ICD
Information, Communications, and Disaster
ICD 1(2): 53–61
ISSN 3047-7476

Institute for Advanced Science, Social and Sustainable Future
MORALITY BEFORE KNOWLEDGE

A case study: Mapping disaster vulnerability of oil palm plantation areas

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Received Date: Mei 10, 2024 Revised Date: June 18, 2024 Accepted Date: August 31, 2024

ABSTRACT

Background: The expansion of oil palm plantations through improper land clearing often leads to forest and swamp fires, exacerbating disaster risks. This study aims to develop a Disaster Vulnerability Map (DVM) for areas under Oil Palm Plantation Rights (HGU) by integrating disaster risk reduction measures, including monitoring location permits and Regional Spatial Planning (RTRW). **Methods:** The research employs the Composite Mapping Analysis (CMA) method to score and weigh the disaster vulnerability factors, focusing on the distribution of hotspots in Riau Province. This quantitative analysis uses a ratio-based approach to assess the vulnerability of each HGU location. **Findings:** The results indicate that 45 HGU locations in Riau Province are situated in high fire risk zones, covering an area of 95,260.7 ha (10.4%). Among these, 70.4% of the total area (647,160.3 ha) is located in forest and land fire-prone regions, while 19.2% is categorized as less threatened. **Conclusion:** The findings highlight the critical need for comprehensive disaster vulnerability mapping to mitigate fire risks in oil palm plantation areas**. Novelty/Originality:** This study contributes an innovative approach to disaster risk reduction by combining spatial analysis with location permit monitoring, focusing on oil palm plantations, which has not been extensively studied in the context of forest fires.

KEYWORDS: disaster vulnerability map; oil palm plantation; fire risk; forest fire; spatial analysis.

1. Introduction

Indonesia's obsession with becoming the largest supplier of palm oil has negatively impacted the release of millions of hectares of land into the hands of investors. The lucrative profits of plantations led to a massive expansion of plantation companies that began in the late 1990s. Indonesia bought 7.2 million hectares of land and ten years later around 9 million hectares were planted with oil palm plantations. Based on data summarized by Aid Environment (2003), it shows that Indonesia and Malaysia were the largest suppliers of world palm oil production in 2002 (84% production), with Malaysia controlling 3.7 million hectares and Indonesia 9 million hectares.

The company's large-scale land expansion through improper land clearing, i.e. large-scale clearing of forests by burning forests and swamps, has resulted in deadly and damaging disasters (Christin et al., 2016). Fighting forest and land fires is, of course, our collective responsibility. Various regulations, concessions, restoration projects, NGO formations and alliances at local, national and international levels are in place to protect

Cite This Article:
Panjaitan. (2024). A case study: Mapping disaster vulnerability of oil palm plantation areas. *Information, Communications, and Disaster, 1*(2), 53-61. https://doi.org/10.61511/icd.v1i2.2024.1888

forests and swamps from fire hazards and damage. The government also issued Presidential Decree (Inpres) No. 10 of 2011 to postpone the issuance of new permits and to improve the management of native forests and peatlands.

These various efforts did not fully stop the violations committed by the company. After the issuance of the Presidential Instruction in 2011, based on EoF (Eye of the Forest) data, when there were still allegations of forest and land fires by companies in 2013 and 2014, the State Council issued Presidential Instruction No. 2015 on the large number of violations that occurred in 2015 (Syaufina & Hafni, 2018). This Presidential Policy contains 6 (six) delays of new licenses from the indicative map, which is revised monthly, whereby no new licenses can be granted for objects within the areas covered by the moratorium. In addition, the Government issued Presidential Decree No. 1 Year 2016 on Peatland Preservation Agency tasked with coordinating and facilitating peat reclamation in the Provinces of Riau, Jambi, South Sumatra, West Kalimantan, Central Kalimantan, South Kalimantan, and Papua (Harnanda, 2022)

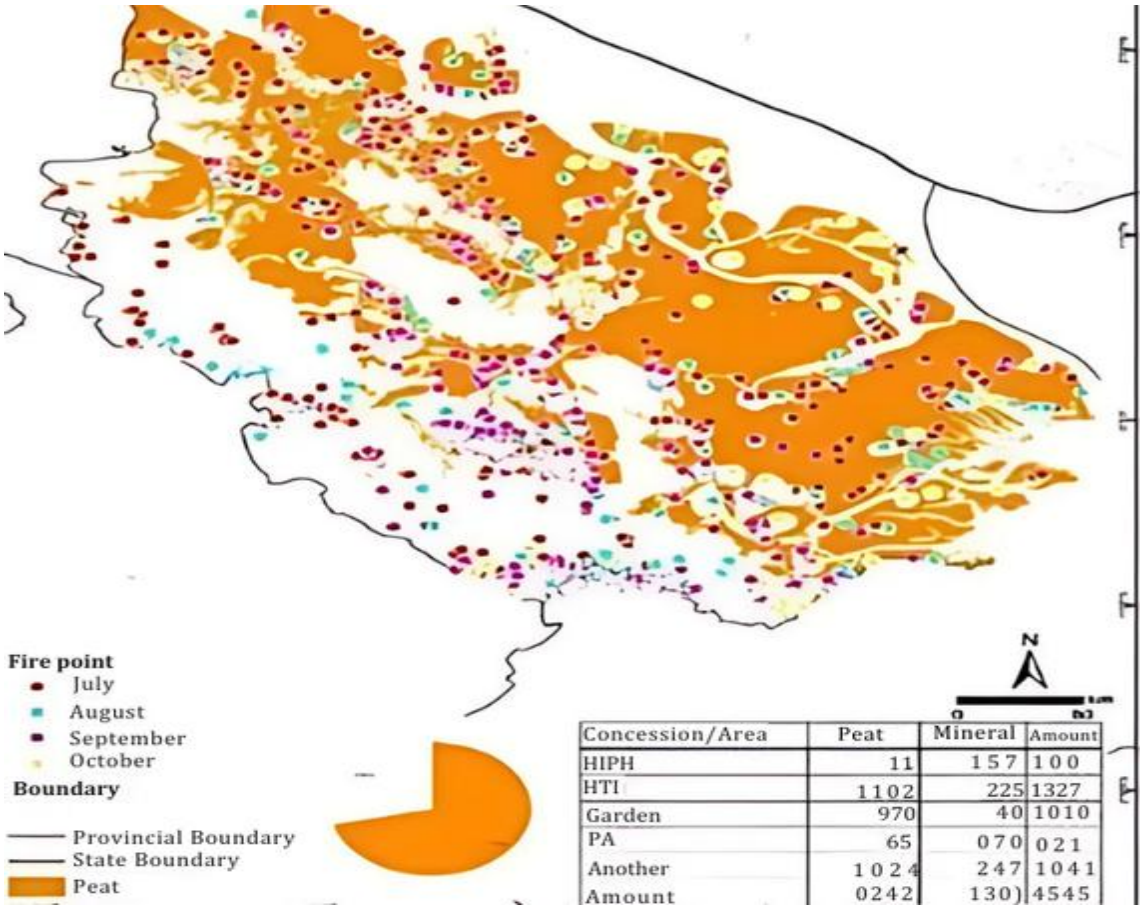

Fig 1. Recapitulation of the distribution of hotspots/fires in forests and peatlands

Preventive efforts to reduce the occurrence of fires include monitoring of new location permits, monitoring of RTRW and monitoring of planting areas, as well as assessing the fulfillment of the principle of compliance with forest management licenses / HTI/HPH trading licenses, permits for the utilization of timber forest products for plantation forestry, natural forests and ecosystem restoration (IUPHHK-HTI/HA/RE) or plantation permit holders. The Ministry of Agriculture and Regional Planning/National Land Agency (ATR/BPN) is one of the ministries that should be responsible for land supervision and control. In this case, the ATR/BPN Department plays an important role in preparing the RTRW and also provides technical aspects of the property in the licensing process before the Regent grants the location permit. This technical aspect becomes one of the prerequisites and is linked to the issuance of the location permit. In addition, the Ministry of ATR/BPN issues the HGU after the governor grants the location permit. Here are the three

key steps taken by the Ministry of ATR/BPN, namely: Issuance of property engineering aspects, (2) Issuance of HGU licenses, and (3) RTRW drafting practices. The property engineering aspect becomes a filter whether a website license request can be accepted or rejected. Meanwhile, the granting of HGU to investors has an impact on the Ministry of ATR/BPN's supervision of company activities operating in addition to the granted HGU.

The complexity of the problem of forest and land fires, ranging from their causes and impacts, encourages the author to examine this topic in more depth, especially in relation to the role of the Ministry of Agriculture/BPN. The creation of a map by overlaying the fire hazard map of Riau Province and the HGU management map can certainly serve as a basis for efforts to reduce the risk of forest accidents and forest fires (Syaufina & Hafni, 2018). This map was created to help monitor and regulate HGU owners to protect and manage plantations in accordance with applicable laws and regulations.

2. Methods

Fire hazard maps are made to map fire-prone areas according to their level of danger. The map is expected to be used as a preventive measure to map the location, determine the size and extent of the area, and as a basis for monitoring fire danger. Simple fire hazard maps can be created by modeling based on a combination of biophysical factors, namely land cover, peat distribution and elevation (climate zone).

Table 1. Classification of bio-fisic factors

Factor	Class
Land cover	Water, scrub, primary mangrove forest, secondary mangrove forest, primary forest, secondary forest, primary swamp forest, secondary swamp forest, peat plantation forest, dryland plantation forest, plantation, settlement, dryland farming, swamp, rice field, swamp scrub, fishpond, mine, open land, transmigration
Types of soil	Peatland, non-peatland
Elevation/climate zone	0-25 m, 25-500 m, >500 m

Topography/elevation, location, slope and soil conditions influence the spread of fire. In steep/hilly areas where the frequency and variability of topography is high, fire spread does not develop rapidly (Hawley and Stickel, 1948). Brown and Davis (1973) say that the topographical factor affecting fire is slope. Fires tend to burn quickly uphill and slowly downhill into the valley. This is due to increased surface winds on the slope while the fire slows down towards the valley due to the high water content in the valley, causing the fire to spread slowly and even die out.

Table 2. Types and sources of research data

No	Data type	Data source/instantion	Format
1.	Distribution of Peatland in Sumatra Island 2011	Ministry of Agriculture, Agricultural Land Resource Research and Development Center	*.jpeg
2.	Elevation	SRTM30 Imag (www.diva-gis.org)	*vrt
3.	Land cover of the province	firms.modaps.eosdis.nasa.gov	*.kml
4.	Hotspot distribution of MODIS recordings 2011–2014		*.shp

The mechanism used to create this map uses biophysical factors that affect fire susceptibility, which are then scored and weighted. Scoring and weighting are done quantitatively using the Composite Mapping Analysis (CMA) method, based on the ratio of each factor to the percentage of hotspots. The grid points used in the CSMA method are the results of MODIS sensor recordings attached to the Terra and Aqua satellites. Hotspot data

is only sorted for those with a confidence level of e "80%. The classification of each factor and the formula for calculating points and weights are presented in Table 1 and Table 2. The distribution of hotspots was analyzed by overlaying the maps that make up the model so that the relationship is known. Spatial relationship between the maps that make up the model and the distribution of hotspots

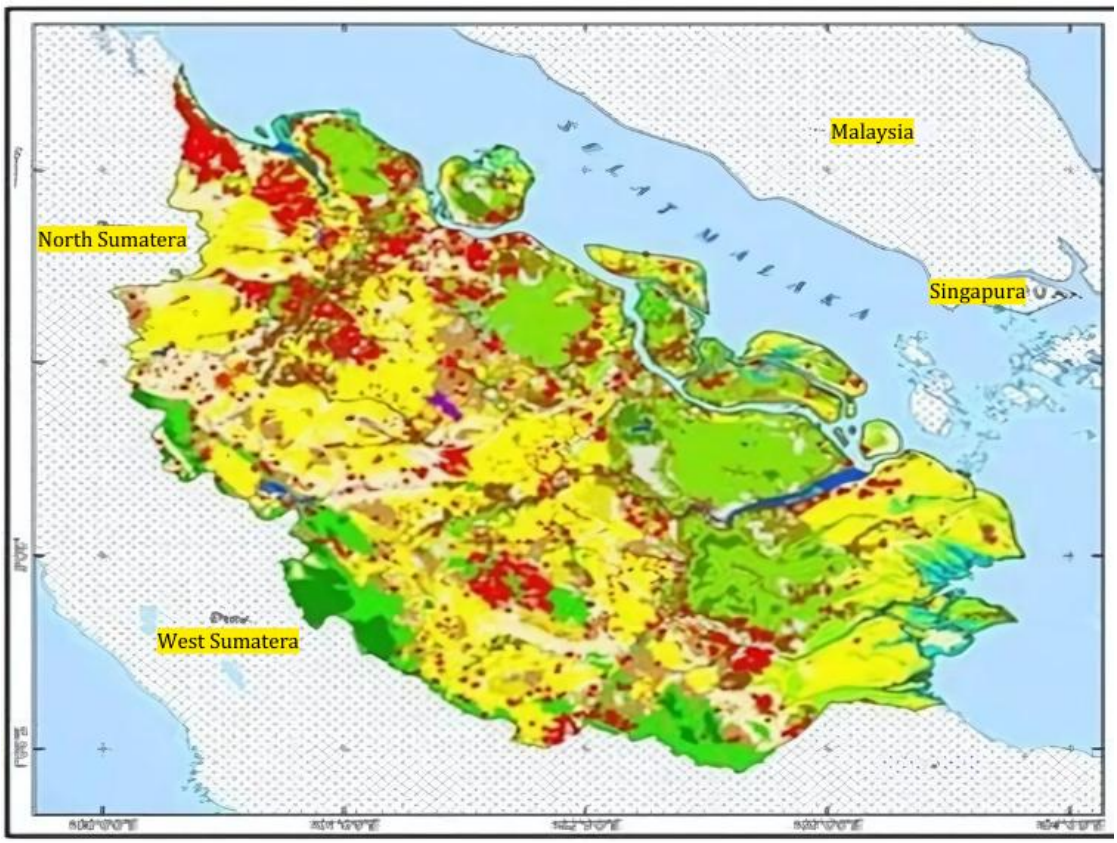

Fig 2. Overlay of land cover map and hotspot distribution map

3. Results and Discussion

3.1 The role of land technical considerations in supporting disaster risk reduction efforts of forest and land fires in Riau Province

Land The Land Technical Consideration is a document issued by the local land office that serves as a crucial reference for land planning and development. This document includes seven essential maps that provide a comprehensive overview of the area in question. These maps are: (1) a location map, which shows the geographical placement of the land; (2) a land use map, detailing current land utilization; (3) a land tenure overview map, indicating ownership or control status; (4) a land capability map, which assesses the physical potential of the land; (5) a land use suitability map, evaluating how appropriate the land is for various proposed uses; (6) a land availability map, showing portions of land available for use or development; and (7) a land technical consideration map, which combines and analyzes the various technical aspects for decision-making.

One important aspect that must be considered in reducing the risk of forest and land fires is the presence of peat (Ikhsan & Setiawan, 2021). Field mapping is mandatory when developing soil capacity maps, and peat should also be considered as a limiting factor when developing soil maps (Badri et al., 2018). According to the Minister of Agriculture's decree, the number is: 14/Permentan/Pl.110/2/2009 Only swamp soil with a depth of less than 3 meters can be used as potting soil, so if peat is found at a depth of more than 3 meters it cannot be used as potting soil. This regulation is clear about protecting and prohibiting the

cultivation of land at a depth of more than 3 meters. To determine the distribution of peat depth areas, the soil map that will be made must contain information on peat limiting factors.

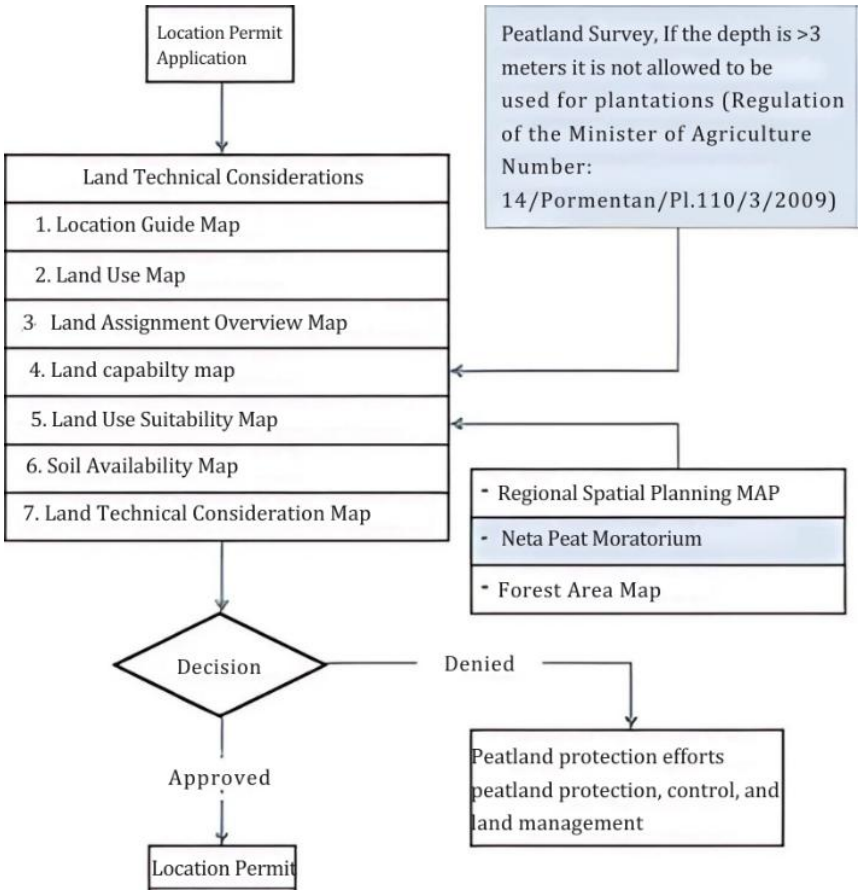

Fig 3. Land technical considerations in support of forest and land fire disaster risk reduction efforts

Land suitability maps as well as location guidance maps and land use maps contribute to the production of land suitability maps. In addition, additional inputs are required to produce the land use suitability map, such as: B. regional plan maps (RTRW), forest area maps and maps indicating delays in issuing new licenses. often referred to as peat moratorium cards. The Peat Moratorium Map is a Presidential Order No. 8/2015, which is an effort to protect the existence of peatlands and is one of the efforts to prevent forest and land fires.

3.2 Disaster Risk Reduction (DRR) Forest and Land Fires Ministry of ATR/BPN Post HGU issuance

In accordance with the mandate of the UUPA, HGU holders are obliged to maintain the land, including increasing its fertility and preventing damage, so BPN as the agency that issues HGU needs to carry out supervision/monitoring of activities carried out by HGU holding companies. The occurrence of land fires in the HGU location is a form of deviation from land maintenance which results in damage to natural resources. One way to prevent land fires is by overlaying a map of land and forest fire disaster prone areas with a map of the distribution of HGU land parcels (CIFOR, 206).

The results of this overlay will provide information on HGU land parcels that are prone to fires and their extent. The next step is for BPN to appeal to companies holding HGUs in locations with very vulnerable and high vulnerability levels to provide facilities and infrastructure to control land fires, provide water resources and take preventive measures

and coordinate with related agencies. The role of the Ministry of ATR / BPN in reducing forest and land fires.

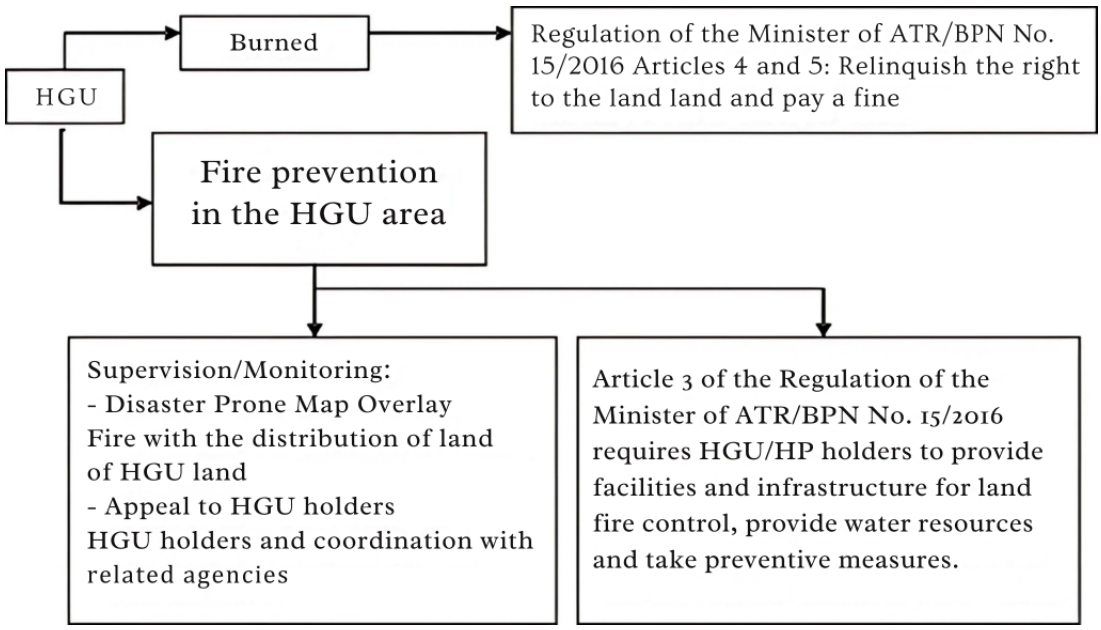

Fig 4. DRR stages of forest and land fires Ministry of ATR/BPN after HGU issuance

3.3 Analysis of Disaster Prone Map with HGU Distribution in Riau Province

To find out and monitor the HGU, a map of fire disaster prone areas was overlaid with the distribution of HGU in Riau Province. Based on the data obtained, in 2012 there were 145 locations of HGU according to the subject of rights (Sudiana, 2019). One HGU location may be included in several levels of disaster vulnerability. From the results of data analysis shows that the distribution of HGU in Riau Province in 2012: there are 45 HGU locations in the area very prone to fire disasters with a total area of 95,260.7 Ha, so that 10.4% of the location of HGU in Riau Province is in the category of very vulnerable; most of which reached 70.4% (an area of 647,160.3 Ha with a distribution of 143 HGU) is in the threat area prone to forest and land fires; while 19.2% of the total HGU area is in the less vulnerable category spread over 25 HGU.

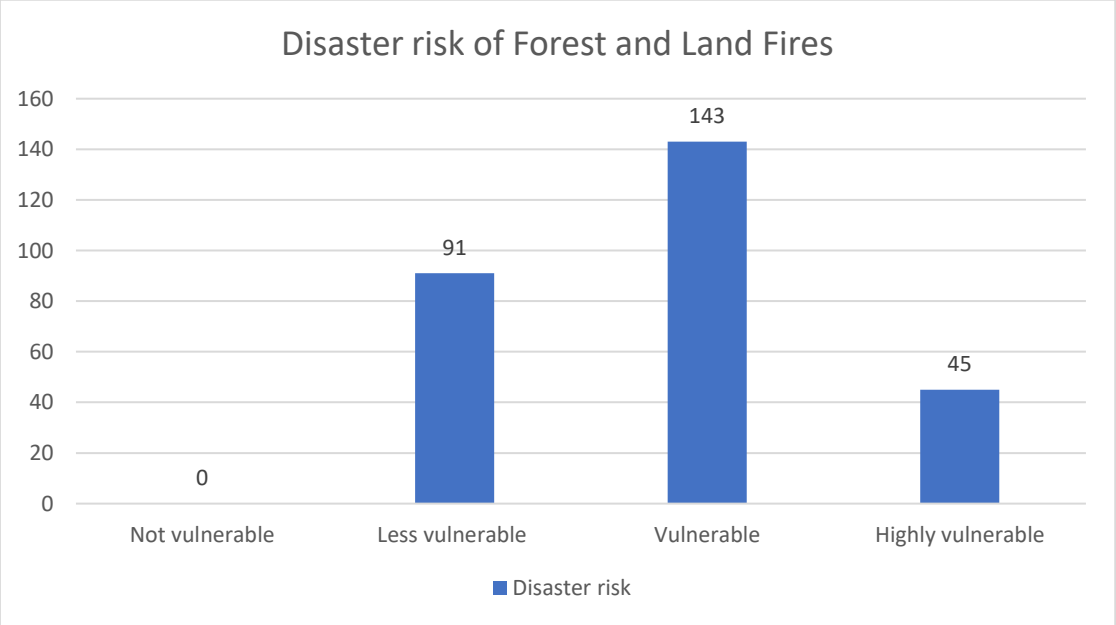

Fig 5. Distribution of HGUs Based on the Level of Disaster Risk of Forest and Land Fires

The distribution of HGUs based on the level of vulnerability to forest and land fires, and the area and percentage of HGU area based on the level of vulnerability.

Table 3. Area and Percentage Distribution of HGU Based on Level of Insecurity

No	Vulnerability zone	Area (ha)	Percenatage (%)
1	Not vulnerable	0	0
2	Less vulnerable	176,864.9	19.2
3	Vulnerable	647,160.3	70.4
4	Highly vulnerable	95,260.7	10.4
Total		919,285.9	100

4. Conclusions

The spatial analysis of the fire vulnerability map indicates that forest and land fires are highly prone in most areas of Riau Province, with high-risk areas covering 2,109,212 ha, fire-prone areas 5,088,928 ha, less threatened areas 1,778,721 ha, and unexposed areas 51,767 ha. Furthermore, the HGU fire distribution map analysis reveals that 45 HGU locations in high-risk areas total 95,260.7 ha, or 10.4% of the forest fire-prone area, while 70.4% of the total HGU area (647,160.3 ha across 143 HGUs) is located in forest and fire-prone zones, and 19.2% is categorized as less vulnerable, spread across 25 HGUs. To mitigate forest and fire risks, the Ministry of ATR/BPN can integrate peat depth and peat moratorium maps with forest and fire hazard maps, overlaying them with HGU distribution maps, and adjust the RTRW to delay new licenses. This strategy will help the Ministry monitor HGU ownership in Riau Province and better address fire vulnerabilities.

A fire hazard map based on biophysical factors can effectively illustrate the fire risk levels in the study area. However, some regions with high hotspot density remain difficult to classify accurately on the modeled map. To enhance the model's accuracy, additional biophysical factors, such as proximity to roads and human activity zones, could be incorporated. This would improve the map's ability to reflect the actual fire hazard, providing a more comprehensive tool for monitoring and management of fire-prone areas in Riau.

Acknowledgement

The author express gratitude to all parties who have contributed to the completion of this research. Support in the form of insights, resources, and constructive feedback has been invaluable in refining this study. Appreciation is also extended to those who provided access to relevant data and literature, which greatly enriched the analysis and discussion.

Author Contribution

The author was responsible for the conceptualization, data collection, analysis, and manuscript writing. All aspects of the research, including the formulation of research questions, literature review, and interpretation of findings, were conducted independently. The author also reviewed and approved the final version of the manuscript.

Funding

This research received no external funding.

Ethical Review Board Statement

Not available.

Informed Consent Statement

Not available.

Data Availability Statement
Not available.

Conflicts of Interest
The author declare no conflict of interest.

Open Access

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