



The Impact of Fire on Tropical Peatlands: Risks and Mitigation

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Introduction to Tropical Peatlands



Formation of Peatlands

Tropical peatlands form over thousands of years from partially decomposed plant material in waterlogged conditions, creating thick layers of organic soil.



Unique Ecosystems

These ecosystems are characterized by their high water table, acidic conditions, and the presence of unique flora and fauna adapted to the wet, anaerobic environment.



Distribution in the Tropics

Tropical peatlands are predominantly found in Southeast Asia, the Amazon basin, and Central Africa, covering significant portions of Indonesia, Malaysia, and the Congo Basin.

Peatland value: Ecosystem services



[Page & Baird (2016) Ann. Rev. Env. Res.]

Ecological Significance



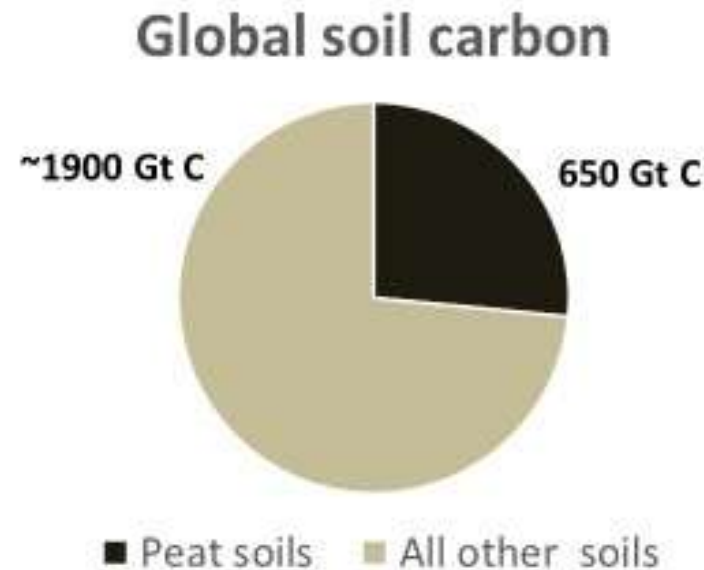
Biodiversity Hotspots

These ecosystems are crucial for biodiversity, supporting numerous endemic species and providing critical habitats for flora and fauna, including endangered species like the orangutan.

Carbon Sequestration

Tropical peatlands play a vital role in storing carbon, sequestering vast amounts of it in their organic- rich soils, which helps mitigate climate change by reducing atmospheric CO₂ levels.

The importance of peatlands – Carbon storage



Some other global C pools (Gt):

- CO₂ in the atmosphere: 830
- All vegetation: 550
- Known oil reserves: 220

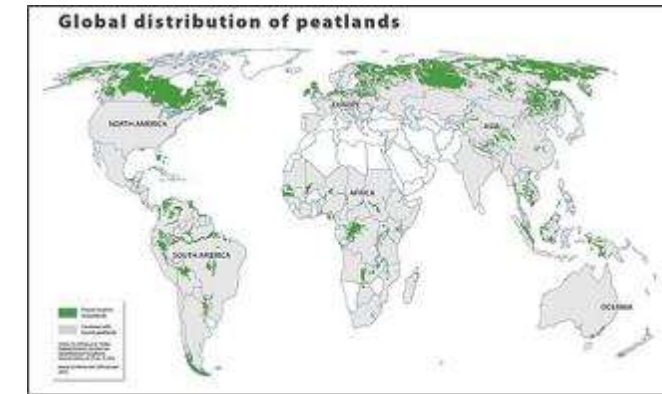
Tropical peat carbon (Gt)

- Total (mostly SE Asia, Congo): 105

Size of the global peatland C stock is not widely recognised or understood – even by scientists

Page et al. (2011), IPCC (2013), Dargie et al. (2017)

Peatland values – Climate regulation



- One of the world's most important natural carbon capture & storage systems
- Undisturbed peatlands absorb atmospheric CO₂
- Waterlogged conditions prevent plant material from fully decomposing
- Peat (~50% C dry weight) forms slowly – over 1000s of years

Peatlands naturally have a climate protection effect

Important values of peatlands

– Biodiversity

- Tropical peatlands support a rich and unique diversity of habitats and species
- Endemic species of habitat
- Special life forms and strategies



New peat swamp tree species
discovered by researchers in Singapore
and Indonesia



RIC researchers at April 2016. Researcher with an inflorescence (a branch of flowers) from the newly discovered species. Photo courtesy of RIC team.





Land use changes and impacts

- Conversion in Indonesia and Malaysia by small-scale farmers (43–44%), plantation companies (39%) and pulp and paper (11–26%)
- Usually related to drainage-drying of peat
- Dry conditions prone to burning

Causes of Fire in Tropical Peatlands



Human: Agricultural Activities and Land conversion

Farmers may use fire to clear land for planting crops, a practice that can easily spread out of control, causing widespread fires in peatlands.

Converting peatlands into plantations or urban areas often involves draining and setting fire to vegetation, which significantly increases the risk of fires.



Prolonged Dry Seasons

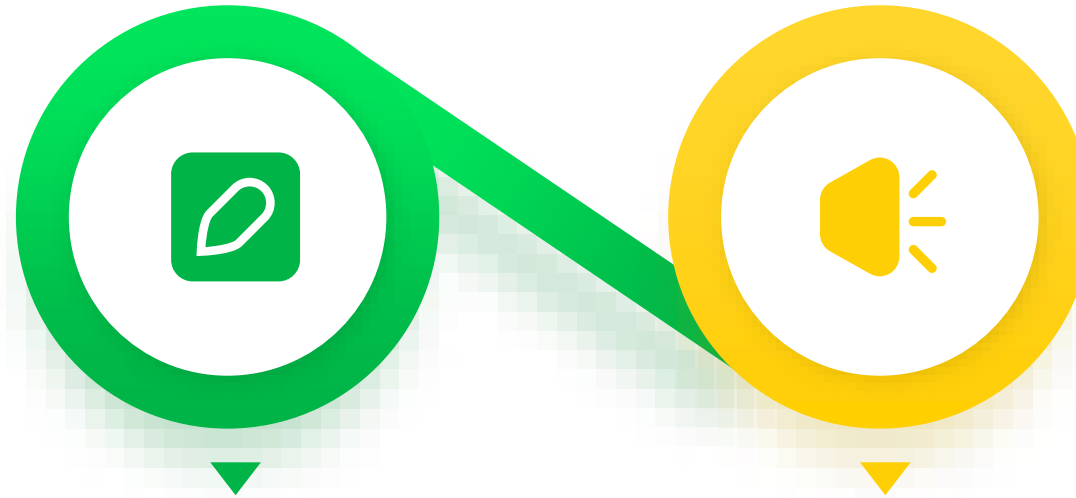
Extended periods of drought can dry out the peat, making it more susceptible to burning when exposed to even a small ignition source.





Peatland and forest fire difficult to stop,
condition is very dry and difficult to get
water

Impacts of Fires on Tropical Peatlands



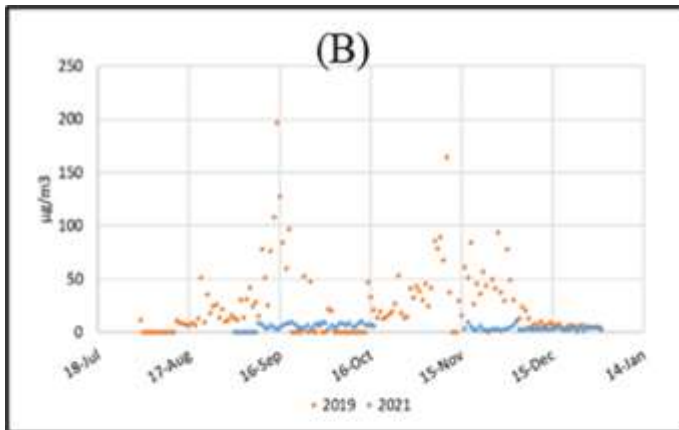
Air Pollution

Fires in tropical peatlands release vast amounts of smoke and particulates, leading to severe air quality deterioration, which can affect human and ecological health.

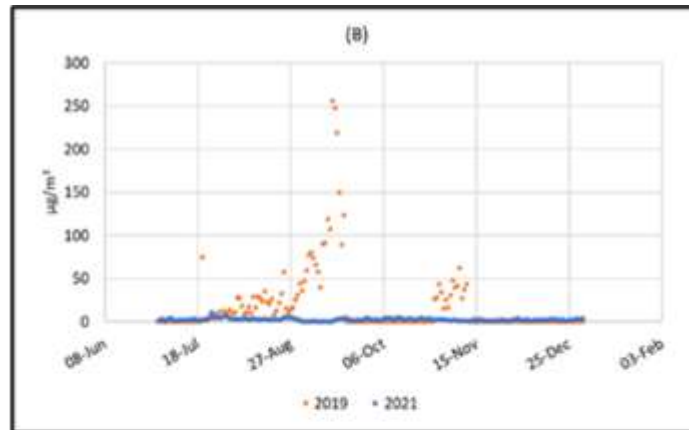
Loss of Biodiversity

The destruction of habitat due to fires severely impacts flora and fauna, reducing species diversity and disrupting ecosystems, often leading to loss of endemic species.

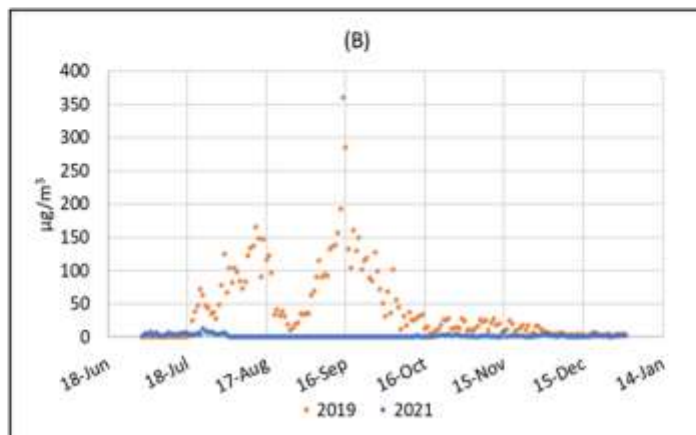
Environmental Consequences



Buntai Village



Tumbang Nusa Village



Perum Pemda Palangka Raya



PM2,5 concentration when forest and peatland fire 2019

Peat and biodiversity lost

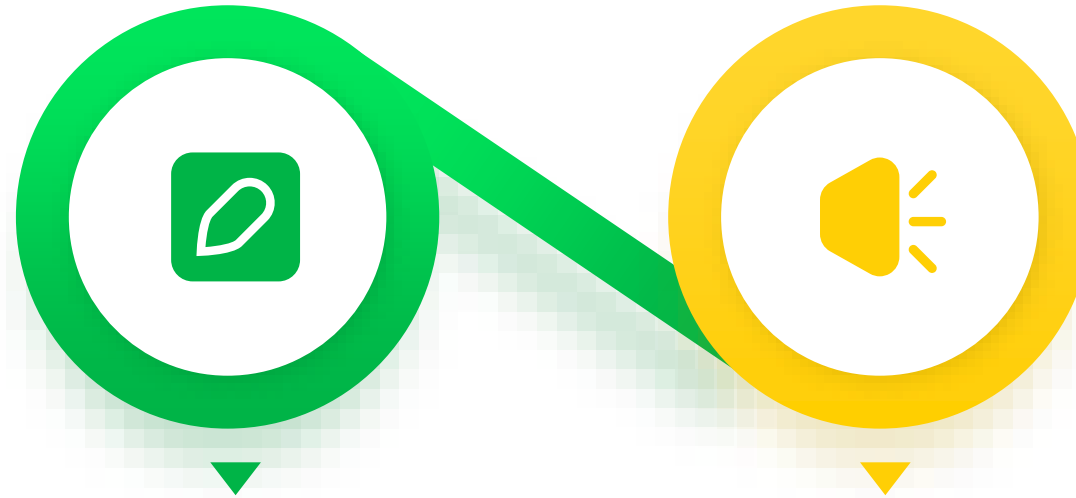


BTEX compounds (benzene, toluene, ethylbenzene, xylenes) are important air toxics and aerosol precursors and were emitted in total at 1.5 ± 0.6 g/kg.

Formaldehyde is probably the air toxic gas most likely to cause local exposures that exceed recommended levels.

Stockwell, C.E., Jayarathne, T., Cochrane, M.A., Ryan, K.C., Putra, E.I., Saharjo, B.H., Nurhayati, A.D., Albar, I., Blake, D.R., Simpson, I.J. and Stone, E.A., 2016. Field measurements of trace gases and aerosols emitted by peat fires in Central Kalimantan, Indonesia, during the 2015 El Niño. Atmospheric Chemistry and Physics, 16(18), pp.11711-11732.

Fire Management and Prevention Strategies



International Agreements

Focus on global cooperation, treaties, and protocols aimed at wildfire prevention and management.

National Policies

- Include fire management frameworks, funding, and regulatory measures
- More on the prevention aspect
 - Eliminate the opening of permits on peat lands

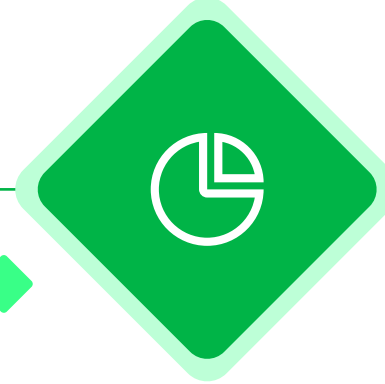
Policy and Legislation

Community-Based Approaches



Awareness and Education

Community education programs, workshops, and awareness campaigns to inform the public about fire risks and prevention methods.



Sustainable Land Management

Practices like controlled burns, reforestation, and land use planning to reduce fire hazards and promote resilience.

Technological Interventions



Remote Sensing and Monitoring

Technology used to detect fires early, monitor fire spread, and assess fire impact using satellites and drones.

Fire Suppression Techniques

Methods to extinguish fires including aerial firefighting, chemical retardants, and ground-based equipment.



Firefighters



Mixing of SOAP into water



Small scale permeability test



**2nd firefighting using a
backpack-type water tank**

Conclusion and Future Directions



- Peatland ecosystems are important ecosystems and are still at risk of damage.
- The problem of forest and land fires has not yet been fully resolved
- Promoting international collaboration to address global challenges and enhance the effectiveness of solutions.



Thank you for your attention