Reducing carbon emissions from Indonesia's peat lands

Interim Report of a Multi-Disciplinary Study

December 2009

This study is commissioned and led by the Indonesian National Development Planning Agency (BAPPENAS), with the support of experts from the Ministry of Forestry, the Ministry of Agriculture, Centre for Climate Risk and Opportunity Management in South East Asia and Pacific, the Bogor Agricultural Institute (CCROM SEAP-IPB) and the Indonesian Centre for Environmental Law (ICEL). The UK Department for International Development and the Netherlands Ministry for Development Cooperation have provided co-funding.

BAPPENAS, Republic of Indonesia

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Summary

Indonesia has made a non-binding commitment to reduce its GHG emissions by 26-41% by 2020. With 22 million hectares of peat land that contribute in the order of 1 billion tons of CO_2 emission per year, the government is assessing policies to meet this target. This study presents the provisional results of an analysis commissioned by the National Development Planning Agency (BAPPENAS) to assess the scientific basis, economic and legal aspects for reducing emissions in Indonesia's peat land.

Current annual average emissions between 2000 and 2006 are estimated to be 903 $MtCO_2$. Based on current trends, a Business as Usual (BAU) scenario is estimated to result in emissions of 1,387 $MtCO_2$ by 2025. A provisional analysis of the current economic contribution of Indonesia's peat land area highlights that the utilisation of peat land probably contributes less than 1 percent of GDP yet accounts for almost 50 percent of emissions, resulting in a highly carbon intensive economy in peat land regions.

The potential emissions under each of three main policy measures are estimated and compared to the BAU scenario. The initial results from this analysis show that:

- *Legal compliance and best management practices in existing land under production* could yield 338 Mt CO_2 emission reductions by 2025 (24 percent of potential reductions)
- *Peat land rehabilitation and prevention of uncontrolled fires* potentially may add a further 430 Mt CO_2 emission reductions (31 percent of potential reductions)
- *Revision of land allocation, forest conservation and land swaps* that direct future development away from peat land could create an additional 513 Mt CO_2 emission reductions (37 percent of potential reductions).

An economic and financial analysis of oil palm on peat land indicates that at the national level, there is unlikely to be a significant opportunity cost associated with relocation of existing permits to mineral soils given the availability of degraded land and the higher yields and lower costs on mineral soils. However, at the local level, districts with significant peat land areas may incur opportunity costs due to the limited availability of suitable mineral soil in their area.

Overall, an effective institutional framework for peat and lowland management is required in Indonesia to overcome overlapping mandates of sector agencies. The first policy option, best practice management in peat lands, can be promoted through a performance-based framework with appropriate standards, incentives and sanctions. However care will need to be taken in the development of appropriate financial incentives. A national strategy, plan and finance for peat land rehabilitation and fire prevention in degraded peat lands is needed, building on and supporting the government initiative to rehabilitate and revitalise the Ex-Mega Rice Project Area in Central Kalimantan. The third policy option will require a comprehensive review of spatial plans and development of spatial planning tools in the context of peat and lowland areas combined with a review of experience on land swaps and the potential to scale up experience from pilots to a national scale policy and program focused on peat land.

The development of peat land carbon policies and their articulation at the international level, in particular the UNFCCC, is required given the uncertainty regarding the position of peat land emissions in a post-2012 agreement. Early action can potentially be achieved through public funds and the Clean Development Mechanism.

Overall strategies to address peat land emissions should form a part of an overall National Strategy for the Sustainable Management of the Lowlands that addresses the specific challenges of peat and lowland development in the context of climate mitigation and adaptation.

The second phase of this study will continue in early 2010 and will further refine the analysis, assess the economic aspects of reducing peat land emissions including aspects relating to carbon finance and costs following the UNFCCC COP in Copenhagen.

1. Introduction

1. Peat lands in temperate and tropical countries are increasingly recognised as an important source of anthropogenic greenhouse gas (GHG) emissions.[i] Indonesia, with peat land covering about twelve percent of the country's land area, is of particular importance, accounting for more than 50% of the global peat land area within non-Annex I countries.[ii] Indonesia has announced a non-binding GHG emissions reduction target of up to 26 percent unilaterally and 41 percent through external support by 2020. Its extensive peat lands present three specific opportunities to achieve this target:

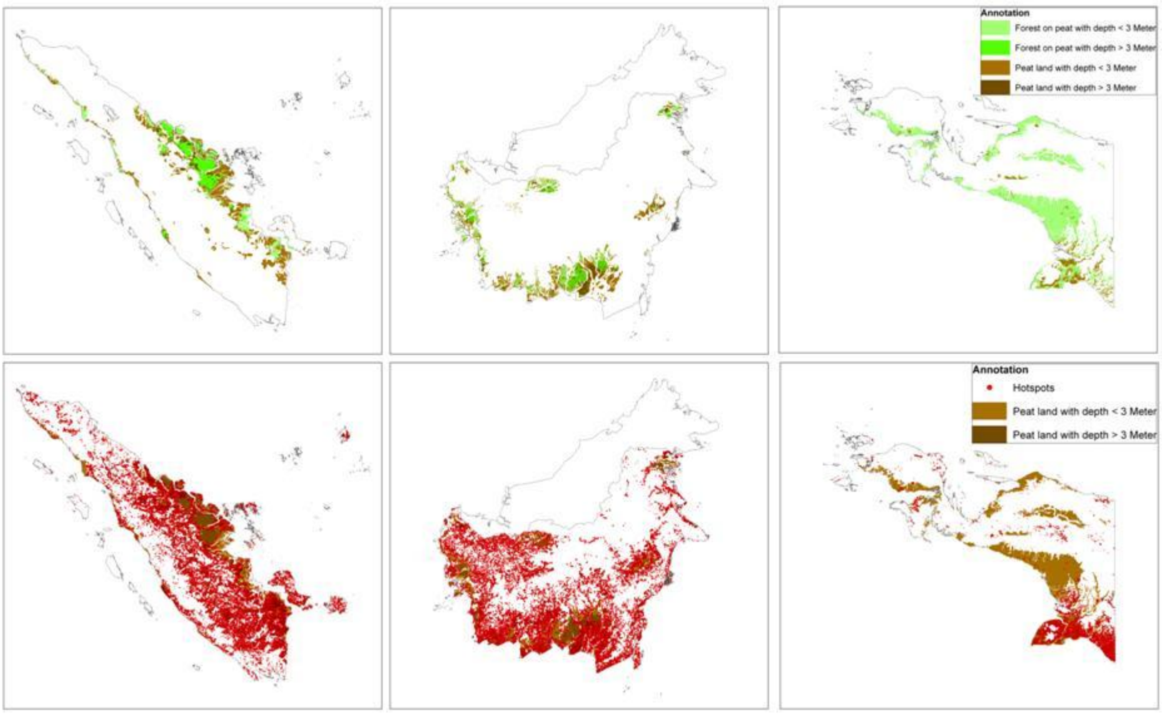
I. Improvement of peat land management practices to reduce emissions in peat land currently under forestry and agricultural land use;

II. Rehabilitation of degraded peat land to reduce emissions through fire prevention and the rehabilitation and management of unproductive peat land;

III. Consolidation and revision of spatial plans and land use permits to reduce emissions through redirecting economic land use away from peat land to mineral soils.

2. This brief presents the provisional results of a detailed analysis commissioned by Indonesia's National Development Planning Agency (BAPPENAS), and undertaken by a multi-disciplinary team of Indonesian scientists, economists and legal specialists. The objective of this analysis is to assess the potential for reducing emissions from the country's peat lands.[iii] The analysis assesses (a) the present extent, land use and land cover of Indonesia's peat lands, (b) the magnitude of current peat land emissions, (c) the possible carbon abatement potentials under the three different policy scenarios, (d) the economic costs and benefits of specific policy options and actions to reduce emissions, and (e) the potential application of national and international policy instruments to achieve GHG emission reductions in Indonesia's peat land.

Figure 1 - The distribution of peat land in Sumatra, Kalimantan and Papua/West Papua with the extent of forest (top) and hotspots during the period of 2000-2006 (bottom)



2. Peat Land in Indonesia

3. Indonesia has around 22 million hectares of peat, mostly in Sumatra (7.2 million ha), Kalimantan (5.8 million ha) and Papua (8.0 million ha). [iv] Peat more than three metres thick, covering around 8 million hectares, is protected by law in order to preserve the unity of the core peat dome.[v] More than 55% of the peat land in 2006 was still forested (Figure 2) with other predominant peat land covers including cropland (14%) and shrub / grassland (20%). Development and drainage of peat land is most advanced in Sumatra, less so in Kalimantan. Much of the peat in Papua remains undeveloped (see Figure 1, top). Nationally, trends in land cover change during 2000-2006 shows that shrub / grassland has expanded by 55% to 4.4 million hectares in 2006, while the forest peat land area has declined by 15 percent to 12.0 million hectares (Figure 2).

4. Almost one-quarter of Indonesia's peat land is protected or conserved (Table 1). About 3.3 million hectares of this is still forested with the remainder in need of rehabilitation. As of 2006, forestry and plantation licenses on peat totaled 5.6 million hectares. Agriculture, plantation timber and plantation crops cover more than 3 million hectares of the land allocated for development with more than 8 million hectares still forested. Over 2.5 million hectares of peat land allocated for development is believed to be more than three metres deep, which is protected by law.

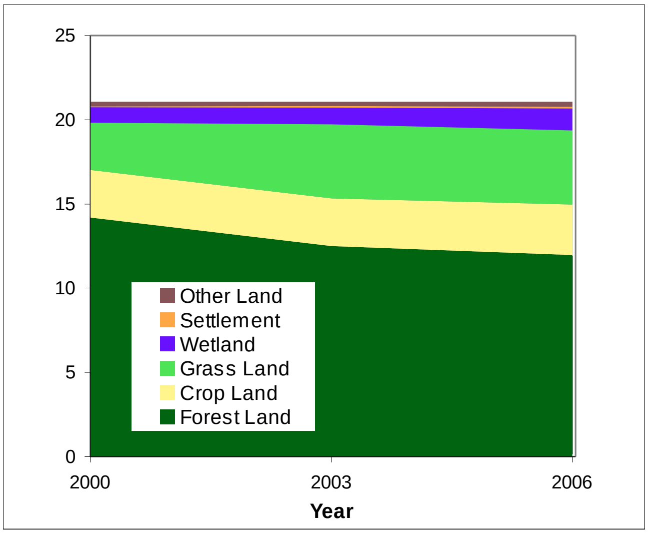


Figure 2: Changes in land cover in Indonesia's peat land 2000-2006. *Source*: Department of Forestry, Indonesia.

Table 1: Land use allocation (conservation, protection or development) and land cover in Indonesia's peat land by main island with peat in 2006. *Source*: Department of Forestry, Indonesia.

Major Land Use / Land Cover	Peat Thickness	Area (hectares)			
		Sumatra	Kalimantan	Papua	Total
1. Conservation					
1.1 Forest	< 3m	179,234	327,951	1,251,741	1,758,925
	> 3m	184,242	400,521	0	584,764
1.2 Non-forest	< 3m	85,779	168,821	346,963	601,563
	> 3m	9,757	98,246	0	108,002
Total (Conservation)		**459,012**	**995,539**	**1,598,704**	**3,053,254**
2. Protection					
2.1 Forest	< 3m	81,328	143,990	617,470	842,788
	> 3m	41,657	132,850	0	174,507
2.2 Non-forest	< 3m	131,281	106,762	203,591	441,634
	> 3m	12,847	242,828	0	255,674
Total (Protection)		**267,113**	**626,430**	**821,061**	**1,714,604**
3. Development (Forestry and Non-Forestry)					
3.1 Forest (land cover)	< 3m	1,294,297	1,429,935	4,309,122	7,033,354
	> 3m	1,116,758	472,937	0	1,589,695
3.2 Timber plantation	< 3m	183,112	6,771	552	190,435
	> 3m	133,522	2,126	0	135,648
3.3 Plantation	< 3m	1,110,082	150,253	2,150	1,262,485
	> 3m	136,051	20,394	0	156,444
3.4 Agriculture	< 3m	855,153	346,596	34,838	1,236,587
	> 3m	22,387	20,333	0	42,720
3.5 Other	< 3m	1,270,766	1,402,106	1,343,495	4,016,367
	> 3m	349,597	292,542	0	642,139
Total (Development)	< 3m	**4,713,410**	**3,335,660**	**5,690,157**	**13,739,228**
	> 3m	**1,758,315**	**808,332**	**0**	**2,566,648**
Total		**7,197,850**	**5,765,961**	**8,109,922**	**21,073,733**

3. GHG Emissions and the Economic Contribution of Peat Lands

5. Although deforestation, forest degradation and agricultural development in peat lands has contributed to economic development, it also causes GHG emissions as a result of (a) peat oxidation resulting from drainage, (b) dry season peat land fires and (c) loss of above-ground biomass (AGB) from non-fire related legal and illegal deforestation and degradation.

6. Most agricultural crops grown in peat land require wet season drainage. However, drainage of peat introduces oxygen into the surface, which promotes decomposition. The result is that (a) organic matter in the peat (carbon) is lost through oxidation and (b) the land surface subsides. In the Netherlands, agriculture and drainage of peat over the years has led to areas being 6-8 metres below sea level, requiring costly sea defenses and other water management systems. Drainage and loss of forest creates degraded peat land that can become highly susceptible to fires lit in the dry season, especially in el Nino years, and canals and roads provide people with access. Fires lit to clear land by plantation companies and smallholder farmers as well as for other reasons can rapidly spread out of control. These fires create trans-boundary haze, at significant cost to the national economy, to the health of people and to efforts to tackle GHG emissions.

Previous Estimates Of Emissions From Peat land In Indonesia

National levels of emissions from peat in Indonesia remain uncertain, although the scientific basis and the conclusion that these are significant emissions remain valid. Interest in this was simulated by the publication of *Peat CO2* in 2006, which used secondary data to estimate average annual emissions of 600 Mt CO_2/yr from peat land oxidation and 1400 Mt CO_2/yr from fire in SE Asia. This study emphasised the uncertainty associated with these estimates and outlined the key knowledge gaps. In particular, understanding of the form of the relationship between drainage depth, peat subsidence and emissions remains poorly developed, although the general

Following on from the *Peat CO2* study, van der Werf *et al.* (2008) used several approaches to estimate annual average fire emissions from peat and forest fires. Their mean annual estimate from 2000-2006 of 470 Mt CO_2/yr is now widely accepted, and this study has been used for both the Indonesian National Climate Change Council (DNPI) assessment of the national GHG cost abatement curve and the Government of Indonesia's Second National Communication (SNC) to the UNFCCC. Uncertainties still remain over the exact figure and overall magnitude of emissions from oxidation and to a lesser extent loss of AGB, with the DNPI estimating oxidation emissions of 300 Mt CO_2/yr and the SNC 222 Mt CO_2/yr (including soil carbon). These figures will continue to be refined and revised but perhaps more critical is the development of MRV methodologies to provide robust methods for quantifying peat land emission reductions.

7. Undisturbed naturally forested peat lands either have a balanced carbon budget or show a net accumulation of carbon through the natural process of peat formation. Carbon sequestration rates from natural peat lands in Indonesia have been estimated to be up to 0.8 t C $ha^{-1}yr^{-1}$ (Page et al. 2004). Carbon is also sequestered by the growth of above-ground biomass in secondary forests (7.0 t C $ha^{-1}yr^{-1}$), plantation crops (2.4 t C $ha^{-1}yr^{-1}$) and other non-forest vegetation such as grassland and shrub land (0.6 t C $ha^{-1}yr^{-1}$).[vi] Overall the amount of carbon sequestered by peat land is much lower than the emissions from oxidation, fire and the loss of above-ground biomass through deforestation.

3.1 GHG Emissions from Peat Land

8. An assessment of Indonesia's peat land GHG emissions from fire, peat oxidation and loss of AGB, completed according to IPCC Tier 2 standards, shows average annual net emissions of 903 Mt CO_2 yr^{-1} between 2000 and 2006.[vii] This estimate is based on (a) team estimates of emissions from oxidation of 220 Mt CO_2/yr using land use and land cover data from 2000-2006 and previously published emissions factors, (b) loss of AGB of 210 Mt CO_2/yr based on past rates of deforestation and carbon stock in peat swamp forests and (c) a fire emissions estimate of 470 Mt CO_2/yr from van der Werf *et al.* (2008) that has been disaggregated into controlled and uncontrolled burning. Controlled burning

is defined as fires occurring in land converted into peat and agricultural land. This estimate is broadly similar to the National Climate Change Council estimate and the data presented in the Second National Communication (SNC) to the UNFCCC.[viii]

9. The majority of the peat emissions during this period are estimated to be a result of uncontrolled burning (defined as fires occurring outside of licensed areas and contributing 46% of total emissions), peat oxidation (25%) and biomass removal (24%) with the main source regions being Sumatra (44%) and Kalimantan (40%) (Figure 3). Emissions show a strong inter-annual variation due to factors that influence dry season rainfall such as El Nino and there has also been a reduction in loss of peat swamp forest in the period 2003-2006. Sumatra and Kalimantan dominate the national peat emissions profile with fire-related emissions being greater in Kalimantan than Sumatra, while oxidation emissions are greater in Sumatra than Kalimantan. This pattern probably reflects the fact that development peat land in Sumatra preceded that in Kalimantan.

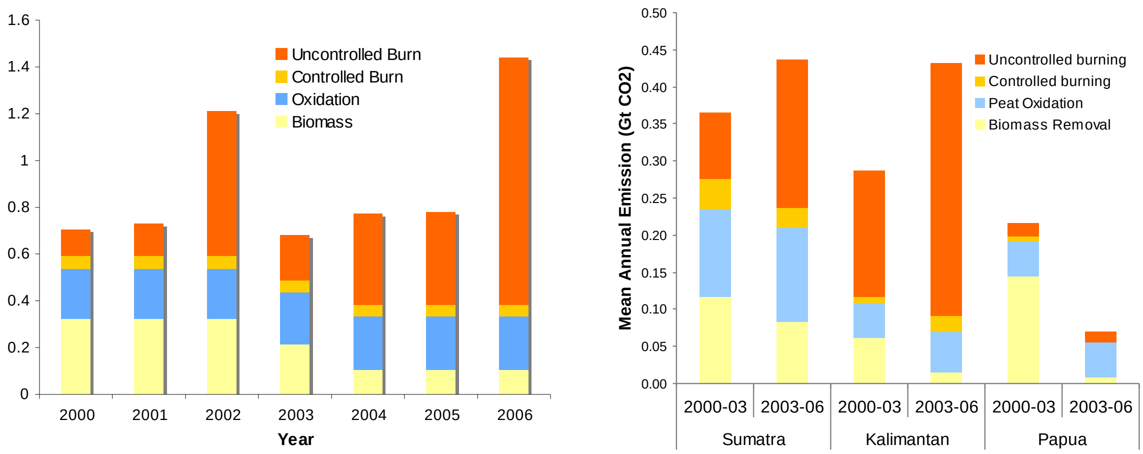


Figure 3: Estimated carbon emissions from Indonesia's peat lands as a result of loss of above-ground biomass, peat oxidation and fires (controlled and uncontrolled) (left) and their source area (right). *Source*: Study team.

3.2 Economic Contribution of Peat Lands

10. Peat land areas contribute to the national economy principally through the forestry, plantations and agriculture sectors. The plantations and forestry sectors contributed 3 percent or USD 12.6 billion to the national economy in 2007. The oil palm plantation sector alone is estimated to contribute 0.85% percent of GDP and to have created in the region of 3 million jobs.[ix] The analysis to estimate the contribution from peat lands to the national economy is ongoing. But assuming their economic contribution is proportionate to their share of productive land use (data suggest it is actually somewhat less than proportionate) and that 25.4% of Indonesia's peat land is now licensed for forestry production (4.79 million hectares) and oil palm plantations (840,000 hectares), then peat land (excluding agriculture for food crops and other local economic activities) contributes in the region of USD 1.06 billion (or 0.26 percent) to the total national economy (GDP).

11. Comparison of the economic contribution of peat lands with their emissions provides an estimate of the 'carbon intensity' of land use on peat land. For example, taking the recent estimate of carbon emissions in 2005 from Indonesia's National Climate Change Council, the carbon intensity of the national economy in 2005 was 7.5 kg of CO_2 for each US dollar of GDP. If we compare the seven "peat provinces" that account for 90 percent of Indonesia's peat, their carbon intensity based on regional GRDP and mean annual emissions as estimated here (i.e. only peat emissions) is 22.1 kg of CO_2 per US dollar of GRDP. Peat land emissions in Indonesia therefore create a high carbon intensity with a relatively limited contribution to the overall economy.

4. Policies and Actions to Mitigate Peat Land Carbon Emissions

12. Indonesia has the potential to reduce emissions from its peat lands but this will require a range of possible actions each with both direct costs and indirect costs to the national economy.

4.1 Policy Options for Reducing Emissions in Peat Land

13. Three broad peat land emissions mitigation policies are identified in this study.

Mitigation Policy 1 - Improvement of Peat Land Management Practices to reduce emissions in peat land currently under forestry and agricultural land use. This policy might be directed at enforcing existing legal requirements and establishing new standards for best practices in 'low carbon' peat land management. Three main mitigation actions are defined:

- Enforce strict compliance by existing forest and plantation concessions with regulations forbidding the cultivation of peat more than three metres thick.
- Provide incentives, sanctions and enforce (a) the zero burning policy for land clearance by companies and (b) best practices for water management to reduce subsidence and carbon emissions from oxidation in peat land under cultivation.
- Establish best practices in soil management including the addition of ameliorant to reduce emissions.[x]

Mitigation Policy 2 - Rehabilitation of Degraded Peat Land to reduce emissions through an integrated approach to prevent uncontrolled fire, hydrological rehabilitation, reforestation and socio-economic development leading to the rehabilitation and wise management of unproductive, unused peat land. This is crucial with a 55% increase in the area of degraded peat land over 2000 – 2006.

Mitigation Policy 3 – Revision of Land Allocations, Spatial Plans and Land Use Permits to reduce emissions through redirecting economic land use away from peat land to mineral soils.

- Reclassification of forest in non-forestry development zone (APL) to protection or conservation zone (revision of spatial plans)
- Reclassification of remaining peat land that is not yet licensed to protection or conservation (no new licenses on peat and a revision of spatial plans).
- Relocate licenses or parts of licenses where companies have not yet initiated operations on the ground, from peat to mineral soils (land swap).

14. The three policy measures and seven mitigation actions have been nested into a series of policy scenarios (see Table 2) and assessed against a Business as Usual (BAU) scenario. The BAU scenario assumes all peat areas currently allocated to companies are developed with fire emissions continuing based on historical emissions, which provides an estimated increase in emissions to 1,387 Mt CO_2 yr^{-1} by 2025. Comparison with the emissions for each of the policy mitigation scenarios that describes increasingly ambitious actions to reduce peat emissions provides an indication of the magnitude of emissions reductions (see Table 2, note that these are provisional figures from the analysis). Further details of the assumptions in the mitigation scenarios are provided in the endnotes.[xi]

15. The three best practice actions under mitigation policy option 1 focusing on peat land currently under management may provide up to 338 Mt CO_2 / year abatement potential, representing a total emissions reduction of 24 percent on BAU. Although these actions are not considered to incur opportunity costs, there are likely to be barriers for action that could be assessed through a Regulatory Impact Assessment. Policy option 2, rehabilitating degraded unproductive peat land and reducing uncontrolled fires in these areas by 90 percent, could add a further 430 Mt CO2 / year abatement potential and combined with policy option 1 reduce peat land emissions by a total of 55 percent from

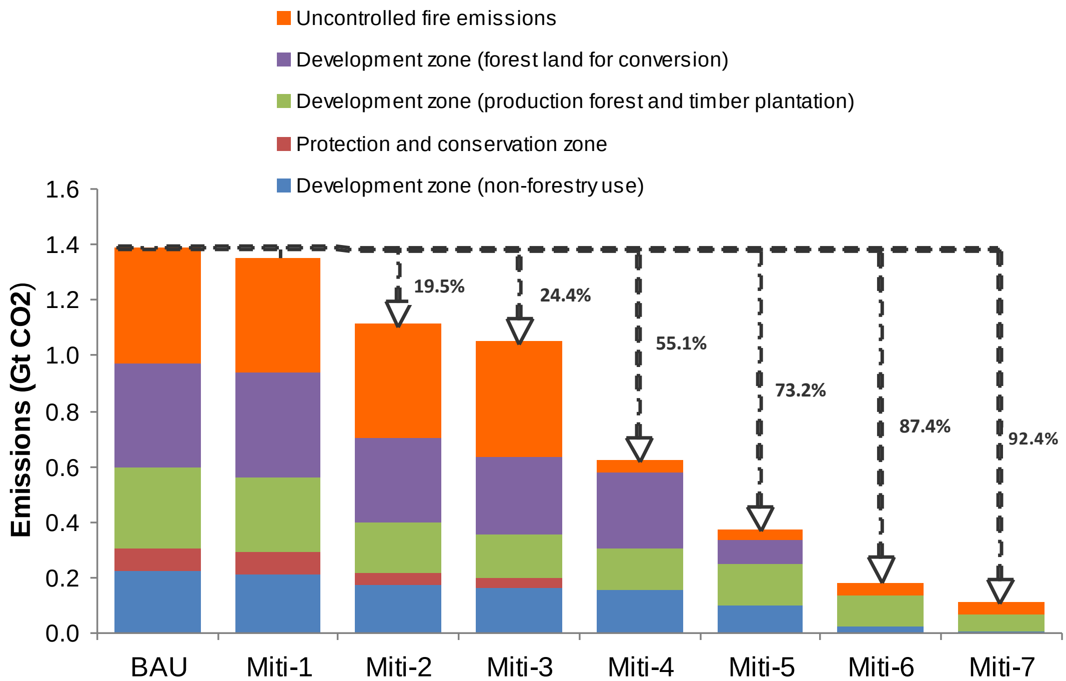
the BAU scenario by 2025. The final policy option of conserving and protecting existing peat land including forest and non-forest areas that is unlicensed and relocating licensed areas that are not yet operational to mineral soils could add a further 513 Mt CO2 / year abatement potential. All actions together are estimated to have the potential of reducing Indonesia's peat emissions by 92 percent, a total reduction of 1.28 Gt CO2 / year by 2025.

Table 2: Mitigation options, emission reductions and policy scenarios for peat land in Indonesia. These show the estimated emissions based on a cumulative series of policy actions to reduce emissions based on a BAU scenario which shows peat land emission growing to 1,387 Mt CO2 in 2025.

Policy	Mitigation Action	Policy Scenario							Emission Reduction	Cost Type
		1	2	3	4	5	6	7		
(1) Best Practice	1. Compliance <3m	3	3	3	3	3	3	3	F,Ox,AD	T*
	2. No burning & improved water		3	3	3	3	3	3	F, Ox	I,T
	3. Ameliorant			3	3	3	3	3	Ox	I,T
(2) Peat Rehab.	4. Peat land rehabilitation				3	3	3	3	F,Ox,AGB	I,T
(3) Land Allocation and Permits	5. Conserve forest in non-forestry					3	3	3	Avoided (F, Ox, AGB)	O,T
	6. Protect unlicensed peat land						3	3	Ox,AGB	O,T
	7. Land swap unused licenses to mineral land							3	F,Ox,AGB	O,I,T
Emissions in 2025 (Mt CO2 / year)		**1351**	**1117**	**1049**	**619**	**372**	**175**	**106**	-	-
% Incremental Emissions Reduction from BAU		2.6	16.9	4.9	31.0	17.8	14.2	5.0	-	-
% Cumulative Emissions Reduction from BAU		2.6	19.5	24.4	55.4	73.2	87.4	92.4	-	-

Source: Team analysis. Abbreviations: *Emission reduction*: F =fire, Ox = oxidation, AGB = increase in above ground biomass, AD = avoided deforestation and degradation. *Cost types*: O = opportunity cost, I = intervention costs, T = transaction cost. * Legal compliance is not considered to incur an opportunity cost.

Figure 4: Baseline (BAU) and estimated emission reductions from peat land in 2025. For further details see text and Table 2.



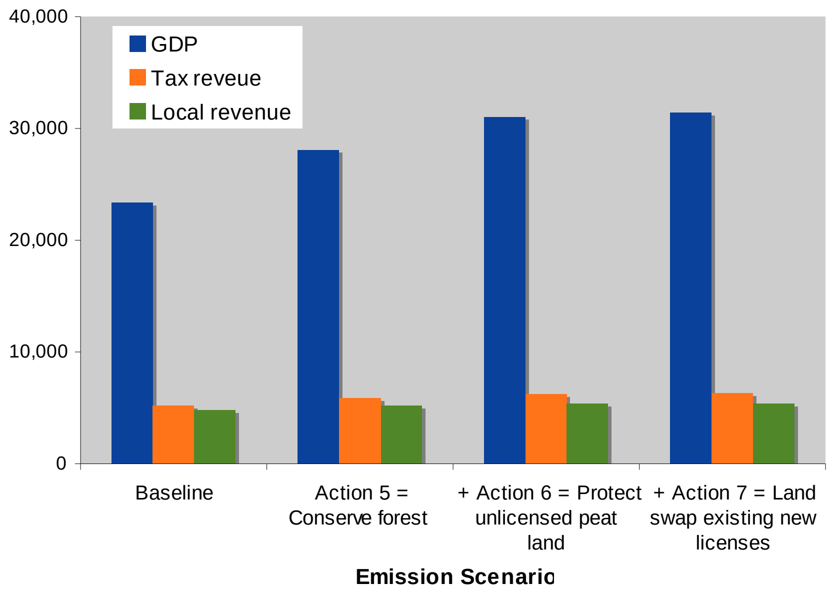
4.2 The Economics of Reducing Emissions in Peat Land

16. The key to emissions reductions in peat lands is unlocking the non-direct use value contained within their total economic value and ensuring that this balances any reductions in direct use value as a result of policy actions. The main objective in the context of climate change is the need to create value through emission reductions that can be traded or used to access public funds based on robust methodologies for monitoring, reporting and verifying (MRV) emission reductions. This study is assessing the overall economics of reducing emissions in peat land and will be presented in full in 2010.

17. A preliminary analysis has been undertaken that assesses the possible opportunity costs for the third policy option - revising land allocations and permits. Opportunity costs for these actions can come through lost revenue as a result of (a) the protection and conservation of unlicensed forested peat land currently allocated for development (mitigation action 5), (b) the protection of all unlicensed peat land (mitigation action 6) and (c) the relocation of existing licenses that are not yet operational from peat land to mineral soils (mitigation action 7). Analysis of this option concludes that it is likely that sufficient degraded mineral land is available for future productive use as an alternative to peat land (current estimates of this are being developed within the estimated 8 million hectares of potentially suitable degraded land, see paragraph 26) and that yields are higher and costs lower on mineral soil (see next section).

18. Overall, this analysis shows that there is a net positive benefit for all three actions on GDP and to a lesser extent on tax revenues and local revenues (Figure 5). Therefore, the macro impact of these mitigation strategies, especially at the national level, is unlikely to involve opportunity cost due to availability of land. However, a potential opportunity cost may still exist at the local level (for instance where land swaps to mineral soils are not possible such as in districts with large areas of peat land), and thus some allowance will need to be made for these local opportunity costs. Low carbon regional development strategies with a particular focus on the unique nature of these lowland areas, pro-poor rural development and alternative livelihood strategies will be required, the cost being borne by any carbon revenue that results from the reduced emissions on such land.

Figure 5: Net Present Value of GDP, tax revenues and local revenues of the BAU baseline compared to the cumulative economic benefits (costs) of the three mitigation actions for revising land allocations and permits under policy option 3. *GDP = net value added, net of financing costs and imports, Tax revenue = export tax (5%), company income tax (15%) and land tax, Local revenue = labour cost plus compensation paid for land.*



5. Government and the Private Sector: Incentives for Action

5.1 The Roles of Government and the Private Sector

19. Achieving emissions reductions will require a range of complementary actions both by government and the private sector (Table 3).

Table 3: The economic costs and potential roles of government and the private sector for the proposed mitigation policies and key actions.

Policy	Key Actions	Economic Costs	Government Action	Private Sector Action
1. Best practice peat land management	* No future development of peat >3m thick * Zero burning * Best practice water and soil management (inc. soil ameliorants).	*Opportunity Costs* – Zero due to legal compliance. *Intervention costs* – Policy, incentives, management practices. *Transaction costs* – MRV and other	Policy and standards setting; provision of incentives and sanctions; MRV systems as part of national carbon accounting.	Financial instruments (such as leaseback and securitisation) to cover intervention costs for zero burning, fire control, water and soil management.
2. Peat land rehabilitation	* Fire prevention * Hydrological rehabilitation * Forest rehabilitation * Agricultural development with a focus on intensification * Community empowerment and socio-economic development	*Opportunity Costs* – Zero as land with no economic alternative *Intervention costs* – Policy, incentives, management practices, direct funding of government programs. *Transaction costs* – MRV and other	Policy and standards setting including priority setting and licensing; direct financing of interventions; MRV systems as part of national carbon accounting; benefit sharing.	Finance for peat land rehabilitation (as current system for restoration of forest ecosystems) including carbon finance
3. Revised spatial plans and land allocations	* Revise status of existing forest in development areas to protected status * Land swaps / cancellation of permits for inactive companies on peat land * Land swaps / cancellation of permits for companies that have not completed permit process on peat land	*Opportunity Costs* – Lost revenue from reduced area for development and revision of land allocation and permits. . *Intervention costs* – Policy, incentives, costs of revising land allocations / land swaps. *Transaction costs* – MRV and other	Policy and standards setting including priority setting; provision of incentives and sanctions; direct financing of interventions; MRV systems as part of national carbon accounting; benefit sharing.	Participation (voluntary / compulsory) in land swaps including review of costs and benefits for current and alternative business models

20. Broadly speaking, each mitigation policy will require the following actions by government and the private sector:

- **Policy Option 1:** Emissions mitigation through best practice peat land management by the private sector (policy option 1) will require government to set clear standards and effectively enforce these through a system of rewards and sanctions based on performance. This may yield up to emission reductions of 338 Mt CO_2 / year.

- **Policy Option 2:** Peat land rehabilitation will require a mix of private sector and government action and could generate a further 430 Mt CO2 / year emission reductions by 2025. The investment finance required can be found through the private sector, where value is generated through tradable emissions reductions. The model of peat land rehabilitation will be vital to successful outcomes and will require strong partnerships between government, the private sector and community. Past experiences in Central

Kalimantan (CKPP) show that community-based approaches are a prerequisite for successful peat land rehabilitation.

- **Policy Option 3:** Revising land allocations in spatial plans and land swaps, will require government action and support from the private sector with the potential to yield an estimated 513 Mt CO_2 / year. Legislation in Indonesia already regulates the termination of a plantation holder's right if plantation development has not commenced after three years, so action here will be required to implemented this combined with revision of spatial plans and possible land swaps. This third policy option is the only policy response that may incurs opportunity costs for Indonesia due to the reduction in peat land area used for production. This too will require government and private-sector action, but will require clear incentive measures including compensation for revenue foregone (interim finance and carbon revenues) and an investment in alternative business practices on mineral soils. Done correctly, the longer-term benefits of this shift may far outstrip the opportunity costs involved (see analysis of the business case, below).

5.2 The Business Perspective: Plantations on Peat

21. This study has assessed these policy measures from the business perspective of the private sector. The main question is to what extent economic incentives might be required for plantation companies (based on oil palm) to (a) implement best practices and (b) participate in land swaps from peat land to mineral soils. This business assessment is based on comparison of the economics of oil palm on peat land and mineral soils, with the costs for plantation establishment and production being higher on peat land due to the need for drainage infrastructure and higher inputs combined with lower yields. Best practice management is also assumed to generate better yields through improved water, fire and agronomic management practices.

Costs of Implementing Best Practices in Oil Palm on Peat

22. Comparison of the performance of a standard 'business as usual' model with a 'best practice' model can be used to calculate the costs and benefits of implementing best practices on peat soil.[xii] The impact of these practices is higher yields, better oil recovery rates, and higher likelihood of a sustainable plantation beyond the end of the first planting cycle.

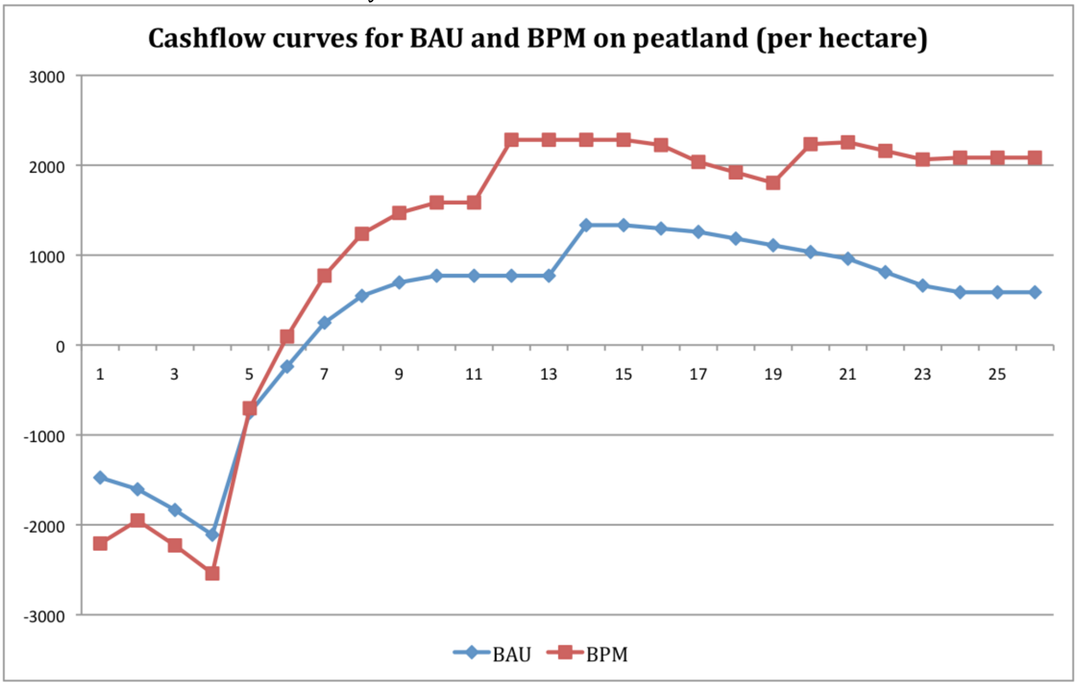
23. Although Best Practice (BP) plantations have higher costs, these are recouped through superior performance (Figure 6). The Malaysian Palm Oil Board has done several studies on this subject (for instance MPOB 2002), and illustrated the high benefit/cost ratio from implementing best practices. Business modeling shows a BP plantation can have a 38% higher Net Present Value than a BAU plantation (NPV of USD -3,277 for BAU vs. USD -2,037 for BP with a 15% discount rate) and an 11.3 percent Internal Rate of Return compared to 6.1 percent for the BAU plantation.

24. The costs of switching from a BAU model to BP model vary according to age of plantation, biophysical condition, relations with smallholders and staff and availability of capital. Taken from the start of the plantation, the costs of following the best practice route are $1,405 per hectare (discounted at 15%). However the benefit is worth $4,626 – a return on investment of over 22%. A private enterprise would not usually require subsidy or compensation to capture such a rate of return. In addition to these costs, it is likely that some extension work would be required with smallholders, which the MPOB estimated to cost just $1 per hectare per annum (MPOB 2002). Assuming that Indonesian smallholders need more intensive support, the cost could rise to $5 per hectare (assuming one extension worker can cover 500 smallholders on 1000 hectares).

25. It is also worth observing that improving yields and financial performance reduces pressure on land, and thus the pressure to open up peat land. The average regional GDP (GRDP) produced by one hectare of best practice palm oil on peat land is USD 2,405, more than double the USD 1,162 produced on a BAU plantation. Therefore if 500,000

hectares of peat land plantations could be upgraded to best practice management, a further 500,000 hectares would not need to be converted.

Figure 6: Cash flow for a Business as Usual and Best Practice Management Oil Palm Plantation on Peat. *Source*: Study team.



Land Swaps from Peat Land to Mineral Soils

26. In order to assess the economic viability of proposing 'land swaps' from peat land to mineral soils for planned plantations, it is necessary to consider the nature of any opportunity cost that exists by failing to develop the peat land. Assuming that alternative land may be found elsewhere (preferably near to the proposed plantation, though for many companies this may not be critical), an opportunity cost can only be said to exist if (a) the total demand for plantation land exceeds the available non-peat land areas on offer and (b) plantations on peat land yield higher rates of return than plantations on mineral soils (expressed as NPV or IRR).

27. In the first case, the demand for plantation land is connected to global demand for palm oil (and its various fractions), the likelihood of consistently high prices (at or above the past ten year average of $677/ton), and the willingness of rural dwellers in Indonesia to become smallholders or offer themselves as paid labour on estates. The actual amount of land required is principally a function of the prevailing yields, and thus a higher prevalence of best practice management will required less land area. Wicke et al (2008) study this in some detail, and conclude that if under the 'sustainability scenario' oil palm is permitted only on degraded land (not deforested land, even if it is conversion forest), and agricultural expansion must also compete for this degraded land, then the net land available for oil palm expansion is 8 million ha. This would be sufficient to cover the planned increase in palm oil production up to 2020, and probably beyond (in view of recent trends in yield improvement).

28. However, if higher yields and higher financial rates of return are available on peat land, then some opportunity cost may occur. Data regarding yields on peat land tend to show that they are lower than those obtained on mineral soils and the costs of establishment are much higher, although this remains debated by various parties.[xiii] Assuming a best practice management model in each case, the financial analysis shows that degraded land offers superior rates of return than either unforested or forested peat land (Table 4).[xiv] The financial advantage to mineral soils is eroded slightly (but is still

not in peat land's favour) if it is assumed that early timber revenue is available on the peat land, but no such revenue results from converting degraded land. Therefore, based on this analysis, the opportunity cost argument against moving oil palm from peat to mineral land (at the macro level, at least) does not appear to be valid, and could only become valid if palm oil demand could be said to be almost unlimited, labour and capital to supply such demand is also unlimited, and thus every landscape in Indonesia (peat land, conserved forest, national parks etc.) could be expressed in terms of the 'opportunity cost' of palm oil.[xv]

Table 4: Net Present Value (per hectare) and IRR for oil palm on different land types.

Financial Indicator	Land Type		
	Degraded Land	Degraded Peat Land	Primary Peat Swamp Forest
Project cash flow (USD)	1,644	-2,037	-989
Rate of Return (IRR)	18.6%	11.3%	12.9%

Source: Study team

29. Although there appears to be a strong business case for completing land swaps in the plantations sector from peat land to mineral soil, there are also likely to be some barriers and constraints to this policy option. In particular, there may be a shortage of land that is suitable from an agronomic perspective or that is without existing community rights or other government land use permits. Overall, this may require plantation companies to review and consider revised business models such as enhanced community-business partnership models or innovative community-based plantation models. Within this context, a key success factor will be enabling Free, Prior and Informed Consent (FPIC) for the participation of local communities and farmers as business partners. Across Indonesia, local farmers are interested in the potential benefits of oil palm as a crop but lack the market and business knowledge to make informed decisions within the context of their existing livelihoods and farm systems. In particular, the commitment and ability (including transparency) of companies to form business partnerships with local farmers is vital to successful outcomes.

Land Swaps and Plantations in Indonesia

WRI's project POTICO (Palm Oil, TImber, Carbon Offsets) uses land use swaps to facilitate the expansion of sustainable palm oil alongside avoided deforestation. POTICO works with plantation companies who have a location permit to establish new plantations on forested or carbon rich areas. The company commits to conserving such areas – potentially managing for sustainable timber or carbon offsets. In return WRI works to find a suitable area of degraded land for the plantation expansion, and offers assistance with critical FPIC and HCV identification processes, both cornerstones of RSPO certification.

Two legal mechanisms exist to make the land use swaps. The first is a revision of the local land use plan whereby the district head (*Bupati*) proposes that treeless areas within the national forest estate are excised and made available for other uses. The second is a true swap - the area removed from the forest estate is compensated for by the return of a similar or greater area of 'non-forest' land with forest on it. The WRI approach is to assess both the suitability and availability of the land. Gauging availability requires field trips and investigation into the legal status and current use of that land, to establish who owns the land, what entitlements local people deem important and what other claims exist. Spatial plans will reveal how the land is zoned by central, regional and local government. Indigenous peoples' traditional claims over land ownership and use rights are of particular importance.

When looking at the potential revenue streams from a rational land use (re)allocation, there are benefits for public and private, local and national stakeholders. WRI is working to prove the concept, set a precedent and create the incentives to have this approach underpin the expansion of palm oil expansion in Indonesia. There is a high degree of demand for a national-level land rationalisation process. Until such a nationwide project takes place, land swaps must be negotiated on a case-by-case basis.

6. Moving Forwards: Creating an Enabling Legal and Institutional Environment

6.1 National Policy

30. The current policy, institutional and legal environment regarding peat land management in Indonesia is currently under review. A range of policies is already in place that regulates peat land management including limits on peat land utilisation for economic development, zero burning for land clearance and water management in lowland areas, however implementation of these is uneven. A major barrier for this is the current institutional framework, within which current mandates for peat land management overlap between sector agencies and between different levels of government in Indonesia. This and other issues are being addressing in a draft Government Regulation on Peat Land that is currently being prepared to help rationalise and harmonise peat land management in the country.

31. Taking forwards the policy actions assessed in this study will require the development of effective policies and incentives in at least the following five areas:

1. Developing Standards and Incentives for Best Practice Peat Land Management

32. A performance-based policy will be required accompanied by incentives for best practice management of peat lands under agriculture. Key goals include the limitation of peat land less than 3 metres thick, which will require completion of a national peat land inventory, zero burning, and soil and water management to reduce emissions. The 2009 Guideline on the Utilisation of Peat for Oil Palm (Permentan 14/2009), for example, provides standards for water management amongst others, prescribing ground water levels to be controlled to 60-80cm below the peat surface. Further development of these is needed to (a) link guidelines to the development of scientific knowledge about peat land emissions and management, (b) creating performance-based standards, (c) developing an accountable and transparent system for monitoring and verifying performance and impacts and (d) developing incentives and sanctions to promote compliance. Indonesia has already developed incentive mechanisms for pollution control. As explained in paragraph 22, the returns on investment to improved management practices are self-evident to private companies, possibly obviating the need for financial incentives such as performance-based tax credits. However, some companies and almost all smallholder farmers may require credit financing to cover the up-front cost of such improvements. This will need to be achieved without allocating a distorting subsidy that penalises more efficient firms, whilst unduly rewarding companies that have hitherto under-invested in this area. One solution may be to allow third parties to co-invest in the necessary improvements in return for a share of the enhanced returns that may accrue, with a share of carbon payments when more costly improvements yield higher emission savings than those predicted by the mitigation strategy. In this way, private capital may discover mitigation methods, and financial models (such as securitisation) that are more innovative than those mandated by central government.

2. Peat Land Rehabilitation Policies

33. Peat land rehabilitation will require value to be created to otherwise unproductive land both within and outside of the country's forest estate. Policy development will need to include a review of land use status and a prioritisation of areas for action, definition of boundaries and existing community rights, and creation of an enabling framework for public and private investment, perhaps based on the existing forestry ecosystem restoration license. An important pilot peat land rehabilitation program that has been established in Indonesia is the rehabilitation and revitalisation of the former Mega-Rice Project area in Central Kalimantan (Presidential Instruction No 2/2007), for which the Government of the Netherlands has provided support to develop a master plan as a strategic guide within a context of regional lowland development. Private-public

partnerships including communities will need to be developed to deliver finance and ensure optimal economic, social and climate outcomes.

3. Policies for Spatial Planning in Lowland and Peat Land Areas

34. For Indonesia to meet its target for emissions reduction by 2020, spatial planning in Indonesia will need to be informed both by peat land and potential impacts of spatial plans on carbon emissions. Low carbon growth will require policies and guidelines for reviewing and revising spatial plans within this context, in particular to assess the possibility for protecting existing peat swamp forest located in development areas, rehabilitating peat land and undertaking land swaps.

4. Land Swap Policies

35. Legal instruments for land swaps already exist within the forestry sector as well as for land consolidation outside of the forest estate. Experience with implementation of these policies along with practical experience of land swaps through programs such as the POTICO program can be used to develop a national policy on land swaps to reduce pressures and emissions from peat land.

5. Peat Land Carbon Policies

36. Indonesia has made considerable progress in developing policy and programs to respond to climate change principally led by the National Council on Climate Change, the National Development Planning Agency (BAPPENAS), the Department of Forestry and State Ministry for the Environment. In many cases, as shown in this study, emissions from peat land are not linked to economic activities (peat, unlike timber, is principally not a primary resource and fire and oxidation emissions from degraded unmanaged peat lands are often not related to ongoing economic activities), so opportunity costs for certain mitigation actions can be negligible. This reduces the potential for leakage from peat land mitigation actions and makes certain peat land mitigation actions more amenable to a project-based approach either through a fund-based or market-based mechanism.

37. In order to mitigate peat land emissions, a policy focused on peat carbon needs to be developed that addresses: (a) institutional issues, (b) policy instruments within and outside of the forest estate, (c) methodologies and systems for MRV emission reductions, (d) national peat land carbon accounting, (e) policies and mechanisms for fiscal incentives and equitable sharing of carbon-related revenues. The Indonesia-Australia Forest Carbon Partnership including the REDD peat land demonstration project in Central Kalimantan (KFCP) is supporting work on developing robust methodologies and national carbon accounting that includes peat land emissions.

38. A critical point to highlight in terms of national policy is that Indonesia's peat and lowlands are home to millions of people, many of whose families have used and depended on the forests and natural resources of these areas for centuries. Past studies have highlighted that these communities often have relatively high levels of poverty and can be caught in a spiral of poverty and environmental degradation. Policies to address peat emissions in Indonesia will ultimately need to be "people- focused" and in particular address issues such as community land rights, local livelihoods and the broader economic development of Indonesia's 40 million hectare lowland area, within which the majority of its peat lands are found. In 2010, BAPPENAS will lead the coordination of a new initiative (WACLIMAD) to develop a National Strategy for the Sustainable Management of Lowlands, which will support the development of future policies and programs including peat management, climate change mitigation and adaptation.

6.2 International Policy

39. The potential for the policy actions identified in this study will to a certain extent be influence by the outcomes of the international multilateral and bilateral processes, most notably the climate negotiations within the UNFCCC. In general, the demand within the

voluntary market is unlikely to be able to match the potential supply of emission reductions from Indonesia's peat land, with the consequence that UNFCCC compliance mechanisms are of primary importance. At present, the Conference of the Parties to the UNFCCC has yet to make any clear decision on whether peat emissions can be included within existing and proposed compliance mechanisms. The Clean Development Mechanism, which is already operational and suited to project-based interventions thereby allowing early action, has to date not approved any methodologies relating to peat land emissions. Negotiations around REDD have neither created any clarity regarding the position of peat land within the REDD framework nor any certainty over the potential eligibility of all peat land and peat land emissions. The other option for Indonesia to access the UNFCCC compliance mechanisms, namely addressing peat land emissions through the NAMA mechanism, will also create a significant delay in action due to the need for further development of this mechanism. Early action is required to address peat land emissions and at present this can only be achieved either through public funds or the current CDM mechanism.

7. Conclusions

40. This study has presented provisional results that show Indonesia has the potential to make significant reductions in emissions from peat land with limited direct costs to the overall economy assuming Indonesia can access finance through public funds or the compliance mechanisms of the UNFCCC. The main findings include:

- Peat land emissions estimated by this study are dominated by anthropogenic fire emissions (46 percent) followed by peat oxidation (25 percent) and removal of above-ground biomass (24 percent) from deforestation and forest degradation;
- Current emissions come mostly from Sumatra and Kalimantan, whereas Papua has extensive shallow peat lands with the potential to increase Indonesia's emissions if they are developed in the future;
- Peat lands contribute almost 50 percent of Indonesia's GHG emissions yet development in peat lands probably contribute less than 1 percent to the national economy (GDP);
- Indonesia has the potential to make significant reductions in its peat land emissions through (a) compliance and better management practices in plantations and other land uses on peat (24 percent of potential emission reductions), (b) peat land rehabilitation and uncontrolled fire prevention in degraded peat areas (31 percent of potential emissions reductions) and (c) revision of spatial plans to conserve existing forest and unlicensed peat land combined with relocation of existing licenses that are not operational to mineral soils (37 percent of potential emission reductions);
- At the national level, there is unlikely to be a significant opportunity cost associated with relocation of existing permits given the availability of degraded land and the higher yields and lower costs on mineral soils;
- At the local level, districts with significant peat land areas may incur opportunity costs due to the limited availability of suitable mineral soil in their area.

41. Nevertheless, meeting the challenges of achieving the potential emission reductions will require further assessment of these policy options, the policy instruments required combined with the availability of finance to undertake (a) preparation and planning and (b) implementation. Key points raised in this study in terms of reducing emissions from Indonesia's peat lands include the need for:

- An effective institutional framework for peat and lowland management in Indonesia to overcome overlapping mandates of sector agencies;
- A performance-based framework to promote best practice management in peat lands through appropriate standards, incentives and sanctions;
- A national strategy, plan and finance for peat land rehabilitation and fire prevention in degraded peat lands building on and supporting the government initiative in the Ex-Mega Rice Project Area in Central Kalimantan;
- A comprehensive review of spatial plans and development of spatial planning tools in the context of peat and lowland areas;
- A review of experience on land swaps and the potential to scale up experience from pilots to a national scale policy and program;
- The development of peat land carbon policies and their articulation at the international level, in particular the UNFCCC given the uncertainty regarding the position of peat land emissions in a post-2012 agreement. Early action can potentially be achieved through public funds and the Clean Development Mechanism.
- Strategies to address peat land emissions to be part of an overall National Strategy for the Sustainable Management of the Lowlands that addresses the specific challenges of peat and lowland development in the context of climate mitigation and adaptation.

42. The second phase of this study will continue in early 2010 and will further refine the analysis, assess the economic aspects of reducing peat land emissions including aspects relating to carbon finance and costs following the UNFCCC COP in Copenhagen.

Endnotes

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[i] See (1) IPCC (2007) Fourth Assessment Report – Working Group III: Mitigation; (2) Page, S.E. et al. (2002) *Nature* 420: 61-65; (3) Government of Indonesia (2009) *Indonesia Second National Communication Under the United Nations Framework Convention on Climate Change*; (4) van der Werf, G.R. et al (2009) *Nature Geoscience* 2: 737-738.

[ii] See (1) Wetlands International Indonesia Peat Atlas (www.wetlands.or.id/publications_maps.php); (2) IMCG Global Peatland Database (www.imcg.net)

[iii] This study is commissioned and led by the Indonesian National Development Planning Agency (BAPPENAS), with the support of experts from the Ministry of Forestry, the Ministry of Agriculture, the Bogor Agricultural Institute (IPB), the University of Indonesia and the Indonesian Centre for Environmental Law (ICEL).

[iv] There remains some uncertainty regarding the exact extent of Indonesia's peat land owing to limited recent inventory data with a range of estimates from 17-27 million hectares.

[v] See (1) Presidential Decree 32/1990 on the Management of Protection Areas; (2) See Wetlands International Indonesia Peat Atlas (www.wetlands.or.id/publications_maps.php).

[vi] Sources for C removal include Prasetyo et al (2000) for shrub lands, Rogi (2002) for oil palm plantation, Palm et al. (2004) for rubber plantation and expert judgement for secondary peat swamp forest.

[vii] Oxidation emissions were calculated using data on land cover and land use from the Department of Forestry using estimates of drainage depth from the literature and field observations for particular crops and land covers and the relationship between drainage and emissions in Hooijer et al. (2006). Above-ground biomass removal was calculated using historical deforestation rates and published estimates of carbon stocks in peat swamp forest. Following Indonesia's Second National Communication to the UNFCCC, fire emissions were based on van der Werf et al (2008) and average annual emissions from peat and forest fire are estimated at 470 Mt CO2 yr-1 between 2000 and 2006. Full details of these calculations will be published in 2010.

[viii] As mandated by COP (see Paragraph 7 of the COP decision in the annex to decision 17/CP.8), for the non-Annex 1 country, the GHG National Inventory in the SNC should use 2000 (*Paragraph 7: Non-Annex I Parties shall estimate national GHG inventories for the year 1994 for the initial national communication or alternatively may provide data for the year 1990. For the second national communication, non-Annex I Parties shall estimate national GHG inventories for the year 2000. The least developed country Parties could estimate their national GHG inventories for years at their discretion*).

[ix] Indonesia National Statistics Agency (BPS) and Department of Agriculture.

[x] The ameliorant is clay soil containing high valenced cations such as Al+3 and Fe3+ that polymerize simple organic acids and thus reduce their oxidation. The recommended rate is about 5-10 t of pulverised clay, applied just one time on peat soil surface. It is expected to reduce emission of 20±10%.

[xi] The mitigation scenarios are nested represneting increasingly ambitious actions to reduce emissions from peat land. Mitigation scenario 1 assumes legal compliance to the limitation of future development of peat more than 3m deep by all companies currently operating on peat land. Mitigation scenario 2 includes all companies operating on peat do no clear new land using fire (zero burning) and achieve best practice water management to maintain higher water level. Mitigation scenario 3 includes the use of ameliorant (see ix above) on all peat land under cultivation. Mitigation scenario 4 assumes all degarded peatland is rehabilitated through canal blocking to reduce oxidation emisions and uncontrolled fire reduces emissions by 90%. Mitigation scenario 5 assumes all forested peat land in the non-forestry development zone is protected and conserved. Mitigation scenario 6 assumes that all remaining unlicensed peat land is protected and conserved Mitigation scenarion 7 assumes issued licenses in peat land that are not operational are relocated through a land swap. Further details of emission reduction scenarios will be published in 2010.

[xii] In this case 'business as usual' practices can be observed to result in:(a) low compensation payments to local people, and no FPIC process, (b) no strategic environmental assessment of the area, (c) limited extension support to smallholders, (d) limited logistic and financial support to smallholders, (e) poor land clearance practices (over-drainage, burning) that damage the land and reduce long-term land viability, (f) no phased re-planting, so yields drop sharply after 23-25 years, (g) insufficient application of appropriate fertilizer and manure, and failure to recycle mill waste as mulch.

[xiii] There is some dispute regarding the attractiveness of peatland for establishing palm oil plantations, compared to using mineral soils within forested or grassland areas. However, most evidence seems to show that peat land yields are 85% of mineral soil yields, and that the negative

NPVs recorded for plantations on peat land (with substantially lower rates of return) are a combination of higher start-up costs, higher ongoing fertilizer costs and lower yield performance. Even where studies have demonstrated decent returns from peat land plantations, this has been accompanied by additional expense in terms of planting density and use of inputs, and still fail to reach the performance of best-practice estates on mineral soils.

[xiv] Details and assumptions of financial analysis of oil palm on peat vs. forest are as follows: Discount rate: 15%, CPO Price: $700/ton, PK price $399/ton, export tax 5%, company income tax 15%, bank interest: 12%, Conversion rate: 70% (area of productive plantation as % of gross allocated area), net income from timber from primary swamp forest: $1100, peat land plantation yields as % of benchmark: 85%, mineral soil plantation yields as % of benchmark: 100%, Compensation for land – mineral soils: $300, peat land: $25, Cost of FPIC and AMDAL: $140, Degraded mineral soil land suffers additional one year delay before planting (to cover time for negotiations and land transactions, peat land has no such delay, Fertilizer, planting and manuring costs 30% higher for peat land. Oil extraction rate is same for all land types, factory set up and running costs same for all land types, Phased re-planting starts in year 16 for all land types, no cost difference in re-planting costs.

[xv] Furthermore, as peat land does not furnish superior financial returns, the opportunity cost of the degraded land on mineral soils exceeds the opportunity cost of peat land, and in a perfect market the plantations would tend to be established on mineral soils. However, the variable cost that may influence the business model is the cost of the land and the absence of marketable high value timber on such land. Compensations costs tend to be higher on degraded land (which may be open-access regimes, with over-lapping claims and entitlements), as do the transaction costs to acquire the land or persuade local people to become out growers. As a sensitivity test, one needs to ask how high this land cost needs to be (including the cost of surveys, FPIC, compensation, central and local government costs etc.) for the NPV of mineral soils to dip below the NPV on peat land. It appears that the cost of securing degraded mineral land would need to be $2,500 or more per hectare for unpopulated degraded peat land to be more attractive financially, and $1,800 per hectare if the peat land was forested (as the degraded mineral land would not enjoy the income of the timber harvest on clearance). It is most unlikely that costs of negotiating and acquiring degraded mineral land would reach these kinds of levels. Indeed, Conservation International considers a 'fair' price of land to be $300, and the WRI POTICO project assesses transaction costs to be $24 per hectare.