PLANT RESEARCH INTERNATIONAL
WAGENINGEN UR

Exploring the possibilities of carbon projects in the tropical peat lands of Central Kalimantan

Gerdien Meijerink[1], Mart-Jan Schelhaas[2], Suwido Limin[3] & Jan Verhagen[4]

1 LEI, Wageningen UR

2 Alterra, Wageningen UR

3 CIMTROP, Centre for International Cooperation in Management of Tropical Peatland
University of Palangka Raya, Central Kalimantan, Indonesia

Kampus UNPAR Tunjung Nyaho
Palangka Raya
Kalimantan Tengah, Indonesia

4 Plant Research International, Wageningen UR

CIMTROP

Plant Research International B.V., Wageningen
January 2004

Report 73

Copies of this report can be ordered from the (first) author. The costs are € 50 per copy (including handling and administration costs), for which an invoice will be included.

Cover photo courtesy Henk Wösten (Alterra)

Plant Research International B.V.

Address	:	Droevendaalsesteeg 1, Wageningen, The Netherlands
	:	P.O. Box 16, 6700 AA Wageningen, The Netherlands
Tel.	:	+31 317 47 70 00
Fax	:	+31 317 41 80 94
E-mail	:	post.plant@wur.nl
Internet	:	http://www.plant.wur.nl

Table of contents

Executive summary

Human activities have increased the concentrations of greenhouse gasses in the atmosphere, primarily due to the combustion of fossil fuels, but also through changes in land use and land cover. The resulting changes in climate and climate variability pose a major threat to the functioning of human and natural systems. The impacts of future changes are expected to fall disproportionately on the developing countries (IPCC WGII, 2001).

As a first step towards reduction of greenhouse gasses emissions to the atmosphere, the Kyoto Protocol was signed in 1997. In this protocol, 39 industrialised countries committed themselves to reduce their greenhouse gas emissions to at least 5% below 1990 levels during the period 2008 to 2012.

The Kyoto Protocol outlines three types of market-based mechanisms: emissions trading, Joint Implementation (JI) and the Clean Development Mechanism (CDM). Emissions trading allows the 39 governments committed to collective reductions under the Protocol to trade the right to pollute among themselves. Under this scheme, due to start in 2008, a country may choose to buy emission credits from another country that has managed to reduce its emissions below its Kyoto targets.

The CDM has two main objectives:
1. To assist developing countries who host CDM projects to achieve sustainable development.
2. To provide developed countries with flexibility for achieving their emission reduction targets by allowing them to take credits from emission reducing projects undertaken in developing countries.

The CDM mechanism provides developing countries with an additional source of income through an environmental service: carbon management. The market as it is now emerging is still in its infancy. As for any market, prices will depend largely on supply and demand relations and the risks involved. The possibility of getting paid for carbon management is expected to stimulate environmental protection and conservation and is expected to be beneficial for social circumstances as well. The implementation of the trade mechanisms and how this will benefit the local poor will differ per region.

This study focuses on Central Kalimantan at the Indonesian part of the island Borneo. Large parts of this region are covered by peatlands, originally covered by peat swamp forests. In 1996 the Mega Rice Project (MRP) was initiated, aimed at increasing the self-sufficiency of Indonesia's food production. To reach that goal, one million hectares of peat swamp forest was planned to be converted into rice fields. Between January 1996 and July 1997, more than 4000 km of drainage and irrigation channels were constructed. As a consequence, the forests became accessible, leading to large-scale illegal logging activities and deforestation. The fastest and easiest way of clearing the land is by means of fire. In 1997 this practice, together with other factors such as the drought caused by El Niño, dried out peatlands due to large-scale drainage, logging activities, led to large-scale forest fires. This in turn led to large amounts of carbon being released into the atmosphere, amounting to 13-40% of the mean annual global carbon emissions from fossil fuels for 1997.

The CO_2 market is defined by demand for and supply of CO_2 reduction possibilities. The study discusses a number of different initiatives taken by public and private parties.

In general, demand for CO_2 reduction comes from industrialised countries that under the Kyoto Protocol need to reduce their greenhouse emissions (Annex 1 countries). Besides these parties, several private corporations (mainly fossil fuel and electricity corporations) are initiating projects to offset their own carbon emissions, out of corporate green image considerations, or expectation that in the future CO_2 reductions will become more strict.

The suppliers of CO_2 reduction are very diverse, ranging from large multinational energy companies to small local operators, and to governments in the so-called non-Annex 1 countries. Most buyers have sought to acquire reductions generated within their own home country, and only a handful of projects located in developing countries have resulted in successful emissions transactions. Projects located in these countries have greater perceived project risk and few developing countries have established adequate institutions to review project proposals and to grant necessary host country approvals.

The financial sector is playing an increasingly important role in the carbon market. Financial derivates already play a major role in emission reduction transactions, and the role of market participants who function as brokers to match buyers and suppliers or who function as consultants is expected to increase.

The CDM can be applied to (community) forestry projects and potentially contribute to local livelihoods and ecosystem restoration as well. The costs of such a project consist of the costs involved in CO_2 sequestration itself (forest management) and costs involved in CDM management (also called transaction costs). For a project to be successful, several criteria have to be met concerning the national and regional institutional setting. The institutional requirements at national level are partially described in the Kyoto Protocol and include the establishment of a national CDM Authority. Although Indonesia is a signatory to the Kyoto Protocol it has not ratified it and meaningful follow-up related to the Protocol has been delayed.

The study also highlights several key elements of project design related to local institutional settings. A transparent and well-defined project with clearly outlined compensation mechanisms and strong local participation are some of the key elements. Attention should also be given to reducing risks (e.g. from leakage, non-compliance) to the investor in the project. Financial institutions can play a role in reducing risks. However, these have not developed sufficiently yet to play a concrete role in CDM forestry projects.

Glossary

Additionality
The Kyoto Protocol established the requirement that JI and CDM projects may only count emissions reductions that are 'additional to what otherwise would have occurred in the absence of the certified project activity' (environmental additionality). These reductions must be 'real' and 'measurable', and must be quantified against a project baseline. Another form of additionality (financial additionality), is the notion that a project is made commercially viable via its ability to generate value in the form of CERs. Currently, there is no international agreement on a method to determine financial additionality.

Annex 1 countries
These are the 36 industrialised countries and economies in transition listed in Annex 1 of the UNFCCC. Their responsibilities under the Convention are various, and include a non-binding commitment to reducing their GHG emissions to 1990 levels by the year 2000.

Annex B countries
These are the 39 emissions-capped industrialised countries and economies in transition listed in Annex B of the Kyoto Protocol. Legally-binding emission reduction obligations for Annex B countries range from an 8% decrease (e.g. EC) to a 10% increase (Iceland) on 1990 levels by the first commitment period of the Protocol, 2008 - 2012. In practice, Annex 1 of the Convention and Annex B of the Protocol are used almost interchangeably. Note that Belarus and Turkey are listed in Annex 1 but not in Annex B and that Croatia, Liechtenstein, Monaco and Slovenia are listed in Annex B but not in Annex 1.

Baseline
CDM project outcomes are measured and verified against a baseline that reasonably represents the anthropogenic emissions of greenhouse gases (GHG) that would occur in the absence of the CDM project.

Carbon offsets
Commonly referred to as to indicate the output of carbon sequestration projects in the forestry sector or to refer to the output of any climate change mitigation project more generally. Carbon credits - as for carbon offsets, though with added connotations of (1) being used as 'credits' in companies' or countries' emission accounts to counter 'debits' i.e. emissions, and (2) being tradable, or at least fungible with the emission permit trading system. ERUs (emission reduction units) - the technical term for the output of JI projects as defined by the Kyoto Protocol. CERs (certified emission reductions) - the technical term for the output of CDM projects, as defined by the Kyoto Protocol.

Carbon sinks
A stock that is taking-up carbon is called a sink. Oceans, soils and forests all offer some potential to be managed as a sink.

CER (Certified Emissions Reduction)
Investors in Clean Development Mechanism projects can earn CER credits for the amount of greenhouse emission reductions achieved by their CDM projects. CERs are equal to one metric tonne of carbon dioxide equivalent (CO_2e).

Clean Development Mechanism (CDM)
The CDM was established by Article 12 of the Protocol and refers to climate change mitigation projects undertaken between Annex 1 countries and non-Annex 1 countries (see below). This new mechanism, whilst resembling JI, has important points of difference. In particular, project investments must contribute to the sustainable development of the non-Annex 1 host country, and must also be independently certified. This latter requirement gives rise to the term certified emissions reductions or CERs, which describe the output of CDM projects and which under the terms of Article 12 can be banked from the year 2000, eight years before the first commitment period (2008-2012).

Emissions Trading (ET)
Article 17 of the Protocol allows for emissions-capped Annex B countries (see below) to transfer among themselves portions of their assigned amounts (AAs) of GHG emissions. Under this mechanism, countries that emit less than they are allowed under the Protocol (their AAs) can sell surplus allowances to those countries that have surpassed their AAs. Such transfers do not necessarily have to be directly linked to emission reductions from specific projects.

ERU (Emission Reduction Unit)
The Kyoto Protocol specified unit of GHG emissions reduction under a Joint Implementation (JI) project.

Flexibility Mechanisms
Refers to the three co-operative implementation mechanisms under the Kyoto Protocol (Joint Implementation, International Emissions Trading and Clean Development Mechanism).

GHG (Greenhouse Gasses)
Generally defined as the six gasses regulated under the Kyoto Protocol, and determined to be the prime contributors to the Greenhouse Effect. The GHGs are:

- carbon dioxide (CO_2)
- methane (CH_4)
- nitrous oxide (N_2O)
- hydrofluorocarbons (HFCs)
- perfluorocarbons (PFCs)
- sulphur hexafluoride (SF_6)

Joint Implementation (JI)
Set out in Article 6 of the Protocol, JI refers to climate change mitigation projects implemented between two Annex 1 countries. JI allows for the creation, acquisition and transfer of emission reduction units or ERUs. The concept of Joint Implementation (JI) was already introduced in the UNFCCC. Dissatisfaction of developing countries with that JI model led to a compromise in the form of a pilot phase, during which projects were called Activities Implemented Jointly (AIJ). Some AIJ projects may be reclassified as CDM or JI projects.

Kyoto Mechanisms
The Kyoto Mechanisms, often referred to as Emissions Trading, allows for emissions permits to be created and transferred between countries with the objective of minimising the cost of reducing global greenhouse emissions. The mechanisms include Joint Implementation (Article 6), the Clean Development Mechanisms (Article 12), and International Emissions Trading (Article 17).

Ratification defines the international act whereby a state indicates its consent to be bound to a treaty if the parties intended to show their consent by such an act.

RMUs (removal units)
The new technical term representing sink credits generated in Annex I countries, which can be traded through the emissions trading and JI mechanisms

Signatory
The head of state or designated official indicates their countries agreement with the adopted text of the convention or the protocol and its intention to become a party by signing.

UNFCCC United Nations Framework Convention on Climate Change
Established in June 1992 at the Rio Earth Summit, its primary objective is 'the stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic (man-made) interference with the climate system. Such a level should be achieved within a time-frame sufficient to allow ecosystems to adapt naturally to climate change, to ensure that food production is not threatened, and to enable economic development to proceed in a sustainable manner'.

Validation
The process of independent evaluation of a CDM project's project design document by a designated Operational Entity against the requirements of the UNFCCC CDM.

Verification
The periodic independent review and ex-post verification by a Designated Operational Entity of monitored reductions in anthropogenic GHG emissions that have occurred as a result of a registered CDM project during the verification period.

1. Introduction

Human activities have increased the concentrations of greenhouse gasses in the atmosphere, primarily due to the combustion of fossil fuels but also through changes in land use and land cover. The resulting changes in climate and climate variability pose a major threat to the functioning of human and natural systems. The impacts of future changes are expected to fall disproportionately on the developing countries (IPCC WGII, 2001).

The logical response has been to mitigate climate change. However, mitigation alone will not be enough to offset the climate change that has already started. Therefore, adaptation will also be necessary to cope with the negative effects of climate change. For land use systems synergies between mitigation (carbon sequestration) and adaptation (reduced vulnerability as result of increased soil carbon content) exist. Integrating mitigation and adaptation is therefore a logical option for land use systems and need to be explored in more detail.

The Kyoto Protocol has opened the way to seek globally the most cost effective way to reduce carbon emissions or enhance terrestrial carbon sinks. Industrialised countries may thus achieve part of their emission reduction target by afforestation and reforestation projects in the tropics (Clean Development Mechanism: CDM). The mechanism offered by the Kyoto Protocol is unique in its attempt to provide global environmental benefits via local project implementation in a global carbon market.

These paid activities should stimulate environmental protection and conservation. The implementation of the trade mechanisms and how this benefits the local poor will differ per region. Positive effects on biodiversity, water resources, and erosion are anticipated, linking three large international treaties: United Nations Framework Convention on Climate Change (UNFCCC) to the Convention on Biological Diversity (CBD) and United Nations Convention to Combat Desertification (UNCCD). The Kyoto Protocol is thus a treaty with a clear global dimension, but also with a local ecological and local social dimension.

The market for environmental services is still in its infancy. This study aims to explore the possibilities for Clean Development Mechanism projects in the Indonesian peat lands (Kalimantan Tengah). Given the resource constraint of the project we will focus on carbon. Chapter 2 describes the Clean Development Mechanism. The environmental system of Central Kalimantan is described in Chapter 3. Chapter 4 gives an overview of possible financial systems, the institutional setting is discussed in Chapter 5, followed by a general discussion.

2. The Clean Development Mechanism

As a first step towards reduction of greenhouse gas emissions to the atmosphere, the Kyoto Protocol was signed in 1997. In this protocol, 39 industrialised countries committed themselves to reduce their greenhouse gas emissions to at least 5% below 1990 levels during the period 2008 to 2012.
These countries are known as the Annex 1 or Annex B countries. The Netherlands for instance, has a 6% emission reduction target for greenhouse gas emissions (carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O) and the fluorinated gases: HFCs, PFCs and SF6).

Instead of reducing emissions, it is also allowed to increase carbon sequestration in terrestrial ecosystems. Measures that are eligible since 1990 under the Kyoto Protocol are ARD (Afforestation, Reforestation and Deforestation) under article 3.3 and additional activities in agriculture and forestry under article 3.4. However, the first commitment period (2008-2012) allows for reforestation and afforestation only[1], other types of land use are still under discussion.

Annex I countries are not obliged to meet their targets within the country itself. Thus, the Kyoto Protocol has opened the way to seek the most cost effective way globally to reduce carbon and non-carbon emissions or enhance terrestrial carbon sinks. Industrialised countries may thus achieve part of their emission reduction target by afforestation and reforestation projects in the tropics. The mechanisms offered by the Kyoto Protocol are unique in their attempt to provide global environmental benefits via local project implementation in a global carbon market.

The Kyoto Protocol outlines three types of market-based mechanisms: emissions trading, Joint *Implementation (JI)* and the Clean Development Mechanism (CDM). Emissions trading allows the 39 governments committed to collective reductions under the Protocol to trade the right to pollute among themselves. Under this scheme, due to start in 2008, a country may choose to buy emission credits from another country that has managed to reduce its emissions below its Kyoto targets.

JI and the CDM grant Northern governments and corporations emission credits through special projects aimed at reducing greenhouse gas emissions in the host country. These projects can be carried out among industrialised countries and corporations (JI) or between one industrialised government or company and one Southern country (CDM).

The CDM has two main objectives:
1. To assist developing countries who host CDM projects to achieve sustainable development.
2. To provide developed countries with flexibility for achieving their emission reduction targets by allowing them to take credits from emission reducing projects undertaken in developing countries.

Rules and guidelines are being developed as the market further matures. Different market segments will most likely adapt different rules, e.g. the 'voluntary' market allows buyers to establish their own rules, while the international market based on Certified Emission is stricter. Although several of the detailed procedures to be applied to CDM forestry projects are still to be agreed upon, the overall framework is already established for approving projects and accounting for the carbon credits generated (Aukland *et al.*, 2002; Murdiyarso, 2003):
1. Only areas that were not forest on 31st December 1989 are likely to meet the CDM definitions of afforestation or reforestation.
2. Projects must result in real, measurable and long-term emission reductions, as certified by a third-party agency ('operational entities' in the language of the convention). The carbon stocks generated by the project need to be secure over the long term (a point referred to as 'permanence'), and any future emissions that might arise from these stocks need to be accounted for.

---

[1] Reforestation refers to establishment of forest on land that had recent tree cover, whereas afforestation refers to land that has been without forest for much longer. Watson *et al.*, 1998.

3. Emission reductions or sequestration must be additional to any that would occur without the project. They must result in a net storage of carbon and therefore a net removal of carbon dioxide from the atmosphere. This is called 'additionality' and is assessed by comparing the carbon stocks and flows of the project activities with those that would have occurred without the project (its 'baseline'). This is to avoid giving credits to projects that would have happened anyway.
4. Projects must be in line with sustainable development objectives, as defined by the government that is hosting them.
5. Projects must contribute to biodiversity conservation and sustainable use of natural resources.
6. Only projects starting from the year 2000 onwards will be eligible.
7. Two percent of the carbon credits awarded to a CDM project will be allocated to a fund to help cover the costs of adaptation in countries severely affected by climate change (the 'adaptation levy'). This adaptation fund may provide support for land use activities that are not presently eligible under the CDM, for example conservation of existing forest resources.
8. Some of the proceeds from carbon credit sales from all CDM projects will be used to cover administrative expenses of the CDM (a proportion still to be decided).
9. Projects need to select a crediting period for activities, either a maximum of seven years that can be renewed at most two times, or a maximum of ten years with no renewal option.
10. The funding for CDM projects must not come from a diversion of official development assistance (ODA) funds.
11. Each CDM project's management plan must address and account for potential leakage. Leakage is the unplanned, indirect emission of CO_2, resulting from the project activities. For example, if the project involves the establishment of plantations on agricultural land, then leakage could occur if people who were farming on this land migrate to clear forest elsewhere.
12. The emission reduction should also account for non-CO_2 Green House Gases (GHGs such as N_2O, CH_4).

The first commitment period or window (2008 - 2012) allows for reforestation and afforestation only, other types of land use are still under discussion[2].

The CDM mechanism provides developing countries with an additional source of income through an environmental service: carbon management. The market as it is now emerging is still in its infancy. As for any market, prices will depend largely on supply and demand relations and the risks involved. The possibility of getting paid for carbon management is expected to stimulate environmental protection and conservation, and is expected to be beneficial for social circumstances as well. The implementation of the trade mechanisms and how this will benefit the local poor will differ per region.

2 Details on the project cycle are not discussed in this document, for information on the project cycle look at www.unfccc.int

3. Central Kalimantan

In this study, we focus on Central Kalimantan at the Indonesian part of the island Borneo. Large parts of this region are covered by peatlands, originally covered by peat swamp forests. It used to be a very sparsely populated area, where the human impact on the environment was negligible. In 1996 the Mega Rice Project (MRP) was initiated, aimed at increasing the self-sufficiency of Indonesia's food production. To reach that goal, one million hectares of peat swamp forest was planned to be converted into rice fields. Between January 1996 and July 1997, more than 4000 km of drainage and irrigation channels were constructed. As a consequence, the forests became accessible, leading to large-scale illegal logging activities and deforestation. The fastest and easiest way of clearing the land is by means of fire. At the beginning of the dry season in 1997, many fires were ignited. The El Niño Southern Oscillation (ENSO) event of that year extended the dry season, so that large areas were burned. Due to the new drainage system the upper peat layers dried out and also caught fire. Fires spread out from the logged areas into the primary forest. The peat layers represent an enormous stock of carbon. As a result of the large fires, it was estimated that between 0.81 and 2.57 Gt of CO_2 were released to the atmosphere, which is more than the annual emission of the total European Union (Page *et al.*, 2002). The cleared peatlands are not suitable for the cultivation of rice. A vast area is left behind, mostly deprived from its original vegetation and not very suitable to grow food for the local population. Due to the drainage, the peat is slowly decomposing, releasing the stored carbon to the atmosphere. There is still the risk of new massive fires, again leading to the release of large amounts of carbon.

3.1 Population and employment

The Central Kalimantan province holds five regencies and one municipality, 85 districts, 1,328 villages including transmigration places settlements and indigenous natives civilisation settlements.

In 2000 the total population of Central Kalimantan was 1,823,715, of which 49% female and 51% male. The population density is approximately 12 persons per square kilometre. In 2000 2641 households (10551 persons) consisted of incoming migrants through the transmigration programme. The teacher student ratio in 2000 was 1:20 for the elementary levels, and 1:10 for the university level. Of the total population, 4.5% is illiterate, well below the average (10%) for Indonesia. More than 80% of the work force has not finished elementary school or secondary school. The health system is basic with an average of 1 doctor per 9000 persons.

The largest part of the labour force is employed in agriculture (55%), whereas the finance sector has the lowest employment. In 2000 47.5% of the regional income was provided by the agricultural sector, followed by trading, restaurants and hotels at 18%, transportation and communication at 8.6%, services at 8.5%, and industry at 6.9%. As result of the economic crises in Indonesia the number of large and medium scale industries dropped from 100 in 1997 to 80 in 1999, resulting in a substantial loss of jobs.

Productivity of food crops, notably wetland and dryland paddy, has increased from 2.2 ton per ha in 1996 to 2.4 ton per ha in 2000. The decreasing forest area also means a decreasing timber production. Animal husbandry (pig, poultry, sheep) and fishery (mainly sea-fish) provide a valuable source of protein. Statistical data of this section was taken from Kalimantan Tengah dalam angka (2000).

3.2 Current land use and possible land use options

No area data were found for the current land use situation. In 1997, before the start of the Mega Rice Project, the land cover situation in a study area of about 5 Mha is shown in Table 1, as well as the changes in the period 1991-1997. These figures were obtained via remote sensing.

Table 1. Land use (1997) and land use change (1991-1997) as assessed by remote sensing for a study area in Central Kalimantan (Boehm & Siegert, 2000).

Vegetation type	Land cover in 1997 (ha)	Land cover in 1997 (%)	Land cover change 1991-1997 (% relative to 1991)
Closed forest	2,231,239	43.0	-8.3
Open forest	365,132	7.0	-1.6
Fragmented forest	494,471	9.5	-0.4
Forest plantation	29,244	0.6	0
Forest regrowth	60,146	1.2	-0.3
Mosaics	477,875	9.2	-1.9
Grasslands, woods & shrubs, non forest regrowth	354,900	6.8	-0.5
Agriculture	408,606	7.9	1.1
Unvegetated	245,529	4.7	4.4
Not visible	441,829	8.5	7.4
No data	76,690	1.5	0

Roughly, current land cover can be classified as follows:

- Forest, including undisturbed forest, logged over forest and spontaneous regrowth
- Forest plantations
- Grasslands, woods, shrubs
- Agriculture
- Unvegetated

Forest

Peat swamp forests encompass a sequence of forest types running from the perimeter to the centre of each swamp. Six forest communities that have a distinct structure, physiognomy, and flora are discernible (Anderson, 1983; Whitmore, 1984). Ramin (Gonystylus bancanus Kurtz) and Meranti (Shorea albida) are the most valuable timber tree species in these forest types. Illegal logging has increased considerably after the construction of the drainage canals, through an improved accessibility. Also legal logging takes place, with a proposed cutting cycle of 35 years. The growth rate of the trees is lower than in comparable forest types on mineral soil.

Forest plantations

Forest plantations form only a very small part of the land cover. Some local people have started to grow a range of peat swamp tree species, including ramin, in small plantations. In recent years, the cultivation of estate crops, particularly coconut and oil palm, has rapidly expanded onto the lowland peats of Indonesia, especially in Riau and West Kalimantan, utilising deep peats. The establishment of plantations faces many specific problems related to the substrate.

Grasslands

Part of the peatlands are invaded by the aggressive grass species Imperata cylindrica, locally known as alang-alang. This species is prone to fire and is not very suitable for cattle grazing. Due to its high competitiveness it is not easy to convert these grasslands into other land uses.

Agriculture

Originally, agriculture was only practised at the shallow peats along the rivers, where crops such as rice could be grown. Also pineapple, banana and cassava, vegetables and various types of beans are cultivated here. The deep peats that became available after clearing the forest are not suitable for rice. A variety of other species are attempted, with varying success (Table 2). Farmers' experience and various studies carried out so far strongly indicate that horticultural crops are the most suitable commodities on the peat soils, irrespective of peat thickness. One of the problems of agriculture on peat soils is the low fertility of the substrate.

Table 2. Suitability of various crops on peat soils based on peat thickness (Boehm &Siegert, 2000).

Thickness of peat	0-100	100-200	>200
Wetland rice	Moderate	Low	-
Upland food crops: rice, soybean, corn, peanut, etc.	High	Moderate	Low
Horticulture: Chinese cabbage, papaya, pineapple, cucumber, kankung, etc.	High	High	High
Estate crops: coconut, oil palm, rubber, cacao, coffee, etc.	High	Moderate	Moderate
Industrial crops: rami, medicinal, etc.	High	Moderate	Moderate

Unvegetated
Part of the area is unvegetated for various reasons. Some parts are recently burned and have not yet revegetated and other parts have been seriously degraded making growth virtually impossible.

3.3 Land use and carbon

When the peat is still accumulating, undisturbed peat swamp forest is probably a small net sink of carbon, and otherwise it will be more or less in balance. Draining and conversion of this forest will inevitably lead to loss of carbon, both from biomass and soil. Not many studies of biomass and carbon sequestration in undisturbed peat swamp forests have been conducted. However, we can get a rough idea if we compare with lowland dipterocarp forests which are much richer in biomass. Yamakura *et al.* (1986) found an aboveground biomass of 509 t dry matter per hectare on a 1 hectare sample plot. If we assume a carbon content of 50%, we get an estimate of around 250 t carbon per hectare in aboveground biomass. This agrees quite well with Kuusipalo *et al.* (1996) who give a value of slightly less than 240 t carbon per hectare; these authors estimate the carbon stock in the root system to be about 95 t per hectare.

Forest plantations
Of the other land uses, the carbon balance of tree plantations probably comes closest to the one of the original swamp forest. If tree species are used that are adapted to high groundwater levels, peat decomposition can be slowed down by maintaining a high groundwater table. The stems of the trees will sequester carbon, but it depends on the management regime how large its contribution to the total carbon balance will be. We made some preliminary calculations for Acacia and oil palm plantations.

Acacia mangium plantation
Acacia mangium Willd is one of the species that can be used for plantations in Indonesia. According to Kuusipalo *et al.* (1996) it can be used to outcompete Imperata on grasslands. Due to the low fertility of the peat, it will probably grow slower than the growth rates of up to 60 $m^3 ha^{-1} yr^{-1}$ on mineral soils that are mentioned in the literature. For this case we assumed an average growth rate of 25 $m^3 ha^{-1} yr^{-1}$. We derived relative proportions of biomass in stem, leaves and branches at different ages from the sample trees and biomass equations from the project 'Carbon sequestration of man-made forest in the tropics' (Http://www.f.waseda.jp/yasu/database.html). From the average growth rate we derived biomass in stems at different ages, from which we estimated biomass in leaves and branches. For turnover of foliage we assumed 1 and for turnover of branches we assumed 0.2. Roots have not been included since no data are available. We assumed a rotation of 10 years. After 10 years, a total aboveground carbon stock of about 60 t per hectare will be reached. This is much less than the 120 t reported by

Kuusipalo *et al.* (1996) The difference is probably caused by the lower growth rate we assumed, and may also be influenced by differences in branch and leaf biomass. See Figure 1.

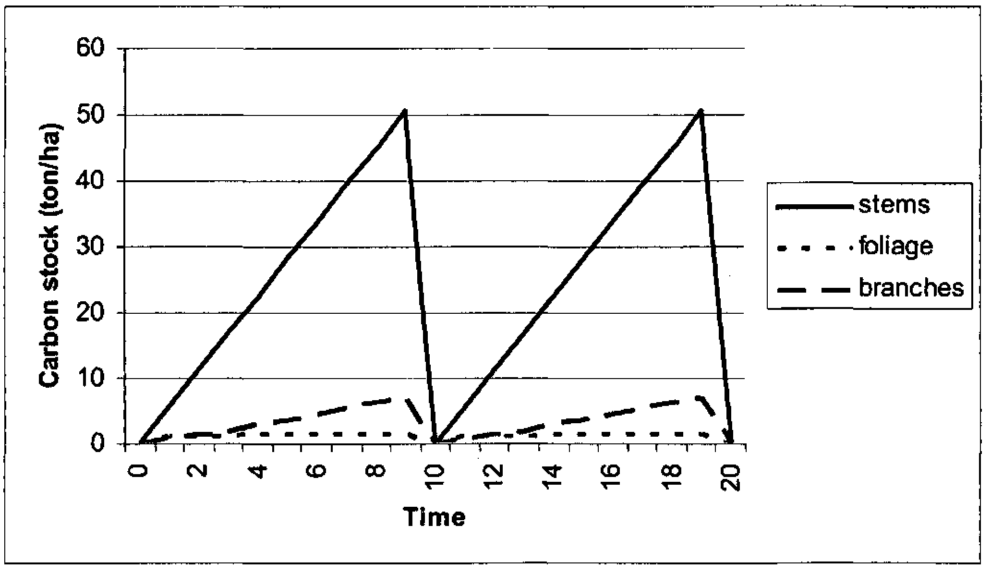

Figure 1. *Carbon stock development in aboveground biomass of* Acacia mangium *plantation in a 10-year rotation, average increment 25 m^3 ha^{-1} yr^{-1}.*

Oil palm

Oil palm is regarded as a possible crop on peatlands. Based on biomass data from Cannell (1982), we made an estimate of aboveground biomass development in an oil palm plantation. With an assumed rotation of 15 years, a maximum carbon stock of about 60 t per ha is reached after 15 years. However, the sample data were from mineral soils. Due to the low fertility of the peat, carbon stocks will probably be lower on peatlands. See Figure 2.

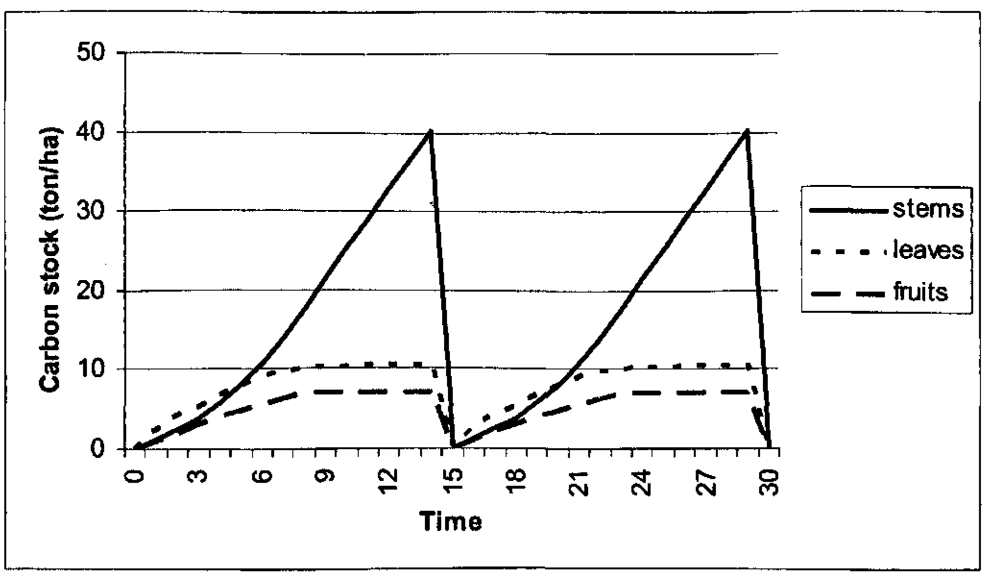

Figure 2. *Carbon stock development in aboveground biomass of an oil palm plantation, based on data from Malaysia.*

Grasslands
Imperata grasslands on mineral soils have an aboveground stock of 5-15 ton C per ha, and the belowground stock in roots and rhizomes is about half of that (Kuusipalo *et al.*, 1996). The figures for Imperata on peat will probably not be very different from those on mineral soils.

Agriculture
The carbon stock in biomass on agricultural sites is very small since it is harvested every year. This means that there is no net effect of biomass growth on carbon sequestration. Due to the drainage, the peat will continuously decompose, turning agriculture into a net source of carbon. Additionally, often ash is applied from burned vegetation from elsewhere. So besides the impact on the site itself, agriculture is likely to change the carbon balance of other areas as well.

There may be other uses of peatland areas than those already mentioned. One of the possibilities is the use of peat for energy production. Out of 8.8 Mha of deep peat in total Indonesia, 4.46 Mha is estimated to be potentially extractable for energy production and other non-renewable uses. This amounts to 3 billion tons of peat. However, peat extraction could lead to serious degradation of the area and is not a sustainable and renewable source of energy.

In general, we see that all drainage and conversion of forest leads to carbon loss. Of the substituting land uses, tree plantations will probably have the least negative effects on the carbon balance since they will form some biomass that remains on the site for a longer period. Imperata grassland, agriculture and unvegetated sites will have a very low carbon stock (Table 3).

Table 3. *Carbon stock in living biomass in various land use types.*

	Aboveground	Belowground
Fallow	small	small
Imperata	10	5
Agriculture	small	small
Oil palm	<30	?
Acacia	30	?
Natural forest	<240	<95

3.4 Problems with cultivation of deep peatlands

Several problems arise during crop cultivation on deep peat. Most peats are poor in nutrients and are very acidic (pH usually < 4). Fertilisation is often done by applying ash of burned vegetation on the soil. However, large quantities of ash are needed to sustain production. Manure is another possible source of nutrients.

Managing peatlands is managing water. After draining and clearing, the peat will relatively quickly subside due to drying and decomposition. After a while, this will slow down to 2-5 centimetres per year. Subsidence speed may be controlled to a certain extent by controlling drainage. Due to the subsidence and the loose nature of the peat, the anchorage of trees will be problematic. If the peat is compacted before establishment of the tree crop, subsidence will be limited and root anchorage will be less problematic. Another problem related to the loose structure of the peat is its low carrying capacity, which causes problems in mechanical farming. Also many undecomposed and partly decomposed logs in the soil hamper mechanisation.

Generally, ground level differences in the peatlands are very small. Due to the subsidence of the peat, the topography may change, causing problems such as flooding and waterlogging after heavy rainfall. In order to cultivate deep peat, a good water management system is required to regulate the groundwater level.

3.5 Risks

The existence of risks is an important factor in CDM projects. Risks pertain to the (unintentional) loss of carbon from the forest project due to various factors. Some are related to forest (or carbon) management, others are related to the procedures linked to the CDM (e.g. financial aspects, payments etc). The risks should be clear to those parties buying carbon emission reductions. When trading, it is in the interest of both parties that the risk of failure is low; eliminating risk is not possible but reducing it to an acceptable level should be possible.

In Kalimantan, forest fires constitute a major risk of loss of sequestered carbon. Fire is part of the peatland forest system and controlled fire is used to clear land for agriculture. Uncontrolled fires, e.g. as result of poorly managed controlled fires, can lead to large-scale destruction of peatland and vegetation. Tropical peatlands are, during the dry season, highly susceptible to fire. In 1997-'98, fires devastated 5.2 +- 0.3 million hectares in East Kalimantan (Siegert *et al.*, 2001). Table 4 shows the damaged area for different land covers.

Table 4. Damaged area for different land covers in East Kalimantan.

Land cover	Area (ha)	Burned (ha)	Burned (%)
Grassland (mainly Imperata cylindrica), low bushes	368,900	292,600	79.3
Lowland dipterocarp forest	5,379,600	2,177,900	40.5
Mangrove forest	1,042,100	91,700	8.8
Peat swamp forest	426,100	311,100	73.0
Secondary forest, plantation, farmland	2,283,400	1,723,400	75.5
Wetlands	358,700	290,400	81.0
Land cover not mapped by ERS (mainly highland dipterocarp forest)	3,882,600	330,800	8.5
Total	13,741,400	5,217,900	-

Source: Siegert et al., 2001.

Page *et al.* (2002) estimated that in 1997 between 0.81 and 2.57 Gt of carbon was released into the atmosphere as a result of burning of peat and vegetation in Indonesia. This amount is equivalent to 13-40% of the mean annual global carbon emissions from fossil fuels.

The damage by fire was greater (49.5%) in recently logged forest areas (between 1966-1998) than in earlier logged forests (26.3%) or pristine forests (17.3%). This means that the risk from damage by fire decreases as the forest matures. However, it also means that (illegal) logging will increase the risk. If risks from forest damage are to be lowered, then land-use policies should be in place to control logging, or to introduce reduced impact logging techniques. Otherwise, recurrent fires will lead to a complete loss of lowland forest (Siegert *et al.*, 2001).

Besides the risks related to forest or carbon management, a reliable legal and institutional infrastructure needs to be in place to be able to start payments for environmental services. As the rules for the CDM are still not clear, capacity is lacking to implement and monitor carbon projects. Especially in Kalimantan the necessary institutional infrastructure is not yet in place (see Chapter 5).

4. The financial system

4.1 Definition of the CO_2 market

We will investigate the CO_2 market by taking a closer look at the demand and supply side of CO_2 reduction. The market is still in its infancy, but it is growing and with several important initiatives underway. The market is, for instance, expected to increase by the decision taken by the EU Commission in December 2002 that 'The EU Member States collectively must reduce their greenhouse gas emissions by 8% between 2008 and 2012. For the period up to 2008, the Parties undertake actions to make demonstrable progress in achieving their commitments by no later than 2005' (EU, 2002). This way, the EU will by 2005 be well prepared to participate in the emissions trading system foreseen in the Kyoto Protocol.

4.1.1 Demand for CO_2 reduction

UNEP-FI (2002) identifies five categories of buyers of CO_2 reduction:
1. Institutional multilateral (e.g. World Bank PCF, IFC, Asian Development Bank)
2. Public Sector Unilateral (e.g. Dutch ERUPT programme, UK Climate Challenge Fund)
3. Private Sector Funds (e.g. Edison Electric Institute, Fondelec, Black Emerald)
4. Bilateral Transactions: mainly involving large industrial corporations (e.g. Shell, TransAlta)
5. Green Certificate Buyers: heterogeneous marketplace requiring heavily structured deals

Some of these will be discussed in the section about existing mechanisms.

The demand for CO_2 reduction comes from industrialised countries that under the Kyoto Protocol need to reduce their greenhouse emissions, the Annex 1 countries. The Kyoto Protocol allows these countries to achieve part of their reduction targets via projects in developing countries. Clearly, countries that have little possibilities to achieve the targets within their boundaries or where costs to achieve the goals are high, are potential buyers. For example, the Dutch government has agreed that a substantial part of their emission reduction should be achieved within the Netherlands itself and the remaining part should be achieved in other countries through the three Kyoto mechanisms, including CDM.

Besides countries, companies are becoming increasingly active on the carbon market. This is partly related to motivations of 'greening' the corporate image or because of stewardship considerations, but at the end of the day it also makes economic sense: carbon is money. Especially power producers such as electric companies and petrochemical concerns such as BP Amoco or Shell International are active in this field. There are several reasons why they voluntarily commit to reduction programs. One important reason, especially for those who emit more carbon dioxide per dollar of operating revenue than others, is the perceived risk of binding limitation that will be imposed on GHG emissions in the future. They can hedge this risk by reducing GHG now because it is believed that current reductions are relatively inexpensive compared to likely future prices in a regulated emissions trading system. Also, gaining experience in emission trading in an early stage might help them in the future, when emission reduction could be obligatory. Besides this, companies have reacted to public concern over the greenhouse effect.

Estimates based on the potential carbon trade in North America and Europe indicate that it could be worth 30 to 100 US$ billion when fully operational (Totten, 1999) and a market clearing price with full carbon trading in the US could go to 30-40 US$ per ton and as high as 70-80 US$ per ton in Europe and Japan.

Interest to invest in (small scale) CDM forestry projects in developing countries may not lie in the possibility for cost-efficient CO_2 reduction alone but in the combination of CO_2 reduction with improving local livelihoods of poor communities. In this way, CO_2 reductions are coupled with sustainable development, as was outlined in the Kyoto protocol (article 12.2). Also, CDM forestry conservation projects may be in line with the Convention of Biological Diversity (CBD), which may add an additional incentive to invest in these schemes.

4.1.2 Supply of CO_2 reduction

The suppliers of CO_2 reduction are very diverse, ranging from large multinational energy companies to small local operators, and to governments in the so-called non-Annex 1 countries. Most buyers have sought to acquire reductions generated within their own home country, and only a handful of projects located in developing countries have resulted in successful emissions transactions. Projects located in these countries have greater perceived project risk and few developing countries have established adequate institutions to review project proposals and to grant necessary host country approvals (Rosenzweig *et al.*, 2002), with Costa Rica as a notable exception. Costa Rica became the first country to turn its forests into marketable carbon sinks by issuing 'Certified Tradable Offsets' (CTOs), based on a forest carbon sequestration program with performance guarantees, carbon reserve pools and third party certification (see also Subak, 2000).

However, tropical developing countries can offer low cost carbon offset opportunities. Based on Brown (1997) and WCFSD (1997), Totten (1999) estimates that some 700 million hectares of land in developing countries and countries in transition might be economically attractive for forest carbon programs, resulting in 60 to 87 billion tons of carbon cumulatively conserved and sequestered by 2050, equivalent to 11-15 percent of the fossil fuel emission over that period. However, if factors such as land tenure, institutional capacity, and other (socio-economic) constraints are taken into account, these figures may be lower.

For these non-Annex 1 countries, it can be attractive to host forest carbon programs, because forests can provide several other functions such as watershed protection and controlling or maintaining biodiversity (Meijerink, 1995). For local communities there are also a number of benefits to be gained in participating in a CDM project, although Smith & Scherr (2002) warn that these benefits can only be gained if the CDM project fulfils several criteria (see 5.2). These gains can consist of livelihoods derived from forestry, but may also consist of direct or indirect payments for carbon sequestration.

Not only forest can capture carbon but other forms of land use and land management provide opportunities as well. These, however, are not eligible in the first commitment period of the Kyoto Protocol.

4.2 Examples of Emission Trading Schemes

In December 2002, the EU reached an agreement on an EU GHG emissions trading system (EU ETS), which will establish absolute limits on the emissions of CO_2. By this agreement, the EU has established the first trans-national emissions trading scheme in the world. In light of the upcoming EU enlargement, the scheme could cover up to 30 countries in the period up to 2012. The CO_2 emissions expected to be covered by the scheme are estimated to account for about 46% of the EU 15 members' total CO_2 emissions in 2010, and about 4,000 to 5,000 installations across the existing EU Member States will be affected (GBN, 2002).

Elements agreed include:

- Opt-out: Although trading will start in 2005, individual installations or economic activities can be exempted from emissions trading in the final period in 2005-2007. Opt-outs are, however, subject to approval by the Commission on strict conditions. These notably include fulfilling the same emissions reduction requirements as companies and installations participating in the scheme.
- Opt-in: Member States can unilaterally include additional sectors and gases from 2008 onwards, subject to approval by the Commission.
- Pooling: The agreement also provides for the possibility for companies to pool their emission allocations until 2012.

- Allocation of emission rights: Allocations of emission permits will be free of charge, but Member States can auction up to 10% of their allowances from 2008.
- Penalties: The penalty rate foreseen for the period from 2005-2007 has been slightly reduced from 50 $ to 40 $ per ton of CO_2 equivalent emitted in excess of the allowance. It will be 100 $ thereafter.

Several governments have initiated a GHG emissions trading system. Rosenzweig *et al.* (2002) and De Conink & Van den Linden (2003) mention three of such schemes, in the US, Denmark and the UK, which we will discuss briefly. The EU system is a trans-national system, and it is still unclear how the systems of Denmark and the UK will fit into this larger system.

Massachusetts was the first US state to impose CO_2 emissions limits on old fossil-fuel-fired power plants. The reduction can be met through internal actions such as repowering from coal to natural gas, but also through the purchase of offsets for compliance. Although specific rules for crediting offsets are not yet in place, emissions reduction or sequestration projects must demonstrate to the Massachusetts Dept of Environmental Protection that the reductions are real, surplus, verifiable, permanent and enforceable.

The Danish government introduced the CO_2 Quota Act in 1999, which imposes a cap on power sector CO_2 emissions. For 2000, the Act specifies a total emissions quota for electricity producers of 23 million metric tons of CO_2. By 2003 this cap will have been tightened to 10 million metric tons. Electricity producers can trade their emission allowances among each other and each year until 2003. If an electricity producer's annual emissions exceed its holding of allowances, it is subject to a penalty of US$ 5-6 per metric ton excess. The revenue from penalties is directed toward energy-saving projects.

In 2001, the UK government published the final framework for a national GHG trading program that covers most of industry, and all GHGs. With this program, the UK is the first industrialised country to develop such a broad-based GHG program. Although the program is voluntary, companies are induced to participate through a tax on industrial and commercial energy consumption, known as the Climate Change Levy (CCL).

4.3 Examples of project-based programs

Besides government systems such as the emission trading schemes discussed above, there are several project-based initiatives that are taken by individual companies to achieve voluntary reduction commitments or programs initiated by (national or state) governments that allow companies to reduce their emissions voluntarily. We will discuss a few examples (information based on: Rosenzweig *et al.*, 2002; Face, 2003; De Conink & Van der Linden, 2003).

4.3.1 Emission Reduction Unit Procurement Tender (ERUPT)

ERUPT is an initiative by the Dutch Ministry of Economic Affairs, designed to assist the Netherlands in achieving its national emissions limit under the Kyoto Protocol through the purchase of Emission Reduction Units (ERUs). ERUPT projects must adhere to criteria issued by the Ministry's implementing agency SENTER. Purchases from five projects (all in Eastern Europe) in the first round involved a total of 4.2 million metric tons of CO_2 reductions, valued at a total of US$ 31 million. Two additional tenders have followed - a second round of ERUPT and a Certified ERUPT which is designed to purchase reductions generated from CDM-like projects (aiming at 3 million metric tons of CO_2 at US$ 42-45 per metric ton).

The Dutch Government has established a separate CDM Division to use the funds allocated by the Dutch government to purchase Certified Emission Reductions (CERs). In fact, the purchase of CERs creates an additional return on project investments. As a result, sustainable projects can be realised, which would not have been feasible without the possibility of selling CERs.

CERs are purchased through the following four tracks:
1. Multilateral international financial institutions.
2. SENTER International, a Dutch agency acting on behalf of several Dutch Ministries.
3. Private financial institutions.
4. Bilateral purchase agreements with Host Countries.

These intermediaries select sustainable projects in developing countries and purchase the resulting CERs. Investors from all countries may submit CDM project proposals to these intermediaries who will judge these projects, including the compliance with the requirements.

4.3.2 Prototype Carbon Fund (PCF)

The PCF was established by the World Bank in 1999 to acquire high-quality project generated emissions reductions *that could potentially be eligible for international recognition under rules governing JI and CDM*. Private firms and governments have invested a total of US$ 180 million. The PCF has purchased reductions from three projects in Latvia, Uganda and Chile.

These two programs, which have a portfolio of 37 CDM and 12 JI projects, are fully consistent with the Kyoto Protocol, and the emerging framework for JI and CDM. They are therefore nominated for approval by the UNFCCC. However, De Conink & Van der Linden (2003) emphasise that the UNFCCC has not yet certified any organisation to verify and monitor JI/CDM projects.

The World Bank recently launched the BioCarbon Fund. This fund which will purchase emission reductions potentially eligible for credit under the Kyoto Protocol. Besides the CDM route, a JI route is opened which aims to demonstrate how carbon projects can work. The rules for the JI are less strict as it is primarily designed as a learning process.

4.3.3 Finnish CDM/JI Pilot Programme

In 2000, the Government of Finland has launched the CDM/JI Pilot Programme in preparation for the Kyoto Protocol. The aim of the programme is to gather experience in issues specific to the CDM/JI project cycle and to facilitate the implementation of the Kyoto Protocol in Finland. The invitation to propose small-scale CDM projects closed on 31 March 2003. In total, 28 tenders were received, from South America, Asia and Africa. The evaluation of tenders is in progress. Projects included in the programs pipeline will produce emission credits until 2012 at least.

4.3.4 US Initiative on Joint Implementation (USIJI)

Although the US did not ratify the Kyoto Protocol, several different initiatives for CO_2 reduction are ongoing in the US. The US Initiative on Joint Implementation (USIJI) was the first JI pilot program, initiated under the 1993 US Climate Change Action Plan. It was established to demonstrate viability of project-based emissions trading. To date the USIJI has approved 50 projects in 26 countries (both developed and developing).

4.3.5 The Climate Trust (Oregon)

This initiative, taken in 1997 by the State of Oregon, obliges new power plants to offset a portion of their projected CO_2 emissions as a condition for obtaining an operating permit. They may do this by acquiring qualifying offsets in the market or by paying US$ 0.85 per metric ton of CO_2 to the Climate Trust. So far all have chosen the latter option and five projects will funded from the first million dollars in the Climate Trust. These projects are all located in North America, except for one, which is in Ecuador. A second round of contracts (US$ 5.5 million) will be awarded coming years.

4.3.6 Activities Implemented Jointly Pilot Phase (AIJ)

This program was initiated at the first Conference Of Parties (COP-1) to the UNFCC in 1995 to gain experience with JI and CDM-like projects. Although the pilot phase was supposed to end in 2000, it continued after the COP-7 in Marrakech and has undertaken 155 projects in 41 countries.

4.3.7 Pilot Emissions Reduction Trading Project (PERT, Ontario)

This well-known Canadian initiative was undertaken by industry and government of Canada to explore and promote emissions trading by fostering voluntary reduction activities. To date it has evaluated a number of projects that together have led to the registration of 14.6 million metric tons of CO_2 reduction.

4.4 Company initiatives

Several companies have set up their own CO_2 reduction programs, notably the fossil fuel and electricity companies. We will discuss a few examples here.

4.4.1 BP

In 1998 BP committed to reduce its GHG emissions 10% below 1990 levels by 2001. It collaborated with the NGO Environmental Defence and launched a pilot project phase in 1999 involving 12 of its business units located in different countries. In 2000, 2.7 million metric tons of CO_2 were traded at an average price of \$ 7.5 per metric ton.

4.4.2 Shell

In 1998, also Shell committed itself to reduce GHG emissions 10% below 1990 levels by 2002. In 2000 it instituted its Shell Tradable Emission Permit System (STEPS) program which is modelled after CDM. Around 20 of its units were required to participate in the program (amounting for 30% of corporate emissions). It has established caps for units in developed countries (Annex B) but also allows units in developing countries (non-Annex B) to generate project-based reductions and sell them into the system. However, the Shell emission trading scheme was not successful due to the voluntary nature of the scheme and therefore ceased to exist.

4.4.3 FACE

The Dutch Electricity Board (SEP), a consortium of five electricity companies, created the FACE Foundation to promote the planting of forests to absorb an amount of CO_2 equivalent to the emissions of a medium-sized coal-fired power plant during its 40-year life span (Moura-Costa, no date). Since 2000, the Face Foundation is working at the development and reconnaissance of markets for the acquisition of funds in order to keep fulfilling its objectives. Services related to Face's objectives concerning forestry and climate are:

- Supplier of verified carbon credits;
- Implementation of forestry projects;
- Generation of carbon credits through forestry projects;
- Consultancy on climate projects, baselines, forestry projects, certification, etc.

4.5 Possible future directions: financial derivates and brokers

Rosenzweig *et al.* (2002) estimate that already between 25 and 50% of the emission reduction transactions have involved an exchange of financial derivates. Once the carbon trading market becomes more mature, it is to be expected that the number of transactions involving these derivates will increase. We will (after Rosenzweig *et al.*, ibid.) discuss four of these: call options, put options, collars and fences on VERs (Verifiable Emission Reductions), or other emissions commodities.

Call options
A buyer of a call option, which is simply a contract specifying certain responsibilities, buys from a seller the right but not the obligation to purchase a fixed quantity of emissions at a fixed price (strike price) on or before a fixed date in the future (expiration date). The buyer pays the seller of the call option to accept the corresponding responsibility to sell emissions reductions according to the agreed terms. The amount paid for the option is called the premium. Sellers are allowed to keep the premium even if the buyer fails to use the option. In this way, call options are a relatively inexpensive way to hedge risks related to future compliance costs (which may be much higher than current costs).

Put options
A put option entitles its buyer the right to sell a commodity (e.g. VER) at the strike price on or before the expiration date. The seller of the option is required to purchase the commodity at the agreed price if the buyer uses the option. The premium is paid by the buyer to the seller at the time the initial transaction is closed.

Collars or fences
These involve two transactions in which one party buys a call and sells a put (usually with different strike prices and the same expiration date), and another sells a call and buys a put. By setting a price floor and ceiling, each position will provide protection against market movement.

Swaps
These are transactions in which one type commodity is exchanged for another, rather than for cash. Swaps in emission trading can involve tax benefits when tax authorities consider them to be non-taxable 'like-kind exchanges'.

The EU's emissions trading scheme, which was agreed by the EU's environment ministers in December 2002 and is expected to be implemented in 2005, has already led to the first speculative trades. In Germany, traders have begun brokering speculative trades of CO_2 certificates between companies (E5 News & Press, January 2003)

Another development that is to be expected is the increase in market participants who function as brokers to match suitable buyers and sellers. As more initiatives will come about, their role will increase. The role of other consultants who will assist parties in issues such as monitoring and quantification of CO_2 sequestration, and auditors is also likely to increase. Such consultants have already stepped into the market (an example is WSP Climate Change Services, part of the WSP Group, a large consultancy based in London). Landell-Mills & Porras (2002) observed a rapid emergence of ancillary service providers such as advisory, exchange, brokerage, investment funding, legal advice, insurance, and certification. The major share is taken up by advisory service providers, which may underline the fact that the market is still at its early development stages. However, they also note that the market is increasingly dominated by the private sector in demanding and supplying carbon offsets, and as a provider of ancillary services. This is a sign of confidence that the carbon market will expand, which is also reflected in the shift from a series of ad hoc deals towards the establishment of trading systems that aim to provide a basis for numerous transactions.

4.6 Relation to International Trade Agreements

Many key aspects of the CDM will entail services or service-related functions. Accordingly, one of the most important WTO agreements related to the CDM will be the General Agreement on Trade in Services (GATS), which has been adopted by the World Trade Organisation (WTO). At least three basic GATS-related components may be identified under the CDM:

- Certified Emissions Reductions (CERs)
- Services employed in the development and management of CDM projects
- Financial services related to trade in CERs

Wiser (2002) concludes that it is unlikely that the tradable allowances issued after certification of a CDM project's accrued emissions reductions could reasonably be considered products or services within the range of the General Agreement on Tariffs and Trade (GATT) or GATS, but rather as a tradable license or permit. This will probably imply that countries will have the freedom to regulate CERs in ways they believe are appropriate, without concern that such treatment will be subject to WTO jurisdiction.

Secondly, many of the individual services that collectively constitute CDM project development are likely to fall under one or more of the categories identified in the list of services covered by the GATS. However, two of the most important GATS provisions affecting the treatment of those services are 'opt-in' commitments. Very few WTO members have made commitments for the energy or environmental services sectors, which are among the most important service sectors for CDM projects. This means that countries have the opportunity to take the initiative to ensure that the GATS enhances rather than interferes with the CDM's sustainable development objectives.

4.7 CDM community forestry projects

Smith & Scherr (2002), in a study drawing on experiences with pilot carbon projects and social forestry, conclude that many types of CDM projects could potentially contribute to local livelihoods and ecosystem restoration, as well as to carbon emission offsets. However, this will only be possible if a number of criteria are met, which are discussed in detail in section 5.2 on institutions.

In general, projects that sequester CO_2 will be profitable when returns (i.e. price per ton C received) are higher than the costs (i.e. cost incurred per ton C sequestered). The cost structure of a CO_2 sequestration project consists of the costs involved in the CO_2 sequestration itself (e.g. the establishment of a forest or plantation) but also of the costs involved in management of the CDM which are called transaction costs. These costs are also linked to the guidelines established for CDM projects (e.g. on additionality, leakage, permanence).

Production costs are the costs per metric ton of carbon of establishing and maintaining the new carbon-augmenting land use. These include tree establishment, management, processing and the opportunity costs of land. To realistically reflect cost effectiveness of the project, production costs should be adjusted to take account of leakage, project duration and the risk of project failure. These aspects are usually not taken into account.

Transaction costs are also often forgotten when calculating the costs of a project (Smith & Scherr, 2002). However, these costs will play a role in every carbon sequestration (CDM) programme. They usually consist of the following (Landell-Mills & Porras, 2002):

- Project identification - searching and selecting projects that will meet Kyoto as well as national crediting requirements
- Project design and implementation
- Project monitoring, enforcement and risk management
- Host countries and national project review — clarification and streamlining national and international registration and approval processes
- Marketing

Smith & Scherr (2002) have looked into the production and transaction costs based on a number of studies on different forestry projects:

Large-scale industrial plantation: Could supply carbon protection at under $ 5 per ton C, especially when carried out on degraded lands with low opportunity costs. However, the studies usually ignored leakage and transaction costs and make no adjustment for project duration.

Agro-forestry and community forest plantations: cost of production differs per type of plantation. Costs will be higher than large-scale industrial plantations because of additional costs such as compensation payments to farmers, co-ordination and management costs of groups of farmers. Estimates in seven studies (including forest fallow) range from US$ 8 to 70 per ton C. However, the studies usually did not include leakage, transaction costs of project duration.

Assisted natural regeneration: The production costs of these schemes tend to be lower than tree planting and are therefore cheaper than agro-forestry and community plantations.

Strict forest protection: Although these projects can supply carbon at a low price (under 5 per ton C), the transaction costs can be substantial, as well as the cost of leakage.

Multiple use community forestry within protected areas: The costs of such projects will be higher than under strict forest protection because of the costs that involvement of communities incur. However, the costs of leakage will probably be lower, as well as the risk of project failure because the local communities have a stake in protecting the forest.

Poffenberger *et al.* (2001) note that within the context of carbon-credit based financing programs, transaction costs are likely to be higher than in conventional (community forestry) programs due to the stringent reporting requirements and the additional costs of dealing with international mechanisms and markets. These transaction costs will increase as the role of the third party 'manager' (e.g. forestry department, NGO) increases. Giving communities greater authority and control over funds for project management and operations would likely reduce transaction costs. However, involving communities also incurs transaction costs, especially when the communities are characterised by a high degree of conflict (De Jong *et al.*, 2000).

5. Institutional system

All well functioning markets rely on a strong institutional foundation. This is especially true for markets for environmental services. Legal and financial structures need to be effective and transparent, but also the way in which the commodity (e.g. biodiversity, carbon) is determined needs to be transparent and verifiable. International rules and guidelines on how to determine and report changes in carbon are still being developed.

The institutional setting is partly prescribed by the Kyoto Protocol. A national CDM Authority should be created to evaluate potential CDM projects and see whether they comply with national and international criteria (Kyoto Protocol, development plans, biodiversity and sustainability indicators).

For Indonesia (which has not yet ratified the Kyoto Protocol) such an authority does not yet exist. Recommendations on the national institutional and legal framework are already presented by the Indonesian State Ministry for Environment (State Ministry for Environment, 2001).

A successful CDM strategy will need active support by all regional stakeholders (local government, NGOs, private sector, etc.) and co-operation from the various sectors (agriculture, forestry, mining, etc.). The integration of these players is probably not the way to go; creating a body with the support from these players, however, could create a platform for discussion and co-operation. Linked to the National Authority, a Regional Focal Point for Environmental Services could co-ordinate and facilitate CDM projects. For example, such a body could protect the integrity of the projects and provide transparency towards the buyers (e.g. no double accounting), and it could assist in bundling small scale CDM projects and attract investors (this instead of having a lot of small scale initiatives that will confuse investors and leave small landowners outside the loop).

Costa Rica has, for instance, invested substantially in its institutional and legislative framework and nurtured capacity so that public, private, and community stakeholders can benefit from forest conservation measures. This conservation infrastructure is crucial when capitalising on and benefiting from opportunities in environmental services. Targeting policies, institutional frameworks and human capacity is critical (GEF, 2002).

CDM forestry projects that enhance livelihoods and result in sustained CO_2 emission reductions can only be successful when a number of conditions are met. Because these conditions are related with the (national) institutional environment of the project as well as the institutional arrangements the project needs to put in place, we will describe the required institutional settings at national level, with special reference to Indonesia, and local level on a more general note.

5.1 Institutional setting at national level

The national institutional settings are important for two main reasons. First, the host country must have institutions in place to facilitate the implementation of CDM. Secondly, the host country should create an enabling environment that support sustainable forestry.

The government of Indonesia is a signatory to the UNFCCC and ratified the convention on August 1, 1994. The government is also a signatory to the Kyoto Protocol but is has not ratified it. Due to the country's economic and socio-political crisis during 1997-1999, meaningful follow-up related to the Protocol has been delayed. This means that Indonesia has not yet established formal policies or national criteria, nor prioritised sectors with respect to CDM.

In 2000, a national task force for 'Indonesia National Strategy Study on CDM' was established to advise the government on Indonesia's negotiating position on CDM, the benefits that could be gained from hosting CDM projects, CDM potentials and policies and institutions required to participate effectively. The government has indicated that possible CDM projects would be mainly in energy sectors, followed by forestry 'sink' projects (Soerawidjaja *et al.*, 2001).

In 2003, the Ministry of Environment, as focal point for the United Nations Framework Convention on Climate Change (UNFCCC), has started an initiative to establish the Designated National Authority (DNA) for host country CDM approval projects in Indonesia. This initiative is funded by the German International Co-operation Agency (GTZ). The DNA is required by the Marrakech Accords for all host countries to approve CDM projects in their countries. In Indonesia, the DNA will be hosted by the Ministry of Environment as focal point of the UNFCCC and as Chair of the National Committee on Climate Change (NCCC). While the project will be carried out in 18-24 months, it is expected that a fully-functioning DNA will take place prior to the COP9 in Milan, Italy (December 2003). To empower the DNA, Indonesia has submitted a law for ratification of the Kyoto Protocol. The draft law is currently under deliberation of parliament. The Asian Development Bank, after its fact-finding mission in March 2003, is likely to approve a $ 900,000 advisory technical assistance (TA) to the Government of Indonesia on sequestration (forestry) CDM. The Ministry of Environment will assume the role as the executing agency (Pelangi News, March 2003).

National governments also play a crucial role in creating the environment for (local) forestry projects. This includes defining land (use) rights, specifying entitlements to forests and forest products and ensuring forest protection. Especially where poor and vulnerable communities are involved, their interests should be well protected. Sari *et al.* (2002) argue that the underlying causes of forest destruction and degradation in Indonesia are rooted in tenure problems, conflicting and ineffective regulatory measures, high demand for forest products, and bad governance and corruption.

Rusmantoro (2002) highlights the problems of governance and bureaucracy in Indonesia which will have effect on implementation of CDM in Indonesia:
'A crucial issue is how the international agenda and national commitment can be linked to the commitment of local government, and how the bureaucracy can be reformed. The failure of last year's multi-sector agenda under the Interdepartmental Committee on Forestry and other previous international programs were due to the absence of intensive communication to link those international commitments with national, as well as local, concerns. Governance and bureaucracy problems are the most important causes of forest degradation. International initiatives cannot be more than a trigger to further work in this area. Experience in the last two years has shown that the forest reform agendas that could be carried out were only those agreed through intensive communication among the central and local government as well as other stakeholders, followed by bureaucracy reform and strengthening. Any one agenda could be better than any other, but it would be futile without sufficient commitment and institutional capability.'

Therefore, Sari *et al.* (2002, p. 35) conclude that 'while the best way forestry CDM can contribute to the forestry sector is additional financial resources, the lack of which is by no means the only — even the most pressing — cause to forest destruction and degradation. Forestry CDM runs a risk of gross unfeasibility when faced by the complex institutional interplay in the forestry sector in Indonesia'.

5.2 Institutional setting at project and local level

A first step in establishing the institutional setting for a CDM forestry project is identifying the community that will be involved in the CDM project and clarifying what is expected of them (in terms of CO_2 sequestration) and what their compensation will be in a carbon contract. This will require well-functioning local institutions. Smith & Scherr (2002) have identified several elements for a CDM project design, based on lessons from past forestry experiences.

5.2.1 Maximise project success through strong local participation

In a CDM project, the local suppliers of CO_2 reduction (groups of individual or community landowners) and the outside investors (or intermediary) negotiate an agreement on carbon emission reduction activities. Although we have seen that the national institutional framework is crucial, it is equally important that the local communities are involved in decisions on project design and that funds are used to finance activities that enable local people to increase their livelihoods. The definition and prioritisation of livelihood benefits from CDM projects and distribution of carbon revenues among project partners should be negotiated directly with the contracting local suppliers.

Poffenberger *et al.* (2001) describe a CDM community forestry project in Central India and how a number of institutions were involved. Some new organisations needed to be established to co-ordinate the program. Because the project aimed to empower local communities as forest managers, Forest Protection Committees and Village Forest Committees acted as primary implementers of the project. The support of the Forest Department to the local communities helped in establishing strong and successful committees and resolving conflicts. Research Institutions in conjunctions with the local FPC/VFCs prepared detailed designs of carbon monitoring, verifying and reporting system, training village monitors in the methodologies and data analysis procedures, and were responsible for verification of the findings.

In Central Kalimantan, stakeholder involvement in carbon and other environmental services (e.g. biodiversity) is just starting. Central in these activities is the Bio-Rights initiative (www.bio-rights.org) which aims at poverty alleviation via payments for environmental services.

5.2.2 Select the most suitable compensation mechanisms

A central question in function endowment (in this case CO_2 sequestration in trees) is how much should be contributed to whom and by whom? And who should be compensated how much, in what way and for how long (Meijerink, 1995)? According to Smith & Scherr (2002) the compensation scheme must clearly increase the well-being of local people and should be negotiated directly with them. Four alternative compensation mechanisms for forest carbon projects can be identified:

- Pay per tree: projects directly reward individual tree growers for carbon sequestration.
- Pay for forest establishment or protection: projects compensate community organisations to protect/ regenerate forest areas or establish plantations. The community organisation distributes benefits to members.
- Facilitate profitable and sustainable land management: projects invest in extension services, tree nurseries, marketing infrastructure, etc. Individual producers gain by participating in new land-use activities or sharing income from forest production. Sustainable forest management for instance, may make it eligible for forest certification and enabling producers to sell certified timber and NTFPs for a premium or as preferred suppliers (see also Jenkins & Smith, 1999).
- Pay communities with improved services: projects reward communities by improving livelihoods through providing health clinics, education, micro-finance, enhanced rights to resources etc.

Poffenberger *et al.* (2001) in their description of the CDM community forestry project in Central India describe a system in which a forest-producer federation was established that negotiated a 50-year contract with a consortium of outside financing agencies at a fixed rate per ton per year. A part of the payments was put into community run micro-credit institutions and the rest was divided among the various support institutions (e.g. community group councils, joint account of the Federation, research institutions that provide support in training, monitoring, verification and reporting, the local Forest Divisions for operations that oversee the allocation of carbon credit resources and co-ordinate the overall technical assistance programme).

5.2.3 Enhance the profitability of new land uses

Because the income from carbon payments to communities will be small in the short term, it is important to stimulate a portfolio of diverse income streams from forest resources to raise incomes and reduce fluctuations in income. Examples are to increase the productivity or value of land uses, facilitating sustainable forest certification, use of non-wood products, etc. This will also reduce the risks of leakage.

5.2.4 Increase transparency in investor-community partnerships

This is closely linked to the local institutional setting. Merely setting up institutions and organisations will not be sufficient. It is also important that there is mutual confidence and trust between communities and external private or governmental agencies. Smith & Scherr (2002) recommend that in negotiating and implementing CDM contracts agreements and processes must be understood and widely known. All stakeholders should agree on clearly drawn maps showing the boundaries of land-use and management regimes. Clear criteria and transparent mechanisms for the distribution of costs and benefits among multiple stakeholders should be put in place. Forest carbon contracts need to clearly specify issues such as the operational plan, ownership of land, carbon sequestration rights, project termination, project governance, financing, division of carbon credits, liabilities for failures to perform, and procedures for dispute resolution.

Davis (2000) provides a blueprint for a comprehensive agreement with 16 articles for a CDM project which may readily be used.

5.2.5 Reduce project marketing costs and investor risks

Project marketing costs and investor risks are potentially high in forest carbon projects. Especially with respect to project duration, there are risks involved. A requirement mentioned in the Kyoto protocol is that CO_2 projects should result in long-term carbon storage change. What exactly is long-term is not clear, but for forestry it is clear that carbon is stored only as long as the forest (or its harvested products) exists. In contrast, fuel switching projects in the energy sector reduce CO_2 emissions permanently. With long-term forest projects there is always the risk that land use will change before the projected time, especially when there is strong population pressures or in case policies or market conditions change. The challenge therefore is finding a formula that values forest-based carbon offsets appropriately when set against more secure emission reductions. One way is to discount forest-based offsets to take account of their non-permanent nature. Another option is to devise mechanisms that provide reasonable assurance of indefinite sequestration.

Besides project duration, leakage poses another risk. 'Leakage' occurs when project activities result in an increase in emissions outside the project, for instance, if the project leads to increased agricultural activities in forest areas that are outside the project.

Risks associated with CDM can decreased in several ways (Smith & Scherr, 2002; Landell-Mills & Porras, 2002):

- Bundling projects within a country to market a large supply of carbon offsets.
- Pooled investments in 'mutual fund' type arrangements to lower transaction costs and the risk of individual project failure.
- Branding of socially responsible investments by site labelling or social certification to market these to utility and other companies that seek to acquire credits labelled as 'earned from livelihood-enhancing projects'. This may also attract investors such as charities or development organisations.
- Project insurance. Provide an insurance buffer, which has been adopted by Costa Rica for its Certified Tradable Offsets. Essentially this means that the host country supplies additional carbon sequestration as a buffer against unexpected loss.

5.2.6 Increase scale and reduce costs of community-based CDM projects

The bigger the project area, the lower the overhead costs such as project design, management and certification. Smith & Scherr (2002) mention various institutional strategies that have been devised to reduce transaction costs and increase the scale of potential projects to keep costs of carbon offset competitive:

- Specialised service contracts
- Intermediary management organisations
- Sites with established community organisations
- Bundling environmental service payments
- Bubble projects

These strategies will also reduce the risks as described earlier.

5.3 Financial institutions

The role of financial institutions in CO_2 reduction trade is an important one, and it is likely that this role will increase in the future. However, UNEP-FI (2002) has found that most mainstream financial institutions can be categorised as being unaware of the business relevance of climate change issues, or have adopted a wait and see attitude. Only a small handful of companies are proactive and have begun to develop new products, lines of business, or new strategies and some have become sector leader in terms of product development and thinking on the GHG markets.

There are several products financial institutions (banks and insurance companies) can take on: financing, insurance, risk transfer, financial derivates, carbon investment funds, corporate equity analysis, and financial advisory services (e.g. trading emission reductions, portfolio advice, capital structuring advice) (see also Janssen, 2000). Risk transfer is especially important for projects in developing countries due to perceived high political risk.

A financial institution can assist in prioritising the risks to be transferred, and by defining the potential third parties best placed to absorb the risk at the lowest cost to the project. Several risks can be envisaged in CDM projects such as economic risk (revenues and costs), political risk (war, political violence, expropriation), regulatory risk, currency volatility risk, construction risk, operating and technology risk.

Political risk may be absorbed by lenders as part of their funding structures in some countries. However, a combination of political risk insurance and an existing group of lenders may provide a more attractive solution. Examples of other sources of political risk insurance include export credit agencies (e.g. the Export-Import Bank of the United States (US Exim) or Japan Exim.) or multilateral agencies (such as Japan Export and Investment Insurance (EID/MITI), or United States Overseas Private Investment Corporation (OPIC)). Traditional insurers are also now providing such insurance (CO_2e, 2003).

With respect to trading, producers of emission reductions may seek to obtain performance guarantees, and insurance against political risks associated with the location of the project or the regulatory implications of the Kyoto Protocol itself. For example, one issue of concern for buyers of CDM emission credits is the political risk of the host government withdrawing approval of the credits at a later date. These types of cover are not yet available but they are expected to be obtainable in the future. Optimising the risk profile will enhance the value and attractiveness of emission reduction projects.

6. Discussion

1. A large carbon offset potential exists in the peatlands of Central Kalimantan

The peatlands in central Kalimantan are a large carbon reservoir; conserving this reservoir is in fact a very cost-effective way to preserve carbon. Reducing emissions and sequestration of carbon is clearly an option in the deforested and degrading areas.

CDM opportunities for reforestation exist on areas near nature reserves and on abandoned agricultural land. Large parts of the claimed land are unsuitable for agriculture (low soil fertility, regular flooding ...); these areas could be rehabilitated using local tree species. Agricultural activities in the peatland area inevitably lead to loss of organic matter, depleting nutrients and in the long run creating an unsuitable environment for crop production. Alternative systems need to be developed, e.g. livestock husbandry, agro-forestry based production systems. So far no clear picture is available on the expansion of the abandoned agricultural land and the various strategies or alternative systems that are currently being explored.

2. The CDM rules, when applied strictly, exclude large parts of Central Kalimantan for carbon offset projects

Given the rules of the CDM only areas that were deforested before 1990 are eligible for reforestation and afforestation. Most of the forest cover in Central Kalimantan was removed after this date. Conservation of the existing carbon stocks is a cost-effective contribution to the greenhouse problem. However, activities aiming at the prevention of deforestation and conservation of the peat are not eligible for crediting under the CDM.

3. Various (mostly uncoordinated) international initiatives (both public and private) to facilitate carbon offset projects exist

Although the market for carbon emission trading is still in its infancy, a large number of international initiatives (both public and private) to facilitate carbon offset projects have been initiated in the past decade. Although several key players, amongst which notably the US, have not ratified the Kyoto Protocol; this has not prevented development of the market. In general, expectations are that the pressure for CO_2 reductions will increase in the future. This has induced the private sector to already invest in CO_2 reduction programmes or projects, and national governments to establish programmes for CO_2 reduction projects.

4. Financial Institutions are moving in on the carbon market; the land use sector has only recently emerged in this market

The expectation that CO_2 reduction initiatives will increase and that the market for CO_2 emission trading will develop has induced financial institutions to become more active in this area. They are slowly moving in on the carbon market.

Within these developments, the land use sector has only recently emerged in the carbon market and there are still many uncertainties concerning the possibilities to invest in CO_2 emission reduction by changes in land use.

5. The Institutional setting at a national and regional level is not clearly defined yet

Many potential suppliers of CO_2 reduction are not prepared to enter the CO_2 market, with a notable exception of Costa Rica. The institutional arrangements that need to be in place (at a national and regional level) to effectively handle CO_2 reduction projects have not been clearly defined or put in place in Indonesia. This will hamper the establishment of CDM projects in Central Kalimantan.

6. A major risk for CDM in peatlands is uncontrolled fire: other risks may be rooted in the institutional setting and local stakeholder involvement

Several factors can be identified that constitute a risk to possible CDM projects in Central Kalimantan. A major abiotic risk for CDM projects is the possibility of large-scale uncontrollable fires. Good provisions need to be made to prevent fires, and to cover this risk in the financial and crediting mechanisms. Other risks may be rooted in the institutional setting and local stakeholder involvement. Several criteria have been identified that should be in place when a local forestry CDM project is to be successfully implemented. Several of these criteria cannot be fulfilled (yet) in Kalimantan.

7. The role of the voluntary market

There may be opportunities to interest the voluntary market to invest in a CDM-like CO_2 reduction project in Central Kalimantan. Especially when such a project combines other objectives such as conservation of biodiversity and improving livelihoods of local communities with carbon sequestration.

7. References

Anderson, J.A.R., 1983.
'Chapter 6: The tropical peat swamps of western Malesia'. Pages 181-199 in A.J.P. Gore (editor), Ecosystems of the World: Mires: Swamp, Bog, Fen and Moor. New York: Elsevier Scientific Publishing Co.

Aukland, L., P. Moura Costa, S. Bass, S. Huq, N. Landell-Mills, R. Tipper & R. Carr, 2002.
Laying the Foundations for Clean Development: Preparing the Land Use Sector. A quick guide to the Clean Development Mechanism. IIED, London.

Boehm, H.-D.V. & F. Siegert, 2000.
Application of Remote Sensing and GIS to Monitor Peatland Multi-Temporal in Central Kalimantan. In: Proceedings of the International Symposium on TROPICAL PEATLANDS Bogor, Indonesia, 22-23 November 1999. Hokkaido University & Indonesian Institute of Sciences, pp. 329-347 (2000) 329.

Brown, S., 1997.
Forests and Climate Change and the Role of Forests as Carbon Sinks. World Forestry Congress, October 1999.

Cannell, M.G.R., 1982.
World Forest Biomass and Primary Production Data. Academic Press. London, 391 pp.

CO2e, 2003.
Available at www.CO2e.com

Davis, P., 2000.
Carbon Forestry Projection Developing Countries: legal issues and tools. Forest Trends Report. Washington, USA.

De Conink, H.C. & N.H. van der Linden, 2003.
An overview of Carbon Transactions – general characteristics and specific peculiarities. ECN Beleidsstudies ECN-C-03-022. Energieonderzoek Centrum Nederland.

De Jong, B., R. Tipper & G. Montoya-Gomez, 2000.
An economic analysis of the potential for carbon sequestration by forests: evidence from southern Mexico. Ecological Economics 33: 313-327.

E5 News & Press, January 2003.
http://www.e5.org/home.php

EU, 2002.
Summaries of the Union's legislation - Air Pollution. Available at: http://europa.eu.int/scadplus/leg/en/lvb/l28060.htm

Face, 2003.
http://www.stichtingface.nl/

GBN, 2003.
Newsletter on Environmental Fiscal Reform: GreenBudgetNews No. 1. Available at: http://www.eco-tax.info/2newsmit/newseng/GBN1.html

GEF, 2002.
The challenge of sustainability, an action agenda for the global environment. Global Environment Facility, 1818 H Street NW, Washington, DC 20433, USA.

IPCC WG II, 2001.
Climate Change 2001: Impacts, Adaptation & Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change (IPCC). James J. McCarthy, Osvaldo F. Canziani, Neil A. Leary, David J. Dokken and Kasey S. White (Eds.). Cambridge University Press, UK.

Janssen, J., 2000.
Implementing the Kyoto Mechanism: Potential contributions by banks and insurance companies. Geneva Papers on Risk and Insurance-Issues and Practice 25(4): 602-628

Jenkins, M.B. & E.T. Smith, 1999.
The business of sustainable forestry: Strategies for an industry in transition. Covelo, CA: Island Press.

Kalimantan Tengah dalam angka (kalimantan tengah in Figures), 2000.
Badan pusat statistik propinsi kalimantan tengah.

Landell-Mills, N. & I.T. Porras, 2003.
Silver bullet or fool's gold? A global review of markets for forest environmental services and their impact on the poor. IIED Research Report. London.

Kuusipalo, J., T.S. Hadi, P.Lattunen, A. Otsamo, & J.A. Griffith, 1996.
'Restoration of land productivity and environment through reforestation of Imperata cylindrica grasslands.' New Zealand Journal of Forestry Science 26(1-2): 307-319.

Meijerink, G., 1995.
Function endowment of tropical forests – safeguarding the goose with the golden eggs. Working Document IKC natuurbeheer 71.

Murdiyarso, Daniel, 2003.
CDM: Mekanisme Pembangunan Bersih. Kompas, Jakarta.

Moura-Costa, P., no date.
Carbon trading and investment in clean energy projects. UNCCD Field document. Ecosecurities Ltd.

Page, S.E., F. Siegert, J.O. Rieley, H.-D.V. Boehm. & A. Jaya, 2002.
The amount of carbon released from peat and forest fires in Indonesia during 1997. Nature 420: 61-65.

Pelangi News, March 2003.
http://www.pelangi.or.id/news.php

Poffenberger, M. (ed.), N.H. Ravindranath, D.N. Pandey, I.K. Murthy, R. Bist & D. Jain, 2001.
Communities and climate change: The Clean Development Mechanism and village-based forest restoration in Central India. A Case Study from Harda Forest Division, Madhya Pradesh, India. Community Forestry international Inc & Indian Institute of Forest Management. Santa Barbara, California.

Rosenzweig, R., M. Varilek & J. Janssen, 2002.
The Emerging International Greenhouse Gas market. Pew Center on Global Climate Change. Arlington USA.

Rusmantoro, W., 2002.
CDM Forestry in Indonesia. Spektrum Volume 2, October 2002.

Sari, A.P., W. Rusmantoro, E. Asidin, I. Rachnan & C. Pannwibono, 2002.
Does money grow on trees? Opportunities and challenges of forestry CDM in Indonesia. Pelangi Report. Pelangi, Jakarta.

Siegert, F., G. Ruecker, A. Hinrichs & A.A. Hoffmann, 2001.
Increased damage from fires in logged forests during droughts caused by El Niño. Nature Vol 414. 437–440.

Smith, J. & S. Scherr, 2002.
Forest carbon and local livelihoods: Assessment of opportunities and policy recommendations. CIFOR Occasional Paper No 37. CIFOR, Indonesia.

Soerawidjaja, T.H., S. Sasmojo, N. Salim, A. Nugraha, M. Eng & E. Hendrawan, 2001.
Clean Development Mechanism Opportunities in Indonesia. Centre for Research on Material and Energy. Institut Teknologi Bandung. Bandung, Indonesia.

State Ministry for Environment, 2001.
National Strategy Study on the Clean Development Mechanism in Indonesia.

Subak, S., 2000.
Forest Protection and reforestation in Costa Rica: evaluation of a clean development Mechanism Prototype. Environmental management Vol. 26 no 3, pp. 283-297.

Toman, M. & M. Cazorla, 1998.
The Clean Development Mechanism: A Primer. Weathervane Feature September 1998.

Totten, M., 1999.
Getting it right: emerging markets for storing carbon in forests. World Resources Institute and Forest Trends, Washington, USA.

UNEP-FI, 2002.
Climate Change and the Financial Services Industry. Module 2: Blueprint for Action. UNEP Finance initiative Climate Change Working Group. UNEP-FI. Available at: www.unepfi.net

Watson, R., I. Noble, B. Bolin, D. Verardo & D. Dokken (eds), 1998.
Land Use, Land-Use Change And Forestry. IPCC Special Report. Available at:
http://www.grida.no/climate/ipcc/land_use/index.htm
WCFSD, 1999.
Our Forests, Our Future. Cambridge University Press.
Whitmore, T.C. (editor), 1984.
Tropical Rain Forests of the Far East. Second Edition. Oxford, UK: Oxford University Press.
Wiser, G.M., 2002.
Frontiers in trade: the clean development mechanism and the general agreement on trade in services. International Journal Of Global Environmental Issues 2 (3/4): 288-309.
Yamakura, T., A. Hagihara, S. Sukardjo, & H. Ogawa, 1986.
'Aboveground biomass of tropical rain forest stands in Indonesian Borneo.' Vegetatio 68(2): 71-82.