How can REDD support the management of vulnerable carbon pools in Indonesian peatlands?

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Summary
Reducing emissions from deforestation and forest degradation (REDD) is a new mechanism currently proposed by the international community under the UN Framework Convention on Climate Change (UNFCCC). If it is implemented it will address 20% of the global emissions that are not covered under the Convention's Kyoto Protocol. In this context REDD in forested peatlands would offer multiple benefits from social, economic and environmental perspectives. As a vulnerable ecosystem with a huge carbon pool, peatlands have to be prioritised in terms of their contributions to the global carbon budget and other ecosystem services, such as flood regulation and habitats for diverse flora and fauna. Indonesian peatlands are estimated to cover an area of approximately 21 Mha, distributed mainly in Sumatra (7.2 Mha), Kalimantan (5.8 Mha) and Papua (8.0 Mha). The peat occurs with varying thicknesses and stages of decomposition, related to age or maturity. Most of the forested and degraded deep peat is located in Riau Province, Sumatra. In the past 5 years (2000-2005) the rates of deforestation on peatlands were 89,251 ha y^{-1} in Sumatra and 9,861 ha y^{-1} in Kalimantan. In Sumatra, deforestation occurred mostly on very deep peat especially in Riau Province (around 33,049 ha/y), while in Central Kalimantan it occurred on both shallow peat (1,620 ha y^{-1}) and very deep peat (2,569 ha y^{-1}). Based on the prospective REDD management options and potential threats to the carbon assets of Indonesian peatlands we propose three clusters namely, conservation, production, and conversion. We suggest that conservation, rehabilitation and wise use of peatland are managed differently. National Parks and protected areas can be managed with new conservation management involving a wide range of stakeholders. Areas under concession should be managed wisely to obtain maximum benefits.

Key index words: REDD, tropical peatland, protection, production, rehabilitation

Introduction
Ten percent of the 400 Million ha of peat in the world occurs in the tropics. However, 33% of the global peatland carbon store is contained in tropical peatlands (Post *et al.*, 1982; Page and Rieley, 1998). Sixty percent, or 25 Mha, of tropical peatlands are found in South-east Asia, and more than 21 Mha are located in Indonesia.

Increased land development, forest conversion and degradation, at times promoted by government economic development initiatives, have reduced peatland resources significantly. The rapid deforestation follows a process starting with degradation through legal and illegal logging, drainage, agriculture development and, increasingly, conversion to oil-palm and timber plantations. These activities cause large amounts of carbon to be released into the atmosphere. Hooijer *et al.* (2006) reported that in the past decade the annual release of carbon dioxide (CO_2) from tropical peatland in South-east Asia was around 2000 Mt comprised of emissions from fire of 1400 Mt y^{-1} and 632 Mt y^{-1} as a result of draining peatlands.

Peatland development is largely driven by the market for palm-oil and pulp and paper. Policies to develop peatland to some extent caused considerable and irreversible damage to vulnerable peatland ecosystems. Sustainable provision of ecosystem goods and services is under considerable threat. Conserving biodiversity, regulating water regime, and storing carbon by peatland ecosystems need considerable incentives and global efforts (Murdiyarso *et al.*, 2004).

European Community demand for palm-oil-based biofuels has been responded to relatively quickly by Indonesia and Malaysia. In 2003, an EU Directive requires that all member states use 5.75 % biofuels for total transportation by 2010, increasing to 8% by 2015 and 10% in 2020. Since locally produced biofuels in Europe compete with food production and security, the choice will be importing biofuels from tropical countries. Indonesia and Malaysia, which currently account for 85% of the world's supply of crude palm-oil, expect to earn US$ 6 billion annually from the premium European biofuels market.

The REDD scheme is being proposed as part of the new climate regime under the UNFCCC. This will provide new opportunities for the parties to the convention to meet trade carbon benefits from conserving the existing standing stocks of carbon. In this context the importance of below ground carbon in the peatlands is discussed.

Deforestation rates in forested peatlands

In connection with the REDD scheme it is necessary to quantify and locate the past and current areas and status of forested peatlands in order to estimate the rate of deforestation, possible threat of existing peatlands, and management options regarding REDD or business-as-usual scenarios. In order to design an effective national strategy for peatland management options, it is crucial to have good quality of spatial and temporal data that are in line with the existing forest management and REDD policies (MoF, 2007).

Assessment on deforestation rate during 2000-2005 was carried out using MODIS and the data were made available for further interpretation (Hansen *et al.*, 2006). After rasterisation, the map (which was in a vector format) was superimposed on peat distribution maps (Wetlands International, 2003; 2004, 2006). The deforestation rate in peatland was then derived and presented by several categories, such as political boundary and biophysical aspects. Table 1 shows deforestation rate by peat depth which can be used to prioritize management action when REDD is implemented. Further relevant analysis is the proximity of fire disturbance. Fire hotspot counts were identified and the frequencies in terms of number of days per year that a particular area is exposed to fire risk were calculated by delineating an area of 2 km radius from hotspot centres.

Clustering peatlands for carbon management options

In order to identify potential demonstration activities it is necessary to have a general guidance. We propose a clustering method which consists of two steps. The first step is based on the designation of forest land mainly owned by the state. There are 10 forest land-use categories recognised for management purposes. The category implies the way forests are used, protected and permanently converted. Based on the general allocation the state forest lands may be clustered into: (i) *protection cluster* with low probability of deforestation; (ii) *production cluster* with medium probability of deforestation and (iii) *conversion cluster* with high probability of deforestation.

The second step is meant to sub-group the above clusters by addressing the interactions between biophysical and human factors. It is also designed to identify target areas for specific sets of management options that meet possible legal framework for demonstration activities.
This grouping includes the following variables:

- ***Peat extent and depth.*** These indicate carbon density in the landscape. The thicker or deeper the peat the higher the carbon density, hence the more preferred for REDD project implementation. Based on the existing maps there will be five classes of peat depth, which we use to weigh the peat extent using the following weighting scheme based on assumed average of peat depth in each category:

- ***Fire risk index***. This reflects interaction between biophysical characteristics and anthropogenic factors. The higher the risk the more prone to fires, hence the less preferred for REDD project implementation. Fire Danger Rating System (FDRS) that indicates the level of fire risk is extensively used in the region, although for a specific use in peatland it still requires improvements.

Table 1. Annual deforestation rate (ha y-1) during 2000-2005 on forested peatlands of Sumatra and Kalimantan by peat depth

Province	Peat depth					Total
	<50 cm	50-100 cm	100-200 cm	200-400 cm	>400 cm	
NAD	47.8	0	541.8	478.8	0	1,068.4
Jambi	188.2	1,218	855	1,929.8	225.6	4,416.6
Riau	256	4,480	18,291.4	15,101	33,049	71,177.4
W. Sumatra	330.6	345	391.2	161.2	1,252.4	2,480.4
S. Sumatra	351.6	293.6	1,666.6	6.4	0	2,318.2
N. Sumatra	232.6	2,664.6	3,817.6	1,075.6	0	7,790.4
W. Kalimantan	0	2,583.2	848.8	199.4	78	3,709.4
S. Kalimantan	21.2	254.8	256.4	77.2	0	609.6
E. Kalimantan	0	43.4	5.8	361.8	0	411
C. Kalimantan	70.2	1,620.4	250.6	620.6	2,569.4	5,131.2
Total	1,498.2	13,503	26,925.2	20,011.8	37,174.4	99,112.6

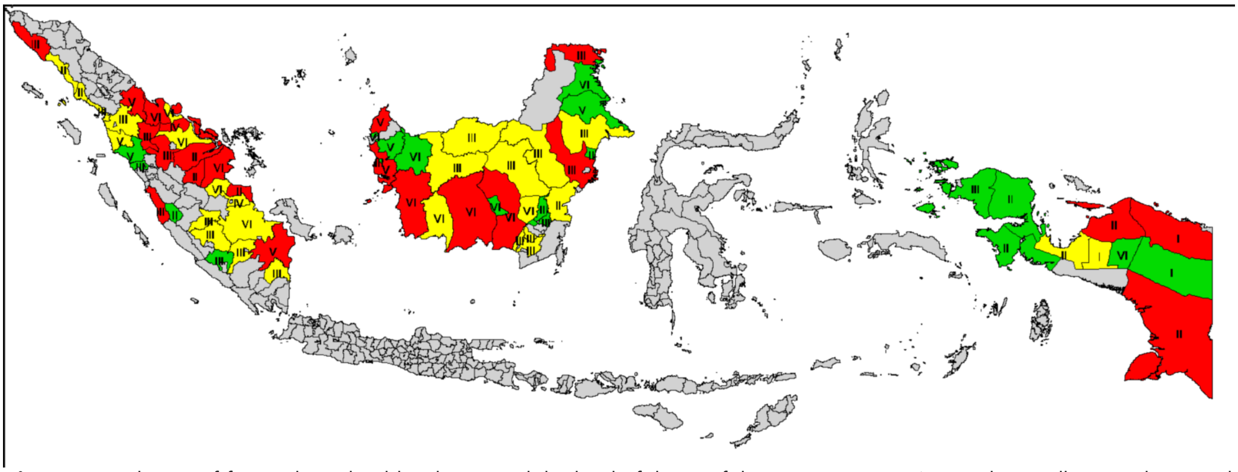

Figure 1. Clusters of forested peatland by district and the level of threat of the REDD activities (green=low; yellow=medium; and red=high)

- ***Deforestation rate*** in the past is used as a proxy of trends of policy-driven 'business as usual' scenario.

Since the three clusters overlap with each others we have six categories of allocation. Assuming each of the three variables (peat extent, fire risk index and deforestation rate) is of equal importance in determining threat level that is categorized into low, medium and high. In order to have a finer resolution, in this analysis we use district as political boundary. This way the clusters of peatland for potential demonstration activities may be shown in Fig. 1.

How would REDD work?

In 2000 2.5 Mha (12% total peatland area) are managed as HPH, 2.1 Mha (10%) as HTI, and 2.8 Mha (14%) as oil-palm plantation. It means that more than one third of Indonesian peatlands are managed, of which around 3 Mha are degraded and need a great deal of rehabilitation that requires international efforts with appropriate sustainable development objectives. The majority of peatlands is not managed and is likely to be eligible for 'strict' REDD project activities.

It is expected that the proposed REDD scheme may be implemented under different management options regarding the designated forest land-use. The demonstration activities may be designated in areas with low level of threats and high level of carbon density (green area in the map). The identified demonstration area should also consider the capacity of the stakeholders, including the local governments.

Peatlands in some Districts of NAD, Riau, Jambi, East Kalimantan and Papua Provinces are categorised in the 'Protection' cluster. The threat in Jambi is low, medium in NAD, and high in Riau. Meanwhile East Kalimantan and Papua experience low to medium threat. In contrast, areas categorised in the 'Conversion' cluster with high threat are found in Riau (Kampar and Rokan Hulu Districts), West Sumatra (Pesisir Selatan District), and East Kalimantan (Nunukan and Kutai Districts). The typology of peatland may be used in considering pilot ideas and necessary interventions.

Concluding remarks

At this point in time it is appropriate to mention that the Peatland Atlases produced by Wetlands International are the best available information, and should therefore be considered as the bases for further improvement.

It would be desirable to undertake additional surveys consisting of: remote sensing analysis, field sampling, and mapping for Sumatra, Kalimantan and Papua. The field surveys for Sumatra and Kalimantan should be based on a planned and optimized sampling grid. In the case of Papua a proper field survey should be undertaken as the 2000-2002 Atlas is based on remote sensing data but no systematic field sampling survey.

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