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Forest Fire Disaster Management Actions: A Systematic Literature Review

Eva Gusmira[1*], Aldri Frinaldi[2], Habibillah Alva Putra[3], and Scendy Nawa Malini[1]

[1]Fisika, UIN Sulthan Thaha Saifuddin Jambi, Indonesia; e-mail: evagusmira@uinjambi.ac.id
[2]Public Administration Science, Padang State University, Indonesia
[3]Fisika, Padang State University, Indonesia

ABSTRAK

Kebakaran hutan merupakan kejadian yang dapat merusak lingkungan dengan kejadian berulang akibat adanya perubahan cuaca dan iklim. Kejadian ini harus dicari solusi dalam mengatasinya agar tidak menimbulkan kerugian besar bagi masyarakat. Penelitian ini dilakukan dengan tujuan menganalisis tindakan mitigasi dalam menurunkan kejadian bencana kebakaran hutan, variabel yang mempengaruhi terjadinya kebakaran, dan daerah yang sering menjadi fokus dalam beberapa penelitian melalui pengkajian literatur. Pendekatan penelitian ini menggunakan kajian pustaka sistematis (SLR) dengan metode Prisma. Pengambilan sampel data dengan Watase_Uake. Artikel yang digunakan dengan indeks Q1-Q4 dalam kurun waktu 5 tahun terakhir yaitu dari tahun 2019-2023. Sebanyak 18 (delapan belas) artikel terpilih telah melalui beberapa proses yang ditentukan. Umumnya tindakan mitigasi yang dilakukan untuk mengatasi terjadinya kebakaran adalah dengan menerapkan peraturan pemerintah melalui regulasi, sangsi pelanggaran dan pendekatan ke masyarakat. Variabel yang mempengaruhi kebakaran yaitu variabel iklim, perubahan demografi, merancang protokol untuk meningkatkan pengendalian kebakaran, dan mata pencaharian alternatif yang berkeadilan sosial. Negara yang paling sering menjadi objek penelitian adalah negara di kawasan Asia khususnya Indonesia. Penelitian ini telah memberikan kontribusi dalam upaya meminimalisir kejadian kebakaran hutan dengan melihat variabel-variabel yang menjadi faktor yang mempengaruhi peran kebijakan pemerintah dalam penanggulangannya.

Kata kunci: Mitigasi Bencana, Kebijakan Pemerintah, Kebakaran Hutan, Literatur Review

ABSTRACT

Forest fires are events that can damage the environment with repeated occurrences due to changes in weather and climate. This incident must be found a solution to overcome it so as not to cause major losses to the community. This study was conducted to analyze mitigation measures in reducing the incidence of forest fires, variables that influence the occurrence of fires, and areas that are often the focus of several studies through literature reviews. This research approach uses systematic literature review (SLR) with the Prisma method. Data sampling with Watase_Uake. Articles used with the Q1-Q4 index in the last 5 years, namely from 2019-2023. A total of 18 (eighteen) selected articles have gone through several specified processes. Generally, mitigation measures taken to overcome fires are by implementing government regulations through regulations, sanctions for violations, and approaches to the community. The variables that influence fires are climate variables, demographic changes, designing protocols to improve fire control, and alternative livelihoods that are socially just. The countries that are most often the objects of research are countries in the Asian region, especially Indonesia. This research has contributed to efforts to minimize forest fire incidents by looking at the variables that are factors that influence the role of government policy in dealing with them.

Keywords: *Disaster Mitigation, Government Policy, Forest Fire, Literature Review*

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1. INTRODUCTION

Forest fire disaster is one of the serious environmental problems throughout the world, including in Indonesia. Forest fires not only damage the natural ecosystem, but also cause significant social, economic, and health impacts for the community (Arum et al., 2021; Syarifah et al., 2020).

Extreme drought caused by El Nino and climate change triggers fires. Forest fires are often caused by land clearing practices by burning by irresponsible parties (Ardiyanto & Hidayat, 2020). Burning is carried out for agriculture with large areas (Rosit et al., 2023). This happens repeatedly every year due to a lack of awareness in maintaining environmental

sustainability, and the failure of the environmental management system (Ardiyanto & Hidayat, 2020; Arum et al., 2021; Ferreira Barbosa et al., 2021).

The impacts of forest fires are extensive and complex. The resulting smoke causes air pollution that can spread to neighboring countries, causing public health crises such as increased respiratory diseases. In addition, the economic losses caused by forest fires are also very large (Oliveira et al., 2020), including the loss of forest products, damage to infrastructure, and disruption of economic activity (Arum et al., 2021).

Forest fire mitigation efforts have become the focus of attention of the government and various related parties. Effective mitigation actions not only require a quick and responsive response when a fire occurs, but also comprehensive preventive measures. Better land management policies, the application of early detection technology, and increasing public awareness of the dangers of forest fires are some of the actions that have been attempted. Fire prevention in community protection efforts (Canadas et al., 2023), effective law enforcement, increasing public awareness, the role of government, and cooperation between institutions are also needed in efforts to prevent and overcome forest fires (Syarifah et al., 2020).

Forest conservation has been regulated by the Indonesian government in Law Number 32 of 2009 concerning Environmental Protection and Management (Ministry of Environment and Forestry, 2019), confirmed in the Regulation of the Minister of Environment and Forestry of the Republic of Indonesia Number P.32 of 2016 concerning Control of Forest and Land Fires. In this regulation, forest fire control has been prepared which includes prevention, extinguishing, post-fire handling, evacuation and rescue support, and support for forest and/or land fire control management (Peraturan Menteri Lingkungan Hidup Dan Kehutanan Republik Indonesia Tentang Pengendalian Kebakaran Hutan Dan Lahan, 2016).

However, the challenges in implementing forest fire mitigation measures are still very large. Delays in the government's response to forest fires (Fitriany et al., 2021), lack of coordination between agencies, limited resources, and low public awareness are the main obstacles in reducing the risk of forest fires. Therefore, this study aims to analyze forest fire mitigation measures that have been carried out by the government, organizations and communities in reducing the risk of forest fire disasters, factors that influence the occurrence of forest fires and areas that are often the focus of research.

2. METHOD

The research method in this paper uses a literature review study (SLR) approach with the PRISMA Method. SLR is a type of research that uses a literature study using several steps (Priharsari, 2022). Literature review has the advantage of being more objective and avoiding bias and researchers becoming research tools (Simamora et al., 2024). Article collection was carried out using the Watase-Uake Method with an automatic literature search with PRISMA. The articles collected used the Scopus Q1-Q4 index database source in the period 2019 to 2024. Watase-Uake has the advantage of helping researchers conduct literature reviews (Wahyudi, 2024).

SLR research consists of 4 stages, namely determining the focus of SLR, initiation and selection of articles to be used as literature, analyzing and coding, and planning the presentation of results (Priharsari, 2022; Simamora et al., 2024). The SLR stages in Watase-Uake with PRISMA also go through 4 stages, namely identification, screening, data retrieval, and reporting of PRISMA results (Wahyudi, 2024).

The subject of the study is the role of government policy in minimizing the occurrence of fire disasters. The research questions to be answered in this study are as follows:

RQ1 : Actions taken to reduce forest fires.
RQ2 : What variables cause fires.
RQ3 : Countries studied in discussing fires with mitigation policies

The identification process was carried out using the keywords “Government policy on forest fires” and “Rule of Disaster”.

3. RESULT AND DISCUSSION

The steps of working with the PRISMA Method can be seen in Figure 2. In Watase, the stages of the PRISMA Method are grouped into 3 stages, namely identification, screening, and inclusion. Each stage has several workflows. The results of the article search were carried out at the identification stage using Watase-Uake with two keywords "Government policy on forest fires" and "Rule of Disaster", obtained as many as 237 Scopus articles. The mapping of words that often appear during the identification process from the 237 articles found are climate change, deforestation, wildfire, forest management, policy, fire and biodiversity.

Next, PRISMA performed automatic filtering, resulting in 117 (one hundred and seventeen) articles that did not meet the requirements because they were outside the specified 2019–2024 time frame, 8 articles were not indexed from Q1 to Q4, and 6 articles without abstracts. A total of 131 articles were discarded. At this stage, we can see the feasibility of the research theme to be continued to the next stage from the trend of the increase in the keyword search results graph. If the graph increases every year, the SLR process can be continued (Figure 1).

From Figure 1, it can be seen that the graph tends to rise, which indicates that the next SLR stage can be continued.

The next step is for the researcher to filter the 106 articles from the previous identification. This filtering is done to test the reliability of the articles that show the similarity of the articles analyzed (Priharsari, 2022).

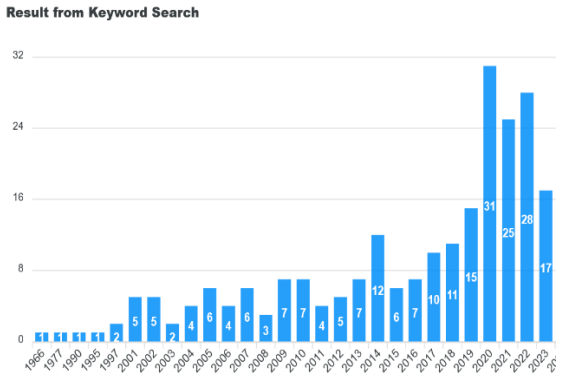

Figure 1. Keyword Feasibility Test Graph

At this screening stage, the content and content of the articles that are in accordance with the research theme are filtered. 80 articles were removed because they did not match the theme and 8 articles could not be taken. At this stage, 18 articles remain ready to be analyzed for their feasibility (Table 1).

The next stage in the SLR process with the PRISMA Watase method is the article review (Included). Researchers will conduct an article review based on the research objectives, namely, the mitigation method used, what variables are the causes of fires, and countries that are widely studied in discussing fires with mitigation policies.

Of the 18 articles analyzed, there were 15 articles based on Q1 journals, 2 journals based on Q2 and 1 journal based on Q3.

The analysis of LSR results begins by answering several questions generated from the watase-uake visualization. The discussion on forest fire mitigation is carried out with a description of the general LSR search results and answers to RQ1. The results of this description are given in the form of independent variables and dependent variables (Table 2).

Table 1. Articles Filtering Results

No	Authors	Year	Title	Journal	Citation	Journal Rank*
1	de Figueiredo Silva et al.	2022	The Increasing Opportunity Cost of Sequestering CO_2 in The Brazilian Amazon Forest	Empirical Economics	2	Q2
2	Granville et al.	2022	A Case-Crossover Study of the Impact of the Modifying Industrial Operations Protocol on the Frequency of Industrial Forestry-Caused Wildland Fires in Ontario, Canada	Journal of Agricultural, Biological and Environmental Statistics	1	Q1
3	Dube	2022	The Rule of Law in a State of Disaster Evaluating Standards for the Promulgation, Administration and Enforcement of Emergency Regulations in South Africa	Hague Journal on the Rule of Law	0	Q1
4	Canosa et al.	2023	Wildfire Adaptation in The Russian Arctic a Systematic Policy Review	Climate Risk Management	6	Q1
5	Mourao & Martinho	2019	Forest Fire Legislation Reactive or Proactive	Ecological Indicators	17	Q1
6	Trihadmojo et al.	2020	Toward a Nuanced and Targeted Forest and Peat Fires Prevention Policy Insight from Psychology	Forest Policy and Economics	3	Q1
7	Astuti	2021	Governing The Ungovernable the Politics of Disciplining Pulpwood and Palm Oil Plantations in Indonesia s Tropical Peatland	Geoforum	21	Q1
8	Eilenberg	2021	The Last Enclosure Smoke, Fire and Crisis on The Indonesian Forest Frontier	The Journal of Peasant Studies	8	Q1
9	Roy	2020	On the Horns of a Dilemma Climate Change, Forest Conservation and the Marginal People in Indian Sundarbans	Forum for Development Studies	5	Q3
10	Brotestes Panjaitan et al.	2019	The Role of Central Government and Local Government and The Moderating Effect of Good Governance on Forest Fire Policy in Indonesia	Benchmarking: An International Journal	9	Q1
11	Nóbrega Spínola et al.	2020	A Shared Perspective on Managing Amazonian Sustainable-Use Reserves in An Era of Megafires	Journal of Applied Ecology	8	Q1
12	Dickson-Hoyle et al.	2024	Community Forests Advance Local Wildfire Governance and Proactive Management in British Columbia, Canada	Canadian Journal of Forest Research	1	Q1
13	Tenzin et al.	2024	Climate and Humans Interact to Shape the Fire Regime of a Chir Pine (Pinus Roxburghii) Forest in Eastern Bhutan	Fire Ecology	1	Q1
14	Zhang et al.	2023	Study on The Impact of Forest Fire Prevention Policy on The Health of Forest Resources	Applied Mathematics and Nonlinear Sciences	1	Q1
15	Falcon et al.	2022	Using Conditional Cash Payments to Prevent Land-Clearing Fires Cautionary Findings from Indonesia	Agriculture	1	Q2
16	Yan et al.	2022	Does the Policy of Ecological Forest Rangers (EFRs) for the Impoverished Populations Reduce Forest Disasters - -Empirical Evidence from China	Forests	5	Q1
17	Al Abri	2022	Evaluating Incentive-Driven Policies to Reduce Social Losses Associated with Wildfire Risk Misinformation	Forests	2	Q1
18	Wilbur et al.	2021	Perceptions of NRCS Assistance with Prescribed Fires on U.S. Private Lands a Regionally Stratified Case Study	Fire	9	Q1

Data source processed from watase-uake

Some efforts made to reduce the occurrence of forest fires in various countries are through government policies in forest management, including the supremacy of law over emergency regulations adopted to address national disasters in South Africa (Dube, 2023). The implementation of forest fire laws is reactive to major events, with the government primarily focusing on the area burned rather than forestry development. In addition, forest fire legislation is interrelated with other aspects, including the effectiveness of legislative instruments or forest management and planning (Mourao & Martinho, 2019). Interaction between central and regional governments and forest fire prevention governance (Brotestes Panjaitan et al., 2019) and educational programs that seek to increase public knowledge (Al Abri, 2022) are also needed in forest fire mitigation efforts. In addition, an integrated approach is needed in planning fire reduction and response actions (D'Evelyn et al., 2022).

Bhutan's 1969 Forest Act, which transferred forest management from local community control to centralized government control, severely restricted grazing, burning, resin tapping, and collection of non-timber forest products (Tenzin et al., 2024). The Chinese government has issued related policies to strengthen the emphasis on forest fire prevention (Zhang et al., 2023), including policies to employ poor rural residents as ecological forest rangers (EFR) (Yan et al., 2022).

Mitigation in British Columbia (BC), Canada, Community Forests, long-term land-based tenure rights granted to Indigenous and/or local communities have emerged as local champions facilitating proactive wildfire management (Dickson-Hoyle et al., 2024). Legislative and regulatory mechanisms, developed at the regional level, were adopted in response to national mandates, and mainstreamed into existing forest management policies (Canosa et al., 2023).

The Indonesian government's efforts to mitigate forest fires include issuing a strict ban on the practice of burning forests for agricultural land clearing, but this has not been effective because it has not educated farmers (Trihadmojo et al., 2020). The government also makes conditional payments for burning forests (Falcon et al., 2022). The Indonesian government's efforts to overcome peatland fires by introducing two disciplinary strategies, namely the spatial and hydro governance approaches to regulate oil palm and pulpwood plantations in peatland landscapes. However, these efforts were unsuccessful due to the messy, unsafe, and incomplete nature of environmental governance (Astuti, 2021). The direct consequence of the Indonesian government is taking firm action by prohibiting farmers from burning land and forests as part of their agricultural practices (Eilenberg, 2022).

The review in answering RQ1 is summarized into variables that influence policies to mitigate the impact of forest fires in the articles analyzed consisting of 20 independent variables shown in Table 2.

Table 2. Independent and Dependent Variables Affecting Forest Fire Mitigation Policy

No	Independent	Dependent	Amount	Researcher
1	Agricultural Outputs	CO_2/ Deforestation	1	de Figueiredo Silva et al., 2022
2	Agricultural Input	CO_2/ Deforestation	1	de Figueiredo Silva et al., 2022
3	Attitudes Toward Burning Behavior	Burning Intention	1	Trihadmojo et al., 2020
4	Awareness of Consequence	Attitudes Toward Burning Behavior	1	Trihadmojo et al., 2020
5	Awareness of Consequence	Subjective Norms	1	Trihadmojo et al., 2020
6	Burn Plan	Perceptions	1	Wilbur et al., 2021
7	Climate Variability	Fire Occurrence	1	Tenzin et al., 2024
8	Climate Change Adaptation and Mitigation Policies	Conservation of SDB	1	Roy, 2020
9	Conduct Burn	Perceptions	1	Wilbur et al., 2021
10	Demographic Changes	Fire Management	1	Nóbrega Spínola et al., 2020
11	Designing Protocols to Improve Fire Control	Fire Management	1	Nóbrega et al., 2020
12	Educate	Perceptions	1	Wilbur et al., 2021
13	Emergency Regulations	Combat a National Disaster	1	Dube, 2023
14	Encourage Socially Just Alternative Livelihoods	Fire Management	1	Nóbrega et al., 2020
15	Environmental Regulations	Swidden Agriculture	1	Eilenberg, 2022
16	Forest Fires	Afforestation Area	1	Zhang et al., 2023
17	Forest Fires	Area Affected by Fir	1	Zhang et al., 2023
18	Forest Fires	Gross Regional Product	1	Zhang et al., 2023
19	Forest Fires	Investment In Forest Fire and Forest Public Security	1	Zhang et al., 2023
20	Forest Fires	Number of Fires	1	Zhang et al., 2023

From table 2, forest fires are the independent variable that most influences other variables in this mitigation policy. Some variables that are influenced by forest fires are the area of reforestation, the area affected by forest fires, gross regional product, investment in forest fires and forestry public security, and the number of fires.

According to the article analysis, there are several things that influence forest fire management, namely climate variables, demographic changes, designing protocols to improve fire control, and alternative livelihoods that are socially just.

11 countries have been the objects of study in this forest fire problem, namely Brazil, the United States, Indonesia, China, China, Bhutan, India, Portugal, Russia, Africa, and Canada. Indonesia is an interesting country to study in the case of forest fires (figure 4). This is because the worst forest fire incidents originated in Indonesia and have become a global disaster (Syarifah et al., 2020).

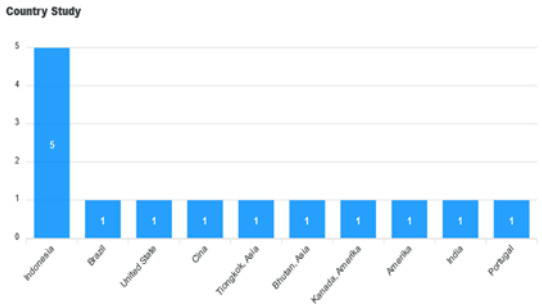

Figure 4. Number of Study Country Research

From figure 4, Indonesia has been the research location for 5 times from the existing articles. Furthermore, 3 articles have made America the study location. The percentage of research countries can be seen in figure 5.

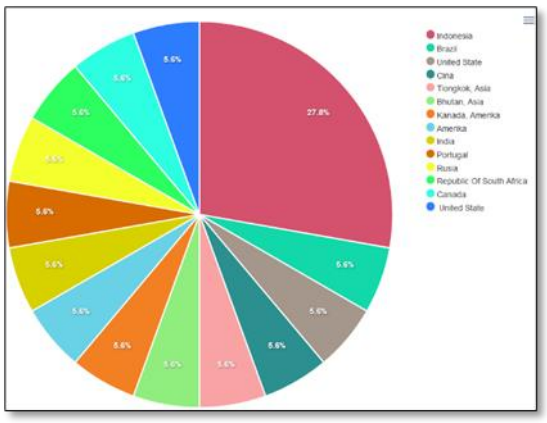

Figure 5. Percentage of Study Countries

The government has a big role in minimizing the impact of forest fires. Most articles conclude that the government must work with local institutions and communities in implementing policies to overcome fire disasters and overcome disasters in a sustainable manner (Pozharliev et al., 2022).

4. CONCLUSION

This literature review research on forest fire mitigation describes several efforts made in various countries to minimize the occurrence of forest fires that occur in Indonesia and most of Asia almost every year, especially during severe El Nino events. The collected articles state that the main cause of forest fires is the dry season which causes drought and is exploited by the community and perpetrators of burning due to the lack of strict regulations on forest burning. Several variables in forest fire management are climate variables, demographic changes, designing protocols to improve fire control, and alternative livelihoods that are socially just. The area that is the focus of this literature study is Asia, especially Indonesia (27.8%). The results of this study provide implications for the importance of implementing consistent policies, and involving the community and educating the community about the importance of maintaining forest sustainability.

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