Peatland fire regime across a peat hydrological unit, Riau, Indonesia

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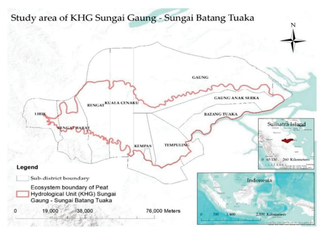
Introduction

- Peatland is one of the most valuable ecosystems providing multiple ecosystem services, amongst is carbon regulating as the most fundamental services
- IPCC AR6 statement of "GHG emission increased is unequivocally caused by human activities" were reciprocal with peatland case, where most of the ecosystem has been artificially modified to support dryland cultivation and alter the peatland natural trait, from carbon sink to carbon source.
- In Indonesia, where peatland stretched for approximately 8% of the country's land, the carbon dynamics of the ecosystem will determine the route of the national emission. Indonesia's commitment to aim for net-zero emission in 2060 or sooner will only be feasible if the forestry sector reaches net-sink in 2030 and zero peat fire starting in 2025.
- Peat fire per se has been the most concerning peatland disturbance as it varied temporally and complicates by its connection with the biophysical parameters (e.g., peat soil, land cover, etc.).
- Many studies have an emphasis on the role of excessive draining to hydrological change and fire vulnerability; however, there is still no study that presents the impact of draining on different land management from an annual basis data. This study aimed to fill this gap.

Method

The study is conducted in Gaung-Batang Tuaka Peat Hydrological Unit (KHG), one of the 7 priority KHG in Riau Province. The total area of the study area is 315,326 ha, of which 87% is peatland.



Results

Main result 1:

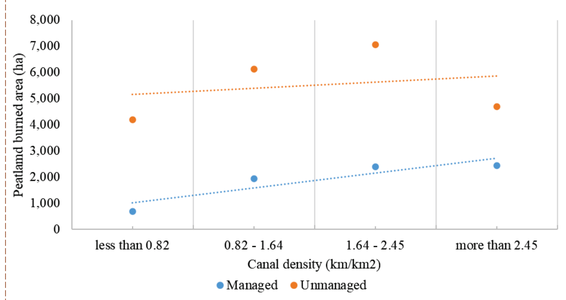
Of all land covers, unmanaged land, particularly in wet shrub and bare ground, has the highest total burned area.

Land-use type	Burned area (ha)												Total burned area (ha)
	2003	2006	2009	2011	2012	2013	2014	2015	2016	2017	2018	2019	
Primary swamp forest								25				11	35
Forest plantation				812	163	38	17	55			2	285	1,373
Estate crop						508	401	779	29	1	871	3,319	5,907
Bare ground		457	162	34	30	53	965	2,147		4	1	476	4,330
Secondary swamp forest	453	699	391	63	12	126	334	176			59	965	3,277
Wet shrub	10	504	1,886	1,128	1,520	859	1,100	1,471	0	40	863	4,018	13,401
Dryland agriculture		20					1					45	65
Mixed dryland agriculture		60					13	30		5	17	889	1,013
Paddy field		17		47			1					25	90
Total burned area (ha)	463	1,756	2,440	2,086	1,725	1,583	2,830	4,683	29	50	1,814	10,033	29,492
Annual rainfall (mm)	2,637	2,696	2,605	2,886	2,702	2,595	2,416	2,094	2,675	2,734	2,599	2,245	
SPAI[1]	0.49	0.79	0.33	1.76	0.82	0.27	-0.64	-2.27	0.68	0.98	0.30	-1.50	

[1]SPAI refers to a standardized annual precipitation anomaly index.

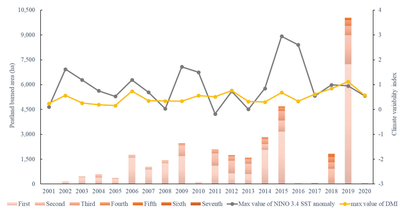
Main result 2:

Draining impact positively correlates with peatland burned area. However, the impact of the draining on unmanaged land is stronger than in managed land.



Main result 3:

Recurrent peatland fire intensively occurred during extreme dry years (positive IOD and/or El-Nino).



Peat fire frequency	Peatland fire identified as unmanaged land all year (ha)	Total burned area
7	8.4	8.4
6	33.3	44.1
5	135.5	269.2
4	355.0	816.0
3	927.7	1,621.6
2	1,583.2	4,484.7

Area identified as unmanaged land for years is found to experienced recurrent fire more compared to other LUC patterns.

Discussion

- Currently, the peatland ecosystem is dominated by the extent of unmanaged land, particularly unproductive areas (e.g., wet shrub and bare ground). Utilizing and supervising this land via a sustainable land-management strategy could reduce fire vulnerability and lower the possibility of recurrent fires event in the future.
- The government of Indonesia has developed social forestry scheme as one of the transformative policies toward net-sink that can be used for the peatland case. The scheme legally grants land access to the community for utilizing the unproductive land. Under the legality status, the community can receive government support (e.g., incentive, capacity building) to increase land economic value.
- The stronger impact from excessive draining to the burned area in unmanaged land indicates the urgency to rewet these areas, particularly in the intact ecosystem with less human activity, where hydrological restoration is likely to be more efficient. In the managed land with dense canal density with the low success of peatland rewetting, mixed-agroforestry farming is the most feasible option to maintain soil moisture by minimizing peat soil to radiation exposure.

Conclusions

- The significant impact of extensive peat drainage underscores the need for peatland rewetting (restoration) to reduce the possibility of multiple fires, particularly in unmanaged land.
- Due to a significant burned area occurs on unproductive land (e.g., wet shrub and bare ground), utilization of this land for production purposes—in particular when combined with rewetting and paludiculture—could reduce fire vulnerability considerably.
- As peatland has been occupied by multi actors (e.g., private sector, smallholder, regional government, etc.), integrated peatland management requires equal participation from both party and non-party actors. The presence of an incentive scheme that makes the environmental benefit apparent economically is key to upscale the peatland restoration work and reach the zero-peat fire ambition.

Acknowledgment:
The authors thank the Ministry of Research and Technology of the Republic of Indonesia for the research funding, and the Ministry of Environment and Forestry for the supporting data in this research.