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Environmental Policy Strategy and Law Enforcement of Peatland Fires: An Environmental Law Perspective

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Abstract. Peatland fires have immensely contributed to environmental degradation, climate change, and health problems in Indonesia. This research article seeks to understand the environmental policy, strategy, and law enforcement mechanisms applied in Riau, Indonesia to reduce greenhouse gas emissions arising from peatland fires. Using a qualitative approach incorporating normative juridical strategies and empirical research data, this study analyzes the institutional framework, existing policies and strategies, and legal mechanisms that have been adopted in Riau, Indonesia to reduce greenhouse gas emissions. The study reveals that Indonesia has put in place a robust institutional framework comprising government agencies and non-governmental organizations tasked with the responsibility of conducting research on peatland fires, and implementing programs and policies aimed at reducing the effects of these fires. Moreover, the study shows that existing environmental policies and strategies, including national, regional, and local regulations, have been instrumental in preventing peatland fires and sustaining eco-friendly practices in Riau. The study concludes by recommending the need for stronger law enforcement, institutional capacity building, and stakeholder involvement to improve the effectiveness of environmental policies and strategies in reducing greenhouse gas emissions.

Keywords: Peatland, Environmental policy, Law enforcement, Greenhouse gas emissions, Eco-friendly practices

Abstrak. *Kebakaran lahan gambut telah memberikan kontribusi besar terhadap degradasi lingkungan, perubahan iklim, dan masalah kesehatan di Indonesia. Artikel penelitian ini berupaya memahami kebijakan lingkungan, strategi, dan mekanisme penegakan hukum yang diterapkan di Riau, Indonesia untuk mengurangi emisi gas rumah kaca yang timbul dari kebakaran lahan gambut. Dengan menggunakan pendekatan kualitatif yang menggabungkan strategi yuridis normatif dan data penelitian empiris, penelitian ini menganalisis kerangka kelembagaan, kebijakan dan strategi yang ada, serta mekanisme hukum yang telah diadopsi di Riau, Indonesia untuk mengurangi emisi gas rumah kaca. Studi ini mengungkapkan bahwa Indonesia telah memiliki kerangka kelembagaan yang kuat yang terdiri dari lembaga pemerintah dan organisasi non-pemerintah yang diberi tanggung jawab melakukan penelitian mengenai kebakaran lahan gambut, dan melaksanakan program dan kebijakan yang bertujuan untuk mengurangi dampak kebakaran tersebut. Selain itu, penelitian ini menunjukkan bahwa kebijakan dan strategi lingkungan hidup yang ada, termasuk peraturan nasional, regional, dan lokal, telah berperan penting dalam mencegah kebakaran lahan gambut dan mempertahankan praktik ramah lingkungan di Riau. Studi ini menyimpulkan dengan merekomendasikan perlunya penegakan hukum yang lebih kuat, peningkatan kapasitas kelembagaan, dan keterlibatan pemangku kepentingan untuk meningkatkan efektivitas kebijakan dan strategi lingkungan dalam mengurangi emisi gas rumah kaca.*

Kata kunci: *Lahan gambut, Kebijakan lingkungan, Penegakan hukum, Emisi gas rumah kaca, Praktik ramah lingkungan*

1. Introduction

As per Wetlands International peatlands contain no less than 550 gigatons of carbon in their organic soil layers.[1] This amount is twice the quantity of carbon stored in worldwide forests. Peatlands' carbon storage greatly contributes to mitigating global climate change. Tropical peat swamp forests serve as habitats for an array of thousands of plants and animals, some of which are scarce and threatened with extinction, like the Orangutan and Sumatran Tiger. In Indonesia, peatlands extend over a 20.6-million-hectare area, equivalent to about 10.8% of Indonesia's total land area. The management of peatlands in Indonesia has seen fluctuations over the years. Peatlands have been utilized in the country for a significant amount of time. As a result of the annual forest fires in these areas, multiple regulations have been introduced. From 1983 to 1991, there were forest and peatland fires, but no laws were established in relation to this issue. Only in 2015, as a result of the largest forest fire in Indonesian history, did the government create policies concerning peat ecosystems.[2]

According to The Climate Change, Forests and Peatlands in Indonesia (CCFPI),[3] it was estimated that during the 1997/1998 period, wildfires occurred in Indonesia's peat forests that affected over 2 million hectares spanning Sumatra, Kalimantan, and Papua. Since then, there have been smaller fires on peatlands until 2015 when a massive one broke out. This burned almost 195,000 hectares of peatland, leading to the Indonesian government focusing on protecting and restoring them by creating a regulation and agency. However, despite these efforts, in 2019, another significant peat fire occurred, burning over 711,000 hectares of land, and causing haze that reached neighboring countries. Peatland fires in Indonesia are a major contributor to carbon emissions and greenhouse gas emissions.[4] According to Page, Rieley, and Wüst,[5] peatlands are wetland ecosystems composed of partially decomposed vegetation that accumulates over thousands of years. When peatlands are drained or cleared for agriculture, they can become highly flammable. Once ignited, the fires can burn underground for

[1] Wetlands International, *Tanya & Jawab Seputar Gambut di Asia Tenggara, Khususnya di Indonesia* (Konsorsium Central Kalimantan Peatlands Project, 2008), 24.

[2] Stephanie Evers et al., "Keep wetlands wet: the myth of sustainable development of tropical peatlands–implications for policies and management," *Global Change Biology* 23, no. 2 (2017): 534.

[3] The Climate Change, Forests and Peatlands in Indonesia (CCFPI), *Seri Pengelolaan Hutan Dan Lahan Gambut: Kebakaran Hutan Dan Lahan* (Bogor: Wetlands Indonesia, 2022), 63.

[4] Vasquez Rodriguez et al., "Estimating greenhouse gas emissions from peat combustion in wildfires on Indonesian peatlands, and their uncertainty," *Global Biogeochemical Cycles* 35, no. 2 (2021): e2019GB006218.

[5] Susan E. Page, J. O. Rieley, and R. Wüst, "Lowland tropical peatlands of Southeast Asia," *Developments in earth surface processes* 9 (2006): 145.

months or even years, releasing large amounts of carbon dioxide and other greenhouse gases into the atmosphere.[6]

According to data from the Ministry of Environment and Forestry, the forest and land fires in Indonesia in 2019 covered a total of 328,722 hectares. Forest and land fires covered vast areas in several regions of Indonesia. Central Kalimantan saw fires affecting 44,769 hectares out of a total of 328,722 hectares. West Kalimantan was impacted by fires in an area of 25,900 hectares, while South Kalimantan saw fires covering 19,490 hectares. Additionally, South Sumatra, Jambi, and Riau were all affected by fires spanning 11,826 hectares, 11,022 hectares, and 49,266 hectares respectively. The annual problem of forest and land fires has had negative effects not only on the people of Riau Province but also on neighboring countries. Sophisticated and efficient technology is needed to combat these fires. Moreover, legal measures to prevent and anticipate the expansion of the phenomenon have been put in place, such as prohibitions against burning which causes smoke haze.[7] Despite these efforts, forest and land fires cases in the Riau Regional Police have increased sharply, especially in 2019 (Table 1).

Table 1. Data on the Forest and land fires in Riau province.

Year	Total cases	Total cases	Burned area	Unit
2018	29	35	160,025	Hectare
2019	74	81	1.687,342	Hectare
2020	56	65	349,475	Hectare

The number of forest and land fire crime cases recently recorded has been quite significant, and there is a high chance of these incidents increasing annually if early control measures are not put in place. Therefore, law enforcement and control methods need to be urgently implemented to prevent the recurrence of forest and land fires.[8] While there are regulations in place for the restoration of peatlands damaged by these fires, it has been a challenge to carry out the restoration process in practice, even with court decisions. The value of peatlands in absorbing rainwater, preventing flooding, and ensuring a steady supply of clean water throughout the year is critical. Many people, including cattle grazers, fishermen, and farmers, rely on intact peatlands for their livelihoods. Unfortunately, human

[6] Lee Yit Leng, Osumanu Haruna Ahmed, and Mohamadu Boyie Jalloh, "Brief review on climate change and tropical peatlands," *Geoscience Frontiers* 10, no. 2 (2019): 378.

[7] Baginda Parsaulian, "Analisis kebijakan dalam upaya penegakan hukum lingkungan hidup di Indonesia," *Jurnal Reformasi Administrasi: Jurnal Ilmiah untuk Mewujudkan Masyarakat Madani* 7, no. 1 (2020): 56.

[8] Vânia R. Pivello et al., "Understanding Brazil's catastrophic fires: Causes, consequences and policy needed to prevent future tragedies," *Perspectives in Ecology and Conservation* 19, no. 3 (2021): 233.

activities such as land burning by corporations seeking to expand their plantation business have wreaked havoc and caused severe damage to peatlands in Riau Province leading to widespread fires. Moreover, in 2019, peatland fires in Indonesia released an estimated 708 million metric tons of carbon dioxide equivalent, making it one of the largest contributors to global greenhouse gas emissions.[9] The fires also release other pollutants such as particulate matter and toxic gases, which can have serious health impacts for people living in the region. The study formulates the environmental policy and enforcement strategy implemented in Riau to manage peat land fires, with the goal of preventing emissions of carbon and greenhouse gases.

2. Literature Review

Reported that many forest and land fires in Indonesia are caused by human actions, either deliberately or due to carelessness.[10] Land conversion activities for agriculture, industry, construction of roads, and similar purposes are a primary cause of human fires. Burning of vegetation for clearance in HTI areas, plantations, and land preparation are other common reasons for uncontrolled fires.[11] Human activities involving natural resource exploitation also contribute to fire outbreaks, with burning of bushes to access resources and fires set for cooking in the forests. Local communities also occasionally initiate intentional fires to establish or reclaim land tenure claims.The motive for obtaining economic benefits is the main cause of land fires. This is manifested in several ways: (a) burning is the easiest and cheapest way; (b) logging activities increase the vulnerability of fires in the forest; (c) fire is the cheapest and most effective method used in land tenure conflicts. The root causes of forest and land fires in Sumatra are overlapping land allocation policies, land tenure conflicts, the effects of demographic characteristics (eg high levels of migration), increased forest and land degradation, and a lack of institutional functioning in natural resource management.[12]

[9] Wiraditma Prananta and Ida Kubiszewski, "Assessment of Indonesia's future renewable energy plan: A meta-analysis of biofuel energy return on investment (eroi)," *Energies* 14, no. 10 (2021): 2803.

[10] Wahyu Catur Adinugroho, I. Nyoman N. Suryadiputra, and Bambang H. Saharjo, *Panduan pengendalian kebakaran hutan dan lahan gambut* (Bogor: Wetlands International, 2005), 72.

[11] Jacob Phelps et al., "Experts and resource users split over solutions to peatland fires," *World Development* 146 (2021): 105598.

[12] Lila Juniyanti et al., "Understanding the driving forces and actors of land change due to forestry and agricultural practices in sumatra and kalimantan: A systematic review," *Land* 10, no. 5 (2021): 471.

According to Leite et al.,[13] human actions have a greater impact than environmental factors on occurrences of forest and land fires. Factors such as distance from villages, road networks, rivers and land use contribute to human activity, while land use mainly influences the likelihood of fires. Additionally, environmental conditions, including temperature, rainfall, humidity, wind speed, slope and land cover, also play a role in supporting forest and land fires.[14] Previous research explains that the features of areas where forest and land fires occur can be determined by calculating the distance between the location of the fire and nearby settlements, access to roads and rivers, as well as conditions of population density and land cover at that location.[15] Data about soil type, rainfall conditions, and slope are also used to ascertain the characteristics of the supporting conditions that contribute to forest and land fires. Morever, previous studies assert that identifying the traits of forest and land fires involves examining factors such as accessibility (including roads and rivers), land cover, hotspot density, soil conditions, land status, and socio-cultural factors that affect the community. [16] The term "hotspot" in forest and lad fires refers to a location that has a higher temperature compared to its surroundings, and this is determined by a specific temperature threshold recorded by satellites. It is considered a single point and is expressed as a numerical value, rather than an area. This measurement is established by identifying forest or land fires at a set pixel size, such as 1 km x 1 km. It is often detected during a satellite pass when there are limited clouds and a particular algorithm is applied.[17] Hotspot analysis is usually applied to assess the probability of land and forest fires in a region, and a greater number of hotspots reflects an increased potential for such fires in a specific area.[18]

Similarly, peat land fires have significant consequences on the immediate community surrounding the location of the blaze. This includes the destruction of property, infrastructure, and homes, as well as the loss of life and injuries. The

[13] F. A Leite. Bento-Gonçalves, António Vieira, and Luis da Vinha, "Mega-fires around the world: A literature review," *Wildland Fires–A Worldwide Reality.* (New York: Nova Science Publishers, 2015): 15.

[14] Wenyuan Ma et al., "Identifying Forest fire driving factors and related impacts in china using random forest algorithm," *Forests* 11, no. 5 (2020): 510.

[15] Endarmiyati, *Zonasi Kerawanan Kebakaran Hutan dan Lahan Beserta Strategi Pencegahannya di Kabupaten Siak Provinsi Riau,* (Yogyakarta: Universitas Gadjah Mada, 2009), 49.

[16] *Idem.*

[17] Louis Giglio, Jacques Descloitres, Christopher O. Justice, and Yoram J. Kaufman, "An enhanced contextual fire detection algorithm for MODIS," *Remote sensing of environment* 87, no. 2-3 (2003): 273.

[18] Arman Nur Ikhsan, Danang Sri Hadmoko, and Prima Widayani, "Spatial Modeling of Forest and Land Fire Susceptibility Using the Information Value Method in Kotawaringin Barat Regency, Indonesia," *Fire* 6, no. 4 (2023): 173.

effects of land fires extend beyond immediate impact on local communities.[19] According to a study conducted by Aiken,[20] the negative impacts of forest and land fires also lead to the destruction of forestland, the production of smoke that can harm air quality and human health, and the eradication of numerous animal species. Moreover, peatland fires can exacerbate both flooding and drought events, change ecosystems, and contribute to global warming and are a matter of concern for both local and global communities.[21] Peatlands are unique ecosystems that store large amounts of carbon. They cover about 3% of the earth's surface but store up to 30% of the world's soil carbon[22]. Peatlands are made up of partially decomposed organic matter, primarily mosses, which accumulates as layers over thousands of years.[23] Peatland fires are becoming more common worldwide, accelerating the loss of carbon from these ecosystems and increasing greenhouse gas emissions. Peatland fires are a natural process, but their frequency and severity have increased due to human activities such as land-use changes and management practices.[24] These fires can burn for months, resulting in large amounts of smoke, smog, and greenhouse gas emissions. The burning of peat releases carbon dioxide, methane, and nitrous oxide, which are potent greenhouse gases, into the atmosphere and contributes to global warming. Peatland fires are a significant source of greenhouse gas emissions. Each year, peatland fires in Indonesia alone emit between 0.7 and 2.0 gigatons of carbon dioxide equivalent. [25] Peatland fires are responsible for around 5% of the global carbon emissions,[26] making them one of the largest terrestrial sources of greenhouse gas emissions in the world.

The Indonesian government has prioritized social aspects in its management of forest resources since the introduction of Minister of Forestry Decree No. 691 of 1991, which focused on Forest Village Development. This regulation aimed to improve the welfare of the people living inside and around the forest. Later, the

[19] Tomasz Mieczan, Urszula Bronowicka-Mielniczuk, and Natalia Rudyk-Leuska, "Effects of Fires on Microbial and Metazoan Communities in Peatlands," *Water* 14, no. 21 (2022): 3406.

[20] S. Robert Aiken, "Runaway fires, smoke-haze pollution, and unnatural disasters in Indonesia," *Geographical Review* 94, no. 1 (2004): 55.

[21] Kevin L. Erwin, "Wetlands and global climate change: the role of wetland restoration in a changing world," *Wetlands Ecology and management* 17, no. 1 (2009): 7.

[22] J. F. Limpens Berendse et al., "Peatlands and the carbon cycle: from local processes to global implications–a synthesis," *Biogeosciences* 5, no. 5 (2008): 1475.

[23] Evgeny A. Zarov et al., "Carbon Accumulation and the Possibility of Carbon Losses by Vertical Movement of Dissolved Organic Carbon in Western Siberian Peatlands," *Forests* 14, no. 12 (2023): 2397.

[24] Yenni Vetrita and Mark A. Cochrane, "Fire frequency and related land-use and land-cover changes in Indonesia's peatlands," *Remote Sensing* 12, no. 1 (2019): 6.

[25] Jukka Miettinen et al., "From carbon sink to carbon source: extensive peat oxidation in insular Southeast Asia since 1990," *Environmental Research Letters* 12, no. 2 (2017): 024014.

[26] István Urák et al., "Worldwide peatland degradations and the related carbon dioxide emissions: the importance of policy regulations," *Environmental Science & Policy* 69 (2017): 57.

decree was revised through SK Menhut No. 69 Jo Decree of the Minister of Forestry No. 523 of 1997, which changed the term to Forest Village Community Development. Community forest management entered a new phase with the introduction of Law no. 41 of 1999, which emphasized the importance of prioritizing the needs of people in forest management.[27] This means that forest management practices that are oriented towards wood production and pay little attention to the rights and involvement of people need to change towards a more community-oriented practice that takes into account all potential forestry resources. Over the years, several forest management policy regulations in Indonesia have been introduced, with some of them dating back to 1999 and others introduced more recently up to 2019. These regulations are mainly focused on forestry and have been introduced by recognized institutions authorized by the government.

3. Research Methods

This study was carried out in Riau Province to investigate the forest and peatland fires caused by corporations. The research was conducted between 2021-2022, and a map of the area was shown in Figure 1. One objective of this study was to analyze the government's policy strategy, with law enforcement officials, regarding the settlement of forest and land fires through an integrated legal approach to preserve the peatland environment in Riau Province. By using this holistic approach, the researchers aimed to present a comprehensive analysis of the situation.

The research method used in this study was descriptive research, which aimed to provide an accurate and factual description of the object being studied. The approach taken was normative research, utilizing a qualitative approach that relied on the analysis of existing literature. The data used in this research included location maps, plantation forests, news about fires, and legal documents related to the case. The researchers used various tools such as stationery, cameras, and GPS devices to conduct the research.

The data collected in this study includes qualitative data. This refers to non-numeric data that is difficult to convert into a numeric form. This type of data is useful in examining social phenomena. The primary data was collected through a literature study that focused on forest and land fire resolution regulations, using an integrated legal approach. Secondary data was collected from various sources such as the Office of the Environment Service, the Police Service, the Prosecutor's

[27] Nustam Nur, *Pengelolaan sumberdaya alam berbasis Masyarakat* (Samarinda: Hatfindo Prima, 2004), 69.

Office, and the Riau Provincial Government's official website. The collected data included maps of forest areas. The study utilized two methods of data collection; the first was a literature study focused on gathering secondary data from previous related research, while the second involved documentation used to examine written sources related to the research subject. Data analysis was carried out on the available data, which was processed using statistical techniques to provide answers to research problems.

Source: Google Maps

Figure 1. The location of Riau province in Sumatra Island.

4. Results

The Indonesian government has taken several measures to prevent and manage forest and land fires, including strict regulations with severe legal consequences. Continuous efforts in implementing these regulations, along with coordinated prevention and management strategies, are crucial in reducing the occurrence and impacts of forest and land fires in Indonesia. Indonesia has implemented several laws and regulations to manage and prevent forest and land fires. Forest burning is strictly prohibited and can result in severe punishments, including imprisonment for up to 15 years and fines up to IDR 15 billion under Law No. 41 of 1999

concerning Forestry Article 50 paragraph 3.[28] Law No. 32 of 2009 concerning Environmental Protection and Management also includes criminal provisions and regulates unlawful acts resulting in environmental pollution and damage from land-burning.[29]

The recent Law No. 11 of 2020 concerning Job Creation strengthens these provisions and prohibits everyone from committing acts that lead to environmental pollution and damage, including clearing land by burning, including peatlands. The Government Regulation No. 4 of 2001 concerning Control of Environmental Damage and Pollution also prohibits burning of forests and land, but administrative sanctions apply. According to Government Regulation No. 45 of 2004 as amended by Government Regulation No. 60 of 2009 concerning Forest Protection, forest protection activities include prevention, suppression, and handling of fire impacts. However, criminal acts resulting from forest fires only apply to parties without letters or permits for forest products, as stated in articles 42 and 43 of the regulation. The Indonesian government has also issued recent regulations such as Government Regulation No. 22 of 2021 concerning Implementation of Environmental Protection and Management and Government Regulation No. 23 of 2021 concerning Forestry Administration to enhance forest and land fire prevention and management efforts. Regional regulations such as Riau Province Regional Regulation No. 1 of 2019 also provide technical guidelines for forest and/or land fire management, including regulating tropical peatlands in Indonesia.[30]

Previous study shows that peat in Indonesia has a higher lignin content compared to peat in temperate climates because it is formed from trees. [31] Furthermore, previous research reported that peat in Sumatra and Kalimantan is generally dominated by woody materials. [32] Table 2 showed the composition of the organic matter is mostly lignin which generally exceeds 60% of the dry matter, while the content of other components such as cellulose, hemicellulose, and protein generally does not exceed 11%.

[28] Andrew Shandy Utama and Rizana Rizana, "Penegakan Hukum Terhadap Kebakaran Hutan Di Kabupaten Pelalawan Provinsi Riau Berdasarkan Undang-Undang Nomor 41 Tahun 1999 Tentang Kehutanan," *Jurnal Selat* 8, no. 1 (2020): 112.

[29] Ade Pratiwi Susanty, "Tanggung Jawab Perusahaan Swasta Terhadap Negara Berdasarkan Undang-Undang Nomor 40 Tahun 2007 Tentang Perseroan Terbatas," *Jotika Research in Business Law* 1, no. 1 (2022): 7.

[30] Andrew Shandy Utama, "Problematika dalam Pelaksanaan Tanggung Jawab Sosial Perusahaan Kehutanan dan Perkebunan di Kabupaten Pelalawan Provinsi Riau," *SUPREMASI: Jurnal Hukum* 1, no. 2 (2019): 138.

[31] Annisa and Nursyamsi, *Potensi Emisi Karbon*, 36.

[32] *Idem.*

Table 2. Composition of tropical peat.

Composition	Sumatra	Kalimantan
Hemicellulose	1.95	1.95
Cellulose	10.61	3.61
Lignin Protein	63.99	73.67
Proteins	4.41	3.85
% Dry Matter		

Peat possesses distinctive properties and serves various roles, such as regulating water systems, managing floods, providing habitats for diverse living organisms, and functioning as a reservoir for carbon, thus playing a crucial part in stabilizing global climate. According to a study,[33] the release of CO2 from peatlands is not caused only by the hastened decay of organic matter or heterotrophic respiration, but also by the practice of burning peatfields, which transforms peat from a carbon sink into a carbon source that contributes to the atmosphere. The large carbon content in tropical peatlands (ranging from 81.79-91.9 Gt C) makes them susceptible to climate change and human activities.[34] According to previous research, some peatlands in Kalimantan have undergone significant losses of carbon due to increased El Nino severity and changes to water levels during the Halocene era. [35]

The Indonesian government has implemented a variety of laws and regulations to control forest and land fires as well as increased efforts following fires such as monitoring and evaluation. A burnt forest inventory was conducted, and a significant aspect included socialization and law enforcement, and rehabilitation of burned forests.[36] In 2015, a Presidential Regulation merged the Ministry of Environment and the Ministry of Forestry, and a Peat Restoration Agency was created in 2016 to respond to fires quickly. However, in 2019, the area of forest and land fires in Indonesia still reached 328,722 hectares, with various regions affected. Laws and regulations prohibit burning to prevent smoke haze that hampers life activities, particularly for burning on peatlands. According to a Government Regulation, a forest is an ecosystem unit with natural resources dominated by trees and cannot be separated from one another, while land is a terrestrial ecosystem designated for business, fields, or gardening activities.

[33] Ai Dariah, Erni Susanti, and Fahmuddin Agus, "Simpanan karbon dan emisi CO2 lahan gambut," *Pengelolaan lahan gambut berkelanjutan* 1, no 1 (2011); 56.

[34] Susan E. Page et al., "The amount of carbon released from peat and forest fires in Indonesia during 1997," *Nature* 420, no. 6911 (2002): 61.

[35] Annisa and Nursyamsi, *Potensi Emisi Karbon*, 39.

[36] Afni Zukifli, Fara Merian Sari, and Prihati Prihati, "The Implementation of Forest and Land Fire Management Policy in Indonesia During the COVID-19 Pandemic," *Indonesian Journal of Forestry Research* 9, no. 2 (2022): 207.

To control and prevent forest and land fires, the Indonesian government has implemented various measures. Beyond issuing laws and regulations, they have increased their effort in monitoring and evaluation after a fire occurs.[37] Additionally, they carry out an inventory of burnt forests as well as focus on socialization, law enforcement, and rehabilitation of burned forests.[38] In this regard, the government combined the Ministry of Environment with the Ministry of Forestry and created the Peat Restoration Agency to respond to fires quickly. However, despite these efforts, the area of forest and land fires in Indonesia remained significant in 2019, affecting various regions. Therefore, laws and regulations have been put in place to regulate the prohibition against burning on peatlands, which causes smoke haze that interferes with life activities. The Indonesian government follows a Government Regulation that defines forest as an ecosystem unit dominated by trees while land is designated for business, fields, or gardening activities.[39]

Forest fires can cause dangerous or catastrophic situations and can arise from various uncontrollable or intentional sources[40]. These sources include natural phenomena such as lightning strikes, volcanic eruptions, and friction generated by shaking dry branches containing oil, which can cause heat or sparks. Forest and land fires refer to the burning of forests and land, either by human activity or natural phenomena, resulting in significant ecological, economic, socio-cultural, and political losses.[41] The efforts to combat forest fires in Riau Province have implemented various policies and priority programs as a result of the emergency forest and land fire alerts declared in eight regions, including Dumai, Rokan Hilir, Bengkalis, Meranti Islands, Pelalawan, Indragiri Hilir, Siak, and Indragiri Hulu (Figure 2).

Several measures have been implemented by the Provincial Government of Riau to handle Forest and Land Fire Disasters. Firstly, they have established an emergency alert status through the Governor's Decree No. Kpts.212/II/2021. Secondly, they have conducted outreach programs to educate the public about the dangers of clearing land through burning. Thirdly, integrated patrols have been carried out to extinguish hotspots. These efforts involve multiple parties, such as

[37] Adji Achmad Rinaldo Fernandes and Raffles Brotestes Panjaitan, "The effect of community and company participation and implementation of good forest fire governance on the forest fire policy in Indonesia," *Journal of Science and Technology Policy Management* 10, no. 1 (2019): 109.

[38] Sri Nurhayati Qodriyatun, *Kebijakan penanganan kebakaran hutan dan lahan* (Jakarta: Pengolahan Data dan Informasi (P3DI) Setjen DPR RI, 2014), 55.

[39] Parsaulian, "Analisis kebijakan dalam," 56.

[40] David MJS Bowman et al, "The human dimension of fire regimes on Earth," *Journal of biogeography* 38, no. 12 (2011): 2223.

[41] Mia Sarmiasih and Prawira Yudha Pratama, "The problematics mitigation of forest and land fire district (Kerhutla) in policy perspective (A case study: Kalimantan and Sumatra in period 2015-2019)," *Journal of Governance and Public Policy* 6, no. 3 (2019): 281.

the army, police, disaster management agency (BPBD), forestry and environment police as well as other enforcement agencies, the business world, and communities in various fire-prone locations. Fourthly, weather modification technology, water bombing, and air patrols are being used. Fifthly, health checks are conducted for firefighters at the location of the fire. Lastly, coordination with the respective agencies to manage peat ecosystems through rewetting, revegetation, and providing economic empowerment for the surrounding community has been put in place.

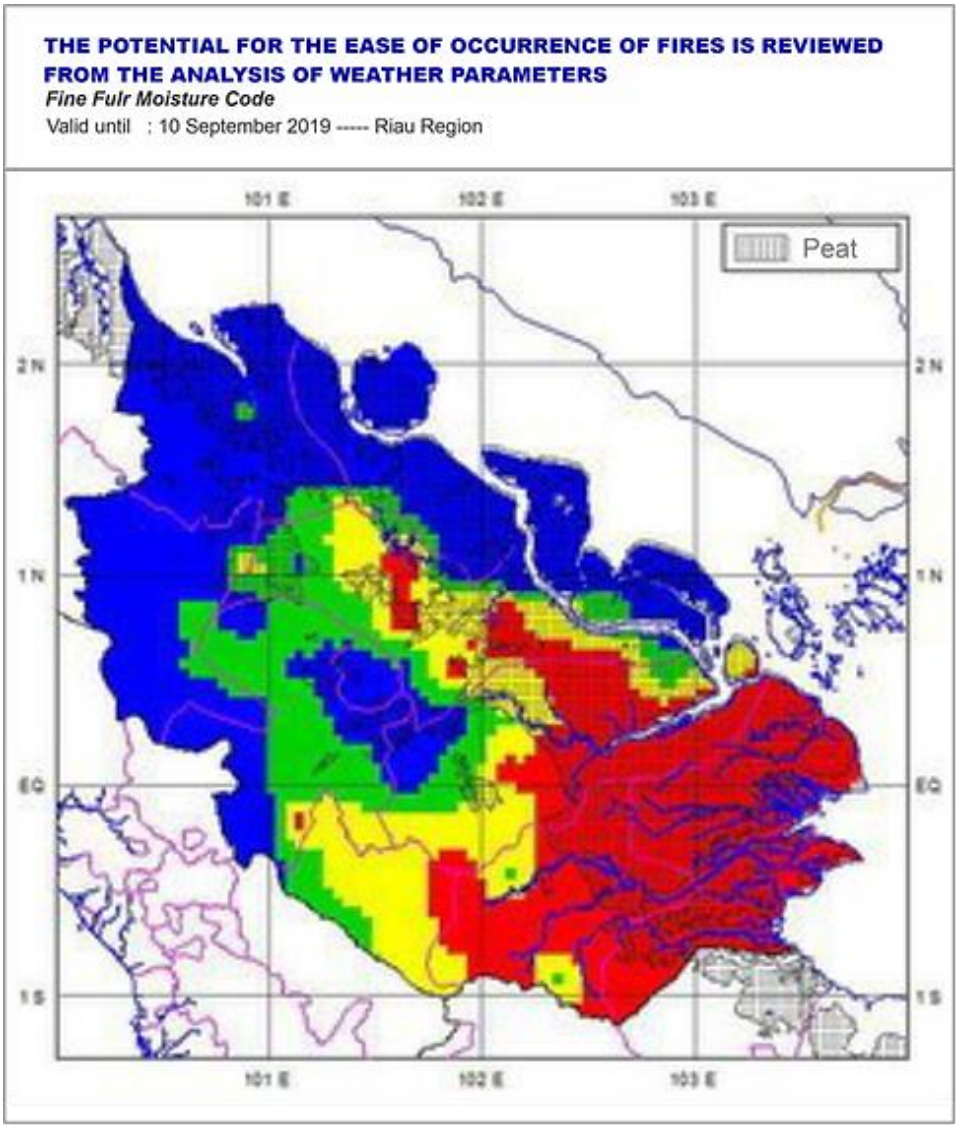

Figure 2. Possibility map of forest and land fires in Riau.

According to IPSDH (2019),[42] the calculations for the extent of forest and land fires in Indonesia during 2019 have revealed that a total area of 1.64 million hectares was affected. This area can be broken down into 1.15 million hectares (70%) on mineral soil and 0.49 million hectares (30%) on peat soil. The provinces with the largest areas of forest and land fires are South Sumatra (336,798 hectares) and Central Kalimantan (317,749 hectares), in comparison to the other provinces in Indonesia (Table 3). Moreover, the data shows that South Sumatra province has highest number of incidents (336,798) and highest number of fires on mineral land (199,923) in the provinces of Sumatra, followed by Riau as the second highest number of incidents (90,550) and highest number of fires on peat land (63,282).

Table 3. Recapitulation of Forest and Land Fires in Sumatra and Kalimantan (2019)

Province	Island	Areas (Ha)		
		Mineral	***Peat***	***Total***
Aceh	Sumatra	528	202	730
Jambi	Sumatra	32.549	24.045	56.593
Bengkulu	Sumatra	11	11	4
Bangka Belitung Islands	Sumatra	4.231	548	4.778
Riau Islands	Sumatra	6.002	132	6.134
Lampung	Sumatra	32.851	2.695	35.546
Riau	Sumatra	27.269	63.282	90.550
West Sumatra	Sumatra	1.274	858	2.133
South Sumatra	Sumatra	199.923	136.875	336.798
North Sumatra	Sumatra	1.799	714	2.514
Total		***306.436***	***229.351***	***535.788***
West Kalimantan	Kalimantan	91.433	60.487	151.919
South Kalimantan	Kalimantan	125.898	11.950	137.848
Central Kalimantan	Kalimantan	133.913	183.836	317.749
East Kalimantan	Kalimantan	62.851	5.673	68.524
North Kalimantan	Kalimantan	8.555	5	8.559
Total		***422.650***	***261.950***	***684.599***

Presidential Instruction No. 11 of 2015 has mandated institutional and regional leaders to take measures in enhancing the control of forest and land fires. The measures include prevention, suppression and post-forest fire management. This mandate has also advocated cooperation and coordination amongst stakeholders to promote effective forest and land fire control. Public participation is encouraged, while law enforcement should be strengthened with strict sanctions imposed on individuals and legal entities that participate in forest and land burning

[42] Direktorat Inventarisasi & Pemantauan Sumber Daya Hutan (IPSDH), *Analisa Data Luas Areal Kebakaran* (Jakarta: Direktorat Inventarisasi & Pemantauan Sumber Daya Hutan, 2019), 34.

activities.[43] In addition, there has been an expansion in the number of institutions involved. While the new institutions are focused on managing social aspects, including education and health, as well as land conflicts and infrastructure development, the institutions concerned with village development have not yet been officially included in controlling forest and land fires. The Presidential Instruction is aimed at improving forest and land fire control measures and promoting effective collaboration among stakeholders to address increasing instances of forest and land fires.[44]

To ensure sustainable forest and land fire control in the future, it is essential for village governments to be involved. While the involvement of numerous government agencies might suggest a more streamlined process for addressing forest and land fires, such fires continue to occur despite the presidential decree on fire control. Consequently, reaching desired levels of fire prevention has proven difficult. Rather than an abundance of institutions, the key to tackling this issue is to clarify roles and functions and promote cooperation between agencies. Prevention is a critical component of forest and land fire control strategy. Coordination between institutions should encompass prevention, as well as fire extinguishing efforts. Effective prevention involves more than simply educating the public on the dangers of burning; it also focuses on preventing fires from starting and snuffing out small fires before they can spread and become unmanageable.[45] The presence of a forest and land fires control agency in the field is crucial to prevent the occurrence of fires and to handle them effectively. This agency plays a vital role in ensuring that fires are not ignited in the first place, or if they do occur, they can be contained before they spread and cause significant damage. This is particularly important for forested areas, which are highly susceptible to wildfires. To strengthen prevention and law enforcement measures, President Jokowi has issued a policy in the form of Presidential Instruction No. 3 of 2020. This policy instructs several relevant parties, including 16 Ministries, Cabinet Secretary, Attorney General, Army Commander, National Police Chief, National Disaster Management Agency (BPNPB), Meteorology, Climatology, and Geophysics Agency (BMKG), Geospatial Information Agency, Head of National Aeronautics and Space, Head of National Search and Rescue Agency, Head of Agency for Assessment and Application of Technology, Governors, and

[43] Rd Siti Sofro Sidiq, "Environmental Protection to Mitigate the Annual Forest and Land Fires Crisis in Riau Province Indonesia," *International Journal on Social Science, Economics and Art* 9, no. 3 (2019): 167.

[44] Courtney A. Schultz, Matthew P. Thompson, and Sarah M. McCaffrey, "Forest Service fire management and the elusiveness of change," *Fire ecology* 15 (2019): 8.

[45] Irfan Kemal Putra, Bambang Hero Saharjo, and Basuki Wasis, "Tantangan kelembagaan pengendalian kebakaran hutan dan lahan pada tingkat tapak," *Jurnal Ilmu Pertanian Indonesia* 24, no. 2 (2019): 151.

Regents/Mayors across Indonesia to work together to manage forest and land fires effectively. By working together and prioritizing prevention and law enforcement efforts, the government hopes to reduce the occurrence of fires and minimize their impact on the environment and local communities.

The primary focus of Presidential Instruction No. 3 of 2020 is to establish a coordinated work pattern for forest and land fire management across the Republic of Indonesia. The Instruction aims to implement preventive measures against forest and land fires, extinguish fires that have already started, and handle the aftermath appropriately. One of the crucial components of fire management is early detection, which can be facilitated through a specialized work unit that receives hotspot information about potential fire outbreaks. However, the current system often relies on data from the previous day, making it difficult to address fires that have already spread. The development of an effective early detection system is necessary, but not all institutions have integrated technological approaches into their fire management systems. Therefore, it is essential to establish a task force comprising regional governments and other stakeholders to ensure coordinated efforts in tackling and containing forest and land fires. By adopting a collaborative approach, the mechanism for controlling these fires can be improved, and quick solutions can be provided to prevent significant damage to natural resources and the environment.

Formulating an integrated policy for community-based forest and land fire prevention and control system is crucial. The policy should consist of three parts, i.e., pre-fire activities, during fire activities, and post-fire activities. It is important to engage the community by developing groups concerned with fire prevention. Multiple approaches must be combined to prevent forest and land fires and the involvement of the community is paramount to ensure the successful implementation of the system. While using technology is essential, it is not enough to manage the issue. The implementation of the system must also consider the regulatory aspects of Law 18 of 2013 concerning the Prevention and Eradication of Forest Destruction. This law seeks to safeguard Indonesia's vast tropical forests, which play a vital role in the global climate. The forests' preservation and survival provide the foundation for sustaining life in the world. Therefore, it is important to reduce the impact of global climate change by protecting these forests from forest and land fires.[46] Law 18 of 2013 emphasizes the importance of utilizing and using forests in a responsible manner that does not harm the environment. This is in line with the Indonesian Constitution, which gives the state control over land, water, and natural resources for the prosperity of the people. Forests are a valuable

[46] D., Susanto, G. P. Manikasari, and M. Putri, *Buku panduan karakteristik lahan gambut*, (Jakarta: Social Human Science (SHS), Unit United Nations Educational, Scientific and Cultural Organization (UNESCO), 2018), 64.

natural resource that must be maintained and managed sustainably for the benefit of the Indonesian nation. Any utilization or use of forests must be planned, rational, optimal, and considerate of the capacity and environmental balance of the forest ecosystem. Law 18 of 2013 aims to prevent and eradicate forest destruction by focusing on sustainable forestry development and responsible forest management. Protecting forests is essential for preserving natural wealth and ensuring the long-term prosperity of the Indonesian people.

Effective management for the prevention and eradication of forest destruction is crucial, and requires extraordinary measures.[47] Law No. 18 of 2013 mandates the establishment of an Agency for Prevention and Eradication of Forest Destruction (LP3H), which has specialized authority to prevent and eradicate forest destruction. This special agency can take action against individuals or organizations involved in any type of forest destruction, regardless of how direct or indirect their engagement may be. LP3H is not only responsible for eradication, but also for coordinating and supervising other institutions that handle criminal acts related to forestry or forest destruction. The agency ensures legal certainty and serves as a deterrent for those who might engage in forest destruction. Its goal is to safeguard forests in a sustainable way, without damaging the environment or the surrounding ecosystems. Through integrated investigations and prosecutions, LP3H is tasked with the eradication of forest destruction and aims to optimize the management of forest products while considering the balance of forest functions for prosperous societies. Moreover, it seeks to enhance the capacity and coordination of law enforcement officials and related parties in handling the prevention and eradication of forest destruction. In summary, the establishment of the Agency for Prevention and Eradication of Forest Destruction (LP3H) is of utmost importance to address the challenges of preventing and eradicating forest destruction, promoting sustainability, and safeguarding the protection of forest ecosystems.[48]

In order to prevent and eradicate forest destruction, the President has created a new body called the Agency for the Prevention and Eradication of Forest Destruction (LP3H), as outlined in Article 54 of Law No. 18 of 2013. This institution will be responsible to the President and will handle all efforts relating to the prevention and eradication of forest destruction. The regulations for this new agency are found in Articles 54, 55, and 56 of the same law, which emphasize the importance of preventing deforestation and the need for a coordinated effort to do so. The creation of the LP3H is a vital step in preserving the environment, which has suffered significant damage due to human activities and commercial

[47] Kamal Hidjaz, "Effectiveness of environmental policy enforcement and the impact by industrial mining, energy, mineral, and gas activities in Indonesia," *International Journal of Energy Economics and Policy* 21, no 5 (2019): 79.

[48] Gokhan Astan, "Factors effecting technology acquisition decisions in national defense projects," *Journal of Defense Resources Management (JoDRM)* 6, no. 1 (2015): 97.

interests. This agency will focus on mitigating the negative impacts of deforestation and promoting sustainable practices to ensure the preservation of forests for future generations. Thus, to avoid the destruction of forests, which is prohibited under Law No. 18 of 2013 on the Prevention and Eradication of Forest Destruction, the government and/or local authorities must establish policies that ensure cross-sector coordination, allocate resources to forest security personnel, provide incentives for those who contribute to forest preservation, accurately define and map forest boundaries, and provide necessary facilities and infrastructure to prevent further destruction. Such measures may be taken through criminal or non-penal means, as stipulated in Article 6 of the aforementioned law.

Furthermore, organizations tackling forest destruction should develop partnerships with environmental and social groups, and provide aid and support to communities as designated in Article 62 of Law No. 18 of 2013. The responsibility of halting forest destruction cannot be solely attributed to the government. It is also the duty of communities, legal entities, and corporations holding forest utilization permits, as outlined in Article 7 of Law No. 18 of 2013, further detailed in Article 58. In accordance with this law, communities possess the right to a healthy environment, including forests, and the right to forest use that aligns with regulations, community empowerment, and education on the importance of forest sustainability and the adverse impacts of forest destruction. Community members may seek information on allegations of forest destruction, receive assistance in reporting incidents to legal enforcers, receive information on permits from local governments, submit input to legal enforcement, and receive legal protection as a reporting witness, eyewitness, or expert witness. The community is required to maintain forest sustainability and manage forests according to laws, and report any signs of forest destruction. Further, the community is encouraged to gather and create social networks aimed at eradicating forest destruction, partake in collaborative anti-forest destruction efforts, raise awareness, offer information on prevention and eradication of forest destruction, supervise law enforcement, and engage in other activities towards forest protection.

5. Conclusion

The study revealed that the Riau Provincial Government's policy strategy to combat forest and land fires includes declaring an emergency alert status for disaster management, conducting outreach and integrated patrols with law enforcement in high-risk areas, utilizing weather modification technology and air patrols through water bombing, and collaborating with the respective agencies to manage peat ecosystems through wetting, planting and empowering the local

community economically. The strategy for land recovery and corporate responsibility involves imposing fines and revoking permits for corporations, while land restoration is conducted through coordination with law enforcement officials, the Attorney General's Office, the Environment and Forestry Service, and the Regional Government.

Specifically, the theoretical contributions of this research could include the development of new approaches or perspectives on the relationship between forest development and environmental governance in Riau Province. This could lead to a better understanding of the complexity of environmental issues, and how different stakeholders can work together to address them. Additionally, the research may identify patterns or trends in the data that can inform future studies, or provide insights into effective solutions for peatland environmental sustainability. The findings also provide practical implications for the government and law enforcement officials. The findings could provide a basis for better policies and regulations aimed at promoting peatland environmental sustainability in Riau Province. For companies involved in forest development, the research may help them identify more effective strategies for minimizing the environmental impact of their activities on peatlands, and increasing transparency and accountability in their operations as the effort to reduce greenhouse gas emissions. Finally, for local communities, the research could provide insights into issues they face related to peatland environmental sustainability and may help them to advocate for their rights and interests.

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