Chapter 3
Peatland in Indonesia

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Abstract Peatland area in Indonesia was about 14.91 million ha spread out in Sumatra 6.44 million ha (43 %), in Kalimantan 4.78 million ha (32 %), and in Papua islands 3.69 million ha (25 %). The important factors of peatland for agriculture are closely related to properties and character of soil, water, and GHGs emissions. The factors should be considered in arranging decision or policy and utilization for agriculture.

Utilization of peatlands for agriculture in Indonesia has a long historical foundation. Starting from success of indigenous peoples who looked peatland as a resource to produce traditionally food crops, fruits, and spices, then they have been growing into large plantations managed modernly to get a better income like palm oil plantation, however it is required to be sustainability for which water level, wild fire, and biodiversity must be managed appropriately. Greenhouse gases (GHGs) emissions issues, also, motivated government to limit peatland utilization because some of the emission was from peatland.

Keywords Peatland • Indonesia • Agriculture

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3.1 Introduction

Tropical peatland (including swamps and forests) are found on islands in the Indonesian and Malaysian Archipelagos, the Amazon lowlands, and Central Africa, they comprise some 42 Million ha, and are estimated to store approximately 148 Gt (1 Gt = 10^{15} g) of carbon (S. Page et al. 2010). Much of the recent increased interest in peat globally has resulted from the importance of peatlands as carbon sinks and stores, and their role in carbon cycling between the earth surface and the atmosphere. Much detailed work has been carried out on carbon gas emissions from tropical peat in Southeast Asia in recent years and is contributing to knowledge of this topic. Because of their inferior nature, these environments remain undeveloped, are found in relatively virgin forests, are extremely fragile and very liable to disturbance. Peat-Forests in Indonesia still remain in large areas, however conservation and rehabilitation here is complicated because of (1) the great impact of Climate Changes including El Niño, La Nina, and ENSO, and (2) human impact such as plantations of oil palms, rubber, and pulp trees, and food production. This makes it necessary to establish strategies for peatland management in view points of (1) mitigation and adaptation of the impact of Climate Change, and (2) sustainable land management on Land Use, Land Use Change and Forestry (LULUCF). For this purpose, an analysis of a Human-Nature Harmonization System is especially the most basic issue in peatland.

The tropical peat swamp forest is important as not only for its wealth of diverse bio-resources but also its huge carbon pool (Tawaraya et al. 2003). Tropical peat swamp forests and deforested peatlands are important stores of carbon whose release in large quantities through burning can contribute significantly to climate change processes (Page et al. 2002). Furthermore, forest fires are an important cause of environmental alteration and land degradation or conversion through human activities. Indonesian forests have been affected by intense burning for plantation agriculture and exploitation practices for commercial logging since the 1970s. Interactions between land clearance activities and drought have caused massive uncontrolled fires that have burned on large areas of forest and agricultural land in the Kalimantan Island.

In 1997, a severe drought began in Southeast Asia. It was related directly to its contemporary El Niño-Southern Oscillation (ENSO) event (Schimel and Baker 2002; Wooster and Strub 2002; Slik 2004), and the 1997 disaster torched more than 2.7 million ha in Central Kalimantan (Aldhous 2004). Records of sea surface temperature anomalies for ENSO event from 1979 to 2002 also showed that the 1997/1998 and 2002 ENSO are among the strongest records set the conditions for widespread fires in South East Asia. Smoke by forest fires also harmed human health and environment. The similar problems caused by ENSO event occurred in 2002, when peat and vegetation fires broke out again in Central Kalimantan from July 2002 and lasted for several months (Siegert et al. 2004). Given that the peat is more than 12 m deep in places, it will burn again and again, each time drought returns (Aldhous 2004). It has become obvious that the incidence of more frequent

ENSO events, coupled with major land development projects that involve drainage of the surface peat, is leading to an increased risk of repeated fire events in tropical peatland areas (Siegert et al. 2004).

Much research of tropical peat has pointed out that the problems which arise with development of tropical peat stem mainly from a lack of understanding of the complexities of this ecosystem and the fragility of the relationship between peat and forest. In its natural state tropical peat is a vast carbon sink and store but once the carbon input is discontinued by forest removal and the peat is drained, the air exposed surface peat oxidizes and loses the carbon stored there, rapidly to the atmosphere, which results in progressive subsidence of the peat surface and contributes to climate change.

Utilization of peatlands for agriculture in Indonesia has a long historic foundation. Indigenous peoples, particularly in Kalimantan looked peatland as a land resources to produce food (rice, corn, sago, cassava), fruits (*durian*, *rambutan*, mango, etc.) and spices. In the history of swampland development, the success of local indigenous peoples in utilization of peatland inspired the government to open peatlands extensively. Controversy about use of peatland came after utilizing peatlands without appropriate and correct management.

An appearance of subsidence and degraded land in peatlands became a serious concern for domestic and international environmentalists and agriculturalist. Depletion of availability of land for agriculture and high rate of national population growth forced Indonesian government to prefer peatland as an alternative land resources which became important and essential land. In relation to GHG emissions issues from peatland, the government is targeting a reduction in GHG emissions by 26 % voluntary and up to 41 % with international collaboration until 2020, where about 9.5–13.0 % of the reduction is from peatland.

Peat soils which are in peatland area have specific properties that are different with other soils (mineral soils). Not all peatland can be used for agricultural crops, such as dome part of peat should not be opened because it will cause harmful environmental impacts (subsidence and greenhouse gas emissions). Only at selected sites, agricultural activities can be done. Peatlands which are suitable for farming have requirements such as (1) thickness of peat <100 cm, (2) saprichemic maturity, (3) thickness of peat about 20 cm at top layer since the peat mix with mineral soil, (4) mineral soil material contain organic matter <25 % after reclamation or drainage, and (5) water level <70 cm. Research results showed that productivity of rice in peat decreased with increasing soil thickness up to 100 cm (Noor et al. 1991; Noor 2001). Peatlands with thickness >100 cm had a very low level of mineralization as well as low level of soil fertility. Rice yield cultivated on thick peat soil continuously declined over time, so it was frequently abandoned. To maintain its productivity, appropriate and sustainable soil, water and plant managements are needed. This paper discus some perspectives about peatland potency and management for sustainable farming.

3.2 Peatlands Distribution in Indonesia

Indonesia, peatlands are distributed widely along the coastal areas of Kalimantan, Sumatra, and West Papua, approximately 30 % of which is in Kalimantan (Borneo in Indonesia territory). The peatlands and swamps are distributed in the lowland areas along the coastlines of Indonesia, and the influence of tides of rivers flowing through the peatlands reaches considerably distances inland. In general, Indonesia classifies peatlands based on hydrological and geological features into three: coastal peat (in areas affected by sea water), transitional peat (in brackish-water areas), and inland peat (in fresh water areas).

Peatland area in Indonesia was about 14.91 million ha spread out in Sumatra 6.44 million ha (43 %), 4.78 million ha in Kalimantan (32 %) and in Papua 3.69 million ha (25 %) (Ritung et al. 2012). Most or about 11 million ha of peatlands were in tidal swampland areas and the remaining land approximately 3.9 million ha were in swampland and beach area. Based on the thickness, about 5.24 million ha (35 %) included shallow peat (thickness 0.5–1 m), 3.91 million ha (26 %) medium peat (thickness 1–2 m), 2.76 million ha (19 %) deep peat (thickness 2–4 m), and 2.98 million ha (20 %) very deep peat (thickness >4 m) (Table 3.1, Figs. 3.1, 3.2, 3.3, 3.4, and 3.5). Several authors have previously stated that Indonesian peat land area was 14.9 million ha (Subagyo et al. 1990), 17.2 million ha (Euroconsult 1984), 18.4 million ha (Soekardi and Hidayat 1988), 19.90 million ha (Wahyunto et al. 2005, 2006), and 20.1 million ha (Radjagukguk 1993). Depreciation or depletion of peatland may occur every year due to fires, decomposition, subsidence, erosion, mining or intensive use.

In the past 10 years, the use and development of peatlands have been more extensive because of conversion of agricultural land into non-agriculture and increase of need for food and agricultural products for both domestic consumption and export opportunities. In this periods many peatlands were exploited for development of palm oil plantations. Approximately 2.0–2.5 million ha of peatlands were cultivated for palm oil in Indonesia. Peatland development, particularly for oil palm plantations, however, might be necessary to be considered over again associated with GHGs emissions reduction targets of 21–46 % by 2020, where 9–13 % of it was from peatlands (Noor 2012a).

Table 3.1 Peatland area in Indonesia

	Peatland area (ha)				
Island	Shallow (50–100 cm)	Medium (101–200 cm)	Deep (201–400 cm)	Very deep (>400 cm)	Total (ha)
Sumatera	1,767,303	1,707,827	1,242,959	1,718,560	6,436,649
Kalimantan	1,048,611	1,389,813	1,072,769	1,266,811	4,778,004
Papua	2,425,523	817,651	447,747	0	3,690,921
Total	5,241,437	3,915,291	2,763,475	2,985,371	14,905,574

Source: Ritung et al. (2012)

Fig. 3.1 Map of peatland in South East Asia. The map *illustrates* that most peatland are distributed on the islands of Sumatra and Borneo (Kalimantan, Sabah, Sarawak and Brunei) and in Peninsular Malaysia (Source: Whitmore 1995)

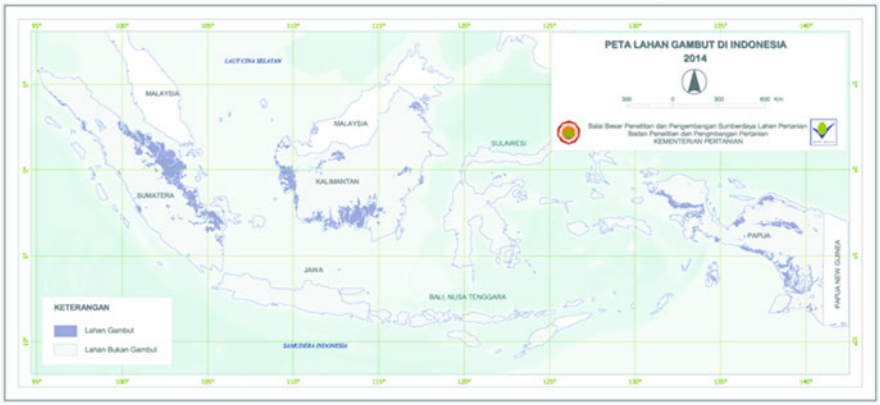

Fig. 3.2 Map of peatland in Indonesia

Peatland in Sumatra Island In Sumatra island, peatlands area was about 6,43 million ha that spread out such as shallow peat was about 1,77 million ha, medium peat was about 1,71 million ha, deep peat was about 1,24 million ha, and very deep peat was about 1,72 million ha. In Sumatra, peatland spread of 11 provinsi, the largest peatlands area in Sumatra was mainly in Riau (60.1 %) and Sumatra Selatan (19.6 %) (Table 3.2).

Peatland in Kalimantan Island In Kalimantan island, peatland area was about 4,78 million ha that spread out such as shallow peat was about 1,05 million ha, medium peat was about 1,39 million ha, deep peat was about 1,07 million ha, and very deep peat was about 1,27 million ha. In Kalimantan island, peatlands spread of four provinsi, the largest peatlands area in Kalimantan was mainly in Kalimantan Tengah (55.7 %) and Kalimantan Barat (35.2 %) (Table 3.3).

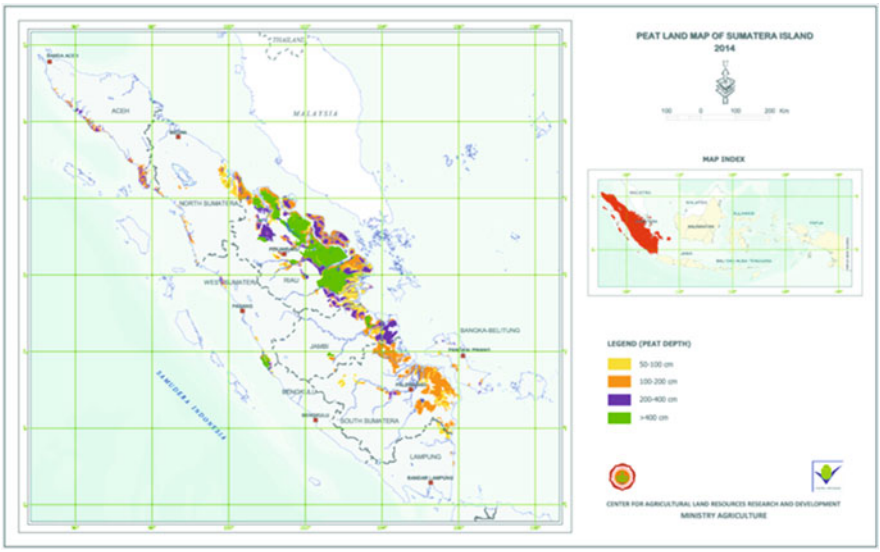

Fig. 3.3 Distribution of peatland in Sumatra Island

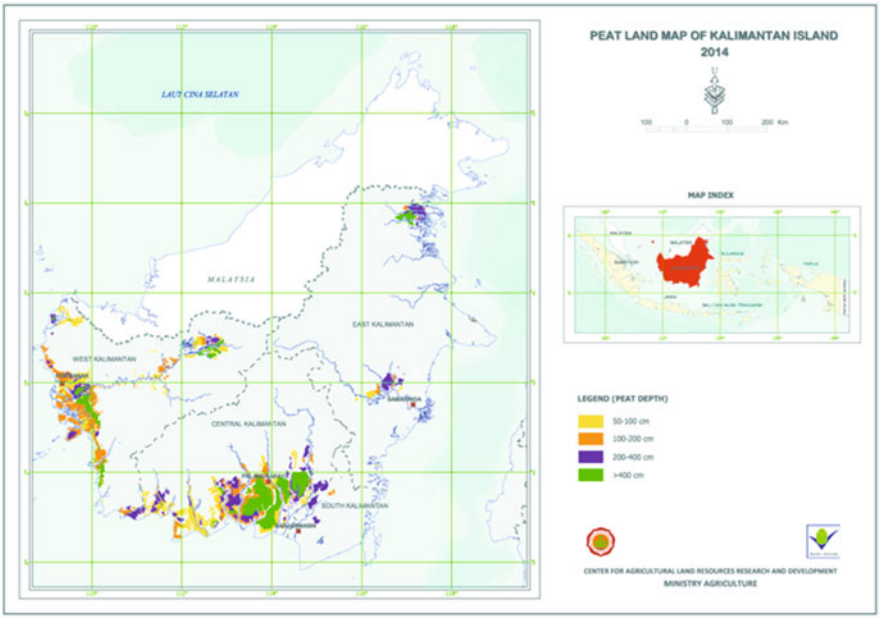

Fig. 3.4 Distribution of peatland in Kalimantan Island

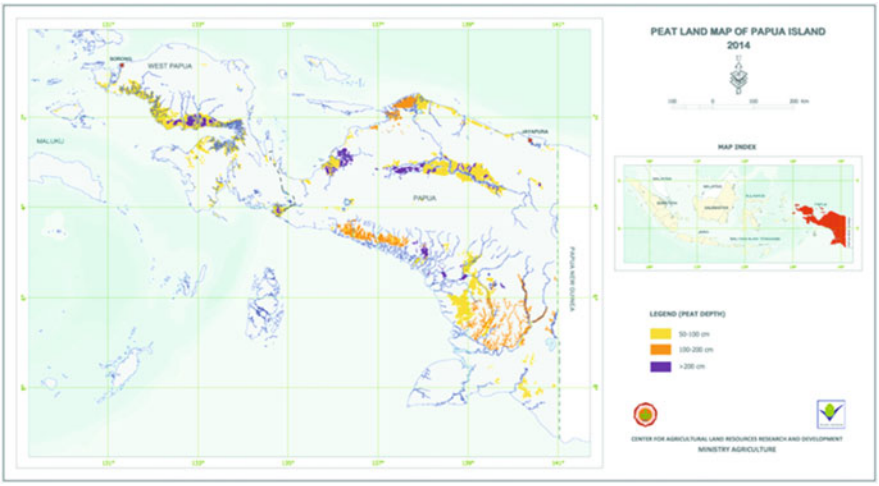

Fig. 3.5 Distribution of peatland in Papua Island

Table 3.2 Peatlands in Sumatra Island

Province	Peatland area (ha)				Total (ha)
	Shallow (50–100 cm)	Medium (101–200 cm)	Deep (201–400 cm)	Very deep (>400 cm)	
NAD	144,274	71,430	0	0	215,704
Sumatra Utara	209,335	36,4721	0	15,427	261,234
Sumatra Barat	11,454	24,370	14,533	50,329	100,687
Riau	509,209	908,553	838,538	1,611,114	3,867,413
Kep. Riau	103	8,083	0	0	8,186
Jambi	91,816	142,716	345,811	40,746	621,089
Bengkulu	3,856	802	2,451	944	8,052
Sumatra Selatan	705,357	515,400	41,627	0	1,262,385
Kep. Bangka	0	0	0	0	0
Belitung	42,568	0	0	0	42,568
Lampung	49,331	0	0	0	49,331
Total Sumatra	1,767,303	1,707,827	1,242,959	1,718,560	6,436,649

Source: Ritung et al. (2012)

Peatland in Papua Island Papua island have peatland area was about 3,69 million ha that spread out such as shallow peat was about 2,42 million ha, medium peat was about 0,82 million ha, and deep peat was about 0,45 million ha, and have not found very deep peat (Table 3.4).

Table 3.3 Peat land in Kalimantan Island

Province	Peatland area (ha)				Total (ha)
	Shallow (50–100 cm)	Medium (101–200 cm)	Deep (201–400 cm)	Very deep (>400 cm)	
Kalimantan Tengah	572,372	508,648	632,989	945,225	2,659,234
Kalimantan Barat	421,697	818,460	192,988	246,989	1,680,135
Kalimantan Selatan	10,185	21,124	74,962	0	106,271
Kalimantan Timur	44,357	41,582	171,830	74,597	332,365
Total Kalimantan	1,048,611	1,389,813	1,072.769	1,266,811	4,778,004

Source: Ritung et al. (2012)

Table 3.4 Peat land in Papua Island

Province	Peatland area (ha)				Total (ha)
	Shallow (50–100 cm)	Medium (101–200 cm)	Deep (201–400 cm)	Very deep (>400 cm)	
Papua	1,506,913	817,651	319,874	0	2,644,438
Papua Barat	918,610	0	127,873	0	1,046,483
Total Papua	2,425,523	817,651	477,747	0	3,690,921

Source: Ritung et al. (2012)

3.3 Peatland for Agricultural Land Use

Agriculture in developing peatland starting from local community efforts of local daily life in the peat. Farming on peat at first naturally highly dependent on natural friendliness sometimes work well and sometimes fail miserably, dependence on natural conditions is very high. Local communities in peatlands have no choice but to seek to empower the peatland his best to make ends meet. Agricultural expertise as a legacy from generation to generation, giving a boost to local communities local to clear the land and cultivate it, especially for foodstuffs such as rice, sago, cassava, maize and others. Indigenous knowledge is passed down from generation to generation a lesson learned for the next generation. Various local wisdom in perspective the growing use of peat in the local community though on a limited scale, but can be used as a good learning (Noor 2012b).

With the growing needs of life, the land use was only limited to the needs of one or two families with three or four children as the number of family members, knowledge and experience, including as the communication and information needs of land increased to more widespread. So in an effort to expand the area of agriculture and food security, the government held the opening of wetlands, including peatlands to support the resettlement program since 1969 and other programs such as Food

Self-Sufficiency; Food Diversification; Revitalization of Agriculture Fisheries and Forestry (RPPK), National Rice Production Enhancement (P2BN) and Plantation Revitalization. Background peatland clearance for agriculture by the government initially inspired by the success of local residents in the region both in Kalimantan and Sumatra. However, not all locations are open to work well even leaving the poor and very serious damage to land.

Utilization of peat is very diverse because of limited understanding and experience. Each tribe or ethnicity who live and have lived in peatlands and the perception of different ways to utilize the resources of peat as agricultural land, including tribal migrants from Java, Madura, Nusa Tenggara, Bali and others who have a habit of farming in upland looked different. For example, farmers looked Banjarese peatland suitable for growing paddy rice, but farmers generally Javanese as newcomers looking peatland suitable for growing crops and vegetables. Similarly other tribes of different views, such as Bugis found more appropriate peatlands planted rice paddy, pineapple and coconut as in Riau and East Kalimantan, Central Kalimantan Dayak found more suitable peat fields planted with rice, rubber, rattan, jelutung, nibung or sago and fruits such as durian or cempedak. Others again, with tribes living in Bali Kalimantan peatland looked suitable for fruits like pineapples, cempeda unlike in West Sulawesi they looked more suitable for citrus and chocolate. Chinese people in West Kalimantan peatland generally looked more appropriate for planting vegetables such as cabbage leaves, ku cai (a type of union), celery, and aloe vera. While the Malays in Riau peatlands looked fit planted pineapple, coconut, rubber or oil palm (Noor et al. 2008).

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