THE HYDROLOGICAL PARADOX OF PEATLANDS: MAPPING FLOOD VULNERABILITY IN INDONESIA'S DRYING PEATLANDS

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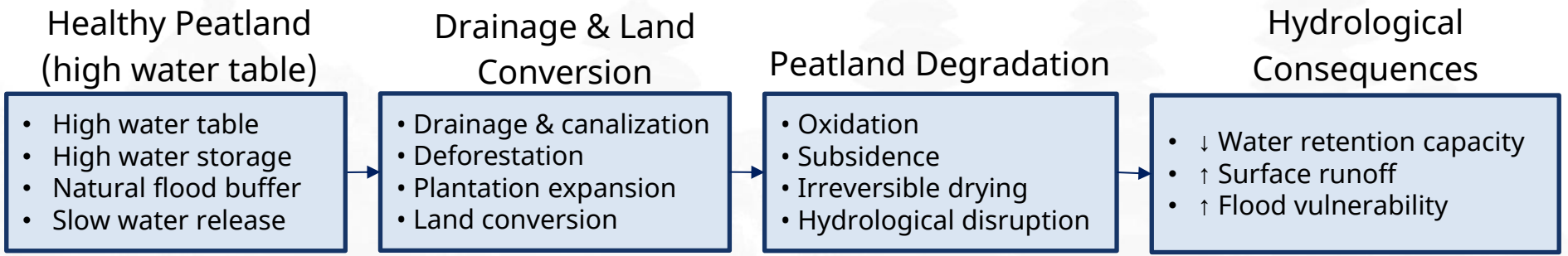
Why do drained peatlands become more flood-prone?

Understanding the Hydrological Paradox

Why do degraded peatlands become more flood-prone?



Drainage and land conversion fundamentally alter peatland hydrology, reducing water storage capacity and increasing flood vulnerability

From Wetland to Disaster

Human intervention fundamentally alters the hydrological function of peatlands, increasing their susceptibility to both drought and floods.

Background

24.2 million hectares of peatland

Pulang Pisau Regency, Central Kalimantan
March 2024
(*Source: Trans Hapakat*)

Dumai, Riau
October 2024
(*Source: Riau Pos*)

Meranti Islands Regency, Riau
January 2023
(*Source: Cakaplah*)

1. Indonesia contains one of the world's largest tropical peatland ecosystems, covering approximately 24.2 million hectares.
2. For decades, peatlands have been drained and converted for plantations through extensive canal construction.
3. Peatland degradation is widely associated with wildfire, yet its role in increasing flood vulnerability remains largely overlooked.
4. Understanding where flood vulnerability occurs is essential for peatland restoration and disaster risk reduction.

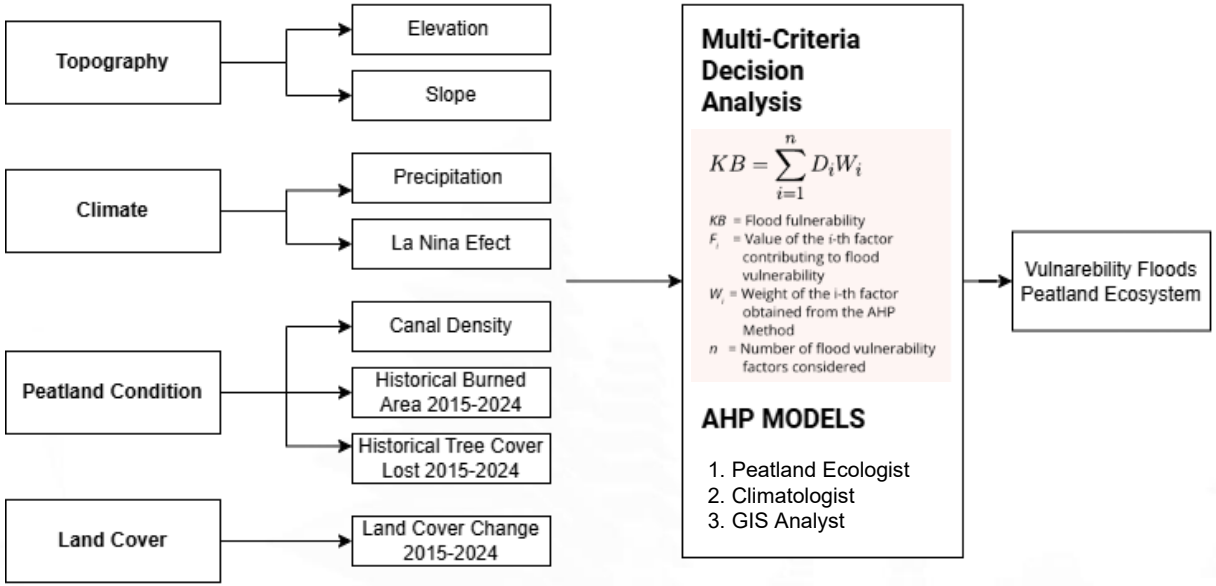
Research Objectives

This study aims to map and assess flood vulnerability across Indonesia's Peat Hydrological Units (PHUs) to better understand the hydrological consequences of peatland degradation.

Indonesia's Major Peatland Regions

24.2 million Ha of peatland are concentrated across three major regions:
Sumatra, Kalimantan, and Papua

Methodology



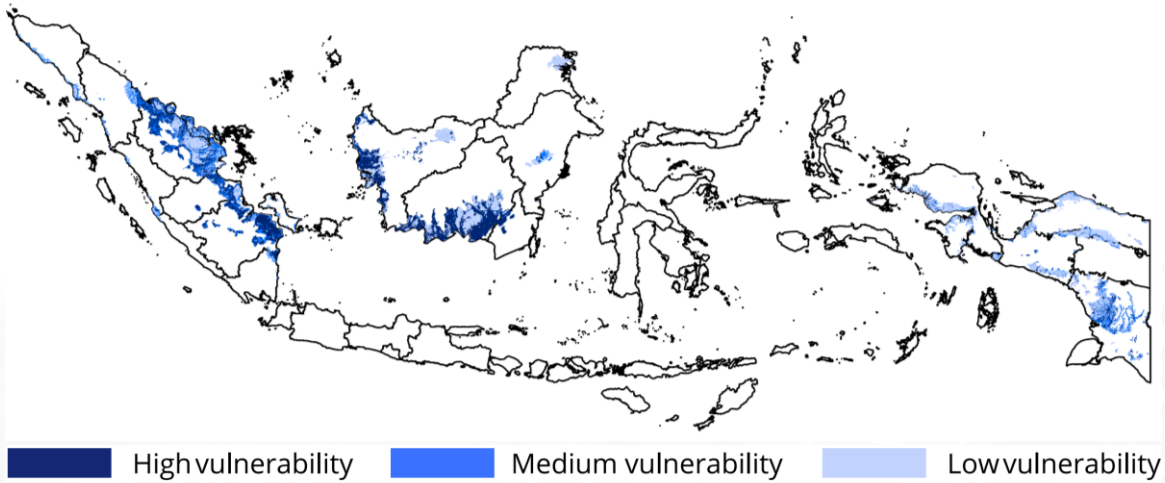
Parameters	Sumatera	Kalimantan	Papua
Peatland Condition	0.332	0.338	0.241
Topopgraphy	0.160	0.097	0.147
Climate	0.239	0.284	0.268
Land Covers	0.272	0.281	0.344
Inconsistency	0.07	0.05	0.008

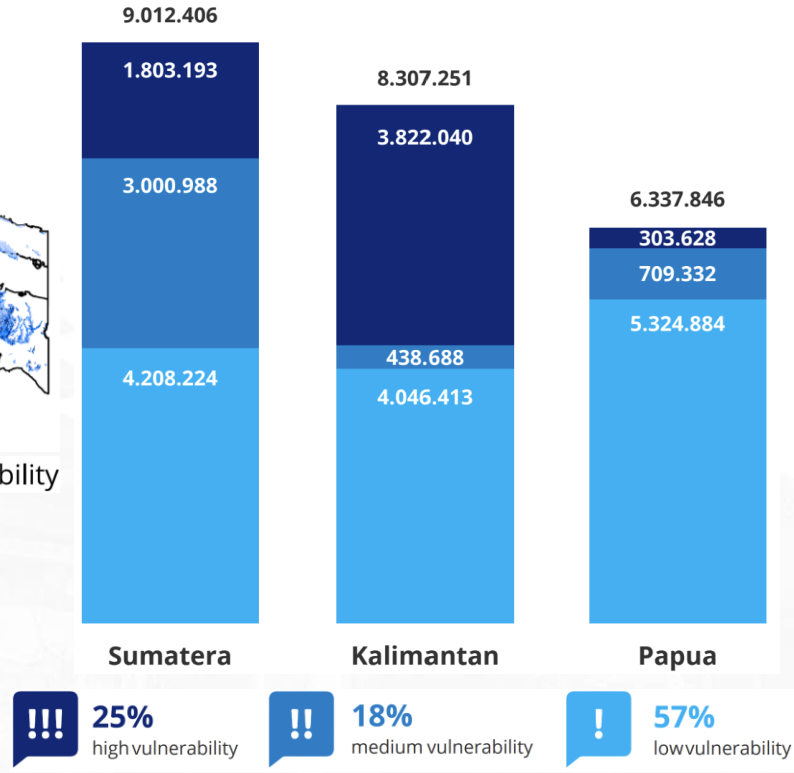
Regional Scope: The analysis focuses on **3 major peatland regions** (Sumatra, Kalimantan, and Papua), each with distinct topography, climate, land cover, and peatland conditions

AHP–MCDA Approach: The analysis integrates **AHP and MCDA**, with regional weights determined through **expert adjustment**

Regional Drivers: **Peatland condition** is the dominant factor in **Sumatra and Kalimantan**, while **land cover** is dominant in **Papua**

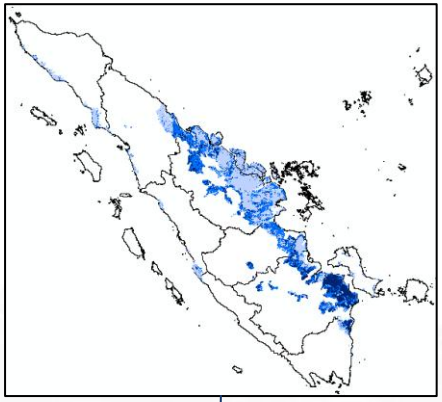
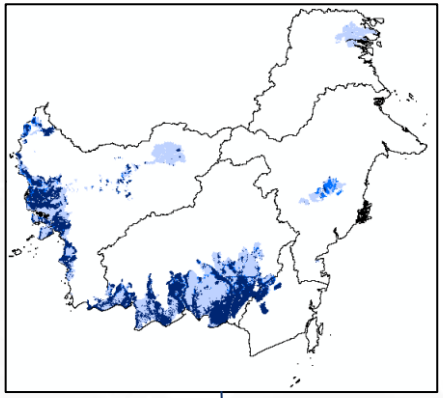
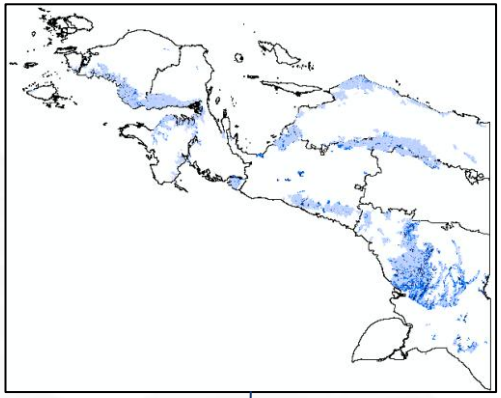
Results



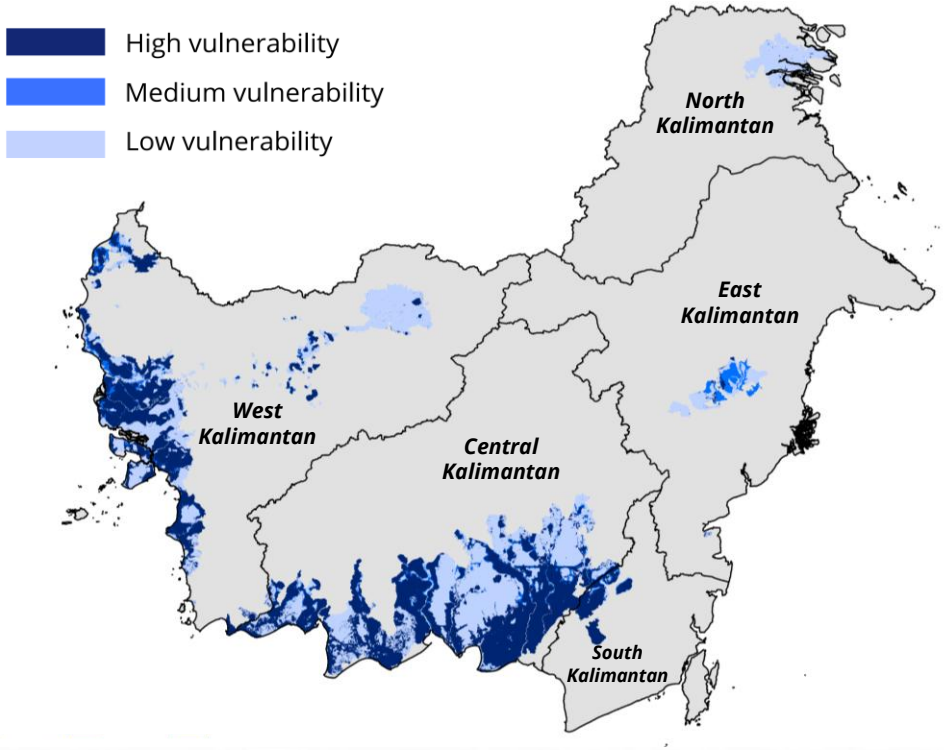


6 Million Ha
Of Indonesian peatlands
are classified as
High Flood Vulnerability

Three Regions, Three Vulnerability Patterns

	Sumatera	Kalimantan	Papua
			
Regional Peatland Area	9.23 M Ha	8.46 M Ha	6.61 M Ha
High Flood Vulnerability Area	1,8 M ha	3,8 M ha	0,3 M ha
Peatland Setting	Coastal peat	Inland + coastal peat	Relatively intact
Canalization	Dense canals & conversion	Dense canals + long-term degradation	Limited canalization

Why Kalimantan?



!!! **3.8 milion Ha** high vulnerability

!! **438 thousand Ha** medium vulnerability

! **4 milion Ha** low vulnerability

Extensive peatlands
Large inland and coastal peatlands located in low-lying (<50 m) landscapes

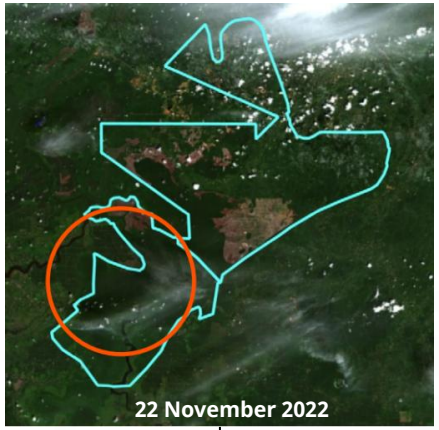
Historical degradation
Drainage began with the Mega Rice Project (1995) and expanded through plantation development

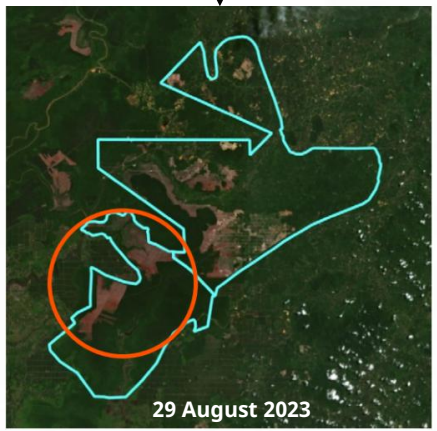
Dense canal networks
Approximately 40% of peatlands have very high canal density, reducing natural water storage

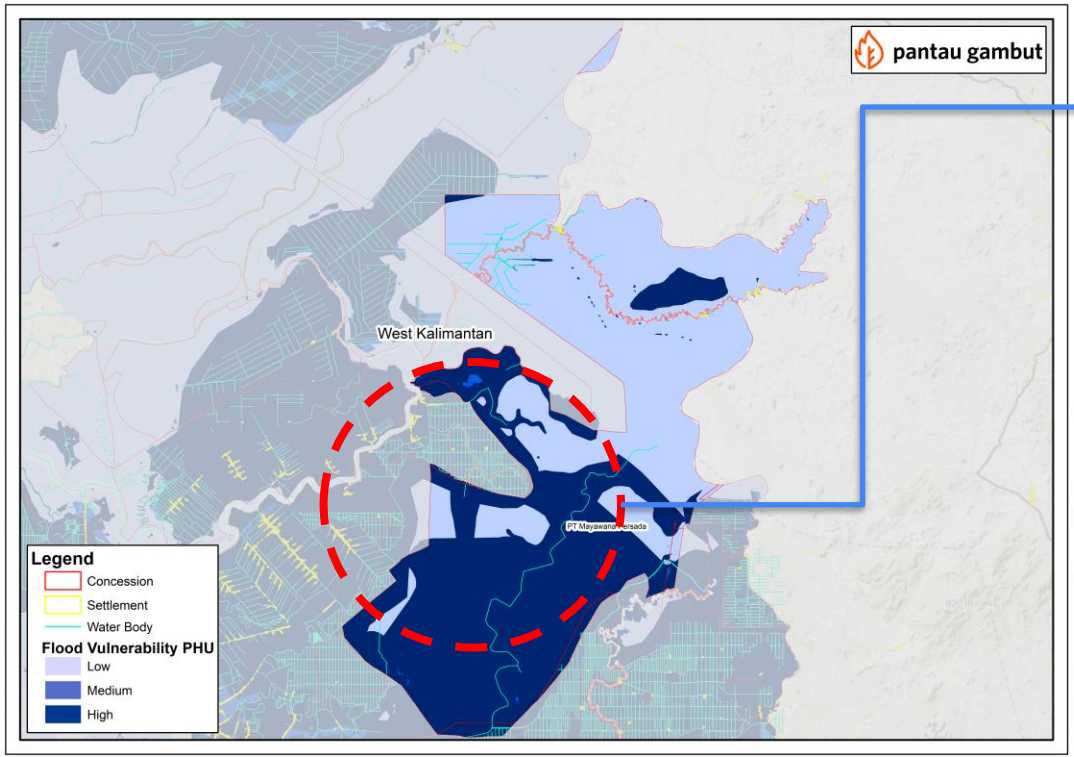
Consequence
Kalimantan exhibits the largest area of high flood vulnerability (≈3.8 million ha)

Flood vulnerability is not solely controlled by rainfall, but by **long-term degradation of peat hydrological systems**

Case Study: PT Mayawana Persada (West Kalimantan)







Canal expansion

Peat degradation

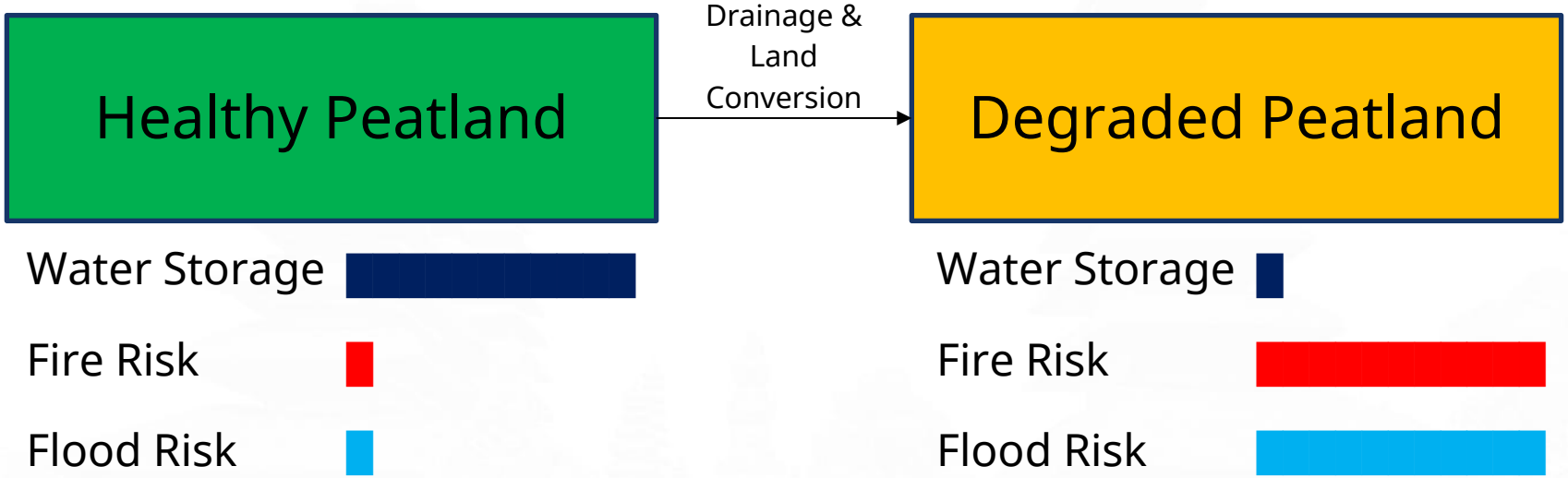
Reduced water storage

High flood vulnerability

This case supports **the model prediction**, where **extensive drainage expansion** coincides with **areas mapped** as **highly flood vulnerable**

The Hidden Consequence of Peatland Drainage

Beyond Fire, Towards Hydrological Resilience



The processes that dry peatlands also reduce their ability to store water, making them vulnerable to both wildfire and flooding

Conclusion

Key Finding:

Approximately 25% of Indonesia's Peat Hydrological Units are highly vulnerable to flooding, confirming that long-term peatland degradation is a key driver of flood vulnerability.

Policy Implication:

Peatland restoration efforts must move beyond fire prevention and address the entire hydrological cycle to reduce both fire and flood risks.

Contact

If you need further guidance or consultation, please contact us at:

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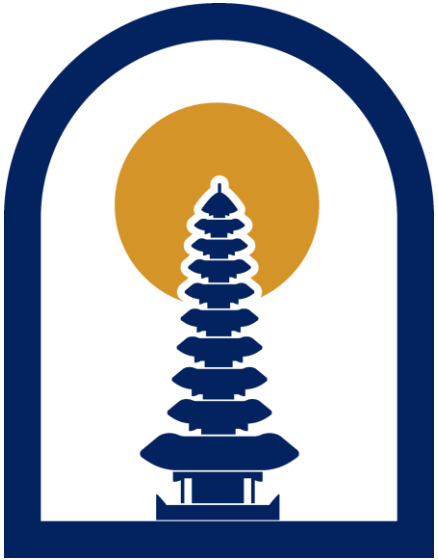
Instagram & Twitter	: @pantaugambut



Thank You