# PEATLAND FIRE ALERT

## Unveiling Forest and Land Fires Vulnerability in the Peat Hydrological Unity Area (PHU) in 2023

pantau gambut

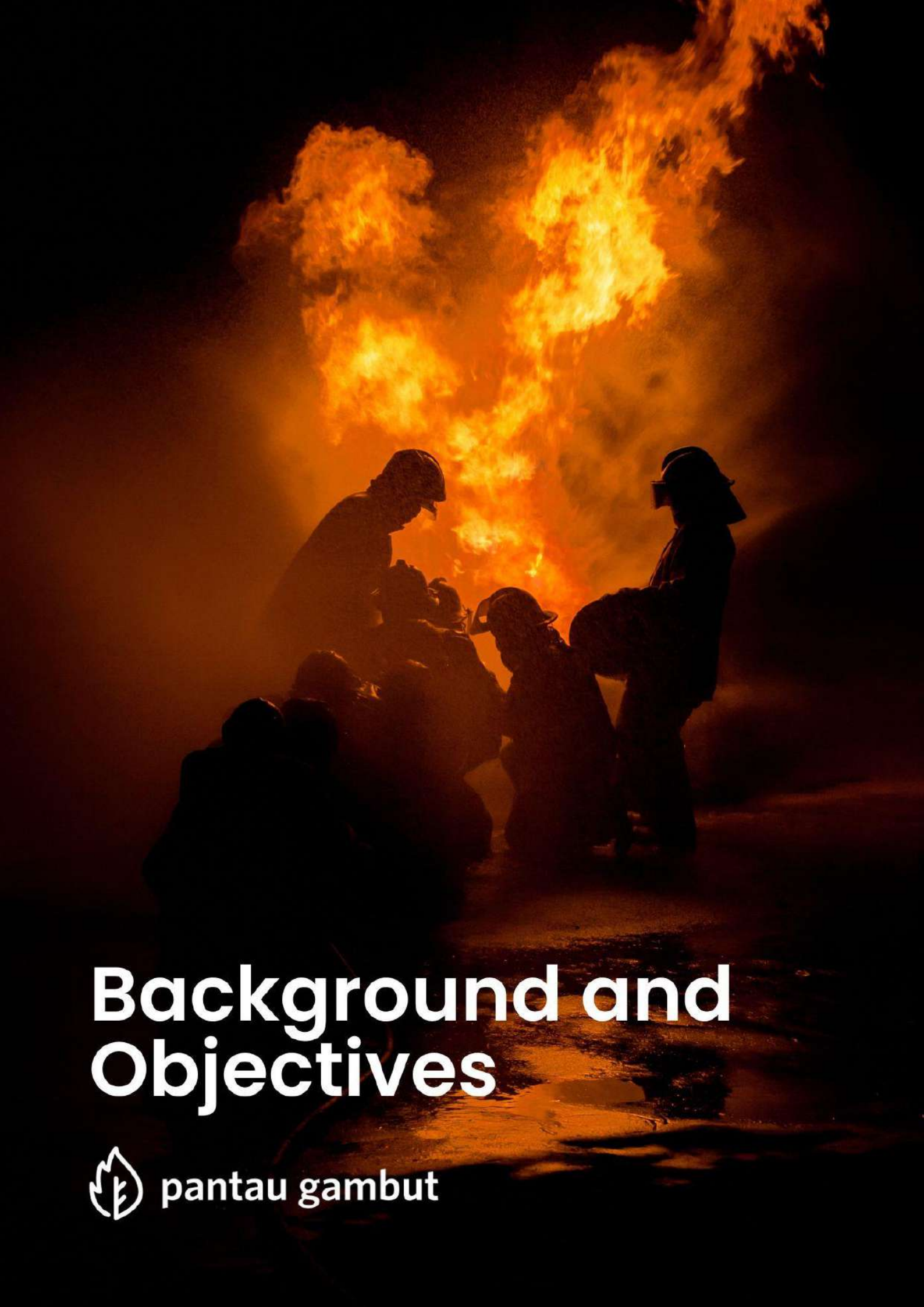
pantau gambut

# Unveiling Forest and Land Fires Vulnerability in the Peat Hydrological Unity Area (PHU) in 2023

Almi Ramadhi, Agiel Prakoso, Wahyu Agung Perdana, Ricky Amukti,
Juma Maulana, Yoga Aprillianno, Iola Abas

Pantau Gambut
20 July 2023

## Table of Content



# Background and Objectives

pantau gambut

## Background and Objectives

Tropical peatlands are wetland environments with soil formed from organic material deposits. Preserving peatlands remains utmost as they store approximately 30% of the world's carbon reserves[1], capable of holding up to 20 times[2] more carbon than mineral soils. Indonesia, known for its remarkable biodiversity, is home to 10% of the world's tropical rainforests[3] and 36% of tropical peatlands[4]. This highlights the crucial role of peatlands, particularly in Indonesia, as integral ecosystems that must be safeguarded for their sustainability.

However, the proliferation of large-scale monoculture plantations has led to Indonesia losing an average of 498,000 hectares of forest annually from 2000 to 2015[5]. Consequently, Indonesia ranked as the world's second-highest deforestation rate after Brazil in 2015[6]. Large-scale monoculture plantations often extensively drain peatlands, and the practice of land clearing through burning is common to reduce substantial opening costs. The transformation of peatlands and forests for such purposes contributes to approximately 79% of Indonesia's total greenhouse gas emissions[7], making Indonesia the fourth-largest greenhouse gas emitter in the world in 2015[8].

The high level of greenhouse gas emissions in Indonesia in 2015 was also closely linked to the extensive forest and land fires that occurred in peatlands. In the 2015 and 2019 fires, it was discovered that at least 50% of the burned areas were peatlands[9]. Furthermore, out of the total area of 4.4 million hectares that burned between 2015 and 2019[10], approximately 789,600 hectares or 18% of them experienced repeated burning. Concession areas also contributed significantly to the occurrence of forest and land dires. About 1.3 million hectares or 30% of the mapped fire areas between 2015-2019 were located in palm oil and pulpwood concessions. In addition to the major forest and land fire event in 2015, 2019 witnessed the worst forest and land fires, engulfing 1.6 million hectares of forests and lands—equivalent to 27 times the size of DKI Jakarta.

Forest and land fires has caused severe damage to peatlands, leading to the release of emissions into the atmosphere and hazardous chemicals that endanger the surrounding environment. This highlights the alarming and critical state of peatland conditions and management in Indonesia. Therefore, it becomes exceedingly crucial to preserve peatlands as a Peat Hydrological Unity Area (PHU) ecosystem through the Forest and Land Fire Vulnerability Map, especially considering the predicted El Nino climate anomaly in 2023.

---

[1] Huijnen V, Wooster MJ, Kaiser JW, Flemming J, Parrington M, Inness A, Murdiyarso D, Main B, Weele VM. 2016. Fire carbon emissions over maritime southeast Asia in 2015 largest since 1997. *Scientific Reports*. 6(26886):1-8. https://doi.org/10.1038/srep26886.
[2] World Resource Institute. Destruction of Tropical Peatland Is an Overlooked Source of Emissions. 21 April 2016.
[3] Food and Agriculture Organization (FAO). Asia-Pacific Forestry Sector Outlook Study: Commentary on Forest Policy in the Asia-Pacific Region. Oktober 1997
[4] Warren M, Hergoualc'h K, Kauffman JB, Murdiyarso D, Kolka R. An appraisal of Indonesia's immense peat carbon stock using national peatland maps: uncertainties and potential losses from conversion. *Carbon Balance Manag*. 12(12). https://doi.org/10.1186/s13021-017-0080-2
[5] World Resource Institute. Forests and Landscapes in Indonesia.
[6] Carbon Brief. The Carbon Brief Profile: Brazil. 7 Maret 2018
[7] World Resource Institute. Forests and Landscapes in Indonesia.
[8] Carbon Brief. The Carbon Brief Profile: Indonesia. 6 Juni 2019.
[9] Greenpeace Indonesia. Karhutla dalam Lima Tahun Terakhir. 22 Oktober 2020.
[10] Greenpeace Indonesia. Karhutla dalam Lima Tahun Terakhir. 22 Oktober 2020.

# Methodology

This vulnerability reviews of forest and land fire utilizes a regression model development method based on historical data from 2015 to 2019. The Independent variables data consists of land cover maps, peatland distribution, concession area boundaries, and vegetation cover loss distribution. On the other hand, the Dependent variables data comprises hotspot points and fire area maps. These datasets are limited to 865 Peat Hydrological Unity Areas (PHU) throughout Indonesia and serve as the training area boundaries to construct the model using historical data from 2015 to 2019.

**Table 1.** Research Methodology Framework

| Stages | Data Sets | Data Used and Data Sources |
|---|---|---|
| 1. Data collection and determination of sub-variable scores<br>2. Regression for determining significant variable weights and data modeling<br>3. Vulnerability analysis | 1. Dataset from 2015 to 2019 to establish variable weights and scores (5 years)<br>2. Dataset from 2020 for vulnerability analysis | 1. Peat Hydrological Unity Area (PHU) Map (Ministry of Environment and Forestry - KLHK, 2017)<br>2. VIIRS Hotspot (High Confidence Level) - SNPP (FIRMS NASA, 2015-2019)<br>3. Burned Area Map (Ministry of Environment and Forestry - KLHK, 2015-2020)<br>4. Land Cover Map (Ministry of Environment and Forestry - KLHK, 2015-2020)<br>5. Peatland Distribution Map (Center for Environmental Research and Development - BBSDLP, 2019)<br>6. Boundaries Map of Concession Areas (HGU & IUPHHK Permits - Compiled Data from Various Peat Monitoring Sources)<br>7. Tree Cover Loss/Vegetation Loss (Global Forest Watch/GFW Hansen Forest Loss, 2015-2020) |

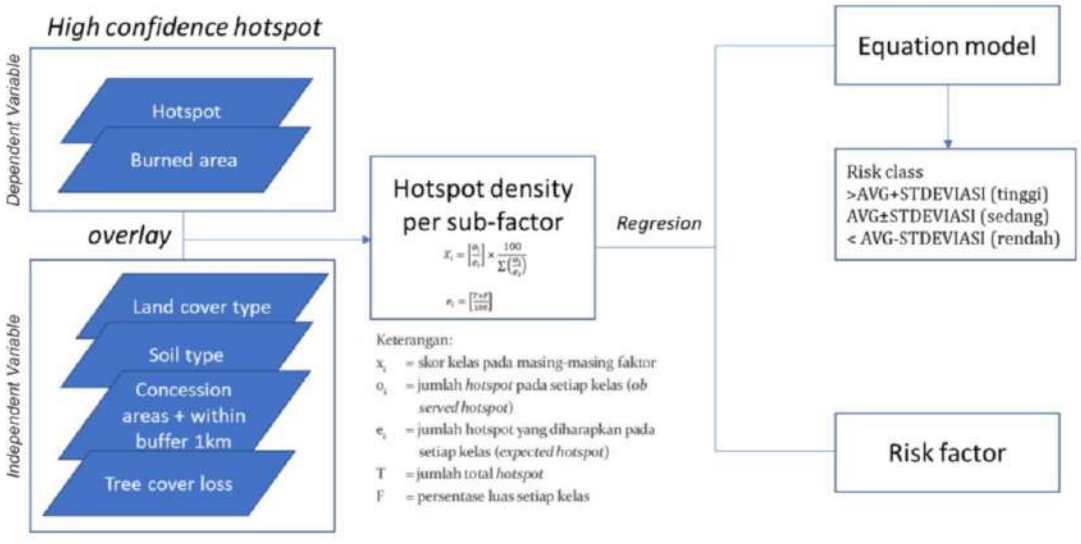



**Figure 1.** Framework of Forest and Land Fire Vulnerability Modeling Method

All the data mentioned above is overlaid to generate sub-variable scores and regression, resulting in the model formula as depicted in Figure 1. Based on the analysis of sub-variable scores presented in Appendix 1, land cover variables such as open land, swamp scrub, and plantations are identified as the land cover sub-variables most frequently associated with forest and land fires according to historical data from 2015 to 2019. Out of a total score of 100 for land cover sub-variables, bare land has a score of 21.99, swamp shrub has a score of 16.81, estate crop plantations have a score of 12.70, and dryland agriculture has a score of 10.59.

Additionally, we have identified three sub-variables that historically show a close association with land and forest fires events: peatlands, concession areas with a 1 km buffer zone, and areas experiencing tree cover loss. This serves as a crucial point of concern, emphasizing the significance of monitoring and safeguarding sub-variables in each variable used to protect the Peat Hydrological Unity Areas (PHU) from recurrent forest and land fires.

Based on the regression analysis of the dataset from 2015 to 2019, the historical fire events are modeled by the equation:

$$Y = -2{,}508 + 4{,}6\ X_1 + 0{,}4\ X_2 + 0{,}1\ X_3 - 0{,}6\ X_4$$

**Notes:**

| | |
|---|---|
| $X_1$ | Land cover |
| $X_2$ | Soil type / peatland coverage |
| $X_3$ | Concession |
| $X_4$ | Tree cover loss |
| Y | Vulnerability value |

The resulting model is used as the calculation formula for the data from 2020 to 2021 to serve as predictive data and location classification for forest and land fire vulnerability levels in the PHU area in 2023. After inputting the predictive data into the model, the average and standard deviation of all final values are calculated to classify the vulnerability levels. The classification is determined as follows:

1. Medium vulnerability class: average value ± of the standard deviation, ranging from -2 to 44.
2. High vulnerability class: values above the medium vulnerability class.
3. Low vulnerability class: values below the medium vulnerability class.

Once the vulnerability classification map for 2023 is modeled, the analysis proceeds to identify PHU rankings vulnerable to forest and land fire based on the assessment of proportion analysis, the extent of the severe vulnerability, and the widest PHU conditions in Indonesia. Subsequently, the analysis continues to determine the responsibility areas based on provincial administration and the vulnerability rankings of concessions to forest and land fire. In the analysis of the vulnerability rankings of concessions in 2023, Pantau Gambut classifies concessions based on data of concessions with Right to Cultivate/*Hak Guna Usaha* (HGU) permits and concessions with Permit for Timber Forest Product Utilization/*Izin Usaha Pemanfaatan Hasil Hutan Kayu* (IUPHHK), leading to focused rankings based on these permit types as shown in Figure 2.

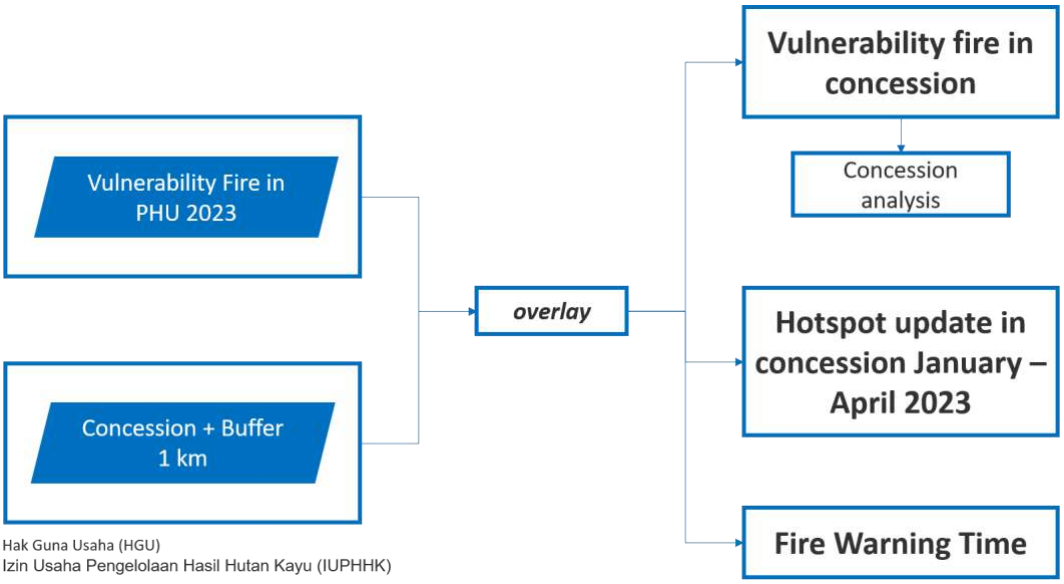



**Figure 2.** Framework of Forest and Land Fire Vulnerability Analysis in Concession Areas

The concession analysis is conducted using data on the boundary areas of concessions from various sources processed by Pantau Gambut. The data on concession boundaries are analyzed within the concession areas and the buffer zone extending up to 1 km from the outer boundaries of the concessions. The rationale for this buffer zone is based on existing regulations and/or those related to forest and land fire management. In the context of regulations, particularly concerning the handling of the impacts of the fires, some regulations adopt the approach of buffer zones:

1. Law Number 5 of 1990 concerning the Conservation of Biological Resources and Their Ecosystems. It is stated that the buffer zone is "*an area located outside natural reserves and conservation areas, including other forest areas, state lands, or lands subject to rights, which are necessary and capable of maintaining the integrity of the natural reserves and conservation areas*."
2. Law Number 32 of 2009 concerning Environmental Protection and Management.
   This law recognizes strict liability for activities that have strategic environmental impacts.
3. Government Regulation Number 4 of 2001 concerning the Control of Environmental Damage and Pollution Related to Forest and Land Fires.
   This regulation explains the damages and impacts of Forest and Land Fires, both directly and indirectly.
4. Decree of the Director-General of Pollution and Environmental Damage Control Number SK.40/PPKL/PKG/PKL.0/3/2018 concerning the Determination of Peat Ecosystem Damage Status. This regulation also adopts the approach of buffer zones.
5. Minister of Environment and Forestry of the Republic of Indonesia Regulation Number P.32/Menlhk/Setjen/Kum.1/3/2016 concerning Forest and Land Fire Control.

Substantively, the buffer zone approach is needed because the characteristics of the peat ecosystem as a unified ecosystem cannot be separated by administrative boundaries. In the context of concession holders—especially those striving to meet sustainability standards, as well

as corporate groups and business associations engaged in High Conservation Value (HCV) certification—the buffer zone approach is inseparable from HCV certification. In fact, within the framework of HCV certification, the commonly used buffer zone approach extends up to 3 km[11]. In HCV certification, the buffer zone rules apply to natural landscape areas that have the capacity to maintain ecological processes and dynamics naturally. In the context of forest and land fires and peatland ecosystems, the buffer zone is utilized as a vigilant area and natural barrier to prevent the spread of peatland fire into the peatland ecosystem areas.

In addition to ranking PHU, concessions, and provinces in terms of vulnerability to forest and land fire in 2023, this study also monitors hotspot points and predicts the occurrence of the dry season, which is closely related to forest and land fire disasters. The hotspot analysis is conducted using hotspot data from two satellite image sensors, namely the Moderate Resolution Imaging Spectroradiometer (MODIS) sensor on Aqua and Terra satellites, as well as the Visible Infrared Imaging Radiometer Suite (VIIRS) sensor on S-NPP and NOAA 20 satellites (formerly known as JPSS-1)[12]. This hotspot analysis employs more than one hotspot sensor to optimize the analysis of location characteristics indicating forest and land fire occurrences[13]. The prediction of the timing of forest and land fire incidents is carried out by plotting the number of hotspot points each month from 2014 to 2022 and also involves desktop analysis through published predictions related to climate anomalies in 2023.

## Research Scope Limitations

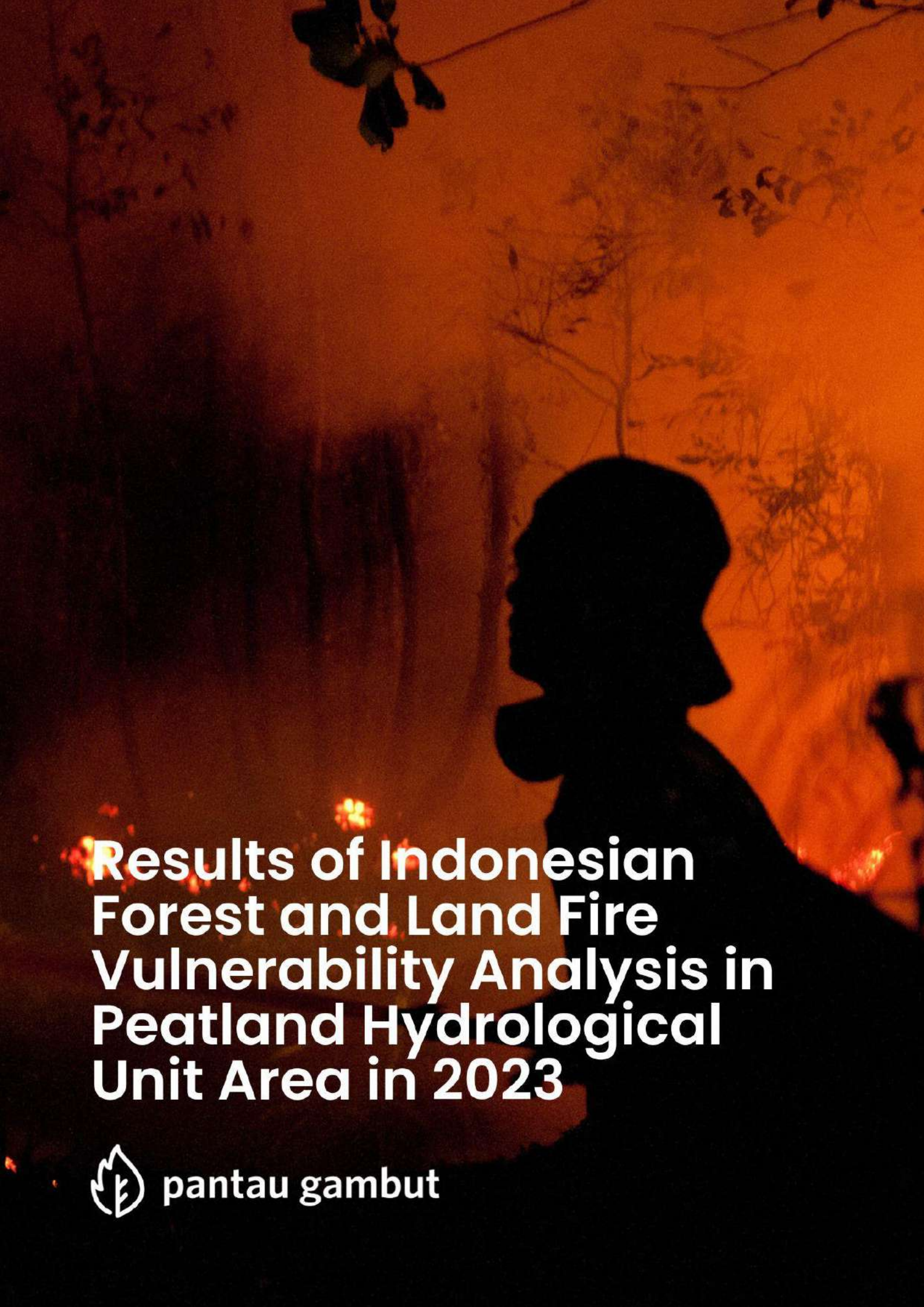
- Referring to the definitions of risk, vulnerability, and disaster hazards by the National Disaster Management Agency (BNPB) [14], this study is limited to the combined analysis of forest and land fire hazards (forest and land type parameters, climate, and soil type) and environmental vulnerability (land cover parameter) using regression modeling without calculating the risk value. Additionally, for the social and physical environmental aspects, this study combines concession data and the 1 km buffer zone as a justification due to recurring issues related to water governance, expansion of plantation areas, and the influence of companies on the surrounding locations.
- This vulnerability assessment is confined to the analysis of environmental vulnerability using the Environmental Vulnerability Index (IKL) that fulfills the variables in BNPB's forest and land fire vulnerability index[15]. Thus, the study is limited to only 4 influential variables and 2 influenced variables, focusing solely on PHU areas in Indonesia.
- The study disregards climate-related aspects (such as rainfall or Indonesia's seasonal zones) in the spatial modeling of forest and land fire vulnerability. This is due to the diverse climate conditions across different regions of Indonesia, which may introduce bias in the

[11] Konsorsium Revisi HCV Toolkit Indonesia. Panduan Identifikasi Kawasan Bernilai Konservasi Tinggi di Indonesia. 12 Juli 2008.
[12] NASA. Fire Information for Resource Management System.
[13] Wibowo AP dan Papilaya FS. 2020. Analisis pola kebakaran lahan di Kalimantan Timur dengan MODIS dan VIIRS. *Media Komunikasi Geografi* 21(1): 84–98. https://doi.org/10.23887/mkg.v21i1.23253.
[14] Peraturan Kepala BNPB nomor 2 Tahun 2012.
[15] BNPB. 2016. *Resiko Bencana Indonesia*. Perumusan indeks kerentanan karhutla BNPB untuk bencara karhutla IKKLH=(IKE x 40%)+(IKL x 60%)

final results of the forest and land fire vulnerability map[16]. However, predictions of climate anomalies and the dry season will still be discussed based on literature studies, to further address the additional considerations related to predicting the periods of forest and land fire occurrences.

- The analysis of hotspot points for the year 2023 conducted by Pantau Gambut in this study is limited to the period from January to May 2023.
- This study serves as the initiation of forest and land fire vulnerability modeling in the PHU area for Pantau Gambut, which will be used to predict forest and land fire vulnerability in the coming years. Therefore, this analysis adopts a significantly different approach from the indices commonly used for forest and land fire hazard prediction, such as the FDRS or KBDI indices.
- Pantau Gambut considers locations falling under the high and medium vulnerability classes as predicted to be vulnerable and warrant caution against forest and land fire occurrences in the year 2023. This study considers values above the average calculations from the model as locations believed to be statistically vulnerable to forest and land fires.

[16] Prasetyo LB, Setiawan Y, Condro AA, Kustiyo K, Putra EI, Hayati N, Wijayanto AK, Ramadhi A, Murdiyarso D. Assessing Sumatran Peat Vulnerability to Fire underVarious Condition of ENSO Phases Using MachineLearning Approaches. *MDPI: Forests* 13(828). https://doi.org/10.3390/f13060828.



# Results of Indonesian Forest and Land Fire Vulnerability Analysis in Peatland Hydrological Unit Area in 2023

pantau gambut

# 1. Extent of Forest and Land Fire Vulnerability in PHU Areas throughout Indonesia in 2023

The basis for the forest and land fire vulnerability analysis conducted by Pantau Gambut is centered on the Peat Hydrological Unity Area (PHU) in Indonesia. This approach underscores the importance of safeguarding and monitoring peatlands within the context of landscapes or ecosystems. The visualization of the forest and land fire vulnerability analysis results in the PHU areas for the year 2023 is presented in Figure 3 and Appendix 2.


**Figure 3.** Map of Forest and Land Fire Vulnerability in PHU Areas throughout Indonesia in 2023 (Source: Pantau Gambut Analysis, 2023)

Locations with high and medium vulnerability are of primary concern, as approximately 50% of the PHU areas in Indonesia with these vulnerability levels are susceptible to fire incidents. Out of the total 24.2 million hectares of PHU area in Indonesia, about 16.4 million hectares fall under high and medium vulnerability categories.

**Table 2.** Extent of Forest and Land Fire Vulnerability in PHU Areas throughout Indonesia in 2023

| Vulnerability Class | Peatland | | Tocal Coverage (ha) |
|---|---|---|---|
| | Peatland Area[17] on PHU (ha) | Non-peatland Area on PHU (ha) | |
| **High** | 2.533.782,86 | 1.310.462,85 | 3.844.243,48 |
| **Medium** | 4.714.648,95 | 7.893.676,62 | 12.608.309,49 |
| **Low** | 3.313.408,82 | 4.435.701,45 | 7.765.938,38 |
| **Total** | **10.561.841** | **13.639.841** | **24.218.491** |

Table 2 illustrates that high vulnerability dominates in peatland-rich PHU areas compared to non-peatland PHU areas. This is evident from 2.5 million hectares of peatland out of the total 3.8 million

[17] Balai Besar Sumberdaya Lahan Pertanian (BBSDLP), Kementrian Pertanian. 2019. Sebaran lahan gambut di Indonesia.

hectares being classified as high vulnerability. In other words, 65.9% of peatland requires heightened attention in landscape-based or ecosystem-based restoration efforts within the PHU areas.

## 2. PHU with the Largest Proportional Distribution of Forest and Land Fire Vulnerability in 2023

Proportional analysis is conducted to assess the distribution of each vulnerability class based on the total area of the Peat Hydrological Unity Area (PHU) as the reference. This calculation is essential to determine the proportion of each vulnerability class relative to the entire PHU area. By analogy, if there is a PHU with a total area of 100 hectares and a high vulnerability class covering 80 hectares, the calculation would be 80/100, resulting in a proportion of 80%.

**Table 3.** PHU with the Largest Proportional Distribution of Forest and Land Fire Vulnerability in 2023

| No | PHU Name | PHU Area (ha) | Province | Vulnerability Proportional Class (%) | | |
|---|---|---|---|---|---|---|
| | | | | High | Medium | Low |
| 1 | PHU Sungai Ifuleki Bian–Sungai Dalik | 1.421 | South Papua | 97% | 3% | 0% |
| 2 | PHU Sungai Kedupan–Sungai Layah | 10.542 | East Kalimantan | 96% | 4% | 0% |
| 3 | PHU Sungai Siriwo | 812 | Central Papua | 94% | 6% | 0% |
| 4 | PHU Sungai Beberi–Sungai Way Mesuji | 8.639 | South Sumatera | 89% | 9% | 2% |
| 5 | PHU Sungai Ifileki Bian–Sungai Lekiage Sentuf | 6.950 | South Papua | 88% | 12% | 0% |
| 6 | PHU Sungai Ifuleki Onam–Sungai Lekiage Wagini | 268 | South Papua | 88% | 12% | 0% |
| 7 | PHU Sungai Alekikos Bakian–Sungai Ifuleki Bian | 2.133 | South Papua | 88% | 12% | 0% |
| 8 | PHU Sungai Tandatuan–Sungai Beberi | 8.707 | South Sumatera – Lampung | 88% | 12% | 0% |
| 9 | PHU Sungai Ajari–Sungai Kubai | 1.494 | Central Papua | 87% | 13% | 0% |
| 10 | PHU Sungai Sangku–Bah Kambang | 4.853 | West Sumatera | 83% | 9% | 7% |

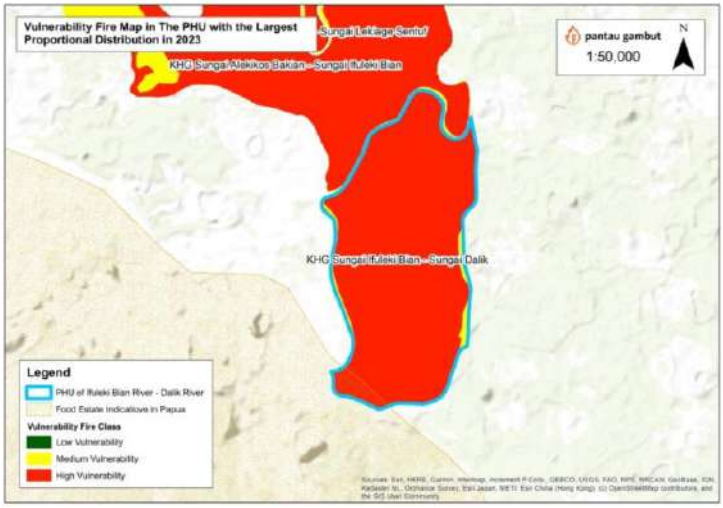



**Figure 4.** Map of Forest and Land Fire Vulnerability in PHU Sungai Ifuleki Bian–Sungai Dalik (Source: Pantau Gambut Analysis, 2023)

Through the proportional analysis approach, which compares the high vulnerability area to the total PHU area, it is found that PHU Sungai Ifuleki Bian–Sungai Dalik in South Papua Province exhibits the largest proportion of forest and land fire vulnerability. As shown in Table 3, approximately 97% of the PHU area of Sungai Ifuleki Bian–Sungai Dalik falls under the high vulnerability class. This vulnerability in the PHU is strongly associated with its proximity to the indicative food estate location in South Papua Province. As indicated on the map in Figure 4, PHU Sungai Ifuleki Bian–Sungai Dalik is in close proximity (±2 km) and even intersects with the indicative food estate area at its southern part.

The conversion of peatland from forest to other land uses, such as for agricultural and plantation purposes, often leads to an increased risk of forest and land fires, particularly when land clearing is carried out through burning to save time and reduce costs. Hence, the potential for forest and land fires rises, posing a threat to the ecosystem if the food estate program continues to be implemented in this PHU.

## 3. PHUs with the Widest Severe Forest and Land Fire Vulnerability in 2023

Based on the results shown in Table 4, 7 out of 10 PHUs with the widest high vulnerability are located in Central Kalimantan Province. PHU Sungai Kahayan–Sungai Sebangau in Central Kalimantan Province becomes the PHU with the widest high vulnerability to forest and land fires in 2023, covering an area of approximately 190 thousand hectares. Additionally, PHU Sungai Katingan–Sungai Sebangau, ranking second in terms of high vulnerability area, is situated within the conservation area of Sebangau National Park and is adjacent to PHU Sungai Kahayan–Sungai Sebangau. In other words, both of these PHUs have a history of forest and land fires throughout the period from 2015 to 2019, despite being inside or near a national park. Initially, before becoming a national park, the Sebangau Area was an area with Forest Concession Rights (HPH) that was active from the early 1970s to the mid-1990s[18]. It was expected that this area would have been restored and returned to a sustainable natural peat forest after being designated as a national park in 2004. However, the location continues to be damaged and prone to fires, even in 2023, making it among the top 10 PHUs with the widest high vulnerability.

**Table 4.** PHUs with the Widest High Forest and Land Fire Vulnerability in 2023

| No | PHU Name | PHU Area (ha) | Province | Vulnerability Area (ha) | | |
|---|---|---|---|---|---|---|
| | | | | High | Medium | Low |
| 1 | PHU Sungai Kahayan−Sungai Sebangau | 451.507 | Central Kalimantan | 190.395 | 222.377 | 38.735 |
| 2 | PHU Sungai Katingan−Sungai Sebangau | 823.060 | Central Kalimantan | 160.896 | 366.300 | 295.865 |
| 3 | PHU Sungai Kapuas−Sungai Barito | 558.168 | Central Kalimantan | 139.598 | 212.868 | 205.701 |
| 4 | PHU Sungai Buru Mappi−Sungai Buru Obaa | 402.643 | South Papua | 119.857 | 141.609 | 141.177 |
| 5 | PHU Sungai Kahayan−Sungai Kapuas | 400.320 | Central Kalimantan | 118.444 | 124.601 | 157.275 |
| 6 | PHU Sungai Pukun−Sungai Mentaya | 303.798 | Central Kalimantan | 101.387 | 150.308 | 52.103 |
| 7 | PHU Sungai Kuis−Sungai Bapai | 615.729 | South Papua | 98.589 | 167.415 | 349.724 |

[18] Taman Nasional Sebangau. Sejarah Taman Nasional Sebangau. 19 Desember 2014.

| | | | | | | |
|---|---|---|---|---|---|---|
| 8 | PHU Sungai Buluh Besar–Sungai Seruyan | 342.852 | Central Kalimantan | 90.096 | 120.073 | 132.682 |
| 9 | PHU Sungai Katingan–Sungai Mentaya | 361.296 | Central Kalimantan | 84.985 | 94.215 | 182.095 |
| 10 | PHU Sungai Rokan–Sungai Siak Kecil | 832.458 | Riau | 78.383 | 438.396 | 315.679 |

Another finding from this study is that 7 out of the 10 PHUs shown in Table 4 are located in Central Kalimantan Province, and 4 of them are adjacent to each other. This indicates that the ecosystem degradation in these areas is interconnected. Meanwhile, the top 3 PHUs are situated in former one-million-hectare Peat Land Development (PLG) Project locations in Central Kalimantan Province during the New Order Development era (Figure 5). These failed ex-PLG sites should have been restored. However, under President Joko Widodo's administration, the locations were re-designated for the food estate program in 2020. Until now, the agricultural program on these lands has yielded no harvest and has only led to deforestation[19].

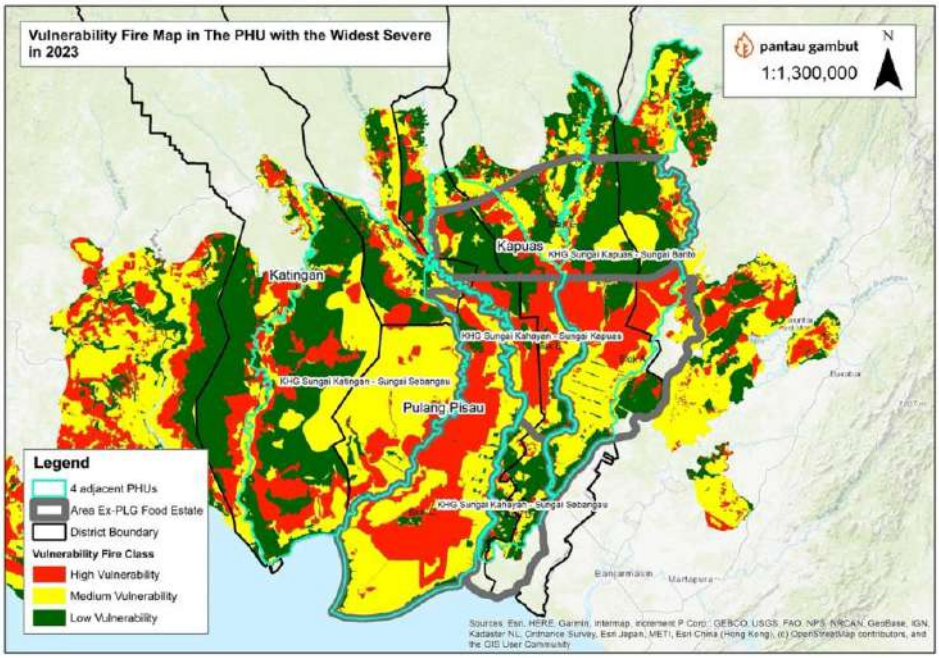



**Figure 5.** Four Adjacent PHUs in Central Kalimantan Province with the Widest High Forest and Land Fire Vulnerability in 2023 (Source: Pantau Gambut Analysis, 2023)

Considering the high vulnerability conditions present in the 4 adjacent PHUs in Central Kalimantan Province, the protective function of these areas, such as this peat ecosystem, should be preserved as a cohesive unit. Despite having a history of fires and being used for other purposes such as food estate or even concessions (explained in the following sections), these areas should be restored to fulfill their original function as sustainable peat ecosystems.

[19] Pantau Gambut. *Food estate* Jilid 2 Pantau Gambut. 15 Maret 2023.

# 4. Forest and Land Fire Vulnerability in 2023 in the Largest PHU in Indonesia

PHU Sungai Rokan–Sungai Siak Kecil, covering an area of approximately 832 thousand hectares, is the largest PHU in Indonesia based on SK.129/MENLHK/SETJEN/PKL.0/2/2017. This PHU is spread across several districts and cities in Riau Province, namely Rokan Hilir Regency, Dumai City, Bengkalis Regency, and Siak Regency. However, this PHU also has a history of forest and land fires throughout the period from 2015 to 2019 and has the potential to experience fires again in 2023. As shown in Table 5, medium vulnerability covers an area of 438 thousand hectares or about 53% of the total land in PHU Sungai Rokan–Sungai Siak Kecil. Meanwhile, high vulnerability encompasses 78 thousand hectares or about 9% of the PHU area. When the vulnerability classes are combined, the forest and land fire vulnerability in PHU Sungai Rokan–Sungai Siak Kecil reaches 62%. In other words, the largest PHU in Indonesia is susceptible to forest and land fire disasters.

**Table 5.** Forest and Land Fire Vulnerability in 2023 in the Largest PHU in Indonesia

| No | PHU Name | PHU Area (ha) | Province | Vulnerability Class Area (ha) | | | Vulnerability Class Proportion (%) | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | High | Medium | Low | High | Medium | Low |
| 1 | PHU Sungai Rokan–Sungai Siak Kecil | 832.458 | Riau | 78.383 | 438.396 | 315.679 | 9% | 53% | 38% |
| 2 | PHU Sungai Katingan–Sungai Sebangau | 823.060 | Central Kalimantan | 160.896 | 366.300 | 295.865 | 20% | 45% | 36% |
| 3 | PHU Sungai Siak–Sungai Kampar | 722.929 | Riau | 43.578 | 275.302 | 404.049 | 6% | 38% | 56% |
| 4 | PHU Sungai Kampar–Sungai Gaung | 710.823 | Riau | 35.078 | 481.739 | 194.006 | 5% | 68% | 27% |
| 5 | PHU Sungai Sugihan–Sungai Lumpur | 636.828 | South Sumatera | 55.302 | 156.348 | 425.179 | 9% | 25% | 67% |
| 6 | PHU Sungai Kuis–Sungai Bapai | 615.729 | South Papua | 98.589 | 167.415 | 349.724 | 16% | 27% | 57% |
| 7 | PHU Sungai Kapuas–Sungai Barito | 558.168 | Central Kalimantan | 139.598 | 212.868 | 205.701 | 25% | 38% | 37% |
| 8 | PHU Sungai Kahayan–Sungai Sebangau | 451.507 | Central Kalimantan | 190.395 | 222.377 | 38.735 | 42% | 49% | 9% |
| 9 | PHU Sungai Buru Mappi–Sungai Buru Obaa | 402.643 | South Papua | 119.857 | 141.609 | 141.177 | 30% | 35% | 35% |
| 10 | PHU Sungai Kahayan–Sungai Kapuas | 400.320 | Central Kalimantan | 118.444 | 124.601 | 157.275 | 30% | 31% | 39% |

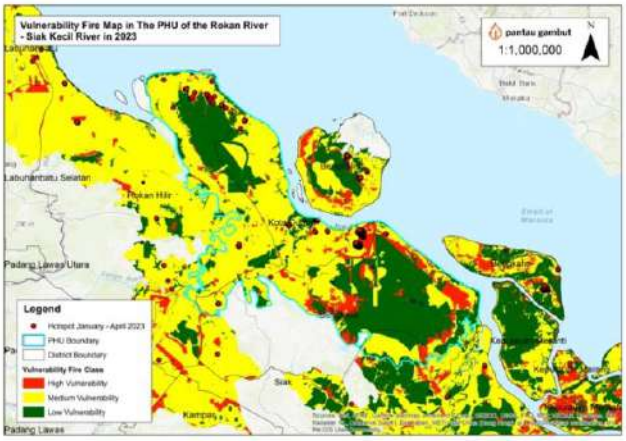



**Figure 6.** Forest and Land Fire Vulnerability in 2023 in PHU Sungai Rokan–Sungai Siak Kecil (Source: Pantau Gambut Analysis, 2023)

Seven out of the ten largest PHUs in Indonesia are among the top 10 PHUs with the widest high forest and land fire vulnerability in 2023 (indicated by the names in red in Table 5). The larger the area of a PHU, the more complex the diversity within it. Therefore, the supervision and attention to such areas should be strengthened. However, in reality, it is different. During the period from January to May 2023, PHU Sungai Rokan–Sungai Siak Kecil is suspected to have experienced forest and land fires. Based on the Pantau Gambut analysis, approximately 534 hotspots were found in PHU Sungai Rokan–Sungai Siak Kecil from January to April 2023. In May, which is predicted to be the beginning of the El Nino anomaly phase[20], 169 hotspots were identified in this PHU. Moreover, the forest and land fires that occurred in Dumai City, which is in the high vulnerability class[21], from April 19 to 27, 2023, were quite severe and lasted for a significant period of time.

## 5. Provinces with the Largest High Forest and Land Fire Vulnerability in PHUs in 2023

The Peatland Hydrological Unity (PHU) is a peatland area as an integrated ecosystem located between two rivers, between rivers and the sea, or marshlands. The determination of areas within one PHU is not based on administrative boundaries in Indonesia, hence the responsibility for management and protection is carried out by one or even several administrative regions (cross-provinces). Pantau Gambut conducted a spatial analysis between 865 PHU areas and provincial administrative regions to determine which province is responsible for a specific PHU.

**Table 6.** Provinces with the Largest High Forest and Land Fire Vulnerability in PHUs in 2023

| No | PHU Area Management Province | PHU Area (ha) | Vulnerability Class Area (ha) | | |
|---|---|---|---|---|---|
| | | | High | Medium | Low |
| 1 | Central Kalimantan | 4.382.252,51 | 1.235.249,98 | 1.767.105,46 | 1.379.897,07 |
| 2 | South Papua | 2.492.914,37 | 547.068,89 | 1.074.588,80 | 871.256,68 |
| 3 | West Kalimantan | 2.764.065,39 | 408.566,94 | 1.390.585,81 | 964.912,64 |
| 4 | Riau | 4.791.231,19 | 402.845,57 | 2.867.713,41 | 1.520.672,21 |
| 5 | South Sumatera | 1.946.395,71 | 351.434,13 | 767.091,33 | 827.870,24 |
| 6 | East Kalimantan | 342.349,93 | 119.826,56 | 136.206,84 | 86.316,53 |
| 7 | North Kalimantan | 351.044,39 | 89.124,75 | 140.656,91 | 121.262,73 |
| 8 | Jambi | 701.618,50 | 86.534,14 | 415.011,61 | 200.072,76 |
| 9 | West Papua | 1.467.059,80 | 73.329,37 | 840.471,14 | 553.259,29 |
| 10 | West Kalimantan–Central Kalimantan | 269.692,60 | 68.108,00 | 102.488,49 | 99.096,11 |

Based on the combination of data from PHU areas and provincial administrative regions, Central Kalimantan Province becomes the province with the largest high vulnerability in Indonesia in the PHU areas in 2023, with a total area of 1.2 million hectares. This study also found that the four PHUs with the largest high vulnerability in this province are adjacent to each other. Furthermore, all four PHUs are located within the Sebangau National Park and former PLG (Table 7). The four

[20] Climate Prediction Center (CPC-NOAA). El Niño/Southern Oscillation (ENSO) Diagnostic Discussion. 8 Juni 2023.
[21] Analisis titik panas pada KHG ini ditampilkan pada laporan ini bagian Hasil Monitoring Titik Panas (Hotspot) Bulan Januari-Mei 2023 pada Wilayah KHG

PHUs are PHU Sungai Kahayan–Sungai Sebangau, PHU Sungai Katingan–Sungai Sebangau, PHU Sungai Kapuas–Sungai Barito, and PHU Sungai Kahayan–Sungai Kapuas.

**Table 7.** Five PHUs with the Largest High Forest and Land Fire Vulnerability in Central Kalimantan Province in 2023

| No | Nama KHG | Luas KHG (ha) | Luas Kelas Kerentanan (ha) | | |
|---|---|---|---|---|---|
| | | | Tinggi | Sedang | Rendah |
| 1 | KHG Sungai Kahayan–Sungai Sebangau | 451.507,24 | 190.394,91 | 222.377,10 | 38.735,23 |
| 2 | KHG Sungai Katingan–Sungai Sebangau | 823.060,30 | 160.895,79 | 366.299,67 | 295.864,83 |
| 3 | KHG Sungai Kapuas–Sungai Barito | 558.167,80 | 139.598,26 | 212.868,41 | 205.701,13 |
| 4 | KHG Sungai Kahayan–Sungai Kapuas | 400.320,16 | 118.444,41 | 124.600,87 | 157.274,88 |
| 5 | KHG Sungai Pukun–Sungai Mentaya | 303.798,40 | 101.386,80 | 150.308,44 | 52.103,16 |

Based on Pantau Gambut's analysis, approximately 340,000 hectares of concessions with HGU permits and 145,000 hectares of concessions with IUPHHK permits in the region of Central Kalimantan Province are classified as high vulnerability (explained in the following section). The total area also makes Central Kalimantan Province the province with the largest high forest and land fire vulnerability in the PHU areas burdened with concessions in 2023. This indicates a significant threat of forest and land fires in the PHU areas of this province.

# Results of Indonesian Forest and Land Fire Vulnerability Analysis in PHU Areas and Concession Areas in 2023

pantau gambut

Peatland ecosystems are unique due to their soil layers composed of accumulated organic materials. The formation of peat occurs after thousands of years of sedimentation, preservation, and decomposition of organic materials. The lower layer (peat) and upper layer (forest) in a peatland ecosystem form a close interconnection in terms of their sustainability. If one of them is damaged, the entire ecosystem will be affected and it becomes extremely difficult to restore it in a short period. Ironically, peatland ecosystems in Indonesia have undergone changes from their original conditions[22]. Peatland ecosystems that were naturally waterlogged and humid[23] have been intentionally drained extensively and gradually converted into agricultural or monoculture plantation areas, such as oil palm, acacia, or other food crops.

Research from the International Council on Clean Transportation (ICCT) predicts that oil palm plantations will cover 23% of peatland areas in Riau Province by 2030[24]. In reality, the percentage of this expansion has already exceeded the percentage of oil palm plantations on peatland in Riau Province. Based on Pantau Gambut's analysis, oil palm plantations dominate 1.5 million hectares of the total 4.7 million hectares of Hak Guna Usaha (HGU) concessions along with their 1 km buffer areas in Riau Province. In other words, the actual situation in the field has surpassed the ICCT prediction, as oil palm-dominated HGU concessions cover 33% of the PHU in Riau Province. Not to mention the concessions with Izin Usaha Pemanfaatan Hasil Hutan Kayu (IUPHHK) along with their 1 km buffer areas, which cover an area of 1.8 million hectares or 39% of the PHU in Riau Province. This area makes Riau Province the province with the largest IUPHHK concessions, especially for Industrial Plantation Forest (HTI) in Indonesia.

Pantau Gambut also found that out of the total 24.2 million hectares of PHU in Indonesia, 33% of the area is burdened with concessions, and 15% of the area is within the 1 km buffer zone of concessions. This means that 48% of the area is managed by extractive industry corporations (HGU and IUPHHK concessions). Among the 33% of PHU area burdened with concessions, various types of concessions are distributed, with 50% being controlled by Hak Guna Usaha (HGU) permits and the remaining 50% being under the Izin Usaha Pengelolaan Hasil Hutan Kayu (IUPHHK) permits.

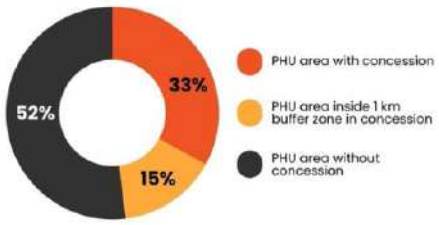



**Figure 7.** Percentage of PHU Area Burdened with Concessions

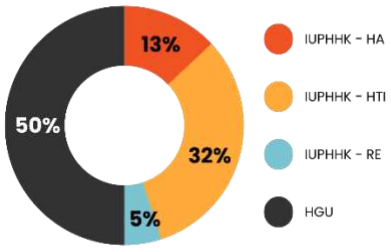



**Figure 8.** Percentage of Concession Types in PHU Areas

[22] Susanti A dan Maryudi A. 2016. Development narratives,notions of forest crisis, and boom of oil palm plantationsin Indonesia. *Forest Policy and Economics* 73: 130-139. https://doi.org/10.1016/j.forpol.2016.09.009.

[24] Miettinen J, Hooijer A, Tollenaar D, Page S, Malins C,Vernimmen R, Shi C, Liew SC. 2012. Historical analysisand projection of oil palm plantation expansion onpeatland in Southeast Asia. *ICCT White Paper*, 17.

The trend of corporate production area expansion with HGU and IUPHHK permits continues to increase as the government grants permits to use land designated as Protected Peat Ecosystem (FEG). During the period from 2015 to 2019, Pantau Gambut's analysis shows that Tree Cover Loss (TCL)[25], or the dominant loss of green vegetation, occurred more in the FEG areas burdened with concessions compared to the FEG areas not burdened with concessions[26]. The use of the TCL parameter may not fully indicate deforestation in those areas. However, TCL can identify the presence of corporate activities in the protected peat areas.

**Table 8.** Tree Cover Loss in Protected Peat Ecosystem (FEG) Areas During the Years 2015-2019 (Source: Pantau Gambut)[27]

| Area Type | Tree Cover Loss Area (ha) |
|---|---|
| Protected Peat Ecosystem (FEG) with concessions | 421.221,87 |
| Protected Peat Ecosystem (FEG) without concessions | 115.696,16 |
| **Total** | **536.918,03** |

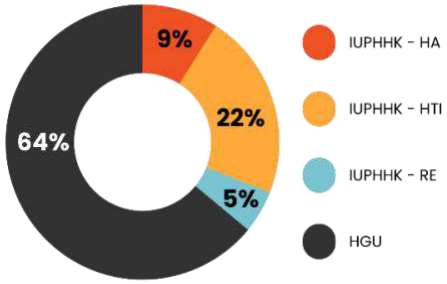



**Figure 9.** Percentage of Concession Types in Relation to Tree Cover Loss in FEG Areas Burdened with Concessions (Source: Pantau Gambut)[28]

Table 8 and Figure 9 show that HGU concessions are predominantly responsible for the loss of green vegetation (TCL) in an area of 268 thousand hectares, or 64% of the total 421 thousand hectares of TCL found in FEG areas burdened with concessions. This indicates that TCL occurs in the protected peat areas due to the activities of extractive companies within these areas, including HGU concessions which have the highest percentage of TCL found.

The amount of Tree Cover Loss (TCL) in protected peat ecosystem (FEG) indicates the degradation of the peat ecosystem. According to Government Regulation No. 71 of 2014 and Government Regulation No. 57 of 2016, any activities within the protected areas, proven by a reduction in area and/or volume of tree cover, signify the degradation of the peat ecosystem in that area and require immediate restoration. The prohibition of activities in protected areas is also regulated in other provisions, such as Minister of Agriculture Regulation No. 3 of 2022, Article 17 Paragraph 5, which

[25] Hansen *et al*. 2013. High-resolution global maps of 21st-century forest cover change. *Science*. 342(6160): 850-853. https://doi.org/10.1126/science.1244693.
[26] Pantau Gambut. Membedah teka-teki kegiatan perlindungan ekosistem gambut di area berizin. 28 Mei 2021.
[27] Pantau Gambut. Membedah teka-teki kegiatan perlindungan ekosistem gambut di area berizin. 28 Mei 2021.
[28] Pantau Gambut. Membedah teka-teki kegiatan perlindungan ekosistem gambut di area berizin. 28 Mei 2021.

states: "HGU is not located in forest and peat protection areas, based on the working unit of the ministry responsible for environment and forestry."[29].

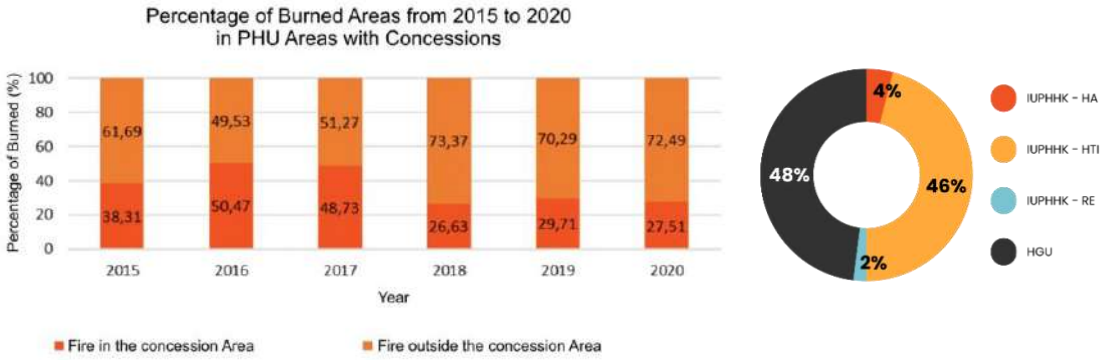



**Figure 10.** Percentage of Burned Areas from 2015 to 2020 in PHU Areas with Concessions[30]

In addition to company activities in protected peat ecosystems, Pantau Gambut also found a correlation between the occurrence of forest and land fires and peat hydrological units (PHU) burdened by concessions from extractive industries. Based on the historical data of forest and land fires shown in Figure 10, approximately 30% of forest and land fires occurred in areas of PHU with concessions. Moreover, in 2016 and 2017, 50% of forest and land fires occurred in areas of PHU with concessions. If we consider the total burned areas in PHU with concessions, concessions with permits for Hak Guna Usaha (HGU) (48%) and Hutan Tanaman Industri (HTI) (46%) predominantly contributed to the occurrence of forest and land fires in PHU areas during the period of 2015 to 2020.

Overall, peatland fire have been occurring continuously in peatlands over the past decade. This is despite the fact that peatlands are naturally wetlands and are difficult to ignite. However, large-scale monoculture planting activities have resulted in excessive drainage, making peatlands prone to fires. The drying of peatlands can alter their characteristics, and they cannot return to their original wetland state, leading to a higher vulnerability to fire[31].

The use of fire is not limited to certain groups only. Large-scale companies to small-scale farmers use fire to clear land for agriculture or plantations. The motive behind this is cost-saving land preparation, as it is believed to be cheaper and more effective[32]. In the end, the irresponsible use of fire has significant consequences for the local, national, and global economy and politics.

[29] Peraturan Menteri Pertanian Nomor 3 Tahun 2022 tentang Pengembangan Sumber Daya Manusia, Penelitian dan Pengembangan, Peremajaan, serta Sarana dan Prasarana Perkebunan Kelapa Sawit.
[30] Analisis Pantau Gambut yang mereferensi pada data Area Terbakar Kementerian Lingkungan Hidup dan Kehutanan Republik Indonesia. Burn Area/Area Terbakar. SIGAP KLHK. [*Diakses pada 2023.*]
[31] Badan Nasional Penanggulangan Bencana. 2016. *Risiko Bencana Indonesia*.
[32] Tomich TP, Fagi AM, De Foresta H, Michon G, Murdiyarso D, Stolle F, Van Noordwijk M. 1998. Indonesia's fires:smoke as a problem, smoke as a symptom. *Agroforestry Today* 10:4-7.

# 1. The Vulnerability of Forest and Land Fires in PHU Areas across Indonesia with Concessions in 2023

In addition to the analysis of vulnerable PHUs to forest and land fires in 2023, the analysis of fire vulnerability based on the vulnerability model created by Pantau Gambut was also conducted on the coverage of concession areas within the PHUs. The analysis of fire vulnerability in PHU areas burdened by concessions utilized data on extractive industry concessions processed by Pantau Gambut from various sources. From this data, there were 1,764 companies with Hak Guna Usaha (HGU) permits and 560 companies with Izin Usaha Pengelolaan Hasil Hutan Kayu (IUPHHK) permits. Out of the 560 companies with IUPHHK permits, 254 companies were IUPHHK for Natural Forests (HA), 292 companies were IUPHHK for Industrial Plantation Forests (HTI), and 14 companies were IUPHHK for Ecosystem Restoration (RE). The ranking of PHUs and provincial administrative regions responsible for managing PHUs heavily burdened by concessions is displayed in Annex 3.

Based on Pantau Gambut's analysis, out of the total 1,764 companies with HGU permits within PHU areas, 666 companies had areas with high fire vulnerability, while 60 other companies were vulnerable at moderate and low levels. In contrast, among the 560 IUPHHK concessions, there was a striking difference, with 151 companies being at high risk of fires, and the remainder (approximately 409 companies) exhibiting moderate and low vulnerability levels.

**Table 9.** Vulnerability of Forest and Land Fires in PHU Areas across Indonesia with Concessions in 2023

| Vulnerability Class | Natural Forest (HA) Area (ha) | Industrial Plantation Forest (HTI) Area (ha) | Ecosystem Restoration (RE) Area (ha) | IUPHHK Total Area (ha) | HGU Area (ha) | Area Outside Extractive Industry Concessions (Within Buffer Area) (ha) | Area Outside Extractive Industry Concession (ha) | Overall Vulnerability Area (ha) |
|---|---|---|---|---|---|---|---|---|
| **High** | 122.342,45 | 295.780,83 | 37.035,01 | 455.158,30 | 826.584,09 | 779.053,38 | 1.783.447,70 | 3.844.243,48 |
| **Medium** | 525.224,83 | 841.978,66 | 46.869,68 | 1.414.073,17 | 2.571.907,96 | 2.035.574,36 | 6.586.754,00 | 12.608.309,49 |
| **Low** | 370.560,45 | 1.419.321,47 | 291.019,02 | 2.080.900,94 | 643.027,31 | 863.513,73 | 4.178.496,41 | 7.765.938,38 |
| **Total** | **1.018.127,727** | **2.557.080,970** | **374.923,708** | **3.950.132** | **4.041.519** | **3.678.141** | **12.548.698** | **24.218.491** |

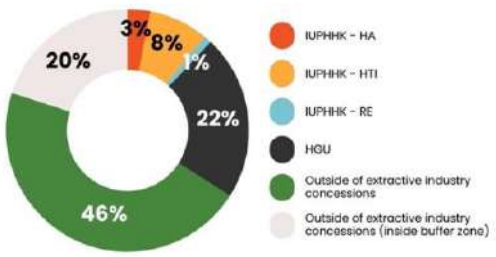



**Figure 11.** Percentage of High Fire Vulnerability in PHU Areas burdened by Concessions (Source: Pantau Gambut Analysis, 2023)

In Table 9, it can be observed that the PHU areas burdened by HGU and IUPHHK concessions have comparable sizes, as each covers approximately 4 million hectares of land. However, upon closer examination, it is evident that around 3.4 million hectares of PHU areas burdened by HGU concessions are located in regions vulnerable to both high and moderate fire risks. This value is smaller than the extent of PHU areas burdened by IUPHHK concessions, which is approximately 2 million hectares in areas prone to fire risks.

This indicates that fire vulnerability in PHU areas burdened by concessions is significantly influenced by companies with HGU permits compared to those with IUPHHK permits. Nevertheless, both types of permits still have significant impacts on the existing peatland ecosystems within the PHUs. Vigilance towards peatland fires should remain a priority, considering that extractive industry activities are often associated with land drainage and monoculture plantation practices that can lead to drying and burning of the land.

When focusing the analysis on high fire vulnerability, as shown in Figure 11, more than half of the total high vulnerability areas within the 3.8 million hectares of PHUs are located in concessions and their buffer zones. Companies with HGU and HTI permits represent the largest share of concessions in the high fire vulnerability category. This underscores the influence of large-scale monoculture plantations, such as HGU concessions (e.g., oil palm plantations), and IUPHHK concessions (e.g., industrial plantation forests), on the high susceptibility to peatland fires in PHU areas.

It should be noted that the concession data analyzed by Pantau Gambut does not represent the entirety of concessions across Indonesia due to limitations in access. This implies that there is still a possibility of increasing the percentage of fire vulnerability in regions where extractive companies operate within PHU areas.

## 2. Concessions in PHU Areas with the Widest High Fire Vulnerability in 2023

### a. Companies with HGU Permits

Pantau Gambut identified that 8 out of 10 HGU concessions with the highest high fire vulnerability are dominated by companies involved in oil palm commodities scattered across Kalimantan Island. Based on the ranking analysis in Table 10 and Appendix 4, out of 726 HGU concessions burdening PHU areas, PT Sangkowong Sinta in Central Kalimantan Province and PT Bumi Sriwijaya Sentosa in South Sumatra Province were the two companies with the widest high fire vulnerability in 2023, covering an area of more than 20 thousand hectares. This highlights the extensive control of Kalimantan Island by HGU concessions susceptible to forest and land fires within PHU areas in 2023.

**Table 10.** List of Companies with HGU Permits and the Widest High Fire Vulnerability in PHU Areas in 2023

| No | Concession Name | Region | Province | High Fire Vulnerability Area (ha) |
|---|---|---|---|---|
| 1 | PT Sangkowong Sinta | Pulang Pisau | Central Kalimantan | 23.648,21 |
| 2 | PT Bumi Sriwijaya Sentosa | Banyuasin | South Sumatera | 231,94 |
| | | Ogan Komering Ilir | | 21.643,77 |
| 3 | PT Alam Sawit | West Kutai | East Kalimantan | 13.808,83 |
| | | Kutai Kartanegara | | 3.179,96 |
| 4 | PT Sintang Raya | Kubu Raya | West Kalimantan | 16.057,51 |
| 5 | PT Globalindo Alam Perkasa | East Kotawaringin | Central Kalimantan | 15.266,67 |
| 6 | PT Pagatan Usaha Makmur | Katingan | Central Kalimantan | 15.166,98 |
| 7 | PT Dinamika Graha Sarana | Ogan Komering Ilir | South Sumatera | 14.644,11 |
| 8 | PT Ceria Prima | Bengkayang | West Kalimantan | 12.383,22 |
| | | Sambas | | 917,31 |
| 9 | PT Cipta Tumbuh Berkembang | Kubu Raya | West Kalimantan | 12.852,47 |
| 10 | PT Persada Era Agro Kencana | Katingan | Central Kalimantan | 12.282,44 |

In the HGU concession data in Appendix 4, at least 9 out of 10 companies with the widest high fire vulnerability had experienced fires in their areas more than once. Based on Pantau Gambut's analysis, PT Sintang Raya and PT Cipta Tumbuh Berkembang, both located in West Kalimantan Province, had a history of forest and land fires for four years from 2015 to 2020. Moreover, 6 out of 10 concessions listed in the PHU areas with the widest high fire vulnerability in 2023 have been involved in legal cases related to forest and land fires or are under government scrutiny (refer to Table 11).

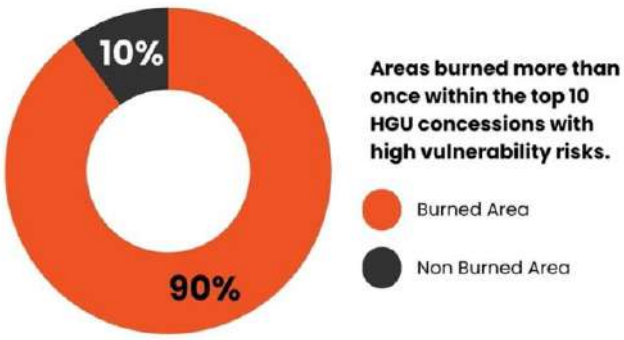



**Image 12.** Historical Forest and Land Fire Statistics for 10 Companies with HGU Permits (Source: Pantau Gambut Analysis, 2023)

**Table 11.** List of Social and Environmental Issues in Companies with HGU Permits and the Widest High Fire Vulnerability in PHU Areas in 2023

| No | Concession Name | Social Issue | Environmental Issue | Note |
|---|---|---|---|---|
| 1 | PT Sangkowong Sinta | - | Permits have been revoked according to the performance report of the 2019 Kalimantan Environment and Forestry Security and Law Enforcement Agency[33] | Forest and land fires issue |
| 2 | PT Bumi Sriwijaya Sentosa | Agrarian conflict with residents[34] | Boicoted by Singapore due to forest and land fire in 2015[35] | Forest and land fires issue |
| 3 | PT Alam Sawit | - | - | - |
| 4 | PT Sintang Raya | Agrarian conflict and the community sued PT Sintang Raya HGU. HGU was revoked through the Supreme Court decision in 2014, has not been executed[36] | Mangrove destruction[37] | Law case (HGU) |
| 5 | PT Globalindo Alam Perkasa | - | Was investigated in relation to the forest and land fire in 2015 case, and was also in a forest area prior to releasing the area. The investigation into the forest and land fire case was stopped through SP3[38] | Forest and land fires issue |
| 6 | PT Pagatan Usaha Makmur | Breach of promises related to the formation of plasma farmers[39] | Reported regarding forest and land fires related to the 2015 fire case to Komnas HAM[40] | Forest and land fires issue |
| 7 | PT Dinamika Graha Sarana | - | KLHK sealed the concession regarding forest and land fires 2019.[41] | Forest and land fires issue |

[33] Balai Pengamanan dan Penegakan Hukum lingkungan Hidup dan Kehutanan Wilayah Kalimantan. 2019. Laporan Kinerja BPPHLHK Wil. Kalimantan Tahun 2019.
[34] Mongabay. Konflik Agraria di Kabupaten OKI Tinggi Karena Status Lahan Tidak 'Clear and Clean': Anwar Sadat. 7 Desember 2014.
[35] Riau Online. 5 Perusahaan Yang Diboikot Singapura Gara-Gara Asap. 13 Oktober 2015.
[36] Mongabay. Kala Perusahaan Sawit Masuk Kubu Raya, Gambut Terancam, Warga pun Kesusahan. 17 Juni 2021
[37] Petisi Unilever – tebang habis hutan bakau Kubu Raya.
[38] DPR RI. Laporan Singkat Rapat Dengar Pendapat Panja Kebakaran Hutan dan Lahan Komisi III DPR RI dengan Kapolda Kalimantan Selatan, Kalimantan Tengah, Kalimantan Barat dan Kapolda Papua. 11 Oktober 2016
[39] Kalteng.co. PT PUM Soal Plasma, Yudea: Kita Beri Batas Waktu 14 Hari.
[40] Pusaka. Petisi Komnas-HAM Segera Melakukan Investigasi Terhadap Perusahaan Penyebab Krisis Kabut Asap dan Perubahan Iklim untuk Bertanggung Jawab dalam Melakukan Pemulihan. 15 Desember 2021.
[41] Kumparan. KLHK Segel 7 Lahan Konsesi di Sumsel, 1 Milik Perusahaan Asing. 3 Oktober 2019.

| | | | | |
|---|---|---|---|---|
| | | | [42][43] | |
| 8 | PT Ceria Prima | - | - | - |
| 9 | PT Cipta Tumbuh Berkembang | Agrarian conflict with the Sungai Asam village community, Kubu Raya Regency[44] | - | - |
| 10 | PT Persada Era Agro Kencana | - | Reported regarding forest and land fires related to the 2015 fires case to Komnas HAM.[45] It was noted that they also opened plantations in areas that had been set in a moratorium.[46] | Forest and land fires issue |

### b. Companies with IUPHHK Permits

Based on the ranking analysis, out of 159 concessions burdening PHU areas with IUPHHK permits in Table 10 and Appendix 5, PT Bumi Mekar Hijau in South Sumatra Province emerged as the company with the widest high fire vulnerability in 2023. The company had a high fire vulnerability area of 68 thousand hectares. In-depth analysis of the company revealed that PT Bumi Mekar Hijau is a supplier for the APP Sinar Mas Group. Furthermore, Pantau Gambut found that 10 IUPHHK concessions had the widest high fire vulnerability area in 2023, and 48% of these companies are affiliated with the Sinar Mas Group and its supply chain.

**Table 12.** List of Companies with IUPHHK Permits and the Widest High Fire Vulnerability in PHU Areas in 2023

| No | Concession Name | Regency/City | Province | High Class Fire Vulnerability Area (ha) |
|---|---|---|---|---|
| 1 | PT Bumi Mekar Hijau | Banyuasin | South Sumatera | 648,71 |
| | | Mesuji | | 62,10 |
| | | Ogan Komering Ilir | | 67.932,60 |
| 2 | PT Damai Setiatama Timber | Asmat | South Papua | 411,20 |
| | | Boven Digoel | | 3.598,94 |
| | | Mappi | | 37.912,46 |
| 3 | PT Baratama Putra Perkasa | East Kotawaringin | Central Kalimantan | 2.766,93 |
| | | Seruyan | | 32.687,23 |
| 4 | PT Rimba Raya Conservation | Seruyan | Central Kalimantan | 26.685,02 |
| 5 | PT Rimbun Seruyan | Seruyan | Central Kalimantan | 25.953,28 |
| 6 | PT Rimba Makmur Utama | Katingan | Central Kalimantan | 11.945,51 |
| | | East Kotawaringin | | 10.607,35 |

[43] Mongabay. Kementerian Lingkungan Selidiki Konsesi Tebu Jadi Kebun Sawit di OKI. 1 Desember 2016.
[44] Antaranews Kalbar. PT CTB Disinyalir Caplok Lahan Warga. 16 Desember 2014.
[45] Pusaka. Petisi Komnas-HAM Segera Melakukan Investigasi Terhadap Perusahaan Penyebab Krisis Kabut Asap dan Perubahan Iklim untuk Bertanggung Jawab dalam Melakukan Pemulihan. 15 Desember 2021.
[46] Mongabay. Waduh... Kawasan Moratorium Hutan Di Katingan Kalteng Dibuka Untuk Sawit. 31 Agustus 2015.

| | | | | |
|---|---|---|---|---|
| 7 | PT SBA Wood Industries | Ogan Komering Ilir | South Sumatera | 20.991,07 |
| 8 | PT Sumatera Riang Lestari | Bengkalis | Riau | 7.116,49 |
| | | Indragiri Hilir | | 1.422,65 |
| | | Indragiri Hulu | | 370,49 |
| | | Kepulauan Meranti | | 7.922,95 |
| | | Rokan Hilir | | 2.651,60 |
| 9 | PT Mukti Artha Yoga | Boven Digoel | South Papua | 4.697,45 |
| | | Mappi | | 13.912,70 |
| 10 | PT Rimba Hutani Mas | Banyuasin | South Sumatera | 191,25 |
| | | Musi Banyuasin | | 18.323,16 |
| | | Muaro Jambi | Jambi | 1,26 |
| | | West Tanjung Jabung | | 1,95 |
| | | East Tanjung Jabung | | 19,41 |

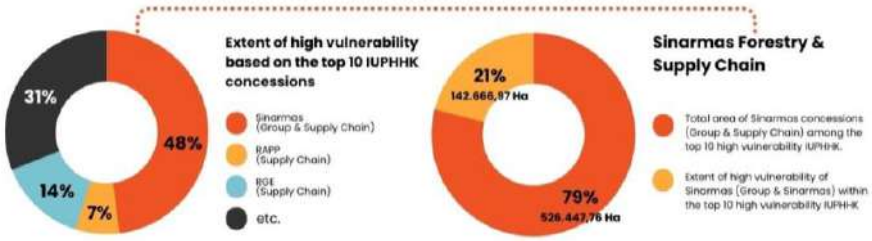



**Image 13.** Statistics on Group Companies among the Top 10 IUPHHK Companies (Source: Pantau Gambut Analysis, 2023)

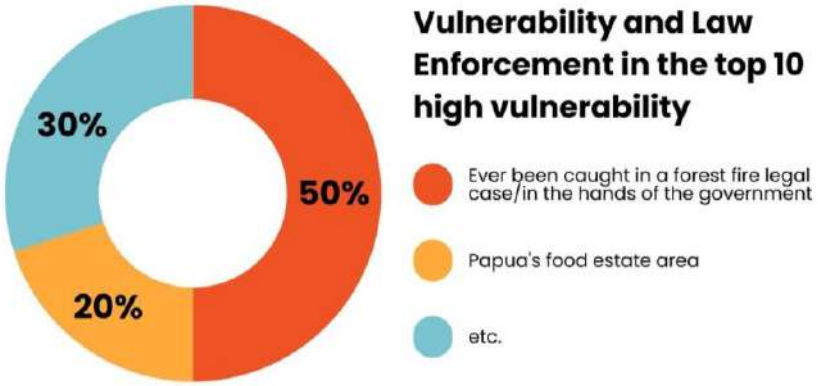



**Image 14.** Historical Legal Cases Statistics for the Top 10 IUPHHK Companies (Source: Pantau Gambut Analysis, 2023)

The data on companies with IUPHHK permits listed in Appendix 5, which have the highest fire vulnerability, indicates that 8 out of 10 companies are located in fire-affected areas. Generally, these companies had a history of forest and land fires in 2015 and 2019. However, PT Rimba Makmur Utama in Central Kalimantan Province and PT Sumatera Riang Lestari in Riau Province, both with HTI status, had a history of forest and land fires for three years during the period from 2015 to 2020.

The high fire vulnerability is indicative of environmental and social issues in these areas. Notably, at least 5 out of 10 IUPHHK concession companies in PHU areas with the widest high fire vulnerability have been subject to government involvement in legal cases related to forest and land fires, and 2 other companies are located in Papua's food estate area.

**Table 13.** List of Social and Environmental Issues in Companies with IUPHHK Permits and the Widest High Fire Vulnerability in PHU Areas in 2023

| No | Concession Name | Social Issue | Environmental Issue | Note |
|---|---|---|---|---|
| 1 | PT Bumi Mekar Hijau | - | Sued by the Ministry of Environment and Forestry regarding forest and land fires[47] | Forest and land fires issue |
| 2 | PT Damai Setiatama Timber | The concession area intersects with the customary territory of the Kombei Tribe[48] | In the HPH concession for the Papuan food estate project, PT Damai Setiatama Timber exploits the largest area of land, namely 109,097 ha[49] | Food estate Papua |
| 3 | PT Baratama Putra Perkasa | - | - | - |
| 4 | PT Rimba Raya Conservation | - | - | - |
| 5 | PT Rimbun Seruyan | - | Forest and land fire issue case in 2019 [50] | Forest and land fires issue |
| 6 | PT Rimba Makmur Utama | - | - | - |
| 7 | PT SBA Wood Industries | - | The permit was frozen by the Ministry of Environment and Forestry regarding the 2015 forest and land fires[51] | Forest and land fires issue |
| 8 | PT Sumatera Riang Lestari | - | The forest and land fires case was stopped by an SP3 (Warranty to Stop Investigation) by the Riau Police[52] | Forest and land fires issue |
| 9 | PT Mukti Artha Yoga | - | The concession area is included in the Papua food estate project, covering an area of 6,774 hectares | Food estate Papua |
| 10 | PT Rimba Hutani Mas | - | Previously sanctioned for forest and land fires, and the company's location ranked among the top 10 fire-affected areas in 2015 and 2019[53] | Forest and land fires issue |

Several companies with high vulnerability concessions in the top 10 list have strong ties to the supply chain of the parent companies, which are believed to be closely linked to individuals in the company's board of directors. For example, two members of the board of directors and commissioners of PT BMH, which are among the high-vulnerability companies and part of the supply chain of the APP Sinar Mas Group, are associated with Sinar Mas Forestry.

[47] Siaran Pers PPID KLHK. Menanti Putusan Sidang Gugatan Pemerintah Terhadap PT. Bumi Mekar Hijau. 29 Desember 2015.
[48] Mongabay. With a feast of grubs, a tribe makes its case for forest stewardship. 30 Oktober 2018.
[49]Betahita.id. Rencana Food Estate dan Ancaman Tenggelamnya Pesisir Papua. 21 Oktober 2021.
[50] Berita Sampit. Lahan Gambut Terbakar, Ini Jumlah Titik Hotspot di Seruyan. 10 September 2019.
[51] Detik News. Ini 3 Perusahaan Pembakar Hutan yang Izinnya Dicabut Kementerian LHK. 26 Oktober 2015.
[52] Senarai. Walhi minta Penyidikan PT Sumatera Riang Lestari Dilanjutkan. 15 November 2016.
[53] Mongabay. Greenpeace Nilai Omnibus Law Lemahkan Penegakan Hukum Kebakaran Hutan dan Lahan. 30 Oktober 2020.

For a more comprehensive understanding of the corporate relationships within the group, please refer to the following document: identification of forestry concessions.xlsx

# 3. PHU (Peatland Hydrological Unit) with the Widest High Fire Vulnerability due to Concessions in 2023

## a. Companies with HGU Permits

Based on Table 14, the PHU area of Sungai Kahayan-Sungai Sebangau, covering 60,000 hectares, becomes the PHU with the widest high fire vulnerability due to HGU concessions in 2023. This PHU holds the highest fire vulnerability in Indonesia and is burdened by 8 palm oil concessions, including PT. Sangkowong Sinta, which is the concession with the highest number of fire vulnerability cases among companies with HGU permits. This indicates that the vulnerability arises not only from the peatland clearing for the former PLG (Peatland Conversion License) program but also from concessions with plantations like oil palm, which dominate and exacerbate the occurrence of fire vulnerability in 2023. According to this analysis, 7 out of 10 PHUs burdened by HGU concessions with the widest high fire vulnerability in 2023 are located on Kalimantan Island. This is a dangerous sign as PHUs on Kalimantan Island are increasingly dominated by concessions, leading to a rise in vulnerability.

**Table 14.** PHU with the Widest High Fire Vulnerability due to HGU Concessions in 2023

| No | PHU Name | Province | High Class Fire Vulnerability Area (ha) |
|---|---|---|---|
| 1 | PHU Sungai Kahayan–Sungai Sebangau | Central Kalimantan | 59.821,26 |
| 2 | PHU Sungai Mentarang–Sungai Sembakung | North Kalimantan | 55.966,72 |
| 3 | PHU Sungai Pukun–Sungai Mentaya | Central Kalimantan | 47.680,38 |
| 4 | PHU Sungai Kapuas–Sungai Ambawang | West Kalimantan | 44.811,82 |
| 5 | PHU Sungai Buluh Besar–Sungai Seruyan | Central Kalimantan | 40.338,24 |
| 6 | PHU Sungai Sibumbung–Sungai Talangrimba | South Sumatera | 38.039,78 |
| 7 | PHU Sungai Katingan–Sungai Sebangau | Central Kalimantan | 36.222,91 |
| 8 | PHU Sungai Rokan–Sungai Siak Kecil | Riau | 32.918,15 |
| 9 | PHU Sungai Ambawang–Sungai Kubu | West Kalimantan | 29.201,26 |
| 10 | PHU Sungai Siak–Sungai Kampar | Riau | 26.989,45 |

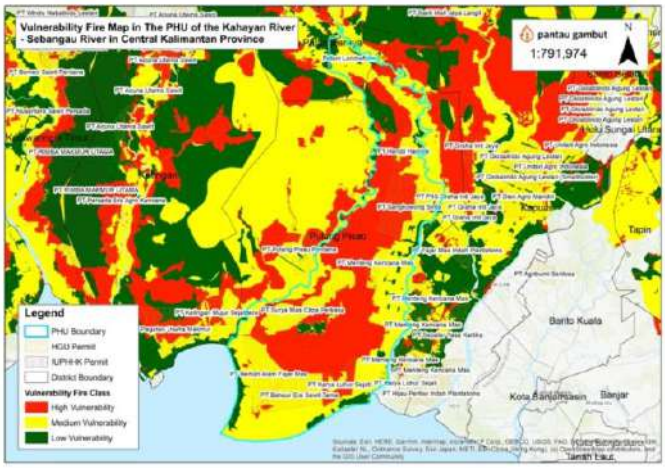



**Figure 15.** Fire Vulnerability in the PHU Area of Sungai Kahayan-Sungai Sebangau (Source: Pantau Gambut Analysis, 2023)

### b. Companies with IUPHHK Permits

Based on Table 15, the PHU area of Sungai Sugihan-Sungai Lumpur becomes the PHU burdened by IUPHHK concessions with the widest high fire vulnerability. The area of high fire vulnerability is the largest and twice that of the ranking below it. Overall, this concession only covers 8% of the high fire vulnerability area, but it is controlled by 5 HTI (Industrial Timber Plantation) companies, including PT Bumi Mekar Hijau, which is the concession with the highest fire vulnerability among IUPHHK permit holders. The visualization in Figure 16 shows that although the high fire vulnerability in this PHU area is relatively small, almost the entire PHU is dominated by HTI concessions.

**Table 15.** PHU burdened by IUPHHK Concessions with the Largest High Fire Vulnerability in 2023

| No | PHU Name | Province | High Class Fire Vulnerability Area (ha) |
|---|---|---|---|
| 1 | PHU Sungai Sugihan–Sungai Lumpur | South Sumatera | 54.867,47 |
| 2 | PHU Sungai Katingan–Sungai Mentaya | Central Kalimantan | 35.025,36 |
| 3 | PHU Sungai Ulakkedondong–Sungai Lumpur | South Sumatera | 30.147,96 |
| 4 | PHU Sungai Wade Passue–Sungai Jo Dairam | South Papua | 27.875,52 |
| 5 | PHU Sungai Siak–Sungai Kampar | Riau | 26.315,11 |
| 6 | PHU Sungai Buluh Besar–Sungai Seruyan | Central Kalimantan | 26.238,63 |
| 7 | PHU Sungai Pukun–Sungai Seruyan | Central Kalimantan | 25.985,59 |
| 8 | PHU Sungai Rokan–Sungai Siak Kecil | Riau | 24.666,65 |
| 9 | PHU Sungai Pukun–Sungai Mentaya | Central Kalimantan | 23.220,86 |
| 10 | PHU Sungai Merang–Sungai Ngirawan | South Sumatera | 19.829,04 |

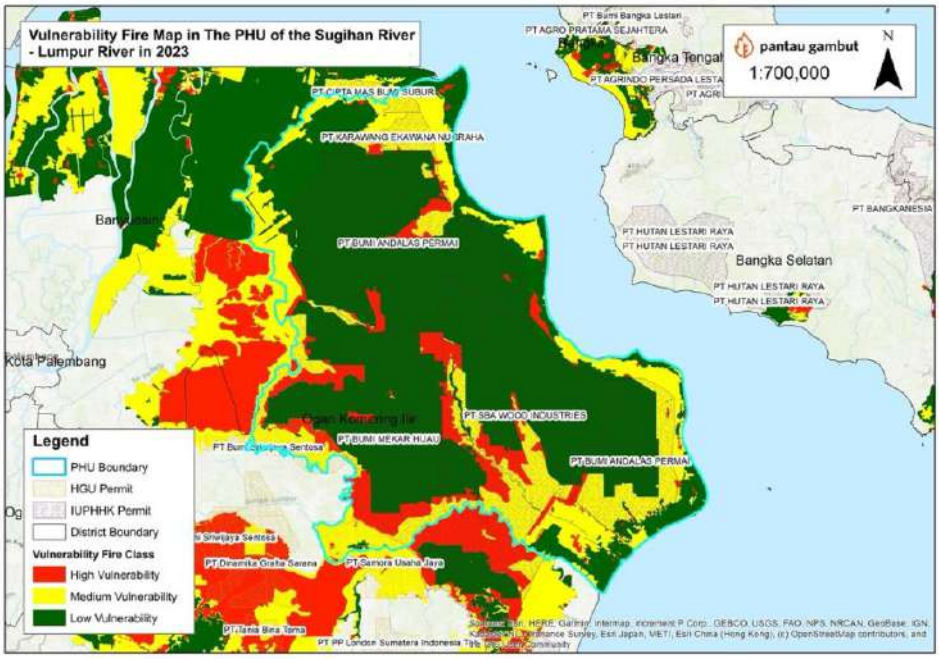



**Figure 16.** Fire Vulnerability in the PHU Area of Sungai Sugihan-Sungai Lumpur (Source: Pantau Gambut Analysis, 2023)

## 4. PHU in Provinces Burdened by Concessions with the Widest Severe Forest and Land Fire Vulnerability in 2023

### a. Companies with HGU Permits

Kalimantan Island has the highest number of HGU concessions among all the islands in Indonesia, as shown in Appendix 3. Table 16 reveals that HGU concessions impacting forest and land fire vulnerability result in a severe susceptibility to burning incidents. As a case in point, Kalimantan Barat and Kalimantan Tengah provinces exhibit a substantial vulnerability to severe forest and land fire incidents, covering an extensive area of 300 thousand hectares each, three times larger than that of Kalimantan Timur. This indicates that the more concession areas a province has, the greater its susceptibility to forest and land fire occurrences.

**Table 16.** Provinces with the most extensive forest and land fire vulnerability in PHU burdened by HGU concessions

| No | Province | High Class Fire Vulnerability Area (ha) |
|---|---|---|
| 1 | Central Kalimantan | 346.804,92 |
| 2 | West Kalimantan | 314.841,49 |
| 3 | Riau | 224.444,46 |
| 4 | East Kalimantan | 97.662,00 |
| 5 | South Papua | 74.516,51 |
| 6 | North Kalimantan | 68.245,61 |

| | | |
|---|---|---|
| 7 | South Sumatera | 65.642,32 |
| 8 | North Sumatera | 27.694,19 |
| 9 | West Sumatera | 23.140,49 |
| 10 | Aceh | 17.212,62 |

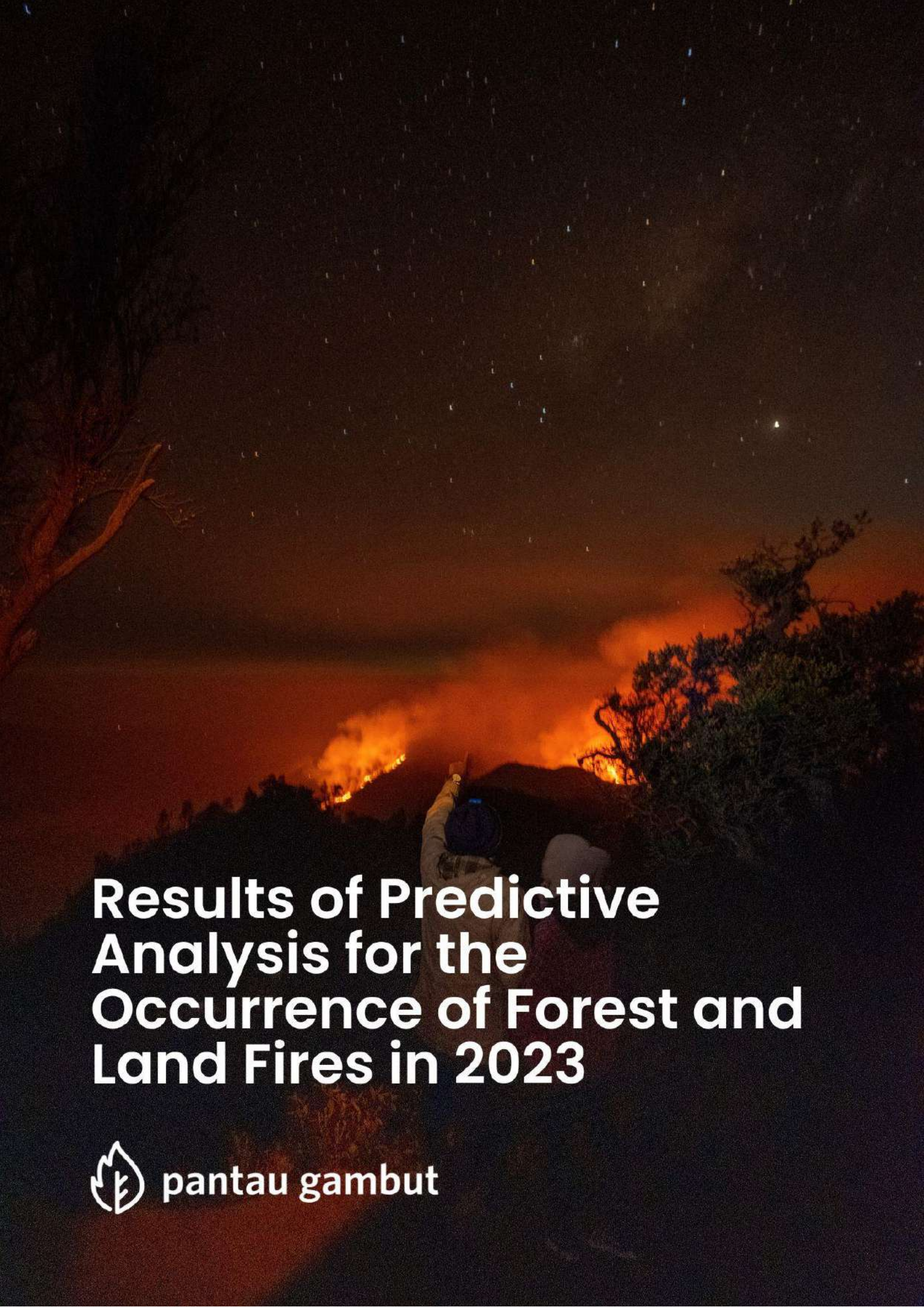
### b. Companies with IUPHHK Permits

The provinces of Central Kalimantan, Riau, and South Sumatra are the three provinces with the most extensive severe forest and land fire vulnerability in PHU burdened by IUPHHK concessions. Each of these provinces exhibits a severe vulnerability spanning over 135 thousand hectares.

The analysis of both HGU and IUPHHK concessions reveals that Central Kalimantan Province bears the highest severe forest and land fire vulnerability in PHU due to the activities of extractive companies, whether through HGU or IUPHHK concessions. This finding highlights the need for attention to compliance with restoring peatlands in PHU that have been granted permits for monoculture planting. The extractive activities of these companies have significantly damaged the peatland ecosystem in PHU through deforestation and the planting of non-peat-friendly commodities, which are unsuitable for peatlands. Activities such as drainage, drying, and even land clearing through burning further exacerbate the degradation of peatlands in PHU areas.

**Table 17.** Provinces with the Widest Forest and Land Fire Vulnerability in PHU Burdened by IUPHHK Concessions.

| No | Province | High Class Fire Vulnerability Area (ha) |
|---|---|---|
| 1 | Central Kalimantan | 145.411,23 |
| 2 | Riau | 140.512,18 |
| 3 | South Sumatera | 136.102,43 |
| 4 | South Papua | 85.838,66 |
| 5 | West Kalimantan | 80.273,41 |
| 6 | Jambi | 26.304,39 |
| 7 | Jambi–South Sumatera | 22.371,32 |
| 8 | North Kalimantan | 21.791,72 |
| 9 | West Papua | 14.633,69 |
| 10 | Bangka Belitung Islands | 7.982,57 |



# Results of Predictive Analysis for the Occurrence of Forest and Land Fires in 2023

pantau gambut

# 1. Influence of Anomalies on Climate in Indonesia

Indonesia is a country located in the tropical region, straddling the equator and situated between the Pacific and Indian Oceans. Its geographic location has an impact on several aspects, including the occurrence of climate anomalies. In general, climate anomalies occur due to the dominance of one or several factors that affect climate variability (particularly rainfall) in Indonesia, such as the meridional cycle (Hadley Cycle), zonal cycle (Walker Cycle), monsoonal wind activity, local influences (topography), and tropical cyclones[54]. Among the dominant climate anomalies in tropical regions are the El Nino Southern Oscillation (ENSO) and the Indian Ocean Dipole (IOD). These climate anomalies can lead to below-normal rainfall causing prolonged droughts or above-normal rainfall resulting in disasters like floods, landslides, and others. One of the primary causes of climate variability (in this case, rainfall) in Indonesia is the ENSO[55], which is responsible for nearly 85% of prolonged drought occurrences in the country.

ENSO is a climate anomaly phenomenon caused by changes in sea surface temperatures in the Central and Eastern Pacific Ocean from its normal average temperature[56]. This phenomenon has a recurring pattern with a frequency of approximately three to seven years. During an anomaly, sea surface temperatures in most tropical regions of the Pacific Ocean are either higher (warm) or lower (cool) by about 1°C to 3°C compared to the normal average. ENSO directly influences the distribution of rainfall in tropical regions and can have a strong impact on weather conditions across the United States and other parts of the world. El Nino and La Nina are the extreme phases of the ENSO cycle, with a third phase in between called ENSO-neutral[57].

During the El Nino phase, there is an increase in sea surface temperatures above the average in the central and eastern tropical Pacific Ocean. This phase is associated with reduced rainfall in Indonesia while increasing rainfall in the tropical Pacific Ocean. The low-level surface winds that usually blow from east to west along the equator ("easterly winds") weaken or, in some cases, reverse direction (blow from west to east, known as westerly winds). In contrast, the La Nina phase is characterized by a decrease in sea surface temperatures below the average in the central and eastern tropical Pacific Ocean. During the La Nina phase, there tends to be increased rainfall in Indonesia and decreased rainfall in the central tropical Pacific Ocean. The normal eastward blowing winds along the equator become stronger. The Neutral phase, on the other hand, indicates the normal average sea surface temperature. However, there are instances when the ocean appears to be in an El Nino or La Nina state, but the conditions are not extreme.

The determination of the ENSO phase is typically based on the calculation of sea surface temperature anomalies on Nino 3.4. Generally, the threshold SST values used for Nino 3.4 are ±0.5°C. El Nino is categorized when SST in Nino 3.4 is greater than 0.5°C or La Nina when SST in Nino 3.4 is less than 0.5°C for six months or more.

[54] Pradiko I, Rahutomo S, Siregar HH. 2017. Mengenal anomali-anomali iklim dan efeknya terhadap produktivitas tanaman kelapa sawit di Indonesia. *Warta PPKS* 22(3): 111-121.
[55] Yamanaka M (ed.). 1998. Climatology of Indonesia Maritime Continent. Kyoto University Press.
[56] National Oceanic and Atmospheric Administration (NOAA). What is El Niño-Southern Oscillation (ENSO)?.
[57] National Oceanic and Atmospheric Administration (NOAA). 2014. What is the El Niño–Southern Oscillation (ENSO) in a nutshell?.

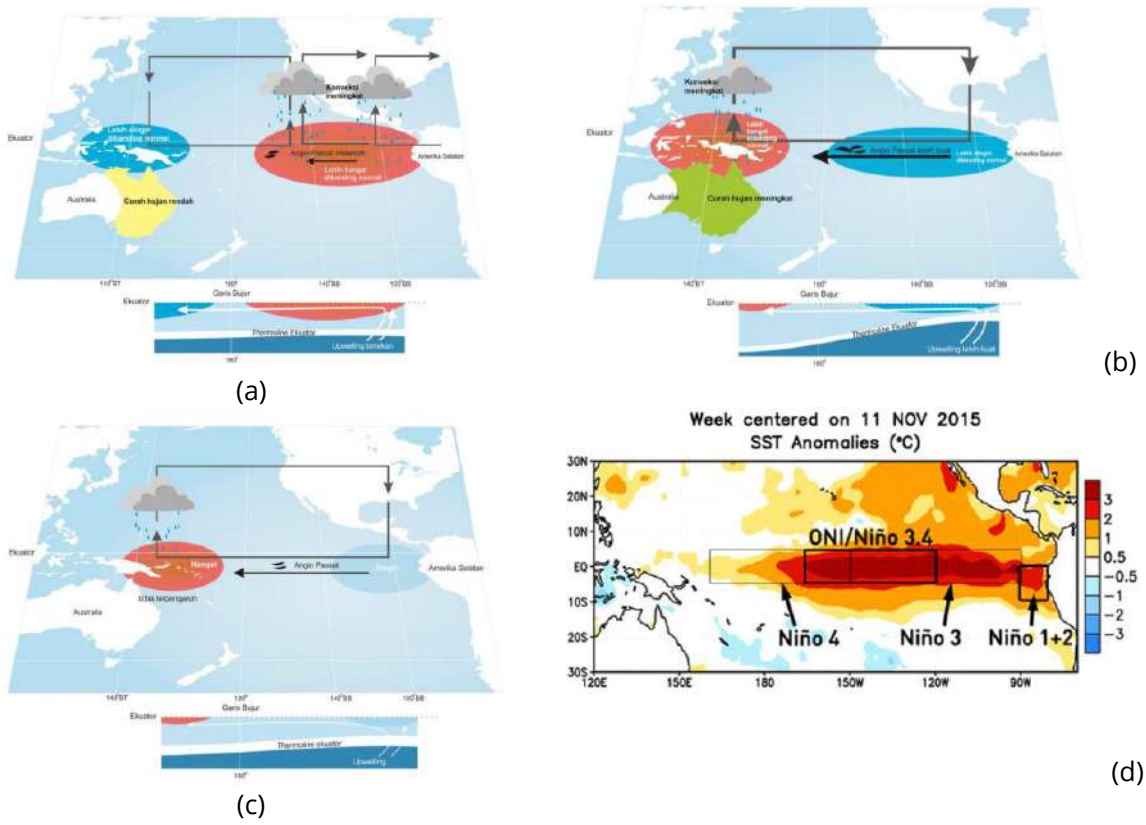



**Figure 17.** Simplified Scheme of ENSO Phase Conditions; (a) El Nino, (b) La Nina, (c) Normal, and (d) Nino 3.4

## 2. Climate Anomaly Prediction for the Year 2023

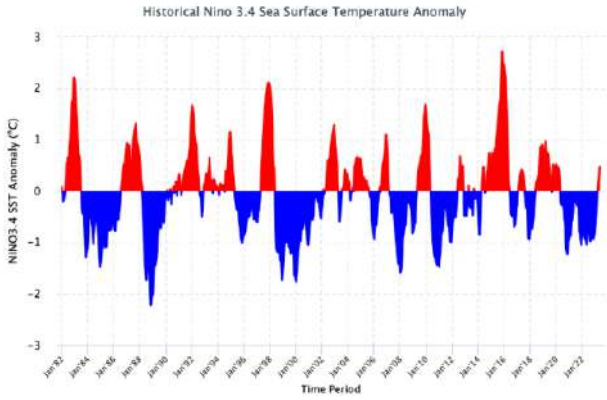



**Figure 18.** Historical Sea Surface Temperature Anomalies in Nino 3.4[58]

The occurrence of El Nino is also closely related to a 4-year cycle or usually happens within a range of 4 years. On the other hand, predicting the phenomenon of La Nina is currently quite challenging. The cycle of La Nina does not occur within a specific period range, but generally happens approximately every 6 to 7 years[59]. Based on Figure 18, El Nino has occurred strongly up to 6 times

[58] IRI Colombia. 2023. Historis Anomali Suhu Permukaan Laut pada Nino 3.4.
[59] Rimbakita.com. El Nino & La Nina – Pengertian, Siklus, Waktu, Proses & Dampak.

in Indonesia, including in the years 1983, 1992, 1997, 2009, and 2015. Historically, El Nino in the years 1997, 2009, and 2015 caused significant forest and land fires in Indonesia. Even in 2019, with only an anomaly of approximately 1°C, forest and land fires occurred in Indonesia. Now, in 2023, it has already shown an El Nino phase (shown in red) and will persist or continue to intensify in the near future, increasing the need for preparedness and vigilance to prevent the recurrence of forest and land fires.

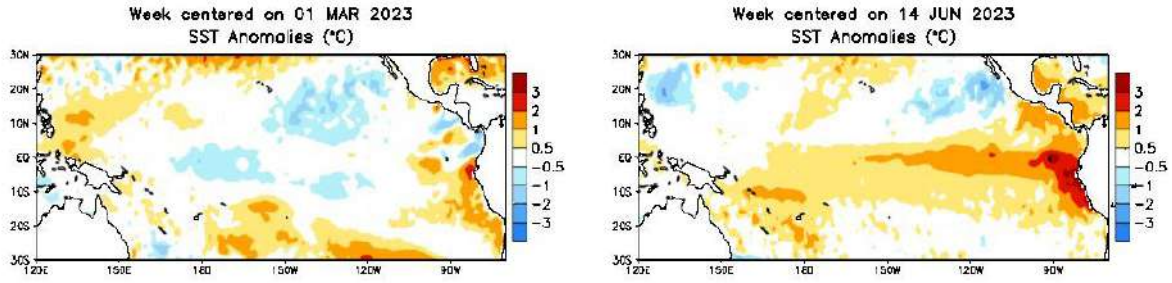



**Figure 19**. Sea Surface Temperature Anomalies in Nino 3.4; (a) March 1, 2023, (b) June 14, 2023[60]

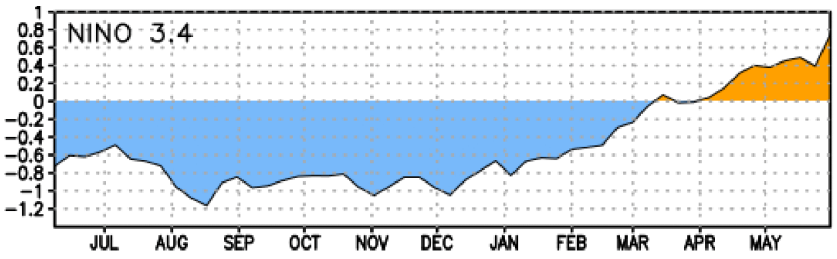



**Figure 20.** Anomaly Values of SST in NINO 3.4[61]

In Figure 19 and Figure 20, the La Nina phase (shown in blue) in March 2023 is still evident in Nino 3.4. However, one month later, the negative sea surface temperature anomaly (La Nina phase) in the Central-Eastern Pacific has weakened further, and by June, it has transitioned into an El Nino phase (shown in yellow-red)[62]. This indicates that the sea surface temperature anomaly is heading towards an ENSO-neutral state (as of April 12, 2023, the last observed value in the NINO 3.4 region is 0.1°C). Most of the models in the IRI ENSO prediction anticipate SST in El Nino to begin from May-July 2023 (probability 73%), and the likelihood of an ENSO-neutral state remains low (probability 27%). Looking ahead, El Nino is predicted to be the dominant category throughout the forecast period with probabilities ranging from 78% to 87%. ENSO-neutral is the most likely category following that, with remaining probabilities in the range of 13% to 20%.

Based on observations from CPC-NOAA[63] in mid-May 2023, the negative sea surface temperature anomaly (La Nina) in the Central-Eastern equatorial Pacific has disappeared. Currently, sea surface temperature anomalies are warmer in the eastern and central Pacific regions, while values in the

[60] Climate Prediction Center (CPC-NOAA). Tropical Pacific Sea Surface Temperature Animation.
[61] Climate Prediction Center (CPC-NOAA). El Niño/Southern Oscillation (ENSO) Diagnostic Discussion. 8 Juni 2023.
[62] IRI Colombia. ENSO Forecast. 16 Juni 2023
[63] Climate Prediction Center (CPC-NOAA). El Niño/Southern Oscillation (ENSO) Diagnostic Discussion. 8 Juni 2023.

western Pacific are within the ENSO-neutral range. All latest weekly Niño indices are above +0.5°C, with Niño-3.4 at +0.8°C, Niño-3 at +1.1°C, and Niño1+2 at +2.3°C. Even in mid-June, as shown in Figure 19, Nino 3.4 is in an El Nino anomaly with temperatures increasing.

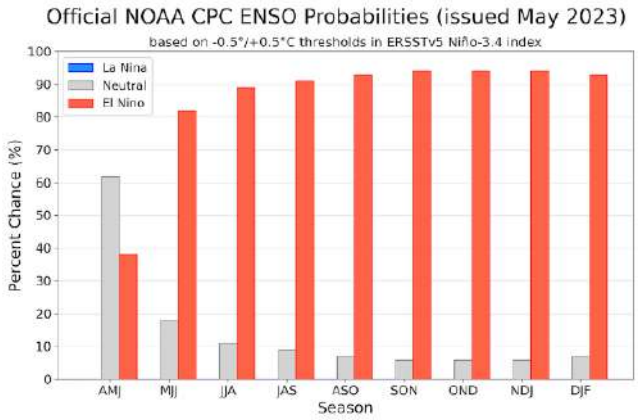



**Figure 21.** Forecasted Probability of El Niño Occurrence[64]

Main oceanic and atmospheric variables are now consistent with the development of El Nino conditions. The Climate Prediction Center (CPC-NOAA) previously issued information on the occurrence of El Nino in April 2023 as an indicator of the start of the warm phase of ENSO, which would effectively take place in May 2023. According to the IRI ENSO prediction[65], most models forecast a continuous El Nino throughout the entire forecast period. Figure 21 shows that in May 2023 (AMJ—read as April May June), the probability of El Nino occurrence is around 40%, and it increases significantly in June 2023 (MJJ—read as May June July) with a probability of occurrence reaching 80%. This is consistent with what is shown in Figure 19(b) and Figure 20, where the Pacific has experienced a temperature increase and is in a warm phase. The transition from ENSO-neutral is expected to occur in the next few months, with a greater than 90% chance of El Nino persisting until the winter season in the Northern Hemisphere (December–March).

## 3. Prediction of Dry Season and Forest and Land Fires in 2023

The dry season is closely associated with the occurrence of forest and land fires in Indonesia. Based on the analysis results in Figure 22, significant forest and land fires occurred in 2014, 2015, and 2019, with the fires mostly happening from February to March, followed by July to October.

[64] IRI Colombia. ENSO Forecast. 16 Juni 2023
[65] IRI Colombia. ENSO Forecast. 16 Juni 2023

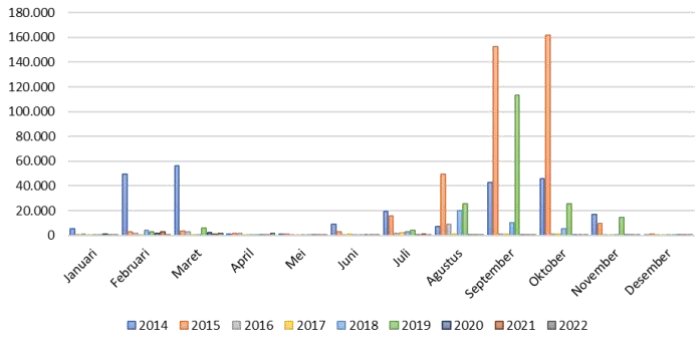



**Figure 22.** Historical Hotspot Points from 2014 to 2022[66]

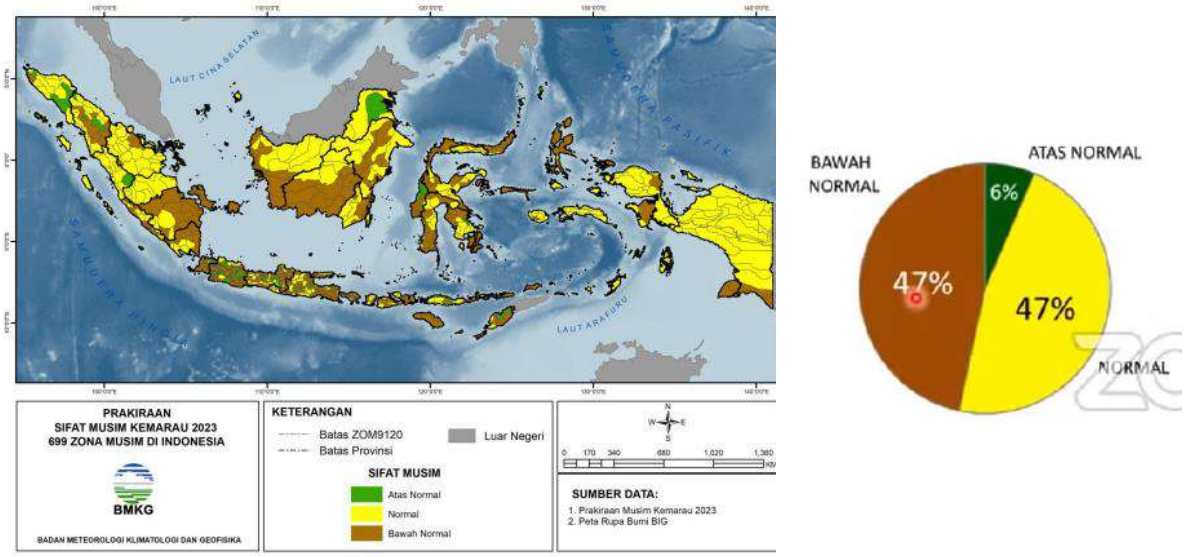



**Figure 23.** Prediction of the Nature of the 2023 Dry Season[67]

Moreover, if the conditions are exacerbated by climate anomalies, the dry season will experience below-normal characteristics, as shown in Figure 23. According to the BMKG prediction, a more extreme dry season will occur in Indonesia, categorized as a below-normal spread of the dry season, resulting in drier conditions than usual. In fact, as much as 47% of 699 seasonal zones in Indonesia fall into the below-normal spread of the dry season. This condition also affects peat-provinces, including parts of North Sumatra, northern Riau, southern Sumatra (such as South Sumatra), southern Kalimantan (West Kalimantan, Central Kalimantan, South Kalimantan), southern West Papua, and southern Papua.

BMKG predicts the peak of the dry season in 2023, with 46% of 699 seasonal zones in Indonesia experiencing it in August. Meanwhile, in other locations, the peak of the dry season occurs in July (27%) and September (13%). The coverage of the peak dry season in August in peat areas includes the eastern part of South Sumatra Province, Bangka Belitung Islands, Lampung, most of Java Island, parts of East Kalimantan, South Kalimantan, parts of Sulawesi Island, and parts of Papua.

[66] Satelit sensor MODIS pada berbagai tingkat kepercayaan. NASA. Fire Information for Resource Management System.
[67] Badan Meteorologi, Klimatologi, dan Geofisika. Prakiraan Musim Kemarau 2023 di Indonesia. 17 April 2023

Based on Figure 24, provinces such as Riau and Central Kalimantan are predicted to experience the peak of the dry season in July 2023, while South Papua Province is predicted to experience it around April and June 2023. BMKG also predicts that the onset and peak of the dry season will occur earlier or undergo changes compared to the normal rainfall period from 1991 to 2020. This is due to the acceleration of the previous rainy season, resulting in an impact on the dry season in 2023.

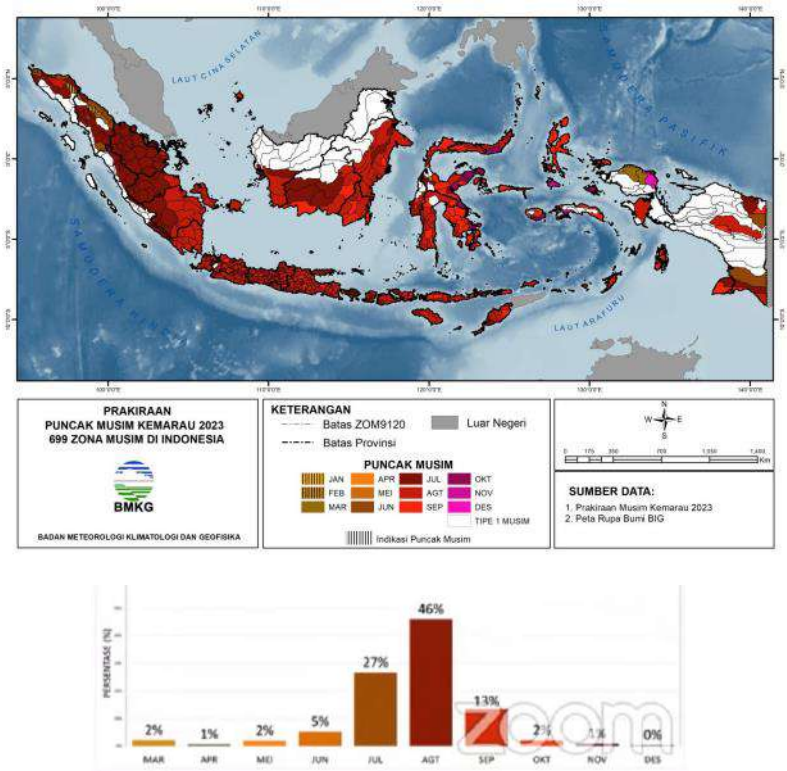



**Figure 24.** Prediction of the Peak of the 2023 Dry Season[68]

When compared with Figure 22, the determination of forest and land fires is generally based on indications of hotspots occurring during the peak of the dry season. However, it is essential to know that the occurrence of Forest and Land Fire in peatlands is highly influenced by the Ground Water Level (GWL) or Tinggi Muka Air Tanah (TMAT). Based on historical data, 50% of Forest and Land Fire in September 2012 occurred when the TMAT ranged from 30 to 39 cm below the peat surface. If the TMAT is below this value, it significantly increases the likelihood of land and forest fires. When related to the dry season, there is a time-lag effect between TMAT and the level of rainfall (influence of the dry season). After a drastic decrease in rainfall, the TMAT will experience a decrease or impact about one month later[69]. This means that if the peak of the dry season and the amount of rainfall decrease in August, the TMAT value in the peatlands will decrease, and the presumed peak of Forest and Land Fire in 2023 will occur in September.

[68] Badan Meteorologi, Klimatologi, dan Geofisika. Prakiraan Musim Kemarau 2023 di Indonesia. 17 April 2023

[69] Putra EI, Cochrane MA, Vetrita Y, Graham L, Saharjo BH. 2017. Determining critical groundwater level to prevent degraded peatland from severe peat fire. *IOP Conf. Series: Earth and Environmental Science* (149). https://doi.org/10.1088/1755-1315/149/1/012027.

# Results of Hotspot Monitoring Analysis (January-May 2023) in PHU Areas

pantau gambut

Hotspot analysis is a brief analysis to identify locations suspected of forest and land fires. The presence of hotspots, which represent areas with higher temperatures than their surroundings, is visualized through pixel images measured by satellite imagery[70]. Hotspots are indicated as areas potentially prone to forest and land fires, but the presence of a single hotspot does not necessarily mean a forest and land fire occurrence. However, hotspots with specific characteristics can be considered as indications of a forest and land fire event.

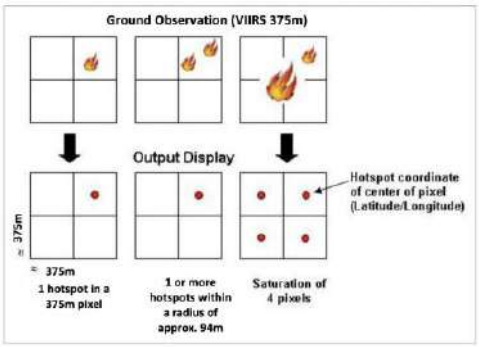



**Figure 25.** Hotspot Visualization Mechanism[71]

A hotspot is considered a forest and land fire if it spreads in clusters or groups in one location and/or occurs for three consecutive days or more[72]. The higher the number and recurrence of hotspots in an area, the higher the potential for forest and land fires.

**Table 14.** Number of Hotspots from January to May 2023

| Month | Forest and Land Fires Vulnerability Class 2023 at PHU | | | Total |
|---|---|---|---|---|
| | High | Medium | Low | |
| January | 126 | 224 | 176 | **526** |
| February | 256 | 300 | 201 | **757** |
| March | 167 | 292 | 305 | **764** |
| April | 396 | 595 | 393 | **1384** |
| May | 357 | 663 | 579 | **1599** |
| **Total** | **1302** | **2074** | **1654** | |

Pantau Gambut's Analysis found 5,030 hotspots during January to May 2023, with high and moderate vulnerability accounting for 67%. The monthly number of hotspots in PHU from January to May increases according to the prediction of the El Nino occurrence, starting in April and continuing to rise in the following months until December 2023. Based on the analysis using the hotspot characteristics as indicators of forest and land fires, Pantau Gambut identified suspected forest and land fires occurrences in 29 locations in the PHU area from January to May 2023. Details of these locations are presented in Annex 6. Out of these 29 locations, 10 were identified only in May. This indicates that after entering the dry season and El Nino phase, the vulnerability to forest and land fires in Indonesia increases. Among the 29 locations, 19 are classified as having high

[70] [PPPJL] Pusat Pemanfaatan Penginderaan Jauh Lapan. 2016. *Panduan Teknis (V.01) Informasi Titik Panas (Hotspot) Kebakaran Hutan/Lahan*. Jakarta: Deputi Bidang Penginderaan Jauh lembaga Penerbangan dan Antariksa Nasional.
[71] Earthdata NASA. FAQ: What does a MODIS active fire detection mean on the ground?. 3 Agustus 2018
[72] Endrawati. 2016. *Analisis Data Titik Panas (Hotspot) dan Areal Kebakaran Hutan dan Lahan Tahun 2016*. Jakarta (ID): Kementerian Lingkungan Hidup dan Kehutanan.

vulnerability, 6 as having moderate vulnerability, and 4 as having low vulnerability. Pantau Gambut found that 25 out of 29 locations with predicted vulnerability to forest and land fires occurred in areas with high and moderate vulnerability. In percentage terms, the accuracy of the 2023 forest and land fires vulnerability prediction in the PHU area by Pantau Gambut is 86.21%.

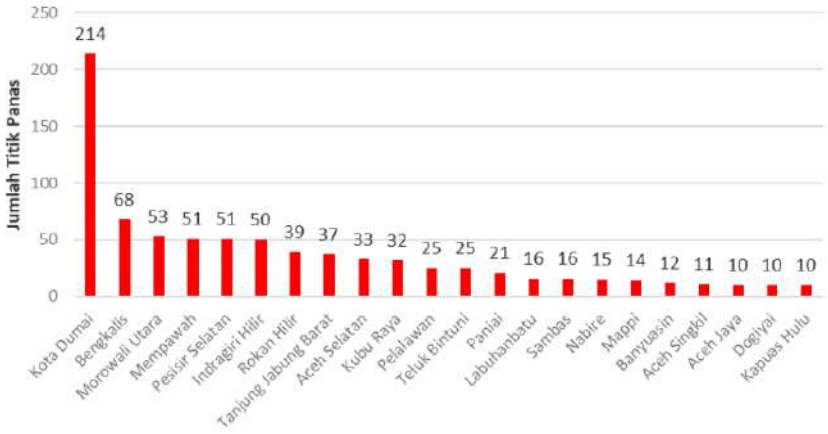



**Figure 26.** Average Number of Highest Hotspots in Cities/Districts from January to May 2023

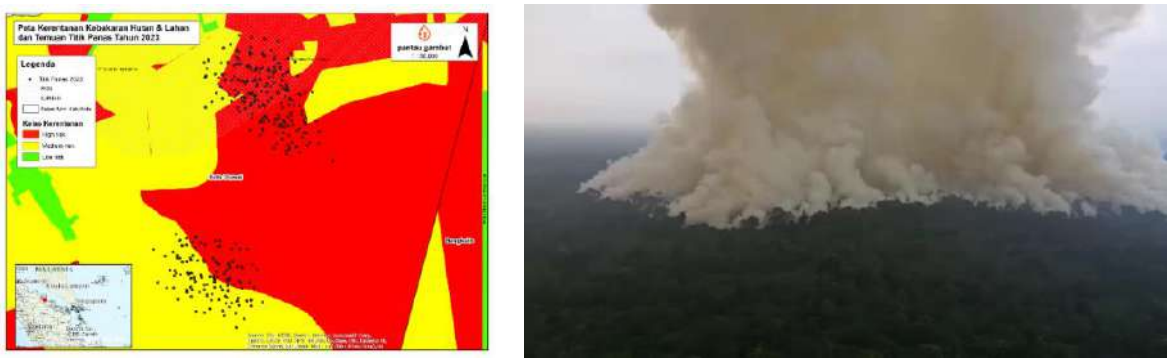


**Figure 27.** Comparison of the number of hotspots seen from satellite images (left) with the actual occurrence of forest and land fires in Dumai City, Riau Province, around April 19-27, 2023 (right)

Dumai City and Bengkalis Regency are the cities/districts with the highest distribution of forest and land fires throughout January to May 2023. On average, Dumai City had over 200 hotspots detected by the three types of satellites used. Furthermore, based on the hotspot spread duration, this location is suspected to have been burning for more than 1 week. The fire location indicated in Figure 27 is within the Rokan River-Siak Kecil River PHU. From the image, it is evident that the smoke caused by the peatland fire is extensive and could lead to respiratory diseases among the surrounding communities.

The Rokan River-Siak Kecil PHU also holds the record for having the highest number of hotspot distributions in Indonesia during the January to May 2023 period, with 712 hotspots detected. Despite being the largest PHU in Indonesia, it experiences a high frequency of large-scale forest and land fires. Additionally, the Aek Ubar-Aek Lunang PHU, located around Pesisir Selatan Regency, is the second PHU with the highest number of hotspot distributions in Indonesia. In fact,

from hotspot identification, around two locations indicating forest and land fires were discovered within the period of May 23 to 26, 2023.

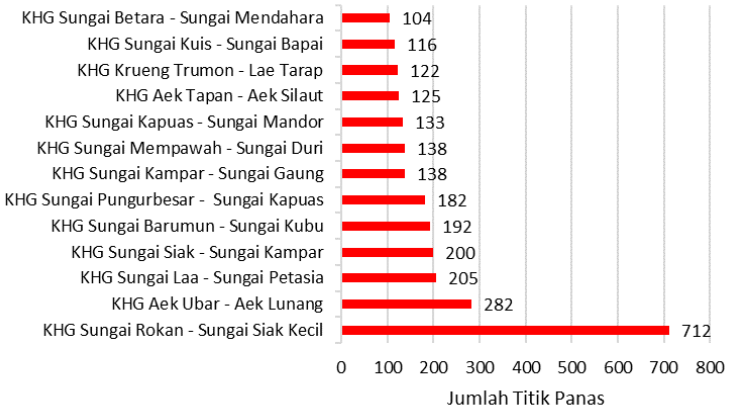



**Figure 28.** Highest Number of Hotspots in PHU from January to May 2023

Forest and land fires and concessions are closely related. Out of the 29 identified forest and land fires locations, 15 were found within concession areas and their buffers. For example, the two previously mentioned forest and land fires locations in Dumai City and Pesisir Selatan Regency occurred within concession areas, namely PT Surya Dumai Agrindo and PT Budidaksa Dwi Kusuma in Dumai City, as well as PT Mundam Sinjunjung Sakti in Pesisir Selatan Regency. All of the mentioned companies hold HGU permits for oil palm plantations.

## Summary

Based on this report, the summary of all the discussed sections is as follows:

1. Vulnerability models were created using weight and score analysis with regression modeling.
2. Regions categorized as having vulnerability to forest and land fires are those with high and medium vulnerability classes, while regions with low vulnerability class are excluded. Out of the total 24.2 million hectares of PHU in Indonesia, approximately 16.4 million hectares fall under high and medium vulnerability classes.
3. Around 2.5 million hectares out of the total 3.8 million hectares in the high vulnerability class, accounting for about 65.9% of the high vulnerability, are located in peatland areas within PHU.
4. Using the proportion or percentage analysis between the area of high vulnerability and the total PHU area, the Sungai Ifuleki Bian-Sungai Dalik PHU in South Papua Province has the highest proportion of vulnerability to forest and land fires (approximately 97% of the area in the Sungai Ifuleki Bian-Sungai Dalik PHU is categorized as high vulnerability).
5. The Peatland Hydrological Unit (PHU) of Sungai Kahayan-Sungai Sebangau in Central Kalimantan Province holds the largest extent of high-class forest and land fire vulnerability in the year 2023, covering an area of approximately 190 thousand hectares.
6. The Peatland Hydrological Unit (PHU) of Sungai Rokan-Sungai Siak Kecil, as the largest PHU in Indonesia, exhibits a moderate vulnerability of 53%, encompassing an area of around 438 thousand hectares. This PHU also includes areas with high-class vulnerability, totaling 78 thousand hectares or approximately 9% of its total area.
7. Based on the integration of PHU area data and provincial administrative regions, Central Kalimantan Province emerges as the province with the widest extent of high-class land and forest fires vulnerability within PHU areas in Indonesia in 2023.
8. Approximately 54% of the 3.8 million hectares at risk of high forest and land fires vulnerability (high-class vulnerability) in 2023 within PHU areas are situated within concession areas and their surrounding zones.
9. Concessions with HGU and HTI permits represent the concessions with the highest percentage located in high-class vulnerability areas.
10. PT Sangkowong Sinta in Central Kalimantan Province and PT Bumi Sriwijaya Sentosa in South Sumatra Province are the two companies with the largest extent of severe forest and land fires vulnerability in 2023 within PHU areas burdened with HGU permits.
11. PT Bumi Mekar Hijau in South Sumatra Province is the company with the widest extent of severe forest and land fires vulnerability in 2023 within PHU areas burdened with HGU permits.
12. The Sungai Kahayan-Sungai Sebangau PHU is the PHU burdened by HGU permits with the largest high vulnerability to forest and land fires in 2023.
13. The Sungai Sugihan-Sungai Lumpur PHU is the PHU burdened by IUPHHK permits with the largest high vulnerability to forest and land fires in 2023.
14. Central Kalimantan Province and West Kalimantan Province are the provinces responsible for the PHUs burdened by HGU concessions with the largest high vulnerability in the PHUs with concessions.
15. Central Kalimantan Province, Riau Province, and South Sumatera Province are the three provinces responsible for the PHUs burdened by IUPHHK permits with the largest high vulnerability to forest and land fires in 2023.
16. The main oceanic and atmospheric variables are currently consistent with the development of El Nino. The Climate Prediction Center (CPC-NOAA) shows that in May

2023 (AMJ), the probability of El Nino occurrence is around 40% and increases significantly in June 2023 (MJJ) to 80%.

17. The transition from ENSO-neutral is expected to occur in the coming months, with a probability of more than 90% that El Nino will persist until the winter in the Northern Hemisphere (December–March).
18. Based on the historical occurrence of forest and land fires in Indonesia, forest and land fires generally occurs in February to March, followed by July to October.
19. Pantau Gambut found a total of 5,030 hotspots during the months of January to May 2023.
20. Pantau Gambut identified potential occurrences of forest and land fires in PHU areas at 29 locations during January to May 2023. Out of these 29 locations, 10 locations were observed only in May. This indicates that after entering the dry season and El Nino phase, the vulnerability to forest and land fires in Indonesia is increasing.
21. Dumai City and Bengkalis Regency have the highest number of forest and land fires occurrences throughout January to May 2023.
22. The Sungai Rokan–Sungai Siak Kecil PHU also stands out as the PHU with the highest number of hotspots in Indonesia during the period from January to May 2023.
23. PHUs that have a historical record of past fires and are being utilized for other purposes such as food estates or even concessions, should be restored to their original function as sustainable peatland ecosystems.

# Annex

**Annex 1.** Results of Each Sub-Variable Scores

**Land Cover**

| Land Cover Code | Description | Score |
|---|---|---|
| 2001 | Primary Dry Land Forest | 0,12 |
| 2002 | Secondary Dry Land Foret/Logged Forest | 0,25 |
| 2005 | Primary Swamp Forest | 0,08 |
| 2006 | Plantation Forest | 1,27 |
| 2007 | Shrub | 7,69 |
| 2010 | **Estate Crop Plantation** | **12,70** |
| 2012 | Settlement Area | 0,14 |
| 2014 | **Bare Land** | **21,99** |
| 3000 | Savanna/Grassland | 7,15 |
| 5001 | Bodies of Water | 0,65 |
| 20041 | Secondary Mangrove Forest | 0,33 |
| 20051 | Secondary Swamp Forest | 1,32 |
| 20071 | **Swamp Shrub** | **16,81** |
| 20091 | **Dryland Farm** | **10,59** |
| 20092 | Shurb-mixed Dryland Farm | 6,00 |
| 20093 | Rice Field | 4,04 |
| 20094 | Fishpond | 0,64 |
| 20141 | Open-pit Mining | 0,50 |
| 50011 | Swamp | 7,72 |

**Distribution of Peatland Areas**

| Soil Type | Description | Score |
|---|---|---|
| Peatland | Inside peatland area | 79,44 |
| Non-peatland | Outside peatland area | 20,56 |

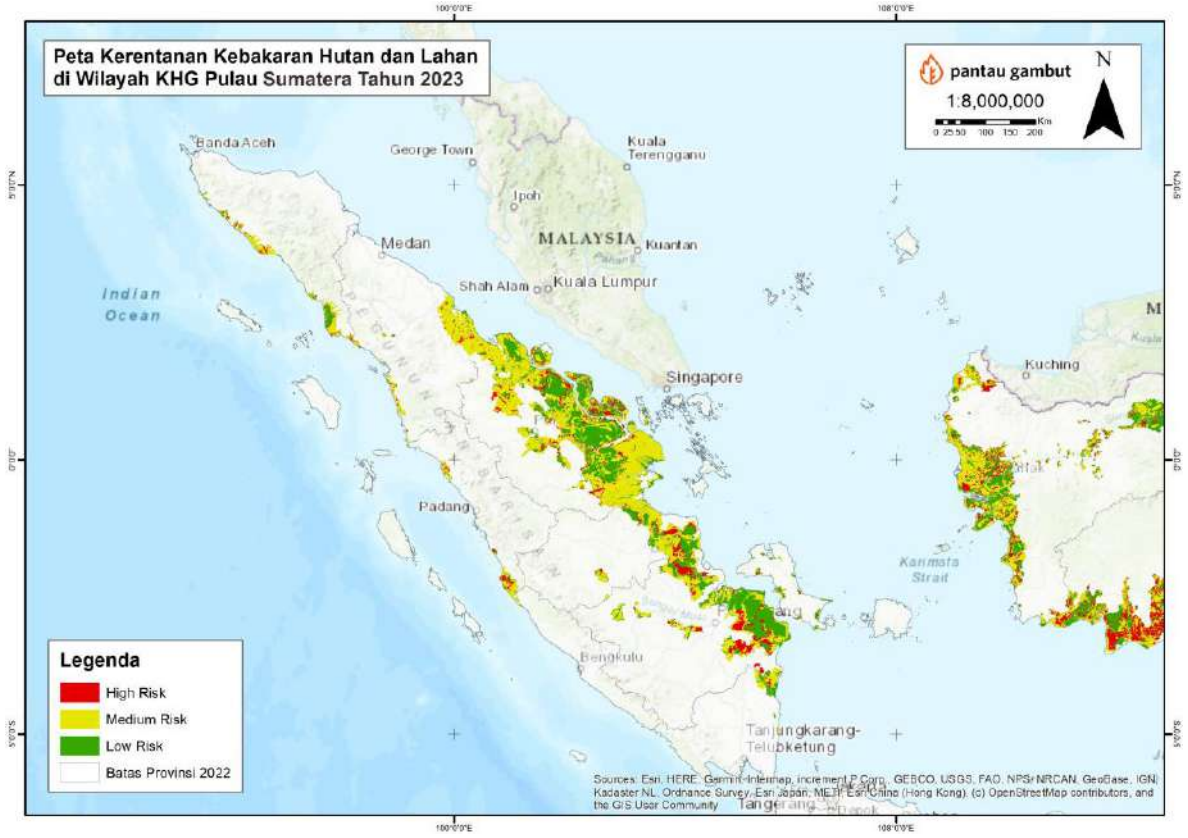
**Boundaries of Concession Areas**

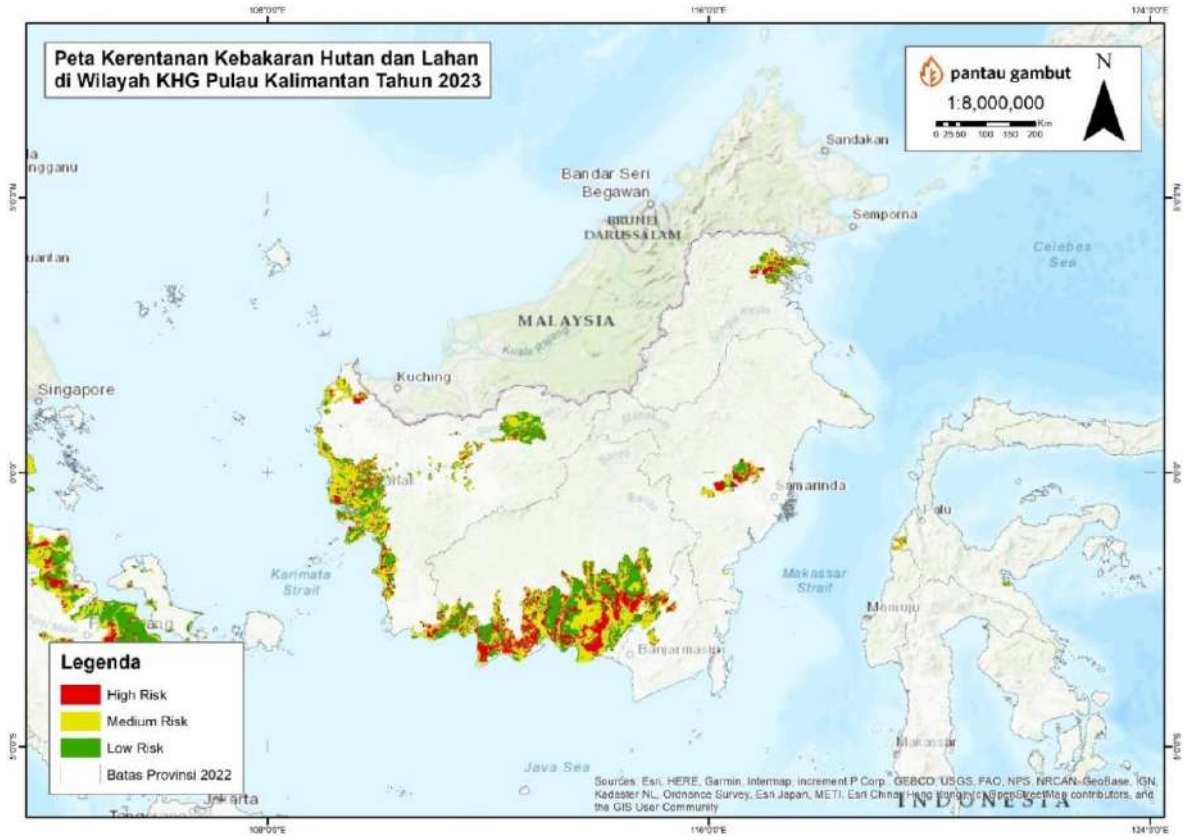
| Concession | Description | Score |
|---|---|---|
| Inside 1 km buffer zone from concession border area | Located inside the concession area + 1 km buffer zone from the outermost area | 55,02 |
| Outside concession area | Located outside concession area | 44,98 |

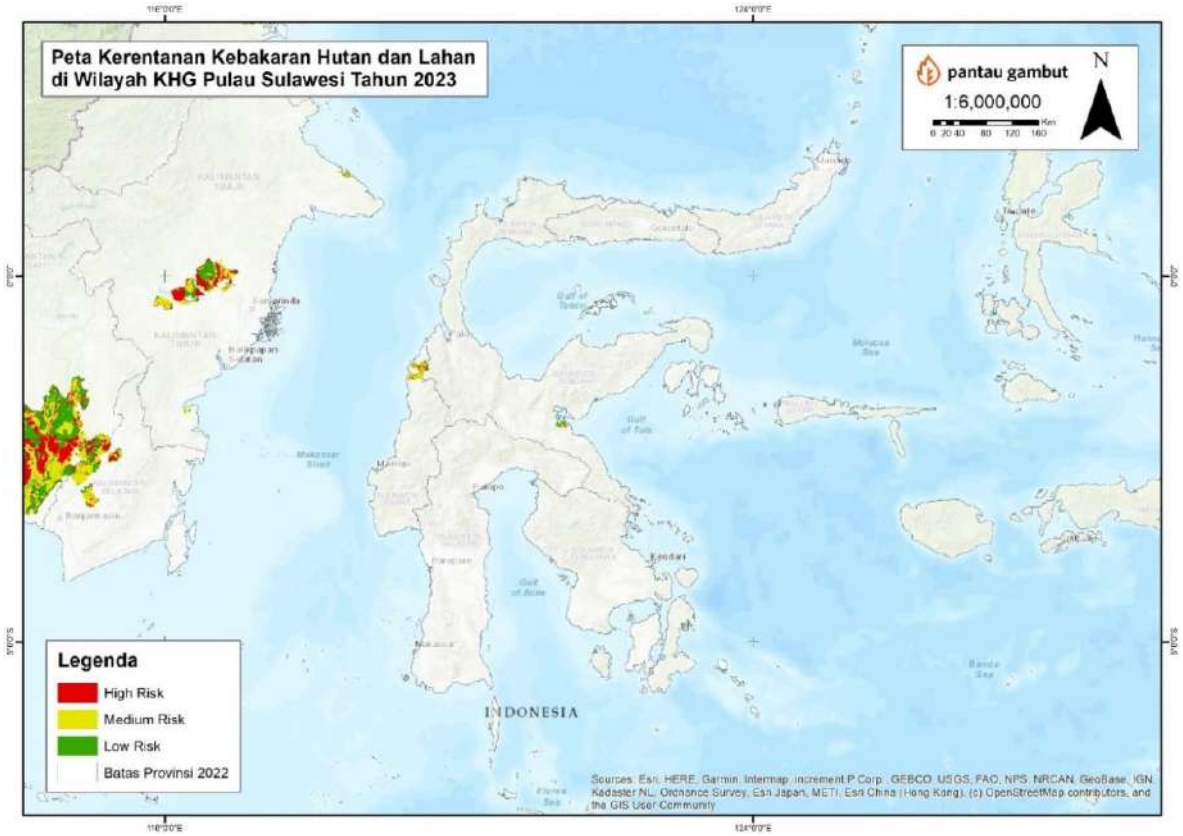
**Spread of Tree Cover Loss (TCL**

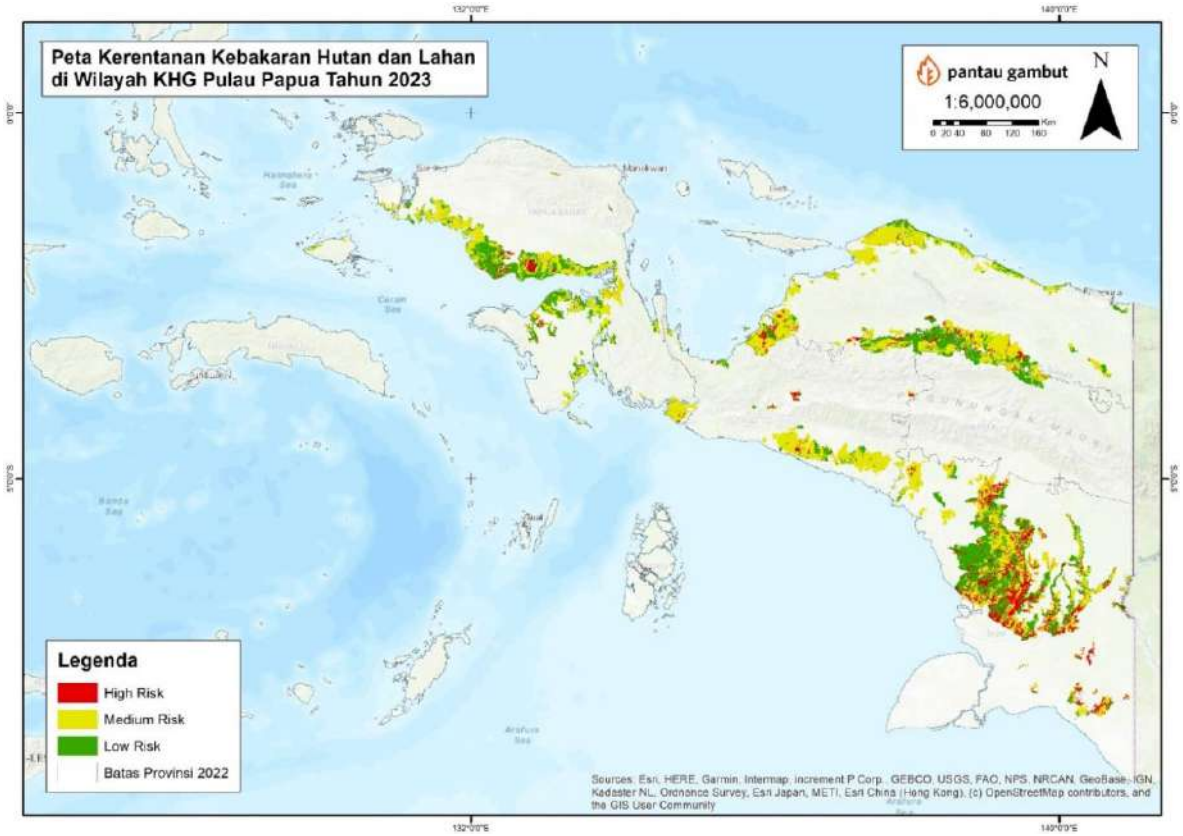
| TCL | Description | Score |
|---|---|---|
| TCL | Loss of vegetation coverage | 99,21 |
| Non-TCL | No loss of vegetation coverage | 0,79 |

**Annex 2.** Vulnerability to Forest and Land Fires in PHUs throughout Indonesia in 2023




Peta Kerentanan Kebakaran Hutan dan Lahan di Wilayah KHG Pulau Sulawesi Tahun 2023
pantau gambut
1:6,000,000
N
Legenda
High Risk
Medium Risk
Low Risk
Batas Provinsi 2022
INDONESIA
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community


Peta Kerentanan Kebakaran Hutan dan Lahan di Wilayah KHG Pulau Papua Tahun 2023
pantau gambut
1:6,000,000
N
Legenda
High Risk
Medium Risk
Low Risk
Batas Provinsi 2022
Sources: Esri, HERE, Garmin, Intermap, increment P Corp., GEBCO, USGS, FAO, NPS, NRCAN, GeoBase, IGN, Kadaster NL, Ordnance Survey, Esri Japan, METI, Esri China (Hong Kong), (c) OpenStreetMap contributors, and the GIS User Community

**Annex 3.** Ranking of PHUs and Provincial Administrative Regions Responsible for Managing PHUs with Concessions

## 1. Ranking of PHUs with Concessions

### a. PHUs with HGU Concessions (Top 15 Ranking)

| No | PHU Name | Province | Area (ha) |
|---|---|---|---|
| 1 | PHU Sungai Kampar–Sungai Gaung | Riau | 339.630,50 |
| 2 | PHU Sungai Kapuas–Sungai Ambawang | West Kalimantan | 181.241,71 |
| 3 | PHU Sungai Siak–Sungai Kampar | Riau | 177.938,01 |
| 4 | PHU Sungai Kahayan–Sungai Sebangau | Central Kalimantan | 168.275,98 |
| 5 | PHU Sungai Rokan–Sungai Siak Kecil | Riau | 145.523,13 |
| 6 | PHU Sungai Pukun–Sungai Mentaya | Central Kalimantan | 126.025,85 |
| 7 | PHU Sungai Mentarang–Sungai Sembakung | North Kalimantan | 111.238,96 |
| 8 | PHU Sungai Belayan–Sungai Kelinjau | East Kalimantan | 106.920,99 |
| 9 | PHU Sungai Pungurbesar–Sungai Kapuas | West Kalimantan | 106.404,90 |
| 10 | PHU Sungai Udi Edera–Sungai Samaleki Digul | South Papua | 102.452,19 |
| 11 | PHU Sungai Buluh Besar–Sungai Seruyan | Central Kalimantan | 101.834,24 |
| 12 | PHU Sungai Kahayan–Sungai Kapuas | Central Kalimantan | 96.471,20 |
| 13 | PHU Sungai Katingan–Sungai Sebangau | Central Kalimantan | 92.276,41 |
| 14 | PHU Sungai Rokan Kiri–Sungai Mandau | Riau | 92.193,97 |
| 15 | PHU Sungai Indragiri–Sungai Batang | Riau | 90.639,07 |

### b. PHUs with IUPHHK Concessions (Top 15 Ranking)

| No | PHU Name | Province | Area (ha) |
|---|---|---|---|
| 1 | PHU Sungai Siak–Sungai Kampar | Riau | 623.587,64 |
| 2 | PHU Sungai Sugihan–Sungai Lumpur | South Sumatera | 533.104,92 |
| 3 | PHU Sungai Rokan–Sungai Siak Kecil | Riau | 385.170,61 |
| 4 | PHU Sungai Katingan–Sungai Mentaya | Central Kalimantan | 224.370,84 |
| 5 | PHU Sungai Kampar–Sungai Gaung | Riau | 194.212,16 |
| 6 | PHU Sungai Terentang–Sungai Kapuas | West Kalimantan | 160.986,90 |
| 7 | PHU Sungai Gaung–Sungai Batangtuaka | Riau | 114.725,09 |
| 8 | PHU Sungai Siak Kecil–Sungai Siak | Riau | 89.301,86 |
| 9 | PHU Sungai Durian–Sungai Kualan | West Kalimantan | 85.388,75 |
| 10 | PHU Sungai Wade Passue–Sungai Jo Dairam | South Papua | 84.800,96 |
| 11 | PHU Sungai Udi Edera–Sungai Samaleki Digul | South Papua | 81.827,09 |
| 12 | PHU Pulau Padang | Riau | 81.325,00 |
| 13 | PHU Sungai Sebyar–Sungai Tembuni | West Papua | 77.563,22 |
| 14 | PHU Sungai Sebuku–Sungai Sembakung | North Kalimantan | 72.294,12 |
| 15 | PHU Sungai Ulakkedondong–Sungai Lumpur | South Sumatera | 62.755,91 |

## 2. Ranking of Provincial Administrative Regions Responsible for Managing PHUs with Concessions

### a. Provinces Responsible for PHUs with HGU Concessions (Top 15 Ranking)

| No | Province | Area (ha) |
|---|---|---|
| 1 | West Kalimantan | 1.641.541,03 |
| 2 | Riau | 1.572.548,51 |
| 3 | Central Kalimantan | 1.056.306,73 |
| 4 | South Papua | 379.216,87 |
| 5 | East Kalimantan | 299.944,66 |
| 6 | South Sumatera | 239.058,03 |
| 7 | West Papua | 184.168,84 |

| | | |
|---|---|---|
| 8 | North Kalimantan | 161.029,39 |
| 9 | North Sumatera | 159.525,08 |
| 10 | Papua | 119.565,18 |
| 11 | Aceh | 115.927,54 |
| 12 | Jambi | 93.795,55 |
| 13 | North Sumatera–Riau | 82.593,37 |
| 14 | West Kalimantan–Central Kalimantan | 64.719,07 |
| 15 | West Sumatera | 56.076,05 |

### b. Provinces Responsible for PHUs with IUPHHK Concessions (Top 15 Ranking)

| No | Province | Area (ha) |
|---|---|---|
| 1 | Riau | 1.840.105,98 |
| 2 | South Sumatera | 787.420,85 |
| 3 | West Kalimantan | 596.632,10 |
| 4 | Central Kalimantan | 495.134,28 |
| 5 | West Papua | 410.732,25 |
| 6 | South Papua | 341.374,81 |
| 7 | Jambi | 179.684,70 |
| 8 | North Kalimantan | 124.111,67 |
| 9 | Papua | 121.123,04 |
| 10 | Jambi–South Sumatera | 102.173,19 |
| 11 | Papua–Papua Pegunungan | 61.319,97 |
| 12 | Bangka Belitung Islands | 51.062,82 |
| 13 | Central Kalimantan–South Kalimantan | 26.210,51 |
| 14 | East Kalimantan | 20.717,75 |
| 15 | Riau–Jambi | 20.036,28 |

**Annex 4.** HGU Concessions in PHU Areas with the Widest High Vulnerability to Forest and Land Fires in 2023

**Table 1.** HGU Concessions in PHU Areas with the Widest High Vulnerability to Forest and Land Fires in 2023

| No | Concession Name | Province | Concession Status | Commodity | Affiliation Group | Concession Area (ha) | Concession Area + 1 km Buffer Zone (ha) | PHU Within Concession (ha) | Vulnerability Area | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | High (ha) | Medium (ha) | Low (ha) |
| 1 | PT Sangkowong Sinta | Central Kalimantan | HGU | Palm | - | 32.569,80 | 40.347,75 | 40.347,75 | 23.490,26 | 14.833,07 | 2.024,42 |
| 2 | PT Bumi Sriwijaya Sentosa | South Sumatera | HGU | Sugarcane | PT Salim Invomas Pratama (SIMP)/Indofood Agri Resources Ltd (IndoAgri) | 40.039,59 | 57.653,57 | 38.425,19 | 21.729,75 | 14.014,75 | 2.680,69 |
| 3 | PT Alam Sawit | East Kalimantan | HGU | Palm | | 20.012,67 | 28.664,29 | 19.469,28 | 16.875,07 | 2.557,66 | 36,55 |
| 4 | PT Sintang Raya | West Kalimantan | HGU | Palm | Daesang Grup | 11.112,30 | 17.593,79 | 17.447,67 | 15.950,02 | 1.485,38 | 12,26 |
| 5 | PT Globalindo Alam Perkasa | Central Kalimantan | HGU | Palm | Musim Mas | 16.208,92 | 28.703,14 | 28.593,36 | 15.164,67 | 6.664,84 | 6.763,86 |
| 6 | PT Pagatan Usaha Makmur | Central Kalimantan | HGU | Palm | Agro inti semesta | 20.962,63 | 27.865,12 | 27.865,12 | 15.065,74 | 5.765,14 | 7.034,23 |
| 7 | PT Dinamika Graha Sarana | South Sumatera | HGU | Sugarcane | Sungai Budi/Tunas Baru Lampung | 17.620,16 | 25.605,55 | 19.701,14 | 14.546,42 | 5.154,72 | 0,00 |
| 8 | PT Ceria Prima | West Kalimantan | HGU | Palm | Darmex Agro | 18.107,44 | 25.882,76 | 15.247,30 | 13.211,54 | 1.903,63 | 132,13 |
| 9 | PT Cipta Tumbuh Berkembang | West Kalimantan | HGU | Palm | | 13.422,55 | 31.408,84 | 29.907,13 | 12.766,44 | 15.782,64 | 1.358,05 |
| 10 | PT Persada Era Agro Kencana | Central Kalimantan | HGU | Palm | Mulia Sawit Agro Lestari (MSAL) Group | 12.933,25 | 25.278,27 | 25.040,45 | 12.200,41 | 8.817,46 | 4.022,58 |

**Table 2.** Historical Forest and Land Fires in HGU Concessions in PHU Areas with the Widest High Vulnerability in 2023

| No | Concession Name | Province | Concession Status | Commodity | Burned Area | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| 1 | PT Sangkowong Sinta | Central Kalimantan | HGU | Palm | YES | - | - | YES | YES | - |
| 2 | PT Bumi Sriwijaya Sentosa | South Sumatera | HGU | Sugarcane | YES | - | - | - | YES | - |
| 3 | PT Alam Sawit | East Kalimantan | HGU | Palm | - | - | - | YES | - | - |
| 4 | PT Sintang Raya | West Kalimantan | HGU | Palm | YES | YES | - | YES | YES | - |
| 5 | PT Globalindo Alam Perkasa | Central Kalimantan | HGU | Palm | YES | - | - | - | YES | - |
| 6 | PT Pagatan Usaha Makmur | Central Kalimantan | HGU | Palm | YES | - | - | - | YES | - |
| 7 | PT Dinamika Graha Sarana | South Sumatera | HGU | Sugarcane | YES | - | - | - | YES | - |
| 8 | PT Ceria Prima | West Kalimantan | HGU | Palm | - | - | - | - | - | - |
| 9 | PT Cipta Tumbuh Berkembang | West Kalimantan | HGU | Palm | YES | YES | - | YES | YES | - |
| 10 | PT Persada Era Agro Kencana | Central Kalimantan | HGU | Palm | YES | - | - | - | YES | - |

**Annex 5.** IUPHHK Concessions in PHU Areas with the Widest High Vulnerability to Forest and Land Fires in 2023

**Table 1.** IUPHHK Concessions in PHU Areas with the Widest High Vulnerability to Forest and Land Fires in 2023

| No | Concession Name | Province | Commodity | Group & Supply Chain | Concession Area (ha) | Concession Area + 1 km Buffer Zone (ha) | Luas KHG di dalam konsesi (ha) | Vulnerability Area | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | High (ha) | Medium (ha) | Low (ha) |
| 1 | PT Bumi Mekar Hijau | South Sumatera | HTI | Supply chain: APP Sinar Mas | 251.123,34 | 305.167,20 | 246.781,37 | 68.185,46 | 50.763,66 | 127.832,26 |
| 2 | PT Damai Setiatama Timber | South Papua | HA | Supply chain: RGE | 316.546,88 | 349.587,28 | 155.877,24 | 41.644,83 | 73.708,59 | 40.523,82 |
| 3 | PT Baratama Putra Perkasa | Central Kalimantan | HTI | Group: SinarMas Forestry | 36.132,64 | 56.218,95 | 55.631,59 | 35.217,46 | 18.950,38 | 1.463,75 |
| 4 | PT Rimba Raya Conservation | Central Kalimantan | RE | | 37.274,35 | 60.899,56 | 58.665,98 | 26.506,92 | 17.589,21 | 14.569,85 |
| 5 | PT Rimbun Seruyan | Central Kalimantan | HTI | | 40.322,68 | 63.628,51 | 48.813,71 | 25.780,06 | 21.523,70 | 1.509,95 |
| 6 | PT Rimba Makmur Utama | Central Kalimantan | RE | | 157.801,02 | 183.167,09 | 175.610,99 | 22.402,22 | 9.586,53 | 143.622,24 |
| 7 | PT SBA Wood Industries | South Sumatera | HTI | Supply chain: APP Sinar Mas | 137.003,06 | 155.007,05 | 155.007,05 | 20.850,97 | 27.833,41 | 106.322,68 |
| 8 | PT Sumatera Riang Lestari | Riau | HTI | Supply chain: RAPP | 217.768,26 | 276.453,25 | 187.125,97 | 19.353,82 | 85.517,34 | 82.254,81 |
| 9 | PT Mukti Artha Yoga | South Papua | HA | | 151.090,78 | 178.003,27 | 96.311,37 | 18.487,33 | 41.889,07 | 35.934,97 |
| 10 | PT Rimba Hutani Mas | South Sumatera | HTI | Supply chain: APP Sinar Mas | 102.188,72 | 144.313,07 | 73.501,87 | 18.413,08 | 13.091,78 | 41.997,01 |

**Table 2.** Historical Forest and Land Fires in IUPHHK Concessions in PHU Areas with the Widest High Vulnerability in 2023 Annex 6. Identification of Suspected Locations of Fires in January–May 2023

| NO | Concession Name | Province | Concession Status | Area Bekas Terbakar | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 |
| 1 | PT Bumi Mekar Hijau | South Sumatera | HTI | YES | - | - | - | YES | - |
| 2 | PT Damai Setiatama Timber | South Papua | HA | - | - | - | - | - | - |
| 3 | PT Baratama Putra Perkasa | Central Kalimantan | HTI | YES | - | - | - | YES | - |
| 4 | PT Rimba Raya Conservation | Central Kalimantan | RE | YES | - | - | - | YES | - |
| 5 | PT Rimbun Seruyan | Central Kalimantan | HTI | YES | - | - | - | YES | - |
| 6 | PT Rimba Makmur Utama | Central Kalimantan | RE | YES | - | - | YES | YES | - |
| 7 | PT SBA Wood Industries | South Sumatera | HTI | YES | - | - | - | YES | - |
| 8 | PT Sumatera Riang Lestari | Riau | HTI | YES | - | - | - | YES | YES |
| 9 | PT Mukti Artha Yoga | South Papua | HA | - | - | - | - | - | - |
| 10 | PT Rimba Hutani Mas | South Sumatera | HTI | YES | - | - | - | YES | - |

pantau gambut

**Annex 6.** Identification of Alleged Burnt Locations in January–May 2023

**January–February**

1. Aceh Jaya Regency, Aceh around 19-24 Feb 2023 (low)
2. Aceh Selatan Regency–Subulussalam City, Aceh around 17–20 Feb 2023 (high)
3. Labuhanbatu Regency, North Sumatera around 26 Feb 2023 (medium)
4. Mempawah Regency, West Kalimantan around 8 Feb 2023 dan 19–20 Feb 2023 (high)
5. Kubu Raya Regency, West Kalimantan around 16–17 Jan 2023 (high)
6. Kubu Raya Regency, West Kalimantan around 21–23 Feb 2023 (high)
7. Sukamara Regency, Central Kalimantan around 15–16 Jan 2023 (medium)
8. Mappi Regency, Papua around 18 Jan 2023 (high)

**March-April**

9. Labuhanbatu Regency, North Sumatera around 17–22 April 2023 (medium)
10. Bengkalis Regency (Rupat Island), Riau around 24–29 April 2023 (high)
11. Bengkalis Regency (Bengkalis Island), Riau around 17–19 March & 10–17 April 2023 (high)
12. Dumai City, Riau around 19–27 April 2023 (high)
13. Dumai City, Riau around 10–15 April 2023 (low)
14. Indragiri Hilir Regency, Riau around 28–30 March 2023 (high)
15. West Tanjung Jabung Regency, Jambi around 11–14 April 2023 (low)
16. West Tanjung Jabung Regency, Jambi around 16–20 March & 13–17 April 2023 (high)
17. Mempawah Regency, West Kalimantan around 16–19 April 2023 (medium)
18. Paniai Regency, Central Papua around 20–23 March 2023 (high)
19. Teluk Bintuni Regency, West Papua aroun 29 March–1 April 2023 & 21–25 April 2023 (low)

**May**

20. Bengkalis Regency (Rupat Island), Riau around 1–3 May 2023 (high)
21. Dumai City, Riau around 2–5 May 2023 (high)
22. Teluk Bintuni Regency, West Papua around 20–21 May 2023 (low)
23. South Pesisir Regency, West Sumatera around 23–26 May 2023 (high)
24. South Pesisir Regency, West Sumatera around 23–27 May 2023 (high)
25. Labuhanbatu Regency, North Sumatera around 23–29 May 2023 (high)
26. Rokan Hilir Regency, Riau around 24–26 May 2023 (medium)
27. East Kotawaringin Regency, Central Kalimantan around 24–26 May 2023 (high)
28. Ketapang Regency, West Kalimantan around 28–31 May 2023 (high)
29. Kubu Raya Regency, West Kalimantan around 29–30 May 2023 (medium)

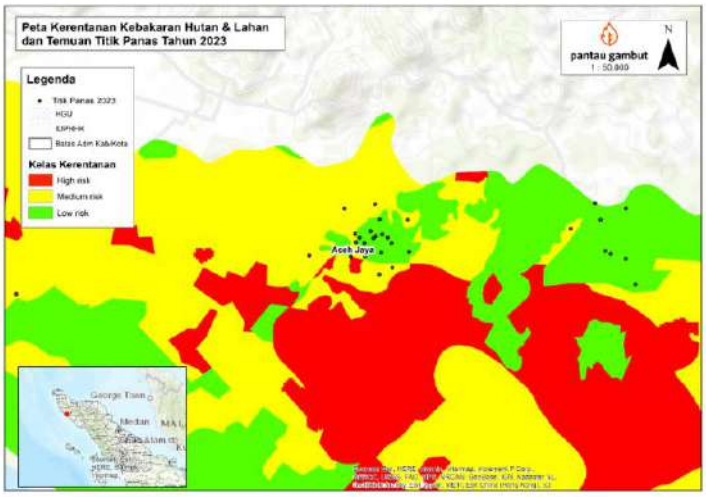



**Image 1.** Aceh Jaya Regency, Aceh Province, around 19th Feb to 24th Feb 2023

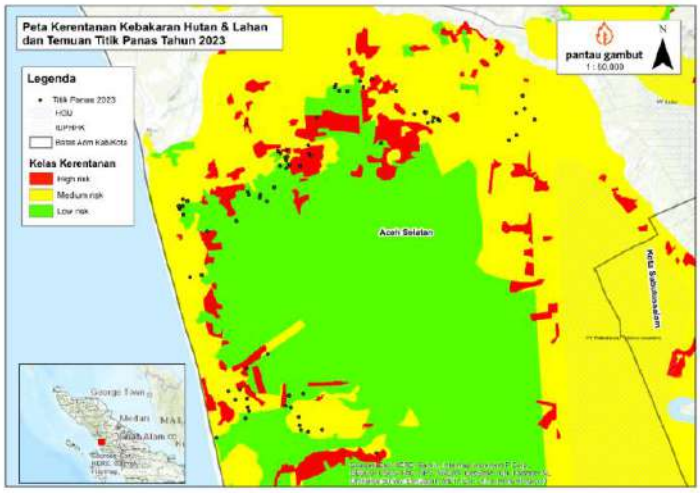



**Image 2.** South Aceh Regency–Subulussalam City, Aceh Province, around 17th Feb to 20th Feb 2023

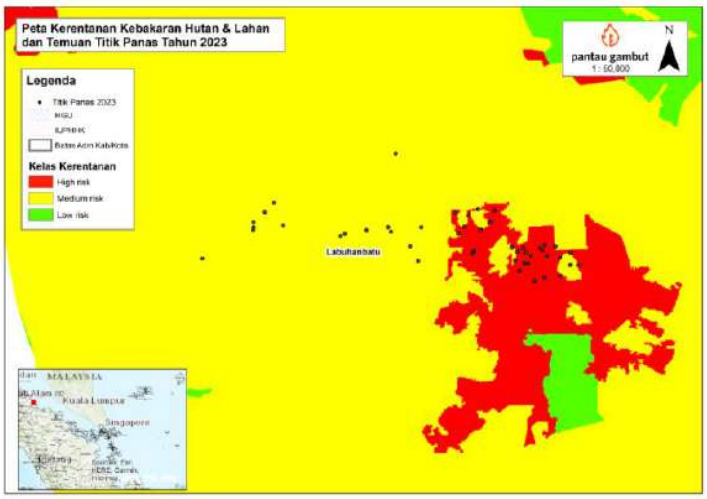



**Image 3.** Labuhanbatu Regency, North Sumatra Province, around 6th Feb 2023 & 17th to 22nd April 2023

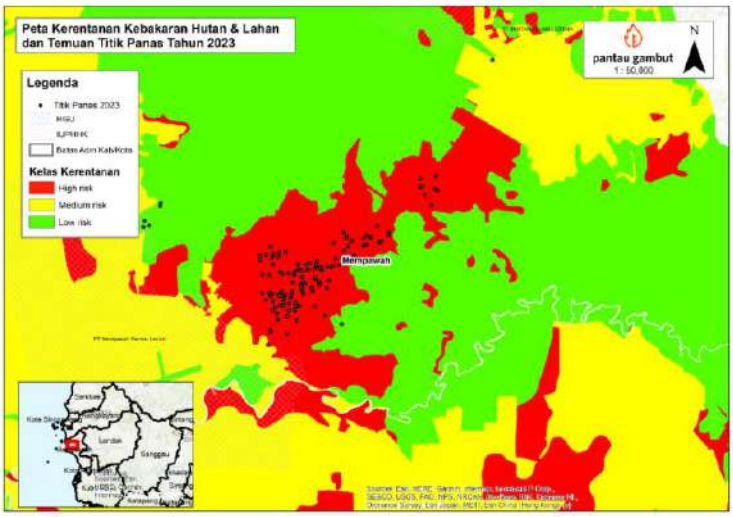



**Image 4.** Mempawah Regency, West Kalimantan Province, around 8th Feb 2023 and 19th to 20th Feb 2023

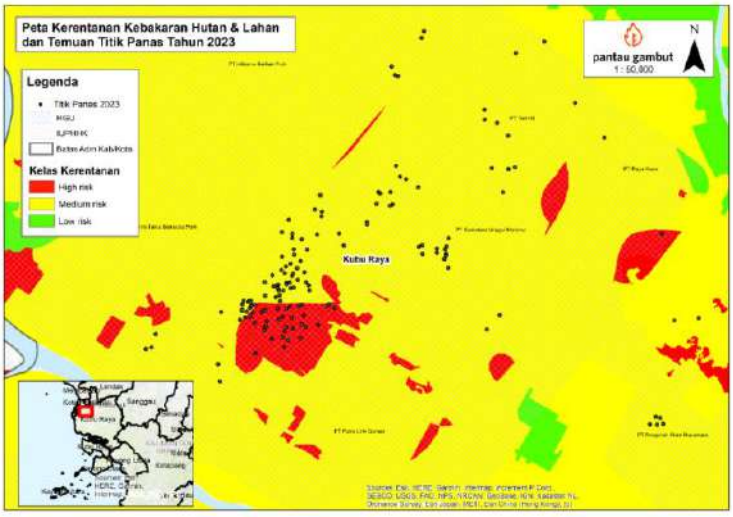



**Image 5.** Kubu Raya Regency, West Kalimantan Province, around 16th to 17th Jan 2023

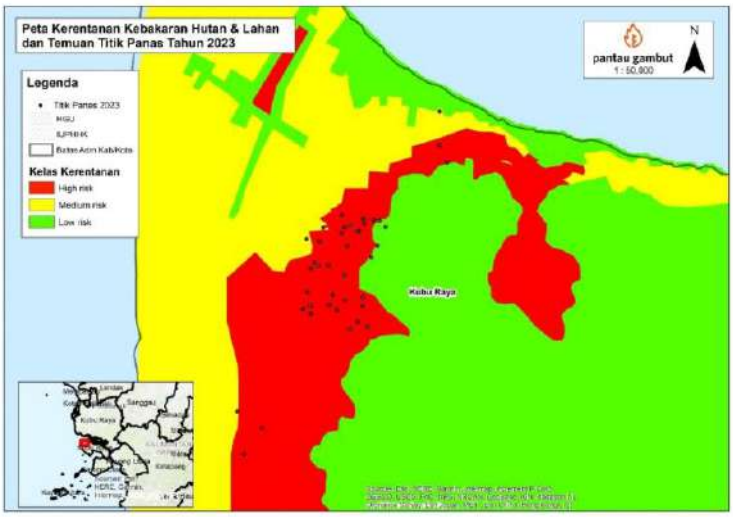



**Image 6.** Kubu Raya Regency, West Kalimantan Province, around 21st Feb to 23rd Feb 2023

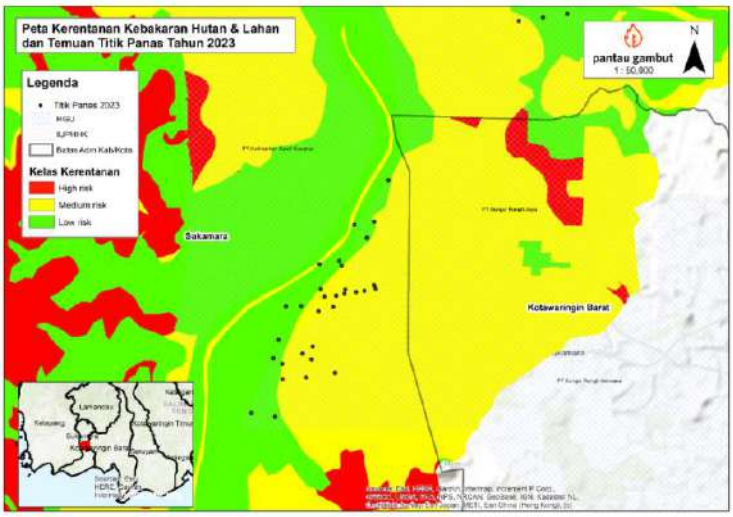



**Image 7.** Sukamara Regency, Central Kalimantan Province, around 15th to 16th Jan 2023

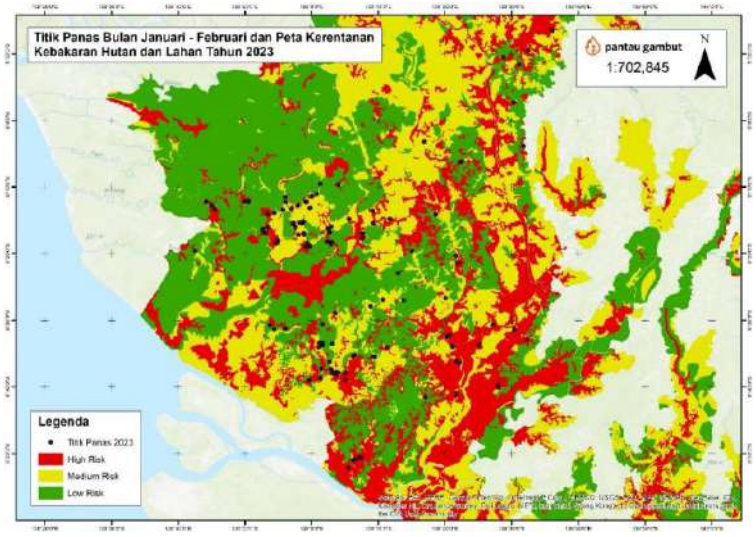



**Image 8.** Mappi Regency, South Papua Province, around 18th Jan 2023

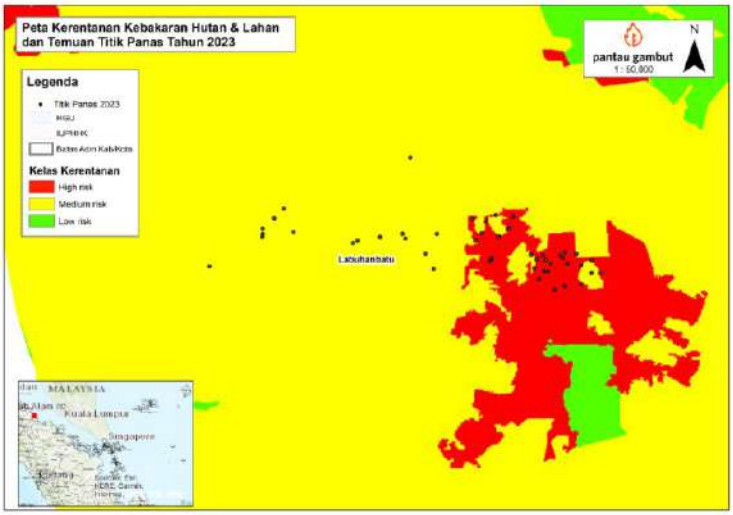



**Image 9.** Labuhanbatu Regency, North Sumatra Province, around 17th to 22nd April 2023

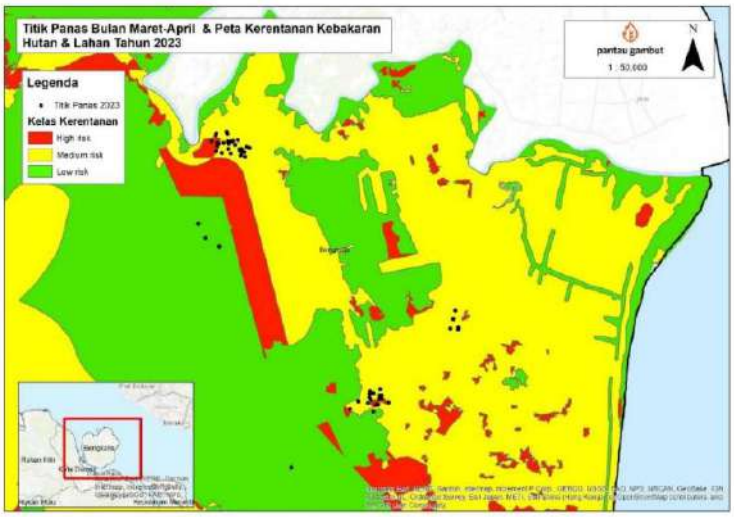



**Image 10.** Bengkalis Regency (Rupat Island), Riau Province, around 24th to 29th April 2023

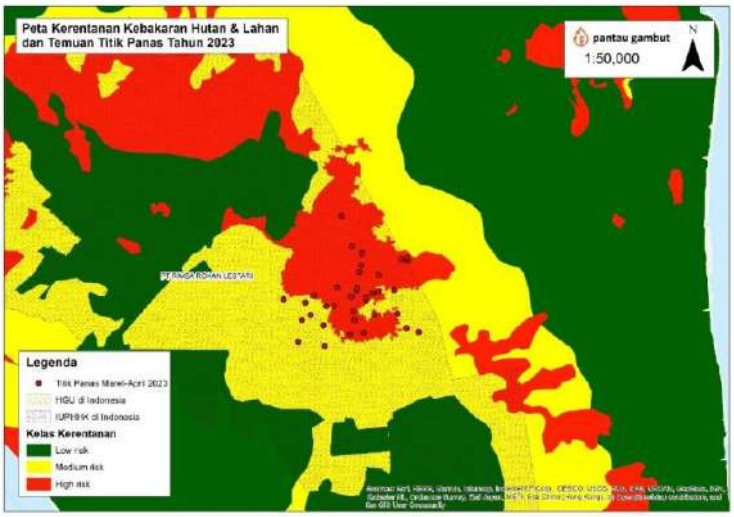



**Image 11.** Bengkalis Regency (Bengkalis Island), Riau Province, around 17th to 19th March and 10th to 17th April 2023

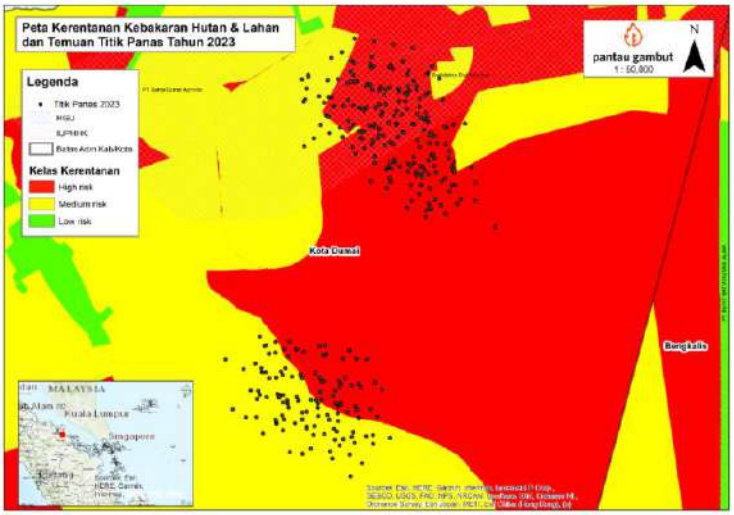



**Image 12.** Dumai City, Riau Province, around 19th to 27th April 2023

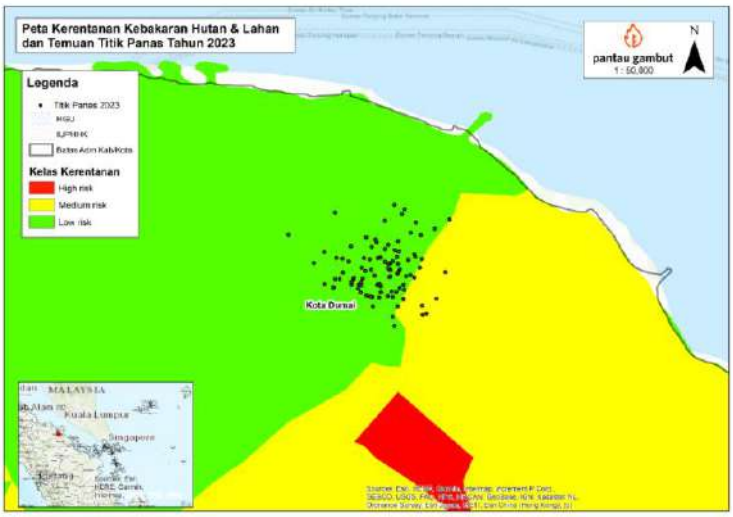



**Image 13.** Dumai City, Riau Province, around 10th to 15th April 2023

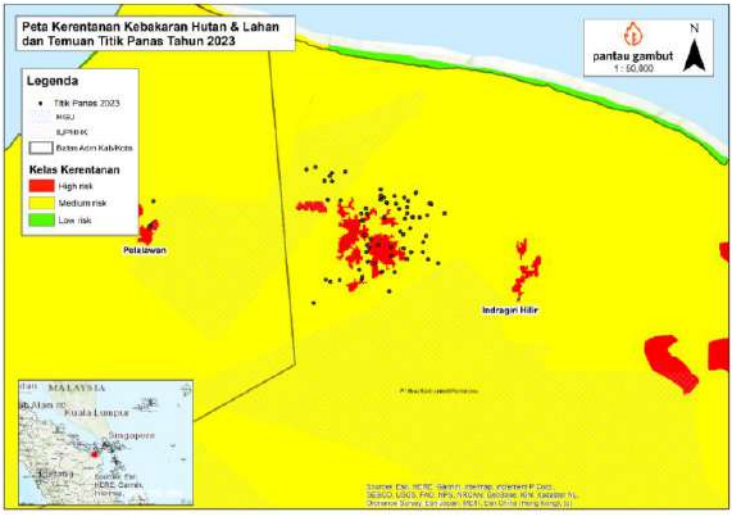



**Image 14.** Indragiri Hilir Regency, Riau Province, around 28th to 30th March 2023

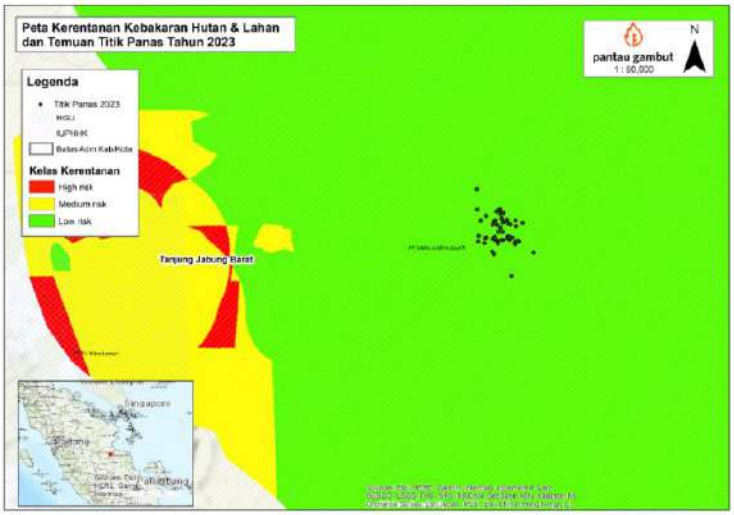



**Image 15.** West Tanjung Jabung Regency, Jambi Province, around 11th to 14th April 2023

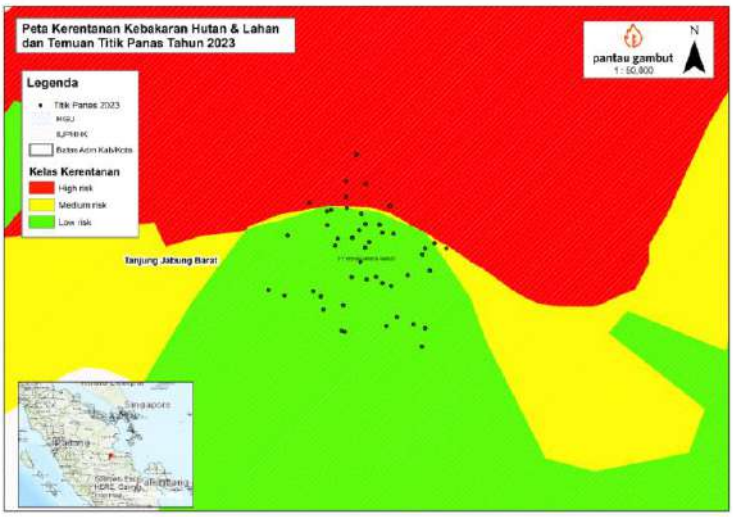



**Image 16.** West Tanjung Jabung Regency, Jambi Province, around 16th to 20th March and 13th to 17th April 2023

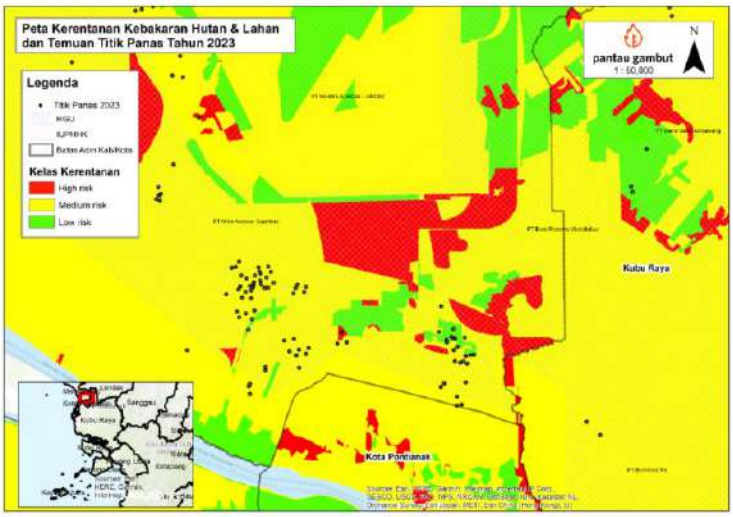



**Image 17.** Mempawah Regency, West Kalimantan Province, around 16th to 19th April 2023

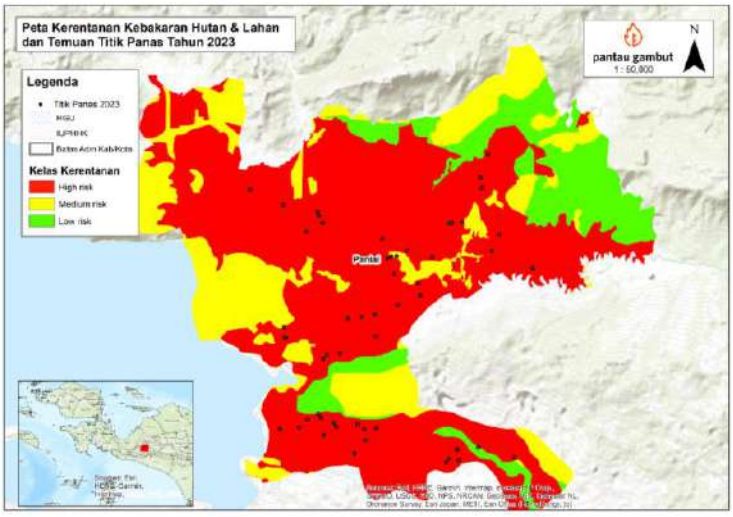



**Image 18.** Paniai Regency, Central Papua Province, around 20th to 23rd March 2023

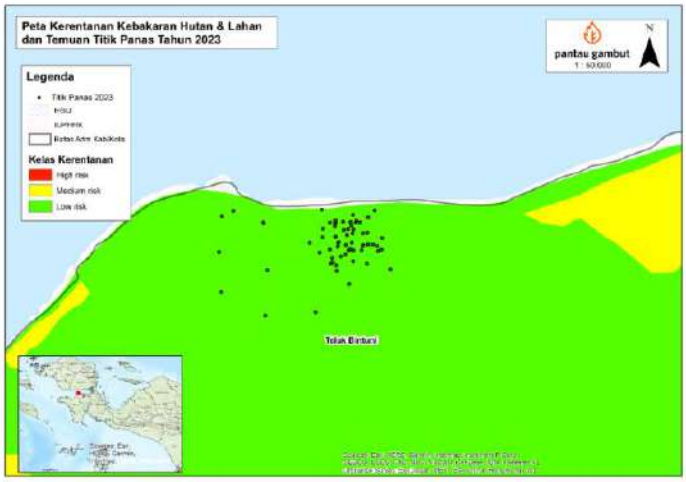



**Image 19.** Teluk Bintuni Regency, West Papua Province, around 29th March to 1st April 2023 and 21st to 25th April 2023

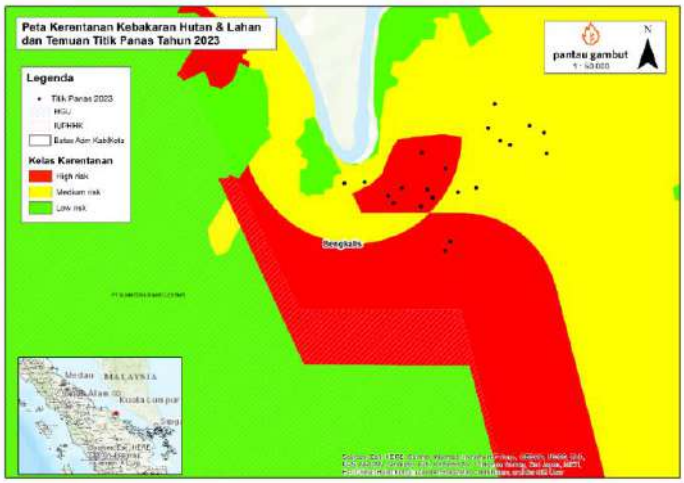



**Image 20.** Bengkalis Regency (Rupat Island), Riau Province, around 1st to 3rd May 2023

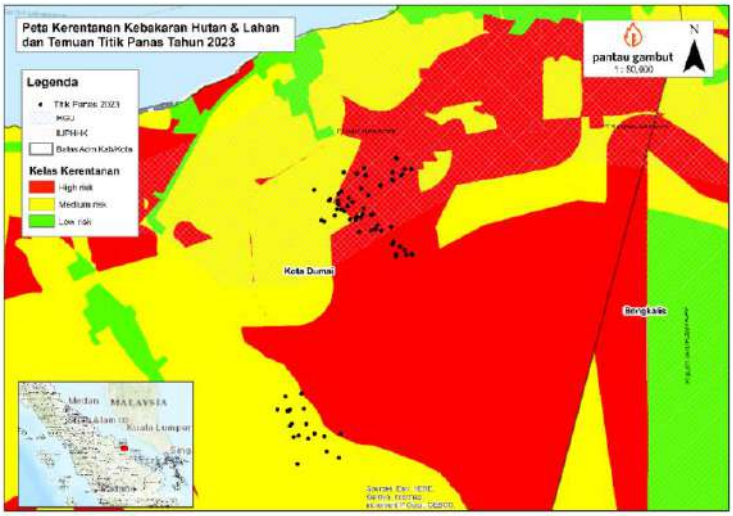



**Image 21.** Dumai City, Riau Province, around 2nd to 5th May 2023

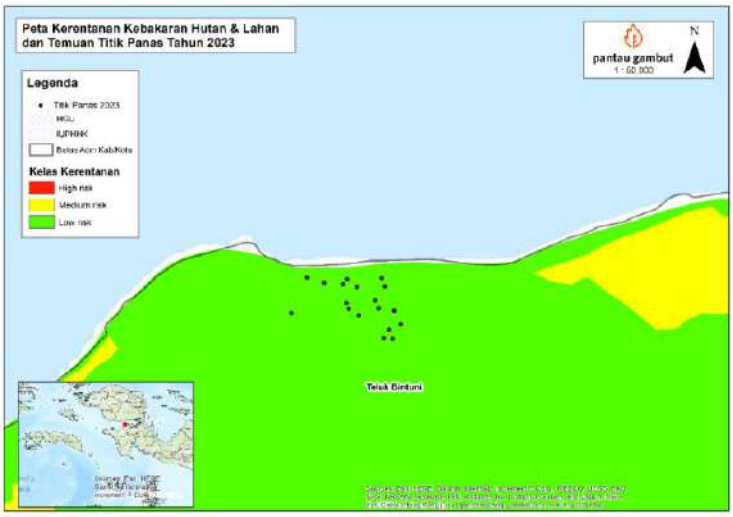



**Image 22.** Teluk Bintuni Regency, West Papua Province, around 20th to 21st May 2023

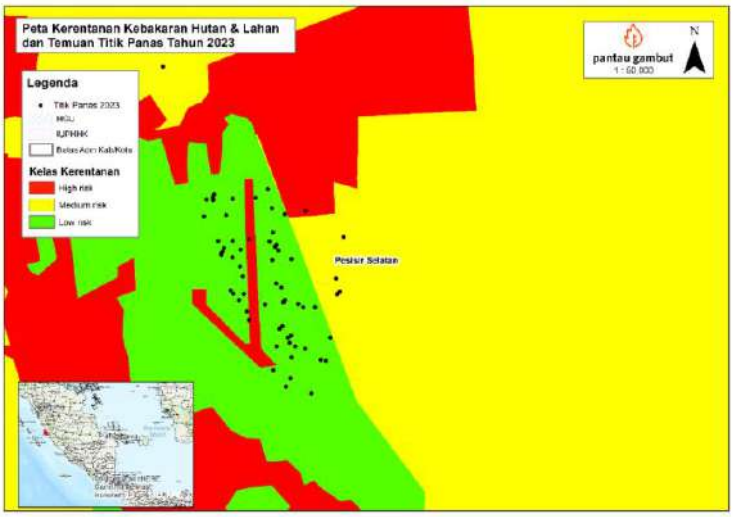



**Image 23.** South Pesisir Regency, West Sumatra Province, around 23rd to 26th May 2023

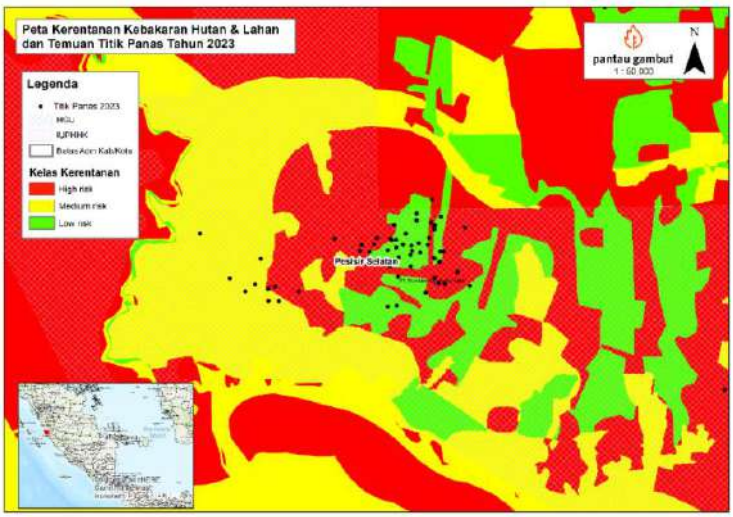



**Image 24.** South Pesisir Regency, West Sumatra Province, around 23rd to 27th May 2023

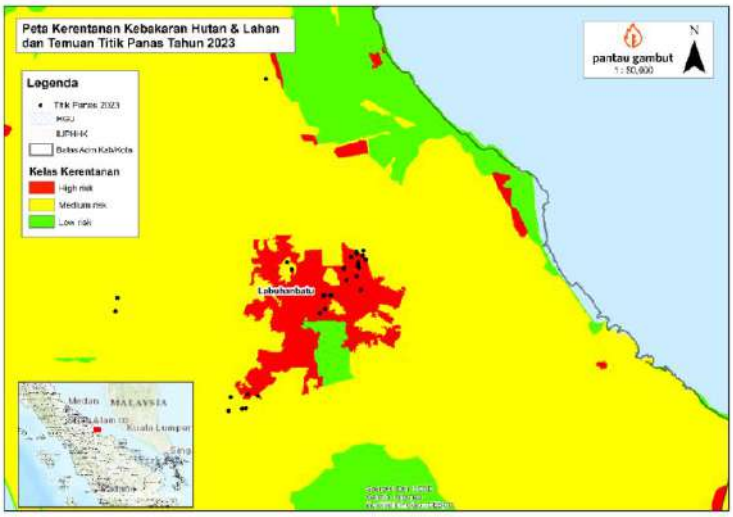



**Image 25.** Labuhanbatu Regency, North Sumatra Province, around 23rd to 29th May 2023

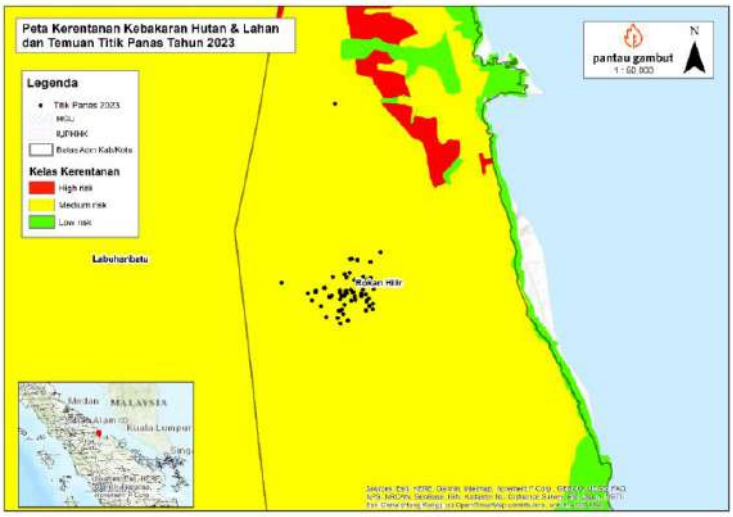



**Image 26.** Rokan Hilir Regency, Riau Province, around 24th to 26th May 2023

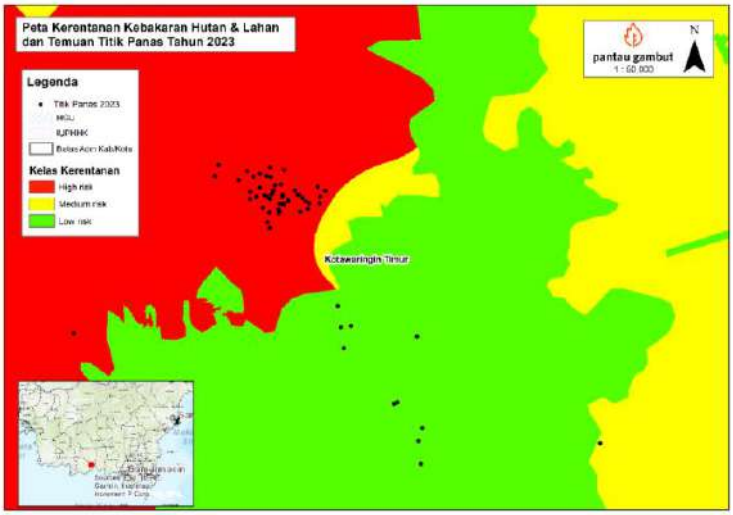



**Image 27.** East Kotawaringin Regency, Central Kalimantan Province, around 24th to 26th May 2023

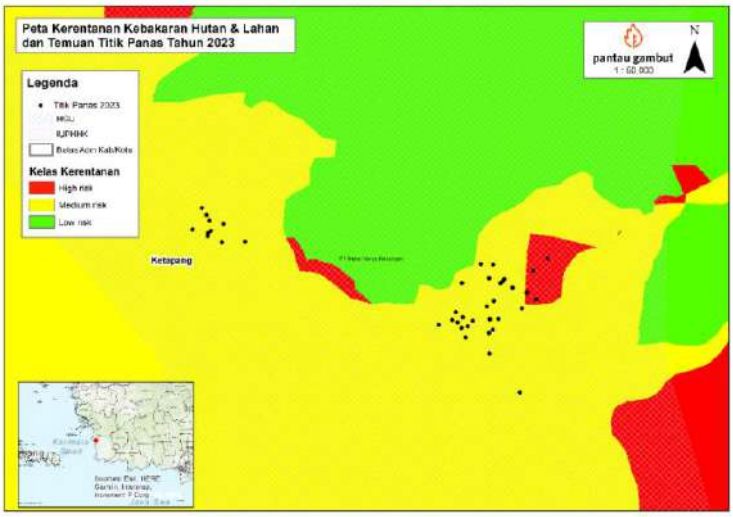



**Image 28.** Ketapang Regency, West Kalimantan Province, around 28th to 31st May 2023

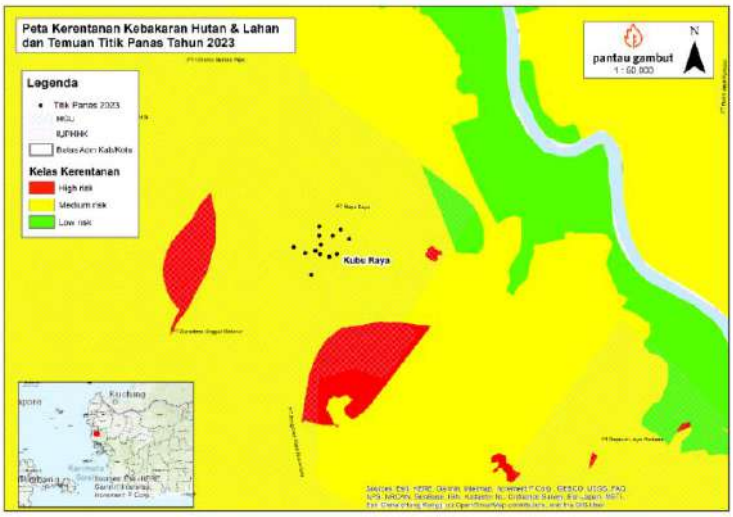



**Image 29**. Kubu Raya Regency, West Kalimantan Province, around 29th to 30th May 2023