(1). https://doi.org/10.22452/mjir.vol7no1.2

Aprilia, Z. (2023). Seperti Malaysia, Singapura ikut salahkan Indonesia, ada apa? CNBC Indonesia. https://www.cnbcindonesia.com/news/20231007082148-4-478665/seperti-malaysia-singapura-ikut-salahkan-indonesia-ada-apa. Accessed October 7, 2024.

Arisanty, D., Putro, H. P. N., Anis, M. Z. A., Hastuti, K. P., Abbas, E. W., & Aristin, N. F. (2023, June). Community and government preparedness to reduce the risk of land fires on peatlands. In IOP Conference Series: Earth and Environmental Science (Vol. 1190, No. 1, p. 012019). IOP Publishing.

Aryani, J., D., & Mashur, D. (2024). Implementasi program mitigasi kebakaran lahan dan hutan berbasis pemberdayaan masyarakat PT. Kilang Pertamina Internasional RU II Sungai Pakning. Nusantara Journal of Multidisciplinary Science, 1(12), 786–795.

Astuti, R. (2021). Governing the ungovernable: The politics of disciplining pulpwood and palm oil plantations in Indonesia's tropical peatland. Geoforum, 124, 381–391. https://doi.org/10.1016/j.geoforum.2021.03.004

Bilodeau, A., & Potvin, L. (2018). Unpacking complexity in public health interventions with the Actor-Network Theory. Health Promotion International, 33(1), 173–181. https://doi.org/10.1093/heapro/daw062

Callon, M. (1984). Some elements of a sociology of translation: Domestication of the scallops and the fishermen of St Brieuc Bay. The Sociological Review, 32(1_suppl), 196-233. https://doi.org/10.1111/j.1467-954X.1984.tb00113.x

Callon, M. (1989). Introduction in La science et ses réseaux: Genèse et circulation des faits scientifiques. Paris, La Découverte.

Couldry, N. (2008). Actor network theory and media: Do they connect and on what terms? In A. Hepp, F. Krotz, C. Moores, & C. Winter (Eds.), Connectivity, networks and flows: Conceptualising communications (pp. 93-110). Cresskill, New Jersey: Hampton Press.

Creswell, J. W. (2009). Research design: Qualitative, quantitative, and mixed methods approaches. SAGE.

Groom, B., Palmer, C., & Sileci, L. (2022). Carbon emissions reductions from Indonesia's moratorium on forest concessions are cost-effective yet contribute little to Paris pledges. Proceedings of the National Academy of Sciences, 119(5), e2102613119.

Herlina, B. (2022). Sejauh mana implementasi restorasi lahan gambut. DW.COM. Accessed

October 10, 2024, https://www.dw.com/id/sejauh-mana-implementasi-restorasi-lahan-gambut/a-60626545

Hermanto, A., & Yuliani, F. (2021). Partisipasi masyarakat peduli api Desa Kesuma dalam penanggulangan bencana kebakaran hutan dan lahan. Spirit Publik Jurnal Administrasi Publik, 16(2), 104. https://doi.org/10.20961/sp.v16i2.55366

Jong, H. N. (2022). As dry season looms, Sumatra villagers hope their peat restoration pays off. Mongabay.com. Accessed October 11, 2024, https://news.mongabay.com/2022/12/as-dry-season-looms-sumatra-villagers-hope-their-peat-restoration-pays-off/

Kementerian Lingkungan Hidup dan Kehutanan. (2020). Sipongi jadi rujukan utama informasi karhutla di Indonesia. PPID KLHK. Accessed October 7, 2024, https://ppid.menlhk.go.id/berita/siaran-pers/5586/sipongi-jadi-rujukan-utama-informasi-karhutla-di-indonesia

Latour, B. (1996). On actor-network theory: A few clarifications plus more than a few complications. Soziale-Welt, 47, 369-381.

Latour, B. (2005). Reassembling the Social. Oxford University Press. https://doi.org/10.1093/oso/9780199256044.001.0001

Leijten, F., Sim, S., King, H., & Verburg, P. H. (2021). Local deforestation spillovers induced by forest moratoria: Evidence from Indonesia. Land Use Policy, 109, 105690.

Martin, A., Ulya, & Bondan. (2020). Regu peduli air (REPAIR): Gagasan, prinsip dasar, pengetahuan, dan potensi pengembangan. Zoological Society of London-Indonesia (ZSL Indonesia). Accessed October 7, 2024, https://www.researchgate.net/publication/346483704_REGU_PEDULI_AIR_GAMBUT_GAGASAN_PRINSIP_DASAR_PENGETAHUAN_DAN_POTENSI_PENGEMBANGAN

Miles, M. B., & Huberman, A. M. (1994). Qualitative data analysis: An expanded sourcebook (2nd ed.). SAGE.

Miller, M. A., Alfajri, A., Astuti, R., Grundy-Warr, C., Middleton, C., Tan, Z., & Taylor, D. (2021). Hydrosocial rupture: Causes and consequences for transboundary governance.

Ministry of Forestry Laws. (2009). Ministry of Forestry Laws regarding forest fires control. https://jdih.menlhk.go.id/new2/home/portfolioDetails/12/2009/5# , accessed October 10, 2024

Moeliono, M., Thuy, P. T., Waty Bong, I., Wong, G. Y., & Brockhaus, M. (2017). Social forestry – why and for whom? A comparison of policies in Vietnam and Indonesia. Forest and Society, 1(2), 78-97. https://doi.org/10.24259/fs.v1i2.2484

Nurhidayah, L., Astuti, R., Hidayat, H., & Siburian, R. (2023). Community-based fire management and peatland restoration in Indonesia. In Environmental Governance in Indonesia (pp. 135-150). Cham: Springer International Publishing.

Purnomo, H., Puspitaloka, D., Okarda, B., Andrianto, A., Qomar, N., Sutikno, S., ... &

Brady, M. A. (2024). Community-based fire prevention and peatland restoration in Indonesia: A participatory action research approach. Environmental Development, 50, 100971.

Qin, S. (2015). A retreat from multilateralism: Foreign policy restructuring under Jokowi. Australian Institute of International Affairs. https://www.internationalaffairs.org.au/australian_outlook/a-retreat-from-multilateralism-foreign-policy-restructuring-under-jokowi/

Rahmah, M., Khairi, H., Anggraini, W., Saribulan, N., & Hamdi, M. (2024). Weaving the nodes: Actor relations in forest fire handling. KnE Social Sciences, 9(7), 511–521. https://doi.org/10.18502/kss.v9i7.15525

Rosyidin, M. (2017). Foreign policy in changing global politics. South East Asia Research, 25(2), 175–191. https://doi.org/10.1177/0967828x17706570

Sagita, D. (2019). Indonesia forest fires surge, stoking global warming fears. The Jakarta Post. https://www.thejakartapost.com/news/2019/09/12/indonesia-forest-fires-surge-stoking-global-warming-fears-.html. Accessed October 2, 2024.

Sayendri, D., & Anwar, K. (2016). Partisipasi masyarakat peduli api dalam penanggulangan kebakaran hutan dan lahan (Studi kasus di Kecamatan Bunut Kabupaten Pelalawan Tahun 2010-2013). Jurnal Online Mahasiswa Fakultas Ilmu Sosial Dan Ilmu Politik Universitas Riau, 3(1), 1–13.

Sitanggang, I. S., Syaufina, L., Trisminingsih, R., Ramdhany, D., Nuradi, E., Hidayat, M. F. A., Rahmawan, H., Wulandari, N., Ardiansyah, F., Albar, I., & Krisnanto, F. (2022). Indonesian forest and land fire prevention patrol system. Fire, 5(5), 136. https://doi.org/10.3390/fire5050136

Situmorang, M. (2015). Orientasi kebijakan politik luar negeri Indonesia di bawah pemerintahan Jokowi-JK. Jurnal Ilmiah Hubungan Internasional, 11(1).

Yao, S., & Liu, K. (2022). Actor-network theory: Insights into the study of social-ecological resilience. International Journal of Environmental Research and Public Health, 19(24), 16704. https://doi.org/10.3390/ijerph192416704