

学位論文の要旨(論文の内容の要旨)  
Summary of the Dissertation (Summary of Dissertation Contents)

論文題目

Dissertation title: Sustainable Peatland Management in Riau Province, in terms of Fire Risk, Biodiversity and Land Management

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Sustainable peatland management has become an international priority as the relationships among peatland management, fires, haze and air pollution, biodiversity, land subsidence, permanent inundation, and climate change have become better understood. A major catalyst has been the fire haze and air pollution in Southeast Asia, which have caused a negative impact on economies and human life across the region.

Sustainable peatland management is a challenge because peatlands have an important role in the economic growth of Indonesia due to their value for agricultural development (e.g., oil palm, acacia). However, tropical peatlands remain poorly understood. Tropical peatlands have experienced extensive fires and deforestation for timber and conversion to plantation and undeveloped land. This rapid land use and land cover change on contested land and complex drivers of peatland degradation and loss requires new research. Research to date has been about peatland characteristics and restoration and has not focused on practical knowledge such as best management practices. As a result, different approaches to tropical peatland management are currently being taken by various stakeholders. Therefore, research on monitoring of tropical peatland management is important.

This study focused on Riau Province (Sumatra), one of the most fire-prone provinces of Indonesia. Riau has the highest deforestation in Sumatra, more than half of forest lost during 1990 to 2010 (3 million ha). A large area of peatland has been converted into plantation area, with associated environmental and economic impacts. Fires in Riau have been associated with land mismanagement policy. To work toward sustainable peatland management, we need to assess peatland utilization by the various types of landholders.

This study was conducted with four objectives:

- (1) Investigate the use of satellites to monitor no-deforestation commitments and no-burning compliance by industrial plantation companies.
- (2) Assess the drivers of fire and the relationship among fire occurrence, land cover type, landholders, and accessibility.
- (3) Examine fire occurrence in relation to climate and deforestation.
- (4) Determine tree diversity in peat swamp forests.

Chapter 1 presents the study background study, statement of the research problem, aims and objectives, significance of the study, scientific contribution of the study, and structure of the dissertation.

Chapter 2 consists of the theoretical background and methodological approaches such as the theory of sustainable peatland management, theory of interactions between human and climate factors on fire activities, theory of biodiversity and land management, general description of peatland management in Indonesia, and methodological approaches.

Chapter 3 presents results of the investigation of the reliability of satellite remote sensing (web GIS) to monitor fire activity. Satellite images, a map of land concessions and a field investigation were used to analyze fire occurrence. We found: 1. Undeveloped peatlands were the target of fires and wildfires spread into plantation; 2. Farmers may have been responsible for fire inside and outside concessions; 3. Industrial actors (unregistered companies) were responsible for fire outside concessions; 4. There was a mismatch between land occupancy and legal concessions; 5. Burned area outside concessions was predominantly State Forest Land. 6. Draining of peatlands within concessions may promote fire in those peatlands. Results suggest that fire was used to clear undeveloped land. Fires will occur in our study area regularly in the future, given the large amount of remaining idle lands. Effective satellite monitoring needs a resolution of overlapping land claims; land tenure inventories are needed to identify de facto ownership, potential claims, and disputes.

We assess the drivers of fires and the relationship among fire occurrence, land cover type, landholders, and accessibility in chapter 4. We investigated data on deforestation, landholder, concession map, State Forest Land, LANDSAT images, and MODIS hotspot data to analyze fire regime. Findings of this study suggest that: 1. People used fire to clear agricultural land and forest land. 2. The drivers of fire were land type, landholder, period of deforestation, and district boundary. 3. Shrublands were the most fire-prone land cover type. 4. Landholder affects fire occurrences in the forest area. 5. Companies had more fires than smallholders due to plantation management differences among landholders. 6. Roads and canal increased fire occurrences in the forest. The results indicate that good land use governance policies such as spatial planning, law enforcement, and best management practices are important to mitigate peatland fire.

In chapter 5, we examine the role of climate and deforestation on fire activity using rainfall data, MODIS hotspot, LANDSAT images from 2000 to 2013, and the land cover map from Ministry of Environment and Forestry. The results concluded that: 1. Climate is a pre-condition that encourages fire activity 2. More frequent fires in the future are likely as continuing deforestation, higher temperatures, and reduced rainfall all contribute to increased fire risk. 3. Fire was concentrated in peatlands; 4. Riau experienced rapid deforestation to plantation and shrubland; 5. Conservation forest and protection forest had low fire activity. These results highlight the important influence of climate anomalies, deforestation, and land management on fire activity in Sumatra.

Finally, this study addresses tree diversity in peat swamp forests in chapter 6. We recorded 59 tree species belonging to 31 families in 9 sample plots (9 ha). *Syzygium acutifolium* and *Shorea uliginosa* were the dominant species. Stand density varied from 78 to 186 stems ha<sup>-1</sup> while the basal area was 7.41 to 12.34 m<sup>2</sup> ha<sup>-1</sup>. Species richness and tree density declined with increasing of tree diameter class. The pattern of tree density indicates good succession. The forests have good tree diversity. This indicated by Shannon–Weiner Index and Simpson Index varied from 1.91 to 2.88 and 0.08 to 0.24 respectively. Priorities for management of peat swamp forest should be conservation, enrichment planting, and prevent degradation of the forests.

The main contribution of this study is that it was successful in assessing the role climate, deforestation, landholders and peatland management on fire activity and tree diversity in peat swamp forest in Riau Province. We suggest the government should prioritize the management of unmanaged peatland and the remaining peat swamp forest. We highlight the importance of peat swamp forest, land tenure, and best management practices to minimize fire activities.

備考 論文の要旨はA4判用紙を使用し、4,000字以内とする。ただし、英文の場合は1,500語以内とする。

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Japanese characters. When written in English, it should not exceed 1,500 words.