FINAL ACTIVITY REPORT

Land-use Change and Terrestrial Carbon Stocks: Capacity Buildings, Impacts Assessment and Policy Support in South and Southeast Asia

Prepared by:
Global Change Impacts Centre for Southeast Asia (IC-SEA)

Supported by:
Asia Pacific Network for Global Change Research (APN)

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MAIN REPORT

1. INTRODUCTION

1.1. Background

Global change has many facets as far as human interaction with their environment is concerned. Among others are the changing land-use and land-cover that will alter the complex process of biogeochemical cycles. Subsequently they will influence the earth's climate system. Human being - with their complex value systems, socio-economic needs, and their ability in using technology and institutional dimensions - remain the most important driving factor. If the goal in achieving sustainable development in the context of global change is not well designed they may become threat to the sustainability of the planet earth. Basic understanding on how earth system responds to rapid environmental change is yet to be explored and continuously improved.

Terrestrial ecosystems are among the most threatened systems since they are more readily accessible and utilised. The recent fantastic economic growth in the region is obviously based on the natural resources. The consequences are observable even by one single generation. Conversion of natural forest, urbanisation and industrialisation, encroachment of coastal zones are among the significant processes with phenomenal impacts on biogeochemical cycles.

The Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) strengthens the international response to climate change. Adopted by consensus at the third session of the Conference of the Parties (COP-3) in December 1997, it contains new emissions targets for Annex I (developed) countries for the post-2000 period. By arresting and reversing the upward trend in greenhouse gas (GHG) emissions that started in these countries 150 years ago, the Protocol promises to move the international community one step closer to achieving the Convention's ultimate objective of preventing dangerous human-induced interference with the climate system.

Since its adoption the Kyoto Protocol is continuously under scrutiny at many levels before its ratification at COP6 late this year. The operationalisation details of the Protocol are awaited with expectations ranging from enthusiasm for the golden opportunities it might create through scepticism over the willingness of the parties to make a real binding commitment to the build-up of atmospheric carbon dioxide. One of the most controversial issues is how forest land-use will be incorporated in the accounting of net emission of greenhouse gases. This has led to a renewed interest in land-use changes and their implications in the policy, scientific, and business communities. Through the Clean Development Mechanisms (CDM), some countries may reduce net emissions in excess of their legal requirements – these could be sold to other countries that need additional emissions reductions. In many cases, for example, the cost of reducing emissions is cheaper in developing countries than it is in the energy sector of developed countries. Forestry sector, therefore, will be financially attractive for investors from the developed countries to purchase credits from the developing countries to meet obligations agreed to in Kyoto.

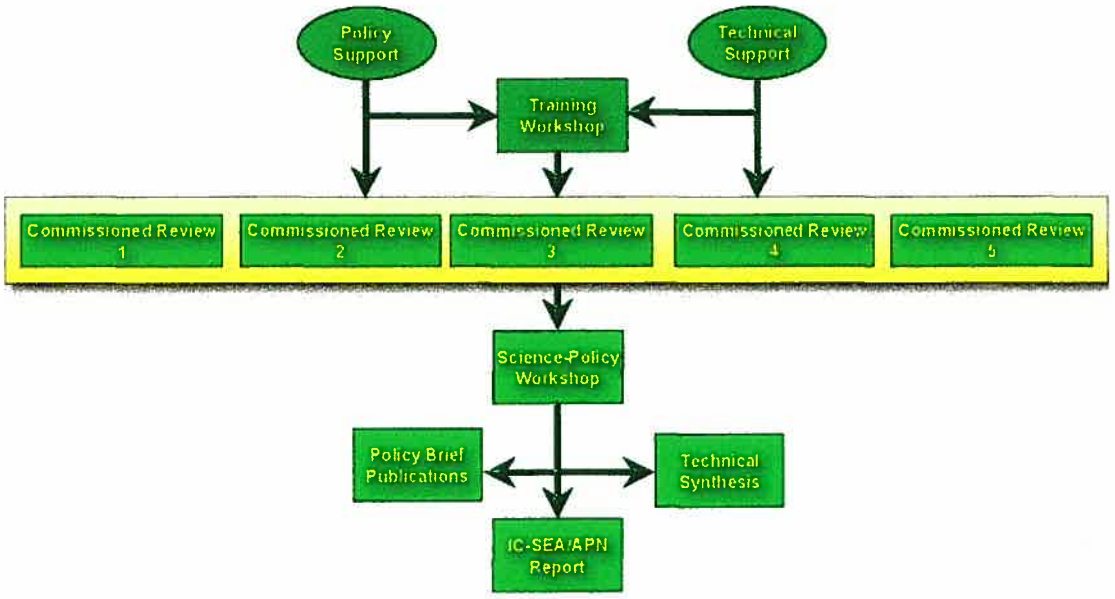
The first implication is that forest land use planning, forest management and tree plantation development projects may need to take into account not only the "traditional" concerns of local land and resource managers, but also their global implications, for the carbon cycle. The questions are, do we have institutions strong enough to support the mechanism? How the legal entity of 'forestry' sector or often termed as 'Kyoto Land' may be defined? What about the social and biophysical risks of going into this business?

This project was originally designed around the said issues, It is high time to interact and communicate with various stakeholders so that communities like scientists, policy-makers, business sector and civil society are ready to actively take part when the Protocol is operationalised. This project has three main components: Capacity Building, Impacts Assessment, and Policy Support. It was designed in such a way that each component are not isolated from one to another, rather they are framed in the context of global change and international conventions like Climate Change

1.2. Scope of the Project

This project involved technical support where Training Workshop and Impacts Assessment commissioned to various global change research group were facilitated. Policy support was also provided through the organisation of Science-Policy Workshop where stakeholders can meet and interact.

The scope of the Commissioned Review is designed to answer various research as well as policy questions regarding terrestrial carbon assessment, accuracy and costing. This information will be highly demanded when CDM project in forestry sector comes into the stage. In short, it was expected that the series of activities supported by APN are connected to each other as shown in the following diagram:



Organisation and Scope of the Project

1.3. Overall Objectives

The overall objective of the activity is to bring global change science into public policy-making processes. Therefore there should be an interaction between the two communities, where sometimes a growing gap is unavoidable. The detailed objectives are:

- To build the capacity of South and Southeast Asian scientists to assess the impacts of land-use change on terrestrial carbon stocks, including above- and below-ground biomass and GHG emissions
- To facilitate the synthesis of commissioned reviews on issues related to the impacts of land-use change and the underlying driving forces on terrestrial carbon stocks and GHG emissions
- To bridge the gaps between the scientific and policy communities by providing a forum that facilitates dialogues that will be benefited by resource managers

2. OUTLINE OF THE ACTIVITIES

The overall objective and detailed of the series of activities were thoroughly discussed in the Inception Workshop following the signing of the Contract of this project. The Summary Report of the Inception Workshop may be found in ***Attachment 1***. The project consists of three main components: capacity building, impacts assessment, and policy support with the following description:

2.1. Capacity Building

This component was aimed at building the capacity of the scientists in assessing the impacts of land-use and land-cover change on terrestrial carbon stocks and GHG emissions. The technical support was provided by organising a two-week Training Workshop on the methodology in assessing terrestrial C-stocks and GHG emissions. Resource persons were recruited from global change research community. The participants were recruited based on the recommendation of the collaborators carrying out the impact assessment studies.

Although the activity was not meant to equip the participants with GHG inventory the methodology, the IPCC/OECD Methodology for GHG Emissions Inventory was reviewed in addition to the assessment of the following components:

- Below-ground carbon stocks
- GHG emissions
- Above-ground carbon stocks

Hands-on computer exercise were provided to comprehend with the modelling tools to estimate:

- Global carbon
- Carbon dynamics in complex systems
- Soil carbon dynamic
- Terrestrial carbon at landscape scale
- GHG emissions from soils

The 5-day class work was then followed by 10-day field work to exercise the methodology and appreciate problems in the fields. It was thought that such process would enable the team to carry out real assessment. Detailed report of this component is summarised in ***Attachment 2.***

2.2. Impacts Assessment

Following the methodology workshop the group carried out impacts assessment and reviews on the existing studies commissioned to them. These groups are:

- Centre for Environmental Forestry (ENFOR) at UPLB, Los Banos, Philippines
- SEAMEO BIOTROP
- Soil and Agronomy Department Brawijaya University, Indonesia
- Faculty of Forestry, Bogor Agricultural University, Indonesia
- Department of Soil Science, Ruhuna Univiversity, Sri Lanka
- IC-SEA, Indonesia

The results of the studies are presented in the Science-Policy Workshop and summarised in this report as the main findings (Chapter 3). The individual reports will be published separately as joint APN/IC-SEA Technical Report. The groups of reviewers are also encouraged to publish the work in reviewed journals.

There is a strong intention to continue the impact assessment since the group found large variability in the systems they work with. It is very likely that the group will seek APN support again.

2.3. Policy Support

Originally this component was meant to provide a forum for scientists and policy community to make initial dialogue on the issue. It turned out that business community and Non-government organisations were strongly motivated. Since CDM has become controversial issue it was decided to intentionally include the isse in the 2-day workshop which was favourably supported by the Government of Indonesia through direct involvement of the Ministry of State for Environment.

The workshop was successfully organised and well attended by critical mass internationally renown participants and presenters. The Summary Report of this activity is shown in ***Attachment 3***. One of the encouraging outcomes of the event is the Workshop Recommendation that is favourably accepted by stakeholders, including NGOs, governments, and business community.

3. MAJOR FINDINGS

The major findings of this project are the original data on biomass and carbon stocks from various tropical terrestrial ecosystems in the region. These data are unique because they are assessed using common methods exercised during the Methodology Workshop. The assessments were made in two different approaches. First, is direct measurement at plot level with intensive measurement in relatively small area. Secondly, larger scale measurements at landscape level where remote sensing and GIS techniques were involved. Moreover, emission factors obtained from direct measurements of soil emissions are also among the major finding, although only limited data set was performed.

3.1. Assessment at Plot Level

At this level the assessment of biomass or C-stocks were carried out thoroughly at small size of permanent plots of 0.1 ha. These plots were monitored and as far as the baseline data is concerned maintaining such plots is essential. It is very likely that similar method has to be employed when the Protocol is operationalised. The activities included the measurements of above and below ground biomass, soil carbon and organic matter dynamics, and greenhouse gas emissions.

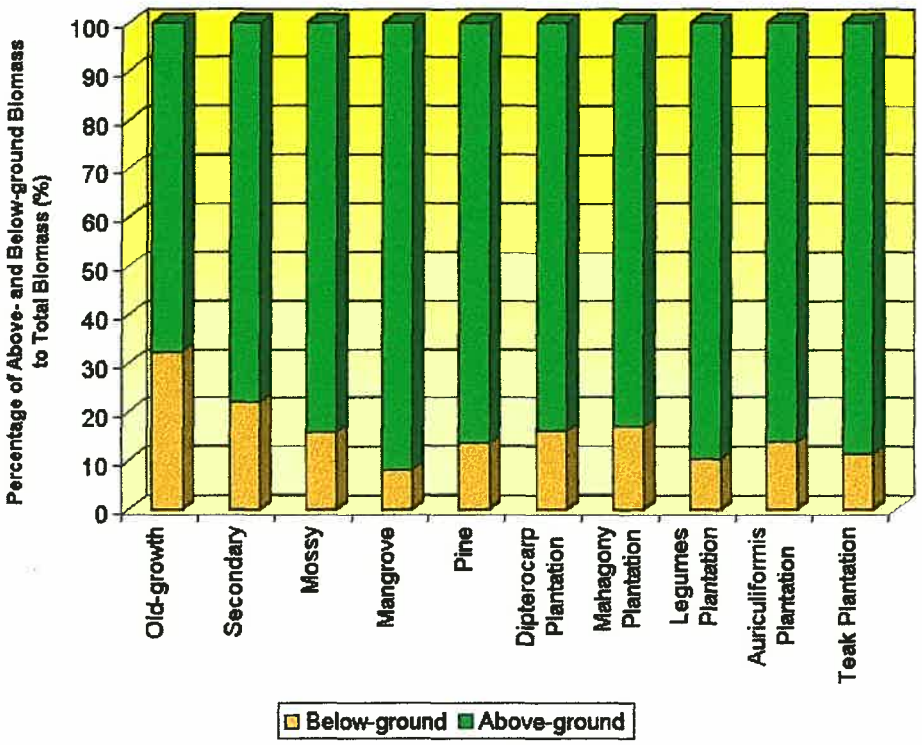
3.1.1. Above-ground biomass and C-stocks

The assessment of above-ground biomass included tree, understorey, herbaceous, litter, and coarse wood debris. In estimating above-ground biomass of tree, the allometric equations such as that proposed by Brown (1997) were employed. However, comparisons with other methods were also exercised. Table 1 summarises the results of above-ground biomass and C-stocks assessment carried out at various ecosystems in the region.

Table 1. Above-ground biomass and carbon density assessed directly and estimated using allometric equations

Category	Biomass density (ton/ha)	Carbon density (ton/ha)	Location	Reference
Natural systems				
• Old-growth forests	1,663		Philippines	Lasco *et al.* (2000)
• Lowland forests		390	Jambi, Sumatra	Sitompul and Hairiah (2000)
• Logged-over forests		148	Jambi, Sumatra	Sitompul and Hairiah (2000)
• Mature agroforests		104	Jambi, Sumatra	Sitompul and Hairiah (2000)
• Young agroforest		16	Jambi, Sumatra	Sitompul and Hairiah (2000)
• Secondary forests	873		Philippines	Lasco *et al.* (2000)
• Mossy forests	497		Philippines	Lasco *et al.* (2000)
• Mangrove forests	444		Philippines	Lasco *et al.* (2000)
Man-made systems				
• Pine	221		Philippines	Lasco *et al.* (2000)
• Mahagony	764		Philippines	Lasco *et al.* (2000)
• Legumes	622		Philippines	Lasco *et al.* (2000)
• Dipterocarp	581		Philippines	Lasco *et al.* (2000)
• *Acacia sp.*	204		Philippines	Lasco *et al.* (2000)
• Teak	87		Philippines	Lasco *et al.* (2000)
• Oil-palm (10yrs)		62	Jambi, Sumatra	Sitompul and Hairiah (2000)
• Oil-palm (10 yrs)		31	Riau, Sumatra	Soekisman& Mawardi (2000)
• Oil-palm (14 yrs)		101	Riau, Sumatra	Soekisman& Mawardi (2000)
• Oil-palm (19 yrs)		96	Riau, Sumatra	Soekisman& Mawardi (2000)
• Coffee		18	Lampung, Sumatra	Sitompul and Hairiah (2000)
• *Chromolaena sp.*		4	Lampung, Sumatra	Sitompul and Hairiah (2000)
• Imperata		1.9	Lampung, Sumatra	Sitompul and Hairiah (2000)
• Cassava		1.7	Lampung, Sumatra	Sitompul and Hairiah (2000)

It is obvious that above ground biomass and C-stocks are highly variable depending on the system and site. Even if the systems are the same but happened to be in different age or stage of growth the biomass is different. The main message here is that natural systems have the tendency to have higher biomass even if they are already disturbed compared with man-made systems.



Figue 1. Percentage of above-ground biomass in various land-use types in the Philippines (Lasco et al., 2000)

As shown in Figure 1 Lasco *et al.* (2000) found that the large portion of biomass resides in the above-ground which comprises more than 70%. They also conducted measurements on carbon content in several pools of various land-use types in their study. On average, the proportion of carbon in all carbon pools of all land-cover types is about 42.56%, ranging from 27.60% to 50.70%, with standard deviation of about 5.15%. In oil-palm plantations the above-ground biomass was about 81.38% of the total biomass in average. Carbon content proportion from all components of oil-palm was around 37.21% in average, ranging from 31.26% to 41.55%, with standard deviation of 2.71% (Soekisman and Mawardi, 2000).

3.1.2. Below-ground biomass and C-stocks

As roots significantly contribute to soil carbon input, Hairiah and Sitompul (2000) conducted a study on root biomass and root turnover using minirhizotron of hedgerow trees species (*Flemingia sp.* and *Peltophorum-Gliricidia*) and food crops species (rice and maize) in North Lampung, Sumatra. The result shows that the root/shoot ratio of hedgerow trees species are lower than that of annual crops (Figure 2). From the study it was found that root longevity of hedgerow trees species from top soil and sub soil ranges from 45 to 60 days.

Soil organic matter (SOM) is one of the most important components in below-ground carbon stocks. Based on the assessment in 10 land-use types in Jambi Province, Sumatra made by Hairiah and Sitompul (2000) it is shown that the mean soil organic carbon from those land-use decreases with depth (Figure 3). It means that in order

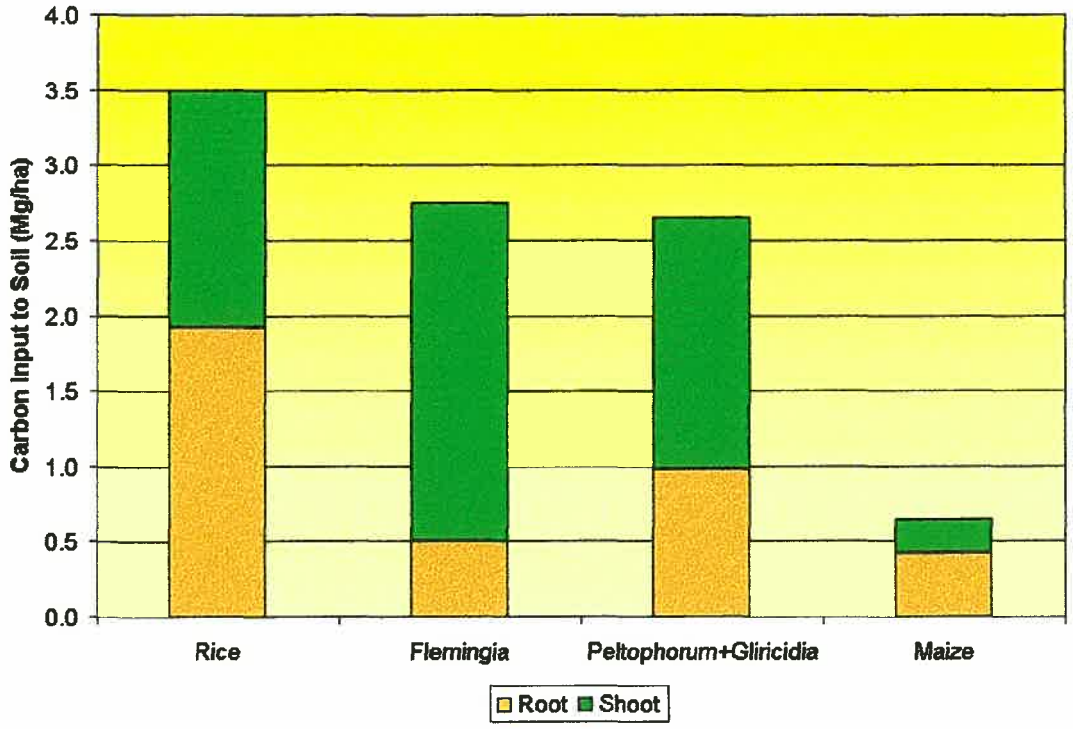


Figure 2. Soil carbon input from shoot+root hedgerow trees and food crop species (Hairiah and Sitompul, 2000)

to maintain soil productivity one should take care of the first 40 cm soil depth since it does not show drastic change in deeper layers.

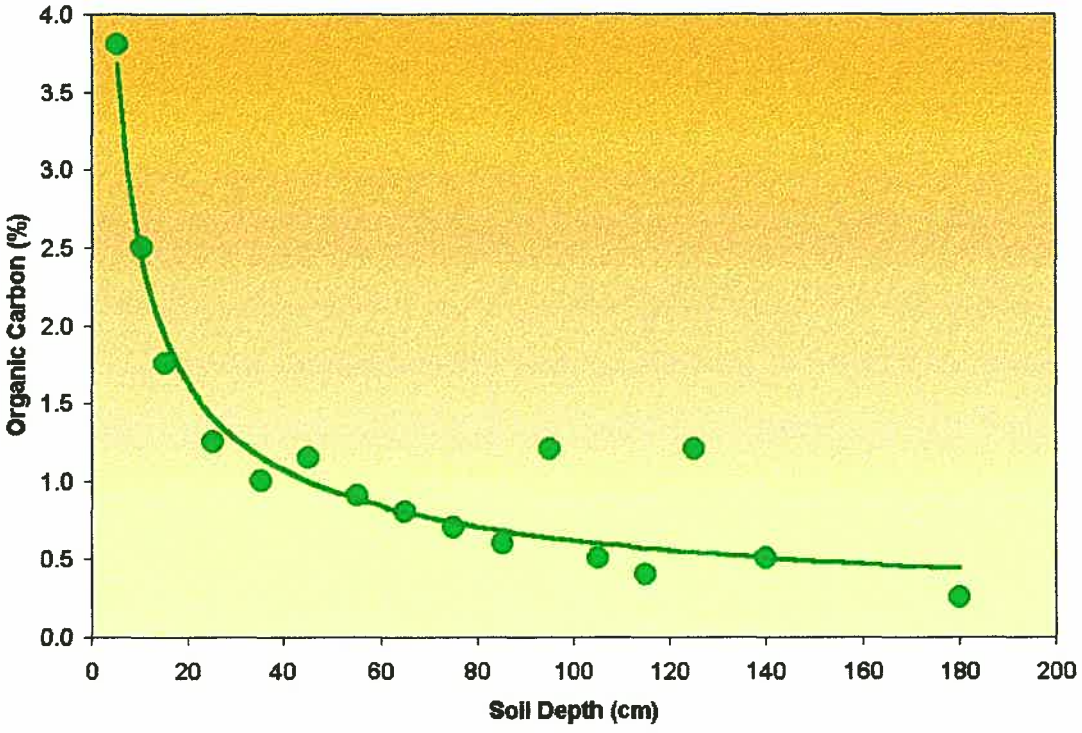


Figure 3. Change of soil organic carbon with depth averaged from 10 different land-use types (Hairiah and Sitompul, 2000)

3.2. Assessment at Landscape Level

The second approach in assessing above-ground biomass and C-stocks is at larger scale by employing remote sensing and GIS technologies. This kind of approach will enable us to monitor the change from time to time provided that the multi-date satellite imageries are available. Based on various types of remote sensing products assessment of above-ground biomass and C-stocks was reported by Wasrin *et al.* (2000). The exercise included study sites at Rantaupandan and Muaratebo in Jambi Province (Indonesia), West Kalimantan Province (Indonesia), and Zambales Province (Philippines).

This method relies on the capability in interpreting the type of land-cover. Therefore the spatial resolution of the image is a key issue. While spectral and temporal resolutions may have less priority. In order to relate land-cover and biomass and then C-stocks one has to carry out ground truthing on several benchmark areas. In their study, Wasrin *et al.* (2000) used land-cover maps interpreted from various sources as summarised in Table 2. The sources of above-ground biomass data from each land-use type were provided by activities shown in Table 3.

Table 2. Land-cover maps used in the study on carbon-stock assessment over landscape

No.	Site	Data source of land-cover map	Land-cover type identified
1.	Rantaupandan, Jambi Province, Indonesia	Landsat TM FCC (June 1988 and September 1996) and topographical map in scale of 1:250,000	Six land-cover types: primary forest, logged-over forest, paddy field, jungle rubber, secondary growth, and mosaic (of upland rice, food crops, and secondary growth)
2.	Muaratebo, Jambi Province, Indonesia	Landsat TM FCC (June 1988 and September 1996) and topographical map of 1:250,000	Seven land-cover types: primary forest, logged-over forest, secondary growth, jungle rubber, estate plantation, lake, and mosaic
3.	West Kalimantan, Indonesia	Landsat MSS (1988-1997), SPOT (1989-1990), Aerial Photograph (1987)	Nineteen land-cover types
4.	Zambales Province, Philippines	(?) 1989	Five land-cover types: Logged-over forest, secondary growth, grassland, estate plantation, and mosaic

Table 3. Data source on above-ground biomass used in the assessment

No.	Site	Source of above-ground biomass data
1.	Rantaupandan, Jambi	ASB Programme
2.	Muaratebo, Jambi	ASB Programme
3.	West Kalimantan	SEAMEO BIOTROP (1992), Repprot (86/87)
4.	Zambales Province, Philippines	BIOTROP-NAMRIA (1990)

Estimates of C-stocks were made by multiplying above-ground biomass with a conversion factor of 0.5. Examples of carbon stock maps as outcome of the assessment are shown in Figure 4 for Muaratebo, Jambi, 1988 and 1996) and in Figure 5 (Zambales Province, the Philippines, 1989). Carbon stock changes due to land-use/cover change in Muarabungo and Rantaupandan are shown in Figure 6.

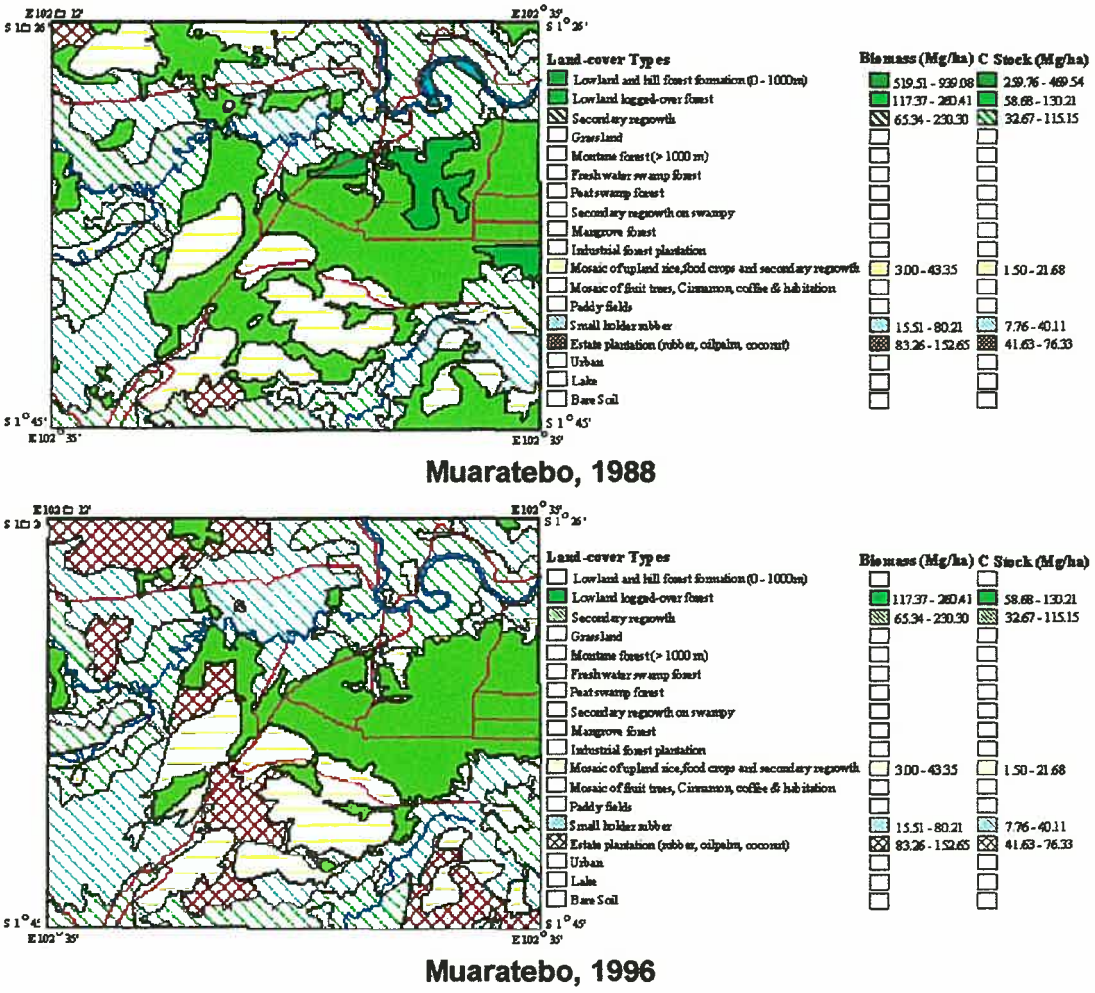


Figure 4. Above-ground biomass and carbon stock over changing landscape in Muaratebo, Jambi Province from 1988 to 1996 (Wasrin et al., 2000)

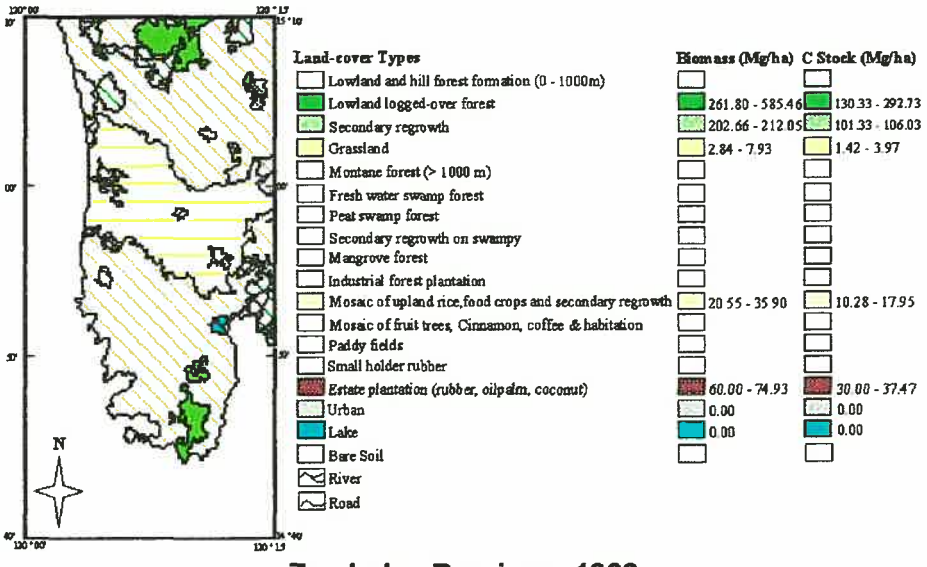
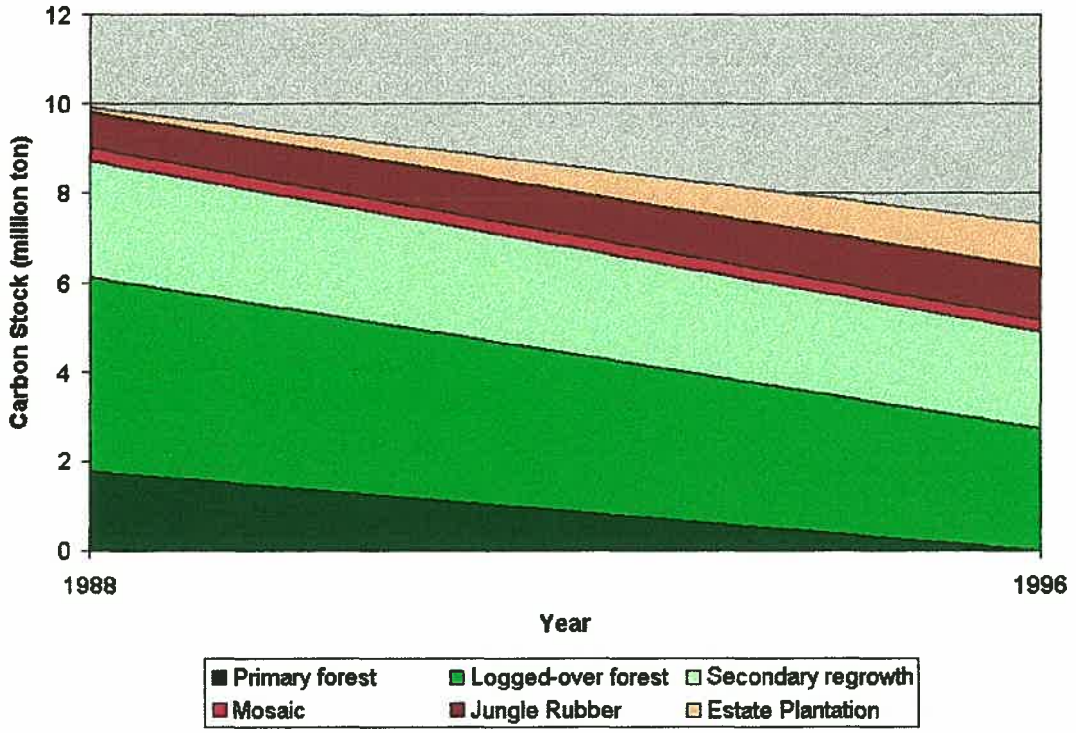
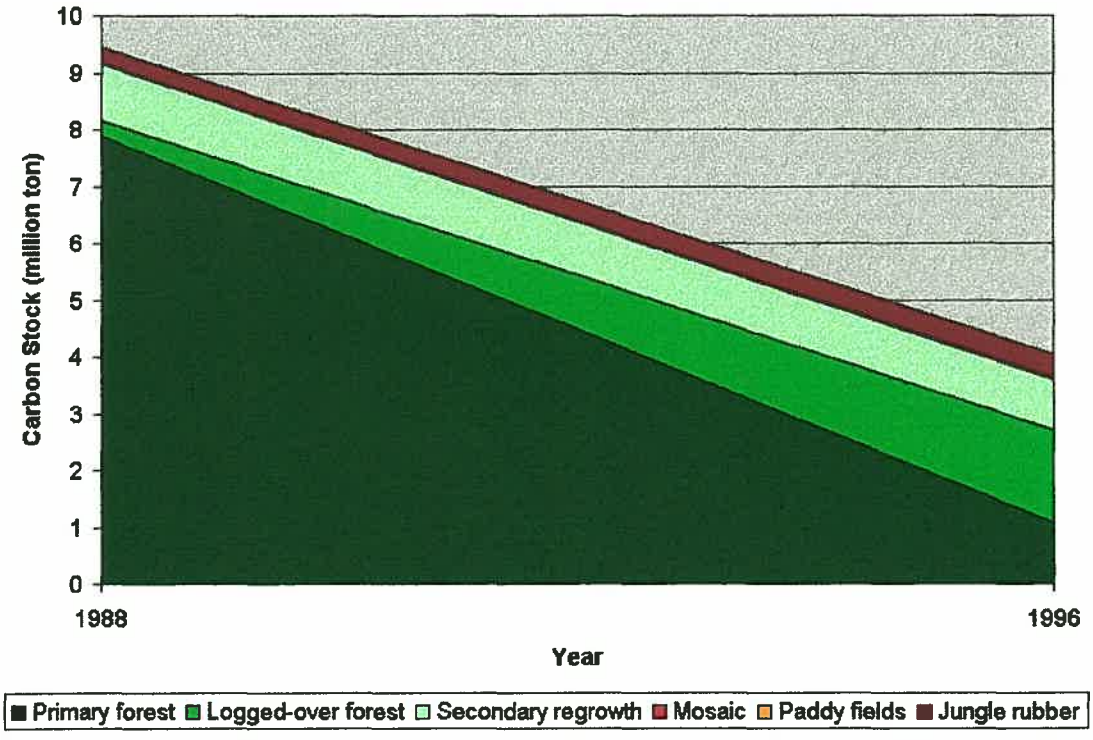


Figure 5. Above-ground biomass and carbon stock over landscape in Zambales Province, the Philippines in 1989 (Wasrin et al., 2000)



Muaratebo



Rantaupandan

Figure 6. Carbon stock change in Muaratebo and Rantaupandan over the period of 1988-1996 due to land-use/cover changes (Wasrin et al., 2000)

3.3. The Use of Models

3.3.1. Allometric equations

Allometric equation is basically a simple mathematical model that shows the relationship between above-ground biomass of tree and its measurable components like tree diameter and/or height. Such approach is usually complex if one wants to apply in a complex systems like tropical forest and other complex agroecosystem where variois species are mixed in a landscape.

Hairiah and Sitompul (2000) reviewed the methodologies used in developing the mathematical models widely employed for tree species in the tropical region, and explored possibilities to include more parameters with regard to individual, community, landscape, and biome. The test was carried out in Jambi Province, Sumatra during Methodology Workshop. The forest communities involved were primary forest, plantation of *Gmelina arborea*, and rubber of different ages. The allometric equations chosen were those developed by Brown (1997) and Ketterings et al. (1999). The results are shown in Figure 7.

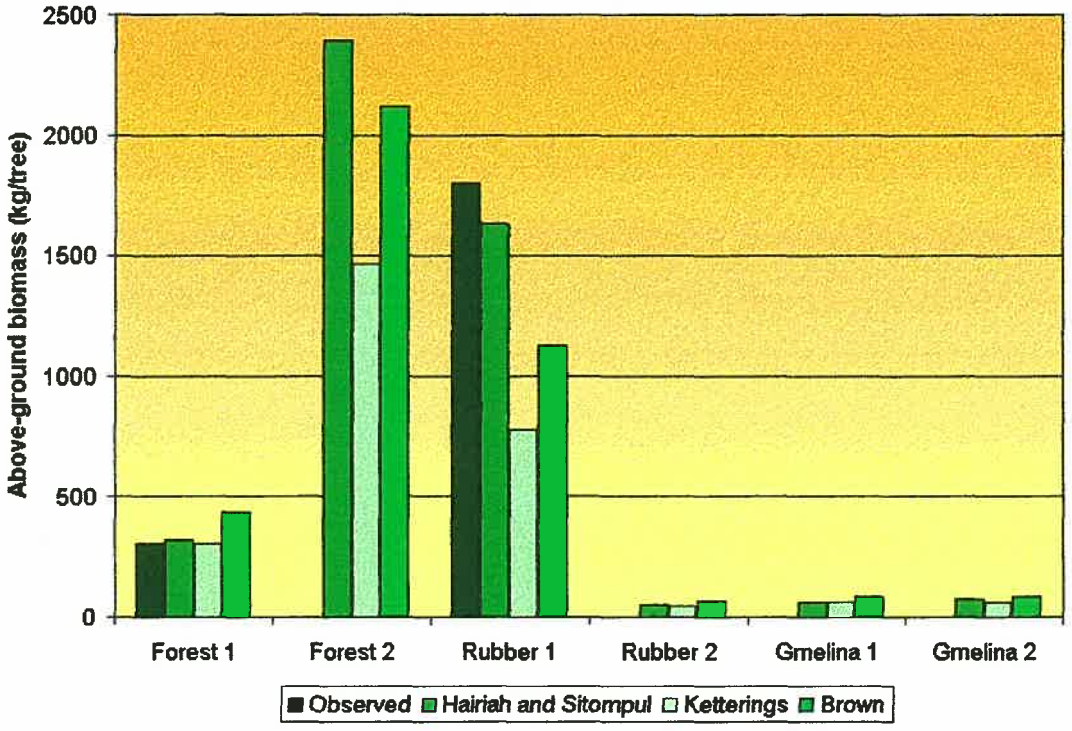


Figure 7. Comparisons of above-ground biomass assessed using different allometric equations (Hairiah and Sitompul, 2000)

After being validated in these plant communities they proposed mathematical model for future use to assess above-ground biomass of tree-dominated communities in the tropical region by considering wood density (α) in order to reduce uncertainty due to individual variation in wood density of single tree and branching properties (λ), in view of the fact that biomass of branch and leaves has relatively big proportion of the total above-ground biomass:

$$\textit{Above-ground Biomass} = [n\prod k/4(2+n)]\lambda\alpha D^{(2+n)}$$

where n and k are proportional diameter-height increment parameters.

Meanwhile Tjitrosemito and Mawardi (2000) carried out a study on a mono-species plantation of oil palm biomass in two different sites representing mineral soil area and peat soil area in Riau, Sumatra. They developed an allometric equation that employs the relationship between diameter of the trunk and total biomass. It was found that diameter of oil palm has high correlation of 0.883 to total biomass in exponential relationship:

$$Total\ Biomass=0.0261D^{2.531}$$

3.3.2. Carbon dynamics and simulation models

Hairiah and Sitompul (2000) conducted study on the effect of burning on nutrients and SOM in North Lampung, Sumatra. In this region the traditional and yet unsustainable method of shifting cultivation using slash-and-burn techniques is still widely practised as land clearing method. As shown in Figure 8, soil organic carbon content will increase in top soil layer (0-5 cm) due to direct impact of burning, and it has no significant changes in deeper layer of soil (5-10 cm).

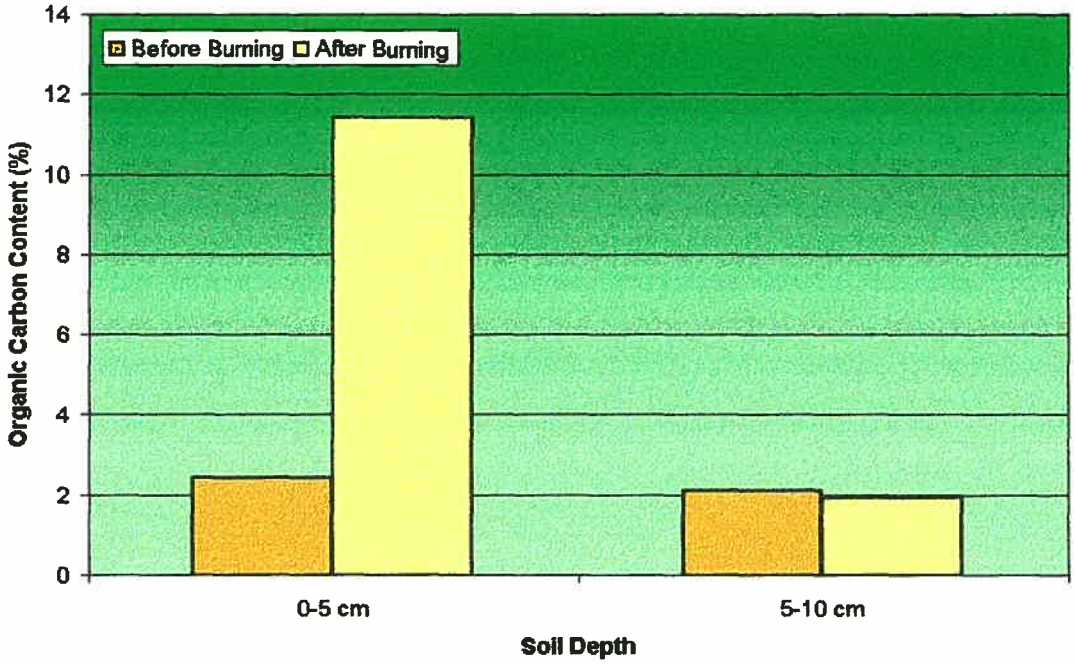


Figure 8. Soil organic carbon content before and after burning (Hairiah and Sitompul, 2000)

The above result shows that soil organic carbon is not very sensitive to the change in land-use/cover. This finding is somewhat inconsistent. It was realised that a better technique should be employed in order to further study the dynamics of soil organic matter. Therefore, a technique that capable of separating fractions of organic matter was later adopted. The SOM colloidal-silica-suspension-based fractionation (Ludox) was used to separate SOM according to its particle density into light-fraction (particle density < 1.13 $g.cm^{-3}$), intermediate-fraction (particle density 1.13-1.3 $g.cm^{-3}$), and heavy-fraction (particle density > 1.3 $g.cm^{-3}$) in order to improve their finding on soil carbon dynamics. As shown in Figure 9 there is significant change of SOM fractions due to land-use/cover change. It is obvious that the lighter (and the more readily mineralised) the fraction the more sensitive they are to the change in land-use. It is suggested that for sustainability reasons maintenance of SOM (especially light fraction) is necessary.

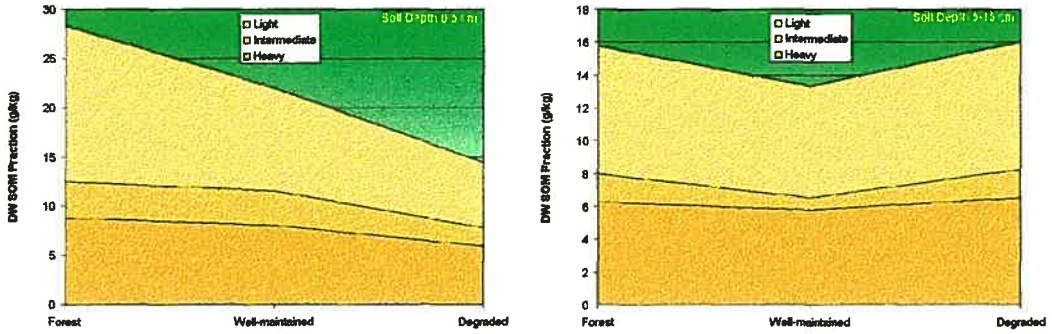


Figure 9. Ludox fractions of SOM under forested area, well-maintained agricultural area, and degraded area (Hairiah and Sitompul, 2000).

Since direct measurement will consume a lot of resources, modelling may be one of powerful tools to study below-ground carbon dynamics. Such approach will also enable us to provide predictive tools as far as modelling is concerned. By using CENTURY Model, Hairiah and Sitompul (2000) run scenario-based simulations to study the impacts of the most possible land-use/cover change in Sumatra on above-ground biomass (AGBM) and below-ground carbon biomass (BGBM) dynamics. Figure 10 shows one of the simulation results.

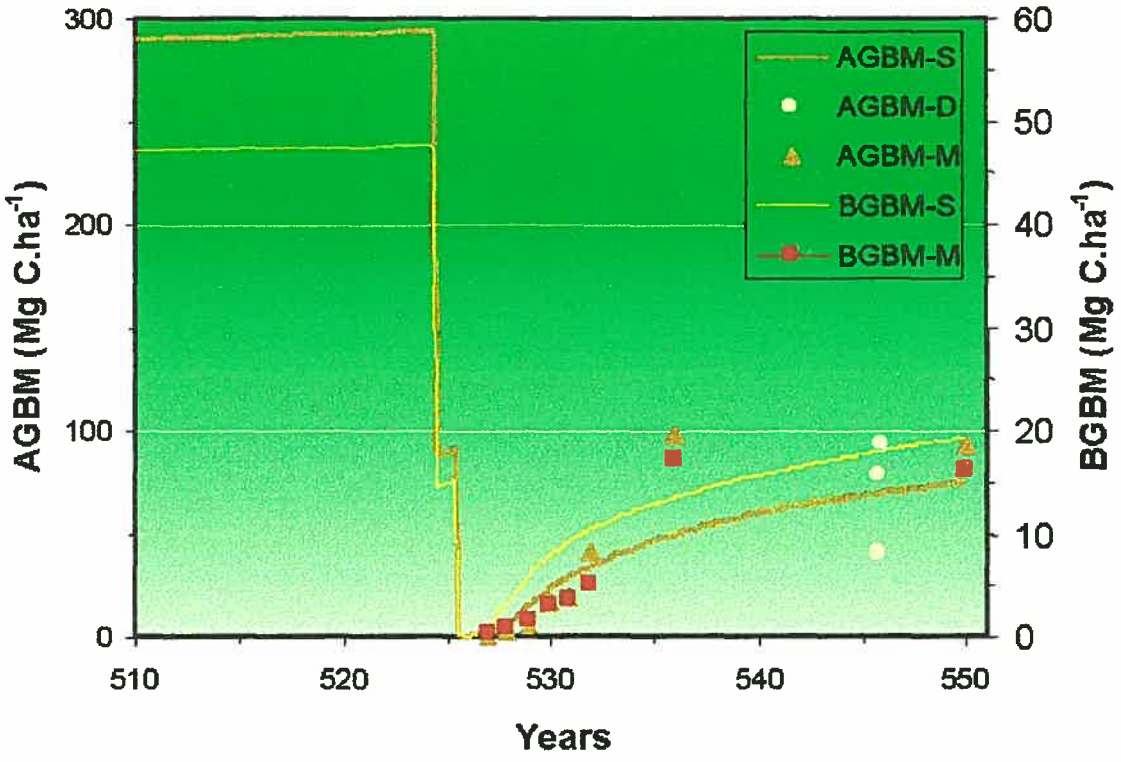


Figure 10. Above- and below-ground biomass dynamics due to land conversion from natural forest into rubber plantation, as simulated by CENTURY Model (Hairiah and Sitompul, 2000)

It is demonstrated that modelling tool capable of predicting long-term above and below ground biomass in various systems at the same time . Requirement of 'site file' which is paralllel to 'baseline' in 'Kyoto' language is very crucial in such study. Similarly the 'schedule file' may be interpreted as management practice to be implemented in the systems from which the criteria sustainable development objectives may be imposed.

3.4. Land-use change and GHG emissions

GHGs flux measurement for three major trace gases (CO_2, CH_4, N_2O) was conducted on five land-cover types: natural lowland forest, jungle rubber, 1-year and 6-year old oil palm plantations, and *Imperata* grassland in Jambi Province, Sumatra. The measurements were carried out at plot level and extrapolated to represent the entire landscape where massive land-use change is presently observed. There is a reason behind the choice of land-use. Forest conversions are taking place for large- scale oil palm plantation. It has been done in the past 6-7 years and still going on. Meanwhile there is a local practice of land-use called rubber agroforest or jungle rubber. In such practice the local people do not clear fell the original trees (forest or old jungle rubber) but inserted new seedlings where canopy gaps are found. This practice is locally known as *sisipan*. Those farmers having large farm and good planting materials have a better chance to succeed but desperate farmers tend to use fire for land clearing. Inevitably they will end up with the worst situation when the land gets poor in nutrients. In such situation *Imperata* grassland will invade the landscape.

This study attempted to demonstrate how land management is imperative to environmental benefit as well as sustainable development objectives. It is well documented that land-use practice is closely associated with the emission of GHG. In a more specific context the study reported by Murdiyarso *et al.* (2000) is expected to show such effects on the flux of GHGs from/to soils. Figure 11, for example indicates how the trend or trajectory of land-use change affects the dynamics of GHG fluxes.

Methane is sensitive to the intensity or degradation of land-use. The negative fluxes of CH_4 shown in the top figure indicate shows that the capability of soil in absorbing CH_4 (sink strength) is weakening with soil degradation. This disadvantage is not only affecting soil productivity hence farmers' income but also not benefiting the environment since the excessive CH_4 in the atmosphere cannot be sequestered or consumed by soil microbes whose environment is no longer favourable. As it is widely known that although atmospheric CH_4 concentration relatively is low its global warming potential is around 25 times as higher as CO_2.

Meanwhile the middle diagram showing N_2O fluxes is associated with soil nutrient (*i.e.* nitrogen) availability. The more nitrogen in the soil would logically cause higher emission of N_2O, another GHG which is closely related to agricultural activities. Such situation may be mitigated if proper land management (including fertiliser application) is implemented. In general, all systems except 6-year old oil palm plantation emits low N_2O to the atmosphere. Two reasons may explain, the soils are poor in nitrogen or the existing practices have inhibit nitrification or denitrification processes that produce gaseous N_2O. At the plot of 6-year old oil palm plantation where nitrogen is regularly applied N_2O fluxes are expectedly high. The application is uneven causing huge spatial variability that merits further study.

As far as CO_2 flux is concerned there is no point in comparing the magnitude with fluxes caused by removal of above ground biomass. However, it is necessary to note that CO_2 flux from soil gives good indication on how soil environment is maintained and carbon is stored to dynamically support other biochemical processes that maintain soil productivity. The bottom diagram shows no abrupt change of flux from one land-use type to another. Seasonal change that will be discussed below might be more relevant to describe the impacts of land-use change on CO_2 flux.

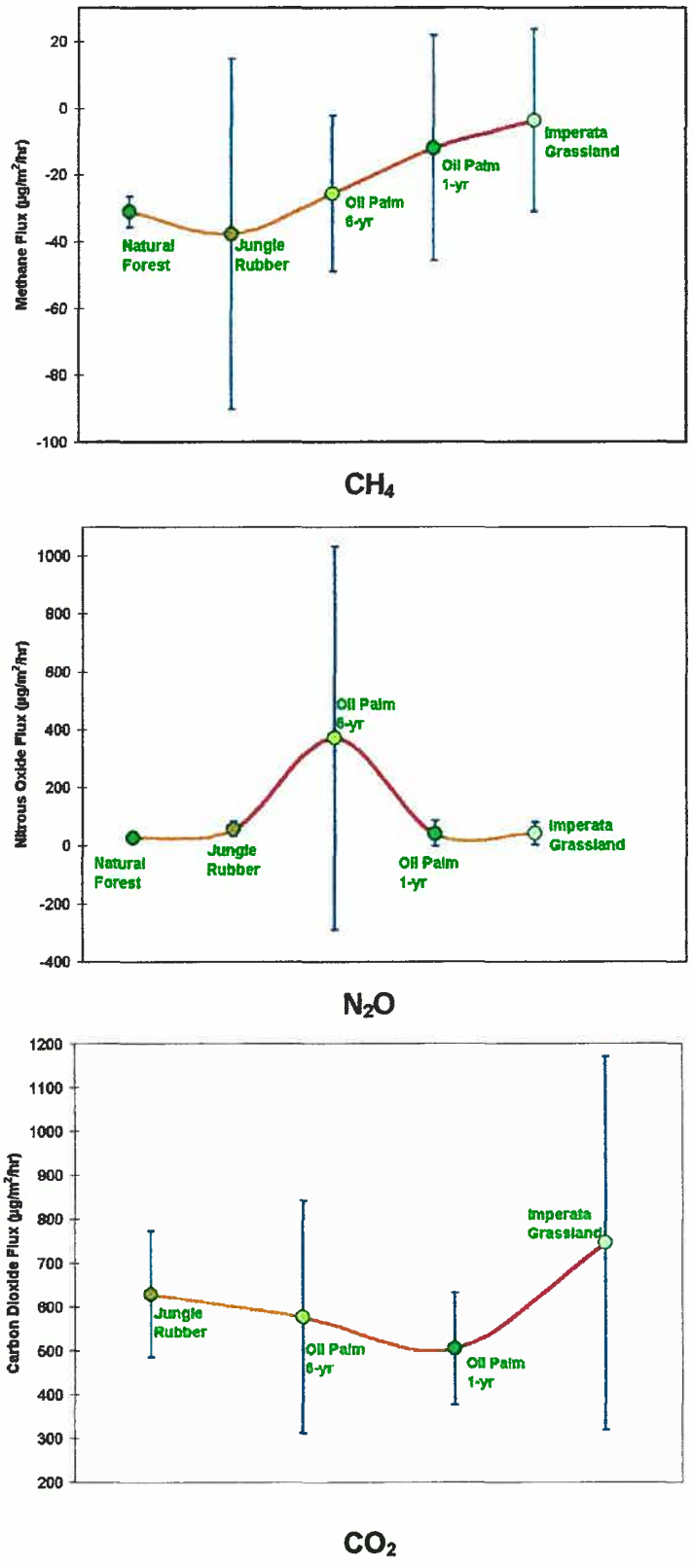


Figure 11. Fluxes of CH_4, N_2O, and CO_2 at various land-use types in Jambi Province, Sumatra. The trends indicate the possibility of land-use change trajectory observed in the region (Murdiyarso et al., 2000)

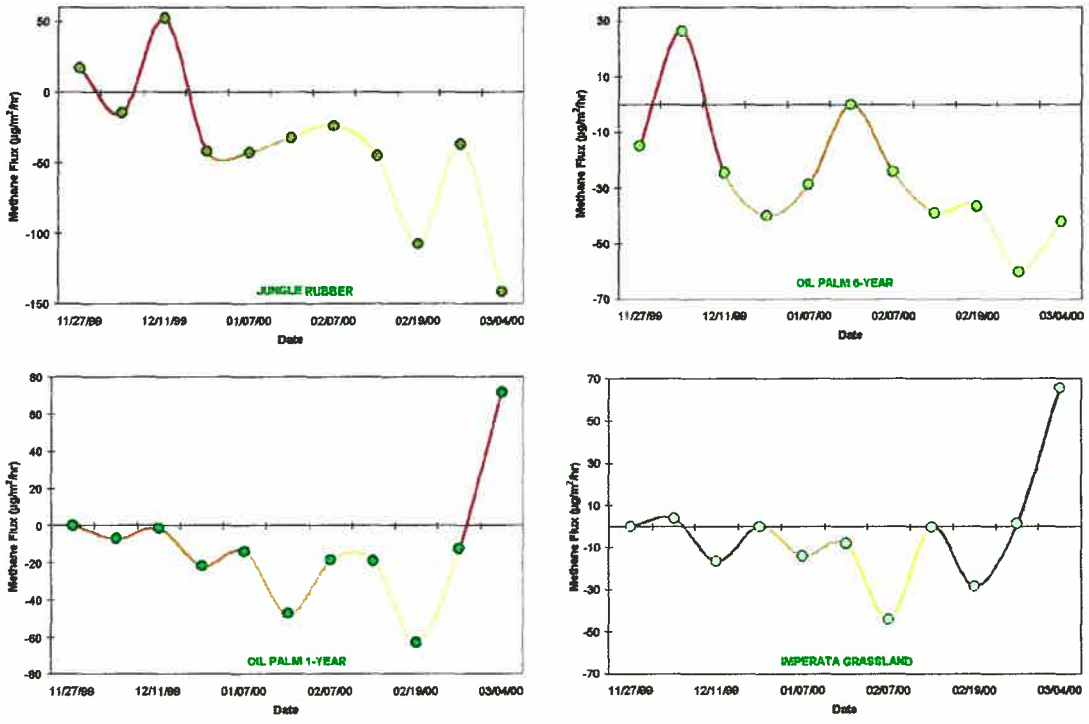


Figure 12. Seasonal change of CH_4 fluxes from various land-use types in Jambi Province, Sumatra (Murdiyarso et al., 2000)

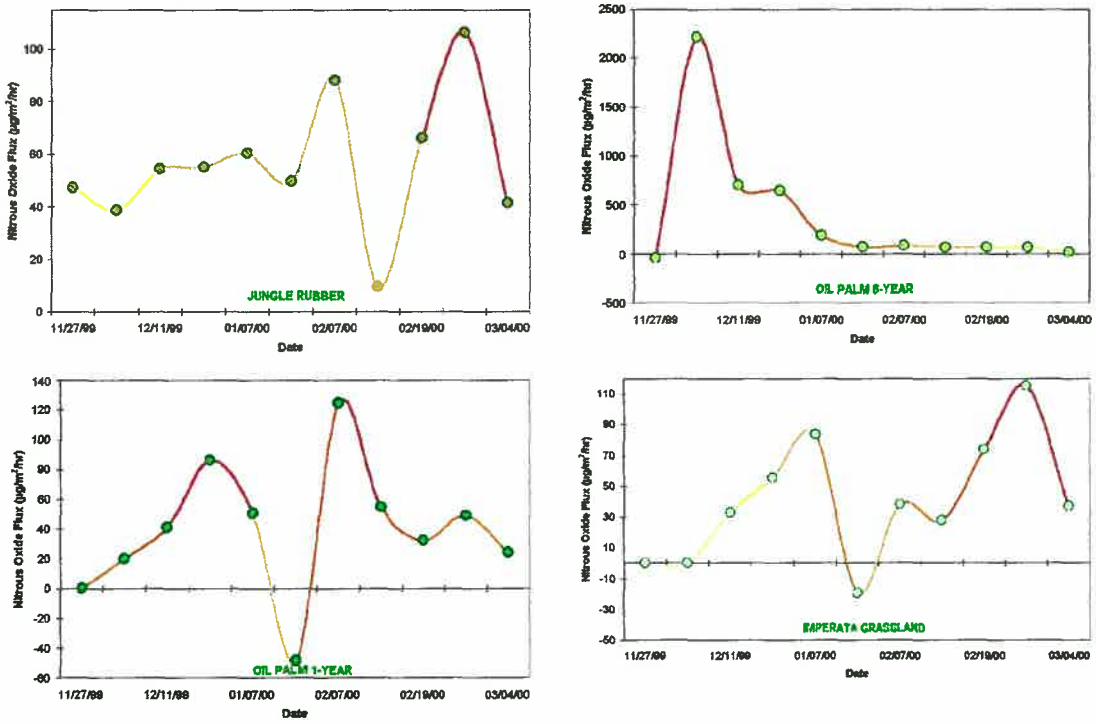


Figure 13. Seasonal change of N_2O fluxes from various land-use types in Jambi Province, Sumatra (Murdiyarso et al., 2000)

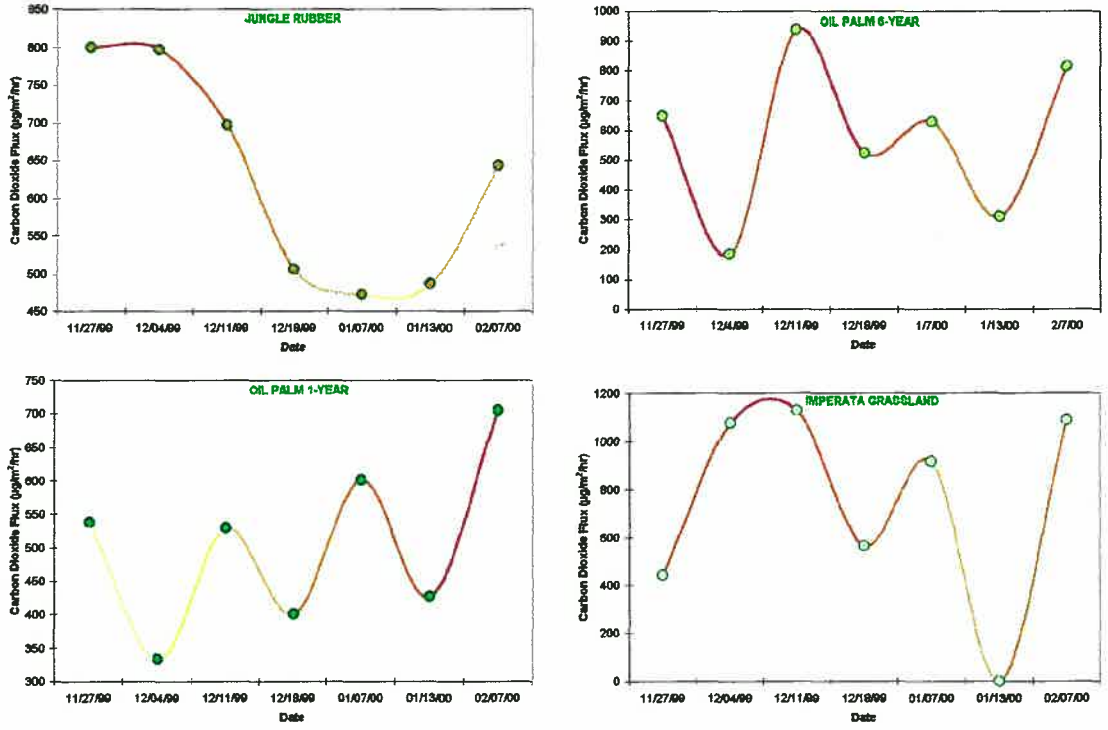


Figure 14. Seasonal change of CO_2 fluxes from various land-use types in Jambi Province, Sumatra (Murdiyarso et al., 2000)

Figures 12, 13 and 14 exhibit seasonal variations of CH_4, N_2O, and CO_2 fluxes respectively. The land-use involved here does not include natural forest for two reasons, since the onset of the experiment the site cannot be accessed due to heavy rainy season. Only very recently (last four weeks) the site was accessible.

The entire period of weekly measurements were basically representing rainy season and moving towards drier and drier conditions. In general these plots indicate that the fluxes of all gases are highly dependent on soil water content. Further analysis on the relationship between soil water content and soil biochemical processes are being analysed.

As far as CH_4 flux is concerned the improvement of soil sink strength is pronounced in more conserved system as the soil environment is getting drier and hence more aerobic for the methanothrope bacteria to be more active in consuming CH_4. Such trend is not demonstrated in more disturbed soil like 1-year old oil palm plantation and *Imperata* grassland (Figure 12). It might be cause by the fact that less bacteria exist in such disturbed or compacted soils.

Nitrous oxide fluxes (Figure 13) may be related to drainage of the soil environment that affect nitrification and denitrification at various soil depth. This merits further analysis of the associated soil properties that being carried out and continued to look at the situation during dry season.

Carbon dioxide is very changeable with soil water content as shown in Figure 14. Again further study showing the entire annual cycle would be worthwhile.

4. OUTPUTS AND IMPACTS OF THE PROJECT

4.1. Public awareness

The ultimate objective of the UNFCCC is to achieve stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous human-induced interference with the climate system. The Convention's principal commitments for Annex I Parties (OECD and East European countries) are to adopt policies and measures to reduce greenhouse gas emissions with the aim of restoring their emissions to 1990 levels by 2000, subject to a number of considerations. Most countries have ratified the Convention.

Further in 1997 some 170 countries agreed to a series of measures to reduce net emissions of greenhouse gasses such as carbon dioxide through an international agreement known as the Kyoto Protocol. The Protocol requires many developed countries to reduce net emission to level below those known to occur in 1990. The primary means of reducing net emissions will most likely be in the energy sector, increases in efficiency and new technologies. However, the clearing and conversion of forest lands to other uses has contributed some 40% of total emissions to the atmosphere (108 Gt C out of a total 265 Gt C) over the last 150 years.

Article 12 of the Kyoto Protocol provides for a mechanism where Annex 1 countries may meet their obligations to reduce GHG emissions by supporting projects in developing countries that will either reduce GHG emissions or enhance removals by sinks. Because of their efficiency and effectiveness in C sequestration, tropical forests are attractive options for the CDM. There is therefore an opportunity for developing countries in the tropics to use this mechanism to promote forest conservation and rehabilitation. However, it is not clear that LUCF projects will be included in CDMs. There are many issues that still need to be resolved such as baselines, leakage, permanence, and measuring and monitoring C to required levels of accuracy and precision (Brown, 1998). The exercise in this activity, therefore, would strengthen the capacity of scientists while improving the awareness of policy makers and resource managers.

It is realised that the exact modalities and specific guidelines of the CDM are still being negotiated. However, tropical countries should be ready if and when these are finalized. The first issue is whether the country wants to participate in CDM. The answer to this may be more political rather than technical. However, assuming there is no political hindrance, a tropical country may consider the following in deciding whether to participate or not:

- its current budget for forest conservation and rehabilitation;
- available area that could be devoted as long-term C banks;
- benefits accruing to the host country, specially to local forest communities;
- financial cost to the host country;
- types of project to be promoted (tree plantation, monoculture, use of exotics, etc.)

It is also crucial that host countries should provide institutional arrangement on how such project may be implemented. There should be enabling environment where all stakeholders from the host's side could take part while the invostors could share fairly the cost and benefits of the project. There is enormous potential of such projects and yet the awareness is still very low.

No need to mention the importance of of the upcoming and ongoing negotiations. Since the specific details of CDM are still to be worked out, tropical countries should actively participate in the negotiating process to ensure that their concerns are reflected in the final outcome. The IPCC is preparing a special report on LUCF which could have a great influence on the role of the forestry sector in C mitigation. To this end it is necessary that negotiators should be well equipped not only from the legal perspective but also scientific merits of the issue.

The CDM provides a way for developing countries to be more actively involved in the mitigation of GHG in the atmosphere, short of actual reduction commitments. But perhaps more importantly in the short term, developing countries stand to benefit from the CDM through investment inflow and technology transfer that will support their respective sustainable development agenda (Frumhoff *et al.*, 1998). In general, what will happen is that developed countries or their private corporations needing to satisfy their carbon reduction requirements as provided in the Kyoto Protocol could finance projects in developing countries designed to conserve or sequester C. Alternatively, one emerging scenario is for developing countries to offer carbon credits for sale to interested Annex I parties under a market-driven carbon trading scheme. For some projects, developing countries in the tropics offer comparative advantages. This is specially true for LUCF projects which are usually more cost-effective in tropical countries.

4.2. Trained people

Although the Training Workshop by no means perfect, it was realised that the network of trained people should continue to work and communicate. From the point of view of the traditional forestry practices CDM Projects are expected to create enormous complication since they will bring a lot more actors, different institutions, and new legal aspects. Therefore, KP and CDM in particular should not be viewed as a magic solution of funding in forestry projects. As far as the forestry science is concerned there is a great need for more integrated research and adequate synthesis to be undertaken. Coordinated efforts should be directed towards a more generic in terms of site characteristics and more specific in addressing the issues. Such approach will undoubtedly improve the implementation of the Protocol in terms of project monitoring and verification in an attempt to be accurate in quantifying the baselines and additionality.

Research-based activities coordinated under the APN support presented in this workshop was expected to give the hints related to the robustness of the method, effectiveness in the cost, and accuracy of the results. The assessors as well as managers need such requirements. The presentations demonstrated the assessment of below and above ground C-stocks using different approaches and methods at various terrestrial ecosystems. In general, they demonstrate a robust academic background to apply the techniques. Although cost-benefit analysis has not been carried out the detailed results and high accuracy may not be able to trade off the costs of assessment.

The methods learnt during the workshop were expected to be improved for further application in assessing terrestrial C-stocks. It is expected that this initial contacts and activities will enhance further interaction in the field of land-use change in general and terrestrial carbon in particular. Electronic network available at IC-SEA will virtually play important role in the near future to continuously warm up its 'members'. Web-based interaction will be further explored to facilitate such interaction. It is the very role of the Impacts Centre that such proces is taking place.

4.3. Policy dialogue

The current issue being studied is highly relevant to many government policy-making processes, more specifically when they talk about global environmental change, sustainable development, etc. The policy dialogue on this issue is just beginning. Again, the Impacts Centre will take the lead in facilitating the dialogue in the region. However, national specific will be considered whenever applicable. It was through the Science-Policy Workshop that we realised such uniqueness of the countries involved. However, there many commonalties that were experienced and shared. Among others were found in the recommendations made by the participants covering

Overarching recommendations:

- Develop National CDM Guidelines (model contract)
- Promote capacity building (develop/learn from first projects)
- Establish Impact Assessment Committee (including environmental, socio-economic and sustainable development)

Specific recommendations:

- National strategic study on CDM in forestry
- Promote transparency by involving local community and NGOs in all stages especially in the development of assessment tools
- Promote public awareness
- Facilitate the formation of the scientific task force to ensure baselines, CERs, etc.
- Facilitate the formation of multi-stakeholder technical, business, and policy task forces / working groups
- Start the exercise to test the guidelines and criteria for approval by considering:
- harmonisation and coordination between national and local government
- risk management standards
- ensure local community share the benefits
- make whole certification, verification process simple, yet accurate
- incorporate sustainable development criteria developed by assessment tool (international standards, probably address only carbon)
- international/regional collaborations on CDM project "learning" (*e.g* at ASEAN)

4.4. Database and Websites

The data obtained during the assessment will improve the Carbon Database being developed by IC-SEA. This will be shared to other users in the network which will be available at various Web-based platform. Further such information will not only be useful for scientist but also resource managers interested in the CDM investment. The following is examples of Website related to APN activites.

Source	Information covered
http://www.icsea.or.id/apn/apnicsea.htm	APN Project Profile
http://www.icsea.or.id/im8apn.htm	Press Release
http://www.icsea.or.id/apn/planning.htm	Planning Workshop
http://www.icsea.or.id/apn/training.htm	Training Workshop : workshop brief
http://www.icsea.or.id/apn/trngprog.htm	Training Workshop : workshop programme
http://www.icsea.or.id/apn/trngsmnr.htm	Training Workshop : workshop seminar
http://www.icsea.or.id/apn/trngptcp.htm	Training Workshop : workshop participant
http://www.icsea.or.id/apn/trngtrnr.htm	Training Workshop : workshop trainers
http://www.icsea.or.id/apn/trngpict.htm	Training Workshop : workshop photo
http://www.icsea.or.id/apn/trngrept.htm	Training Workshop : workshop report
http://www.icsea.or.id/apn/trngform.htm	Training Workshop : workshop online form
http://www.icsea.or.id/apn/commrevw.htm	Commissioned Reviews
http://www.icsea.or.id/apn/scipolws.htm	Science Policy Workshop

5. CONCLUSIONS

- The activity under APN support was very timely and appropriately framed under one of the most relevant global issues such as land-use change, greenhouse gas emissions and the subsequent climate change.

- There is a potential application of such approach made for this activity, therefore, it is necessary to always design research as policy-relevant as possible. Likewise, it is also crucial to design policies based on the best available knowledge. Hence, they are scientifically sound and valid.

- Scientists in the region are very responsive to new knowledge and eager to apply them whenever possible. The need of organising them in a meaningful and focused studies is overwhelming.

ATTACHMENTS

ATTACHMENT 1

SUMMARY REPORT ON

Planning Workshop on Land-Use Change and Terrestrial Carbon Stocks: Capacity Building, Impacts Assessment, and Policy Support in South and Southeast Asia

Bogor, 10-11 June 1999

1. INTRODUCTION

Changes in land-use and cover in rapidly developing Asia, apart from their immediate implications for the structure and functioning of terrestrial ecosystems, also have longer and larger-scale implications for global climate and biodiversity. A key management issue is how to improve sequestration and long-term storage of carbon in the landscape, while at the same time meeting needs for food, fibre and energy. Estimating carbon stocks and understanding their dynamics is crucial, both from the perspective of sustainable landscape management and global change feedback.

The Impacts Centre's experience in capacity building, policy support and technical support to regional networks will be vital to this task. We then proposed to APN to undergo the activity in line with APN objective in the region. The proposal aims to provide technical and policy liaison support to the nations of South and Southeast Asia so they can be ready to participate in the Kyoto Protocol using the best available research-based knowledge. The project involves training workshops, a series of commissioned studies, and a science-policy workshop.

To mark with the inception of the series of activities, this two-day Planning Workshop is planned. We expect that all important players in our project including the sponsor, implementing agencies, and collaborators will take part in designing the activities. The objectives of this workshop will primarily be to:

- discuss the overall workplan and budget
- scrutinise the commissioned reviews
- draft detailed plan and structure of the Training Workshop and the Science-Policy Workshop

The detailed programme of the workshop may be seen in Appendix 1

1.1 PARTICIPANTS

The Planning workshop was attended by 14 participants as follows:

- Prof. Sitanala Arsyad (SA)
- Mr James Robertson (JR)
- Ms Connie Chiang (CC)
- Dr Daniel Murdiyarso (DM)
- Dr Rodel Lasco (RL)
- Prof. Ranjith Senaratne (RS)
- Dr Kurniatun Hairiah (KH)
- Prof. SM Sitompul SMS)
- Dr Upik R Wasrin **) (URW)
- Mr Rokhis Khomarudin *) (RK)
- Dr Soekisman Tjitrosemito (ST)
- Dr Meine van Noordwijk (MvN)
- Mr Desi Suyamto (DS)
- Ms Atiek Widayati (AW)

*) *present only on the first day*
**) *present only on the second day*

The detailed address of the participants is shown in Appendix 2.

1.2 PROFILE OF THE INSTITUTIONS INVOLVED

In order to introduce the players in this project it was thought that a short presentation on each organisation would help.

APN *(by James Robertson)*

- The Asia-Pacific Network for Global Change Research (APN) is an inter-governmental network. Its primary purposes are :
    - to foster global environmental change research in the Asia-Pacific region
    - to increase developing country participation in that research,
    - to strengthen links between the science community and policy makers,
    - to promote, encourage and support research activities on long-term global changes in climate, ocean and terrestrial systems, and on related physical, chemical, biological and socio-economic processes.
- The activities are decided by the annual Inter-Governmental Meeting, and supported by the Steering Group and Scientific Planning Group.
- APN activities are supported by research programs created by large scientific unions which address the need to reduce scientific uncertainties related to global environmental and related social change. Several organisations providing those supports are International Human Dimensions Global Environmental Change Programme (IHDP), International Geosphere-Biosphere Programme (IGBP) and World Climate Research Programme (WCRP).
- The APN also has collaboration with other inter-governmental networks supporting global change researches, like IAI which covers North and South America and ENRICH which covers Europe and Africa.

IC-SEA *(by Daniel Murdiyarso)*

- In his presentation DM briefly described the establishment and implementation of IC-SEA programme, its objectives, linkages as well as the framework of issues under global change which are of major interest to IC-SEA.
- Two of the various activities having been conducted by IC-SEA during its first phase, i.e. capacity building activities through 6 training workshops and science-policy workshops, were put as the emphasis in the presentation due to their high relevance to this project.

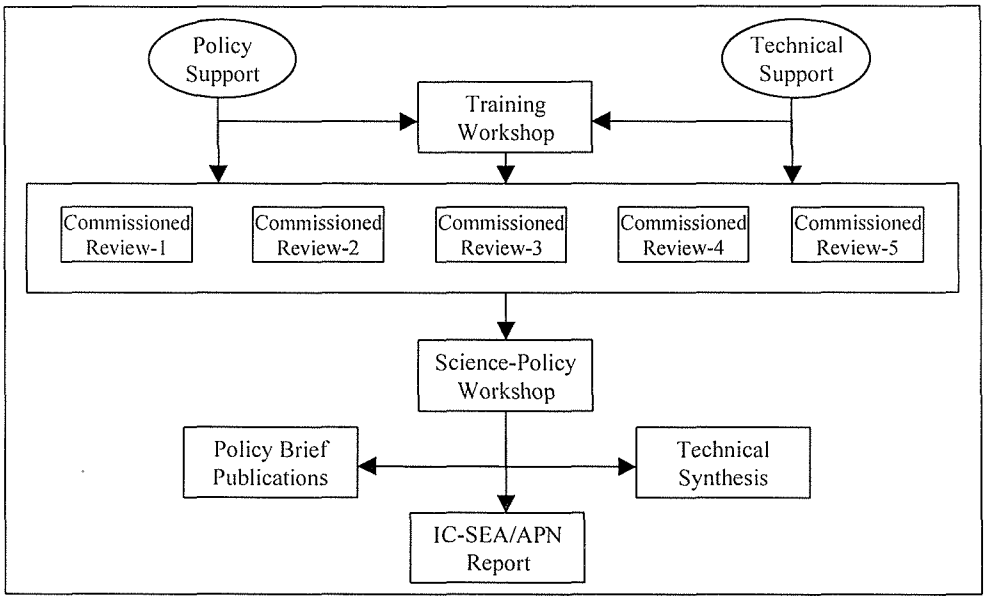
OTHER ORGANISATIONS

- SEAMEO BIOTROP , as the host of IC-SEA, has been established since 1968 and is one of the three SEAMEO centres located in Indonesia. Its mission is to provide leadership in the areas of tropical biology in the region, through research, consultancy, information dissemination and other related activities. In 1998, BIOTROP launched the program of Master Course on Information Technology for Natural Resources Management, which is also under collaboration with IPB and College of Geographic Science, Canada.

- The other organisations which were briefly introduced are Environmental Forestry Programme (ENFOR) - UPLB, University of Ruhuna Sri Lanka, ICRAF SEA Programme, University of Brawijaya and SARCS

1.3 ORGANISATION OF THE PROJECT

The organisation of the project was briefly described by DM , as shown in the diagram below. Basically, the activity consists of three major components Training Workshop, Commissioned Reviews and Science-Policy Workshop. All of these activities will be supported by APN through IC-SEA. It is clear that the three main activities are integrated under the theme of the project. Two internal reports will be produced (Technical Synthesis and Project Report), while other documents will also be externally published (Policy Brief and Reviewed Papers).



2. TRAINING WORKSHOP

2.1 BRIEFING MATERIALS

BACKGROUND

This will largely be equipping the participants, mainly from the collaborators' team, to comprehend with common methodologies to assess carbon-stocks in various compartments both above and below-ground. Modelling tools will be used and explored to build and enhance the capacity of participants in the long-term projection. Combination of class, field, and laboratory works will be exercised. Resource persons will be drawn from our Global Change network having world reputation in their respective fields.

PARTICIPANTS

We expect to have 14 participants (including those from Sri Lanka) to attend the Training Workshop. Lead authors for the commissioned reviews may propose two names from their organisation. Their participation will financially be supported by APN. Fee-paying participants may be invited as long as the facilities permit.

Participants should have related field and interest. Computer literate is a must and those with research experience are most preferred since workshop like this is not to be a teaching session, but rather a lively interaction and exchange of expertise.

DATE, VENUE, AND LOGISTICS

The Training Workshop will be held on 3-16 August 1999. The classroom and laboratory sessions will be held in the first week at IC-SEA, Bogor. The field work will be carried out in Jambi Province. Participants and Resource Persons will be transported and accommodated to Jambi during the second week of the activities. Domestic air travel, accommodation, and meals will be arranged by IC-SEA.

COURSE CONTENT

The course will consist of:

- General Overview (Global Change Science, Role of GHG, Integration and Modelling Approach, Policy Relevance of Global Change Research)
- Above and below ground carbon assessment (method and analysis)
- GHG emissions from soils (sampling method and analysis)
- Modelling Tools and Data Interpretation

The practical/field works will consist of:

- Field method of vegetation transects
- Field method of SOM and below ground carbon measurements
- Field method of GHG sampling
- Laboratory analysis

2.2 DISCUSSION

PARTICIPANTS

Participants will be selected from both field people and modelling people, with possibility of including government people in order to involve the key policy makers since the beginning of the activity. In order to synchronise the activity with the IPCC activities re National Communication on GHG Inventories (see Figure 2 as suggested by MvN) and to get workshop effectiveness in terms of its multiplier effect, participants will be selected from organisations who are involved in IPCC process. Researchers, NGO, and private sector having interest in the JI/CDM projects may also be recruited (RS proposed two persons from University of Ruhuna, Indonesia will involve people from Ministry of Forestry Training Centre.)

The main requirements for participants recruitment are:

- Principally, potential participants are those who will assist in the commissioned reviews.
- It means that the PI can also be the participants as well as resource person

- People who are involved in "real projects", not just doing academic exercise of C-stock issues.
- Those who are likely to disseminate the knowledge obtained during the workshop to the relevant parties in their home institutions.
- Those who have been involved in the national GHG inventories
- Those who are potentially applying the knowledge gained in the project level
- Considering that there are only 14 people to participate from the whole SE Asia, this training should bear the principle of 'training for trainers'.
- Since the content of the training will be concentrated on carbon density of various land-use types, participants should have research background on carbon density of various land-use types, in the context of data collection, data analysis, or modelling.

Various aspects in identifying the potential participants were also discussed, as follows:

- Participants should bring the data on carbon density from their country, at least from the default values of current national inventory. It will be very useful since country reports session will be eliminated.
- Participants' recruitment will be under the PI or lead author's responsibility of every commissioned review under IC-SEA co-ordination.
- A survey will be conducted and organised by IC-SEA in order to recruit the best possible composition and distribution of the participants
- The recruitment should be completed by mid-July 1999
- Since there are 20 seats available for training participants, there is a possibility of inviting fee-paying participants, adding the 14 participants funded by the project.

COURSE STRUCTURE AND CONTENT

- Content of the workshop will be based on the Soil Training Workshop conducted by IC-SEA with some improvement. The content will not necessarily be science-based.

- The main content of the training:
  - Above-/below Ground Biomass (incl. FBA)
  - Microbial Biomass
  - Macro-fauna (incl. the role and biodiversity)
  - GHG Emission/Sequestration (incl. the use of GC and application of the Protocol)
  - Modelling (incl. CENTURY and WaNuLCAS)

- The date for the training workshop is confirmed to be: 3-16 August 1999 consisting of 5-day Training Course and 9-day Field Trip (incl. transfers to/from the field)

- The training is designed to be interactive one, therefore the participants should be considered as experienced participants, since they are experts in their fields.

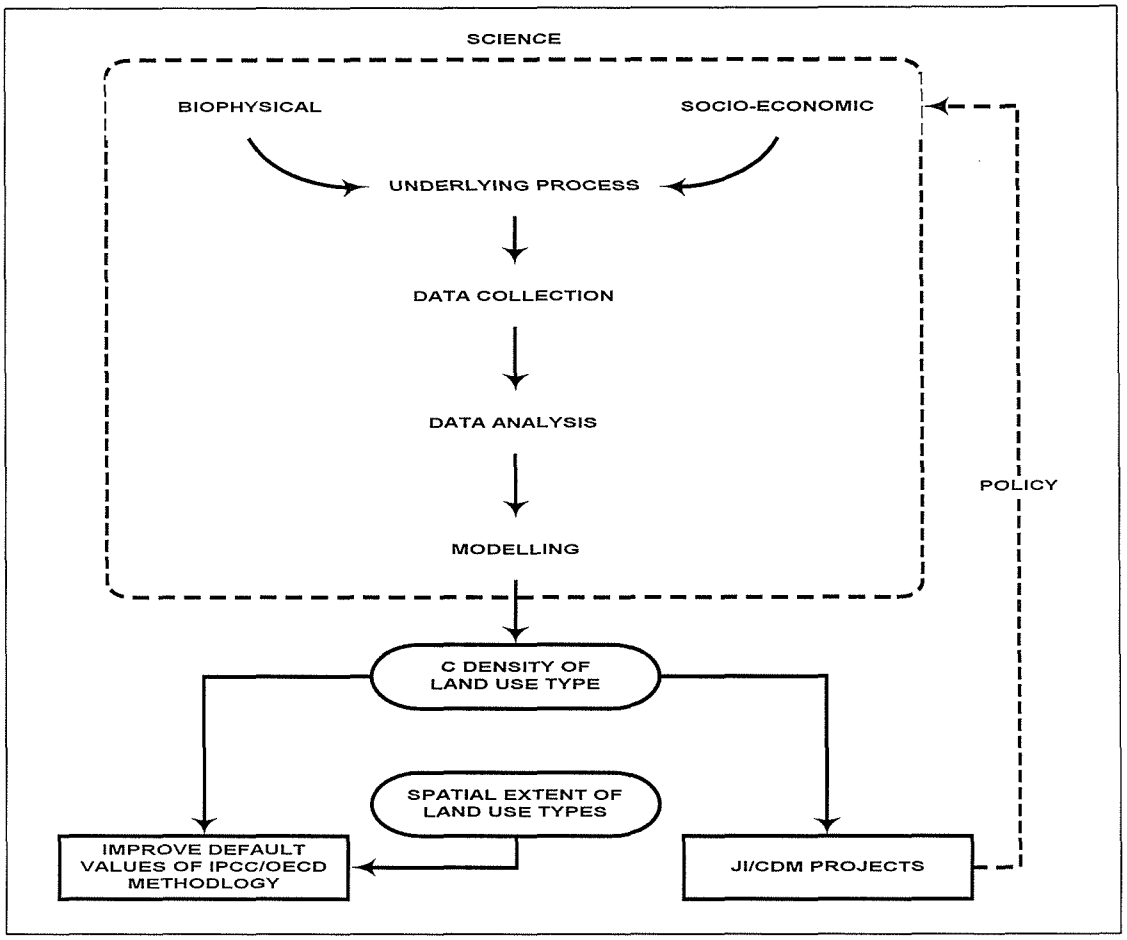


Fig 2. The Training Workshop is serving various types of clients.

The general daily schedule of the training course will be as follows:

DAY	a.m.	p.m.	Evening
1	• *Lectures* • *Review and discussion* • *Modelling*	• *Lectures* • *Review and discussion* • *Modelling*	*Computer lab exercise*
2			
3			
4			
5			

RESOURCE PERSON

- Lectures by experts in the related fields will be conducted as the programs for the opening day. In addition, possibility of START guest lectureship will also be explored (CC from SARCS is the contact person). Proposed keynote speakers/guest lecturers identified in the meeting:
  - Aca Sugandhy –Indonesian Ministry of Environment
  - Kenneth McDicken – CIFOR
- Resource persons will be selected based on syllabus from the commissioned reviewers. One candidate for resource person in the topic of microbial biomass is Junaedi

- Regarding the field works, each resource person is encouraged to prepare materials to be practiced.

FIELD TRIP

Destination of the field trip to Jambi, Sumatra, includes Pasir Mayang (specific: various land-use types), Rantau Pandan (specific: local community issue), and Wanagama (specific: large-scale operators). It is proposed to include socio-economic survey exercises during the field trip. Regarding transportation to Pasir Mayang base camp, it is important to check the water level of the river in July. DM is going to survey these sites in July and seek feedback from all involved upon his return.

3. COMMISSIONED REVIEWS

3.1 BRIEFING MATERIALS

BACKGROUND

There is wide range of information available elsewhere with regard to the assessment of terrestrial carbon stocks. The techniques, methodologies, and approaches usually differ from one place to another or from one researcher to another. Comparisons, therefore, can hardly be made at any basis. By differentiating the issues based on the techniques, ecosystems, it might be possible to scrutinise the essence of the information. It is highly relevant if critical reviews, at this stage, are carried out from various different angles before a sound synthesis is carried out.

Team of people based in several institutions will be assigned (perhaps on contract basis) to assess and review the existing information the topic(s) that are appropriate and relevant to their interests and mandate.

BUDGET AND DURATION

Research grant will be allocated from the fund provided by the APN to carry out the work that will take 6-7 months. The experience gained from the Training Workshop may be implemented in this work to carry out necessary field assessment. Reporting the progress of the work will be needed halfway before the completion of the work.

TOPICS

The reviews will consist of the following topics:

- *Assessment of above-ground C-stocks - Using RS/GIS*
  By: Upik R. Wasrin (IPB) and Agus Hidayat (LAPAN)
- *Assessment and simulation of below-ground carbon dynamics*
  By: K. Hairiah and SM Sitompul (UniBraw)
- *C-stocks in degraded forests*
  By: Rodel Lasco (UPLB)

- *GHG emissions from soils under changing land-use*
  By: D. Murdiyarso and D. Suyamto (IC-SEA)
- *C-stocks in oil-palm plantation*
  By: Soekisman Tjitrosemito (BIOTROP)

3.2 DISCUSSION

- Activities time line for commissioned reviews (incl. writing, progress reporting, etc) is scheduled for 6-7 months.
- Each reviewer presented their ideas and summarised as follow:

No	Topics	Comments, Suggestions, And Improvement Plan
1.	Assessment and Simulation of Below-ground Carbon Dynamics *(KH and SS)*	• It should consider the role of fast decomposed species (*i.e.* Macaranga) and competition interference in land-use change scenarios • It is planned to develop below-ground C-stocks maps based on a look up table resulted from CENTURY simulation by considering 3 factors: rainfall type, clay content, and land-cover types. • Land-use change scenarios used in the simulation should start from other land-use types not necessarily from primary forest.
2.	C-stocks in Degraded Forests *(RL)*	• Should complete the data on soil properties • Topic will be broadened to various land-use types
3.	GHG Emissions from Soils under Changing Land-use *(DM, DS and AW)*	• Should complete the profile data • Review from other tropical regions
4.	C-stocks in Oil Palm Plantation *(ST)*	• It will be enlarged by considering oil palm plantation under peat soil condition • Soil biomass may also be explored
5.	Assessment of Above-ground C-stocks Using RS/GIS *(UW)* *)	• Should contact CIFOR in clearer context on "degraded forest" • Recent RS product may be obtained or other sites will be selected as trade-off

*) *Presented on the second day*

- Paper by each reviewer will be based on case studies in the respected countries elaborating the title /topic determined in the project as mentioned in the briefing materials.

- Syntheses of the reviews will be done across the topics of the commissioned papers, which means there will be two broad topics:

  - Above-ground C-stock
  - Below-ground C-stock

- Ranjith Senaratne from Sri Lanka is willing to unofficially contribute in the reviews, considering there are projects funded by other sources that are related to this project.

- An e-mail discussion will be arranged to facilitate commissioned reviews development.
- JR suggested that all commissioned reviews should be re-reviewed by key people from the government.
- Since the commissioned papers will be presented at the Science-Policy Workshop, the topics and the discussion should be relevant and appropriate to the needs.
- Maximum budget per topic is about USD 8,000. Fund monitoring of every commissioned review will be under IC-SEA co-ordination.

On the second day the participants of this workshop prepared a draft proposal outlining the activities of Commissioned Review. It covers the Background (area, issue, and focus), Methodology (approach and technique), Activity and Timeline, and Budgetary requirement. They are attached in Appendix 3.

4.SCIENCE-POLICY WORKSHOP

4.1 BRIEFING MATERIALS

BACKGROUND

The current issue we are going to study is highly relevant to many government policy-making processes, more specifically when they are talking about global environmental change, sustainable development etc. It is important to bring our results and findings from the Commissioned Reviews to the policy community to increase their awareness. In addition, experts' lecture will also be arranged to give broader views from both science and policy perspectives. Only through this kind of process scientists, at the same time, can learn more on what kind of policy-relevant researches are needed.

PARTICIPANTS

Pair of scientist and policy-type of person will be invited. These people are likely to be involved in the carbon-related research and debate. They should be people who have been and will be working together back home.

DATE AND VENUE

It is planned that the Science-Policy Workshop will be held on 11-12 January 2000, in Indonesia. Partnership with other institutions having similar event will be sought in order to broaden the audience. This will be the third workshop of its kind that is going to be organised by IC-SEA. The first one dealt with 'living with global change', and the second one was on 'land-use management and transboundary haze pollution'.

4.2 DISCUSSION

In order to stimulate the discussion on Science-Policy Workshop, a presentation on "Are there gaps to bridge?' was given by Meine van Noordwijk.

- Learning from the recent 'Methodology Workshop on Environmental Services and Land-use Change' organised by ICRAF in Chiang Mai, Thailand, MvN underlined that with regard to the gaps between science and policy we should consider the following issues:
  - Research society recognizes certain issues to be raised and to attract policy attention
  - Policy makers have questions which need to be answered
- With regards to the land-use management, the mass lateral flows (*e.g.* smoke/haze, CO_2, eroded soil/sediment, germ plasms) resulted from the land-use practices by the resource managers have been regarded as externalities in economic term. Although the pressure from the stakeholders is strong enough, very often the market fails to mitigate the impacts because government policies tend to ignore it. Lack of information and motives are among the reasons why mitigation measure cannot be devised (*e.g* incentives, taxes, subsidies) - see Figure 3.

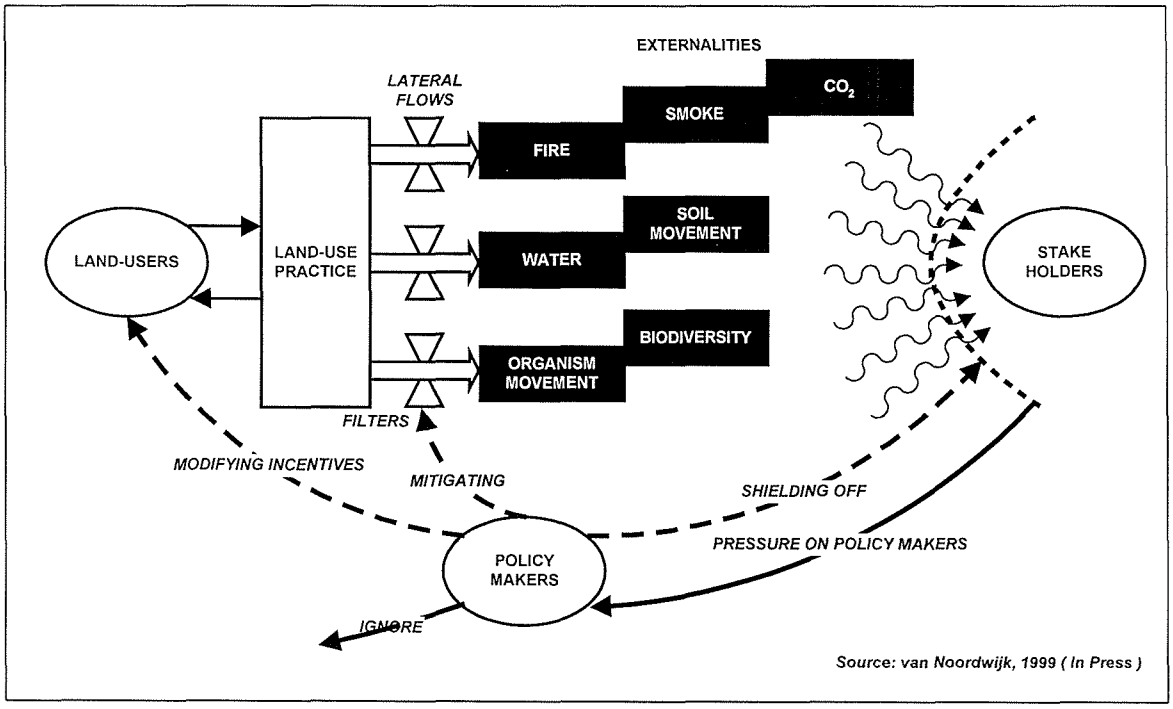


Fig. 3 Mass flows, filters, and policies

- Several comments were made to the presentation (see Figures 3)
  - Stakeholders can be considered as the policy makers due to the pressure they push to the policy society which are usually effective in triggering decisions by policy makers

- Important issues identified by scientific society need not be problems in the policy society, whereas getting certain people in the society to be influenced or to be interested in the issues is more critical and at times is more effective in the efforts of bridging the gaps

- It is realised that as far as the carbon issue is concerned there is a sizeable number of people who concern

- Critical issues that do not succeed in getting policy's attention need to be raised as public awareness.

- There are two different levels in bridging science and policy

    - Efforts to get policy's attention upon certain issues which are considered critical
    - Information extracted from the research findings to be disseminated to the policy society

- There is a need to follow up findings from C-stock studies. 'Carbon trade' issue was identified as one option to attract private sector to get seriously involved in this global issue. During the brainstorming, several potential invitees for the Science-Policy workshop were identified, among others:

    - Ministry of Environment
    - Ministry of Foreign Affairs
    - Private sectors
    - ITTO
    - NGOs
    - Parliament members
    - Local Press
    - Human-dimension science
    - Consulting agencies
    - Universities

- Press release of this Science-Policy event needs to be made to some prominent newspapers in the region, *e.g.:* Jakarta Post, Bangkok Post, *etc.*

APPENDIX 1

AGENDA

DAY-1, 10 JUNE 1999

08.30-09.00	Introduction and Overview (*D. Murdiyarso*)
09.00-09.30	Contract Signing
09.30-10.00	What is APN (*James Robertson*) What is IC-SEA (*D. Murdiyarso*)
10.00-10.30	*Break*
10.30-11.30	**Training Workshop**
11.30-12.30	Discussion
12.30-13.30	*Lunch*
13.30-15.00	**Commissioned Reviews**

- Assessment of above-ground C-stocks using RS/GIS techniques
- Assessment and simulation of C-stocks and SOM dynamics
- C-stocks in degraded forests
- GHG emissions from the changing land-use
- C-stocks in man-made (oil-palm) plantations

15.00-15.30	*Break*
15.30-17.00	Discussion
19.00	*Dinner*

DAY-2, 11 JUNE 1999

08.30-09.00	Bridging science and policy gaps (*Meine van Noordwijk*)
09.00-10.00	**Science-Policy Workshop**
10.00-10.30	*Break*
10.30-11.30	Discussion
11.30-12.30	Admin. Matters
12.30-13.30	*Lunch*
13.30-15.00	Discussion
15.00-15.30	*Break*
15.30-16.30	AOB and What's next?

APPENDIX 2

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ATTACHMENT 2

SUMMARY REPORT ON

Methodology Workshop on the Assessment and Modelling of Terrestrial Carbon Stocks

Bogor, 3-16 August 1999

1. BACKGROUND AND RATIONALE

Changes in land-use and land-cover in rapidly developing Asia, apart from their immediate implications for the structure and functioning of terrestrial ecosystems, also have longer and larger-scale implications for global climate and biodiversity. A key management issue is how to improve sequestration and long-term storage of carbon in the landscape, while at the same time meeting needs for food, fibre and energy. Estimating carbon stocks and understanding their dynamics are crucial, both from the perspective of sustainable landscape management and global change feedback.

In the recent dramatic economic growth of Asia the change of land-use at the cost of the environment often occurs on a massive scale. Although developing countries are not committed to the legally binding Kyoto Protocol, there is a wide opportunities for them to participate while enhancing their own physical environment. This is particularly true when one has to relate with the existing global phenomenon of the changing land-use/cover in the tropics. Land-use/cover change and its impacts has been driven by so many factors, including human interactions at various levels, right from individual farmer's decision up to legal, large scale and collective government decisions. Removal of terrestrial carbon stocks, changes in biogeochemical cycles, and lost of biodiversity are always associated with the rapid change of the terrestrial landscape.

The challenge is particularly acute for developing countries, which are coming under increasing pressure to modify their development strategies to reduce the adverse impacts of climate change, due to the increase of greenhouse gas (GHG) emissions, reduce land and water degradation, and conserve the biodiversity of their natural ecosystems.

2. OBJECTIVES

The objectives of the APN-sponsored Training Workshop are:

- To build the capacity of South and Southeast Asian scientists and resource managers to assess the impacts of land-use change on terrestrial carbon stocks, including above- and below-ground biomass
- To facilitate the synthesis of commissioned reviews on the issues related to the impacts of land-use/cover change on terrestrial carbon stocks

3. SCOPE

The scope of the workshop covered theoretical as well as practical aspects. The time spent therefore gave the balance between class and fieldwork. Before the course was started a half-day symposium was organised to broaden the perspective of the participants.

4. OPENING SESSION

- Half-day symposium: three guest speakers were invited, they were:
  - Dr Kenneth MacDicken from the Centre for International Forestry Research (CIFOR), who gave a talk on
  - Dr Bambang Saharjo from Faculty of Forestry, Bogor Agricultural university who gave a talk on
  - Mr Benny Luhur from a private company, who gave talk on
- Country reports: presented by participants which express their understanding on land-use change and climate change issues in their respective countries.

5. CLASS WORK

In the first four days participants received and reviewed background information of the subject matter and work together with the resource persons on the modelling exercise in the Classroom and Computer Laboratory at IC-SEA, Bogor. The Course Modules provided consist of five components:

- IPCC/OECD Methodology for GHG Emissions Inventory
- Below-ground carbon stocks
- GHG emissions
- Above-ground carbon stocks
- Modelling tools

They are mainly reading materials and related lecture notes. Hands-on exercises on the computer modelling consists of:

- GlobalC
- WaNuLCAS
- FBA
- ANDALAS
- CENTURY

Another class work was spent on the last day when the work plan was drafted related to the Commissioned Reviews.

6. FIELDWORK

The 5-day fieldwork was carried out in Jambi Province, Sumatra where IC-SEA collaborative researches with other organisations like ICRAF, NIAES of Japan, CIFOR, and GCTE are taking place. It was an excellent opportunity for the participants to observe the changing land-use in a vast landscape with its consequences in terms of terrestrial carbon stocks. Moreover the participants also had the chance to practice the methodologies to assess carbon stocks at various land-use types. Among other types we visited and worked on primary forest, mono-species plantation forest, jungle rubber, mono-species rubber plantation, and oil palm plantation)

The exercises consists of the assessment on the above- ground (phytomass, litter and necromass), below ground biomass (root and soil organic matter), GHG sampling, and soil sampling to support the interpretation of the GHG emissions. The sites were:

Pasir Mayang
In Pasir Mayang we stayed in the Base Camp of BIOTROP, a research site where a number of forest ecological studies are taking place. This place was reached from Jambi city, the capital of Jambi Province within 5.5 to 6 hours after crossing Batanghari River using 'pontoon' bridge.

The site belongs to a concession holder called PT IFA a member of the Barito Pacific Timber Group (BPTG). For research purposes 5,000 ha of primary forest has been set aside among which 10 ha is considered as Permanent Plot for routine measurements. The above and below ground biomass and greenhouse gas emissions were measured in one of the blocks in the Permanent Plot. The plot size is 20x50 m2 where each individual trees and saplings have been numbered and recorded.

Similar measurements will be carried out in *Gmelina arborea* plantation forest. Two plots with different slope have been chosen for the exercise. Both of them were planted in 1994.

Rantau Pandan
On this spot we visited a very heterogeneous plot of old rubber tress with various fruit and wood producing trees. The land is owned by Mr Uyub, a 75 years old rubber tapper who inherited the land from his father. He still remembers that most of the rubber trees in his plot was planted when he was young. While replenishing the ageing rubber trees in this inherited land he opened new land five years ago. He only planted rubber in this plot with relatively homogeneous age. The plant materials he uses for both replenishment and monospecies plot are obtained locally.

We then visited another farmer's plot at Dusun Buat village owned by Mr M. Nur. This plot is older but the owner is younger and has different job opportunity than Mr Uyub who is much older. Since there was not enough time that allowed us to do measurement we had discussion in the field and it turned out to be a good opportunity to appreciate how different people maintain their lands.

Kuamang Kuning
Kuamang Kuning is a famous Transmigration Project area which was established in 1984. This government-sponsored activity has entirely changed the landscape. Nowadays, the general view of the area is like most of Javanese village in Central or East Java, where most transmigrants came from.

We visited and work at an oil palm plantation managed by PT Sari Aditya Loka, a private company which act as nucleus company holding their own concession of 5,000 ha plantation. In this Nucleus Estate Smallholder (NES) or locally known as PIR scheme they collaborate with transmigrants who were granted land by the government but left abandoned. The scheme is later called PIR Trans, where the transmigrants are involved as the plasmas of the scheme. In this transmigration area around 10,000 ha of plasma are being established.

We visited a six-year old plantation, which was established using burning technique for land clearing. Another visit and comparison were made at the recently planted oil palm, which was prepared using mechanical land-clearing technique. We observed different soil structure and composition in these two contrasting sites.

Muara Kuamang
In this village we will be working with a group of farmers. Mr Abidin and Mr Adenan are among those who are rubber taper in the lowland area near River Pelepat. They

will be asked to estimate how many big and small trees they have in their plot. Participants can freely ask what would they do if their old trees is dying and need to be replaced?. Would they shall their wood or just burn it because it is not valuable?. These kind of questions and discussion with farmer will help them to value how much they can offer in term of carbon sequestration.

This PRA-like survey should be considered as a new approach. The activity may be improved in the future for two reasons:

- smallholder farmers should be considered as carbon 'planters'
- smallholder farmers should be able to enjoy the credit made available to the private sector

But how they should be empowered? Our findings and appreciation from this field visit will be a valuable contribution.

7. ROLE PLAY

At the end of the field work while the participants were still afresh with the problems and issue in the field a Role Play on 'Carbon Offset Project Review' was exercised. The setting was played by group of participants representing:

- International donor
- Local government officials
- Plantation companies
- Local University
- Local farmers
- Local NGOs

It was announced that an International donor was seeking a local agency who are eligible to run a CDM Project on Carbon Sequestration. The donor invited proposals and 3 groups of people from Plantations (forest and oil-palm), and a NGO on behalf of the local farmers. After the presentation of their proposal the donor asked the local University and government on their views of these proponents.

The story ended when the donor made the decision that all the proposals are weak in terms of their methodology to secure the carbon trading. Therefore they decided to channel the fun to a research organisation, namely IC-SEA, to conduct more research and charged this agency to disseminate the result to the proponents as part of its capacity building role. Everybody was happy.

8. SCHEDULE

The schedule of the workshop is summarised in Appendix 1.

9. PARTICIPANTS

The participants were selected through a process using Questionnaire (see Appendix 2) in order to have good balance. They are consisted of the APN-funded Participants, SARCS-funded and Fee-paying Participants. The list is shown in Appendix 3.

They were given the opportunity to evaluate the workshop, so that we have a good feedback. The results are shown in Appendix 4.

APPENDIX 1

SCHEDULE

Date	Morning	Afternoon	Evening	Resp.
Mon 2 Aug	Arrival	Arrival	Stay at Pakuan Hotel	Staff
Tue 3 Aug	• Opening Session • Half-day Seminar	Country Report	Introduction to the Computer Lab.	• Staff • MBM • All
Wed 4 Aug	Overview on IPCC/OECD Methods	Below-ground biomass	• GHG Sampling Protocol • ESCAPE • ANDALAS	• DM • MvN • KH • DS
Thu 5 Aug	Above-ground Biomass (Quadrant methods)	Above-ground Biomass (Remote sensing/GIS techniques)	Computer Lab.	• URW • KH • AW
Fri 6 Aug	WaNuLCAS	WaNuLCAS	Computer Lab.	• MvN • BL
Sat 7 Aug	CENTURY	CENTURY	Computer Lab.	• SMS
Sun 8 Aug	Transfer to Jambi	-	Stay in Pasir Mayang	Staff
Mon 9 Aug	Pasir Mayang Group 1: GHG Group 2: Above-ground Group 3: Below-ground	Pasir Mayang Group 1: GHG Group 2: Above-ground Group 3: Below-ground	Discussions	All
Tue 10 Aug	Pasir Mayang Group 1: GHG Group 2: Above-ground Group 3: Below-ground	Transfer to Muara Bungo	Stay in Swarna Bhumi Hotel	All
Wed 11Aug	Rantau Pandan Group 1: Above-ground Group 2: Below-ground Group 3: GHG	Rantau Pandan Group 1: Above-ground Group 2: Below-ground Group 3: GHG	Discussions	All
Thu 12 Aug	Kuamang Kuning Group 1: Below-ground Group 2: GHG Group 3: Above-ground	Kuamang Kuning Group 1: Below-ground Group 2: GHG Group 3: Above-ground	Discussions	All
Fri 13 Aug	Wanagama Group 1: Below-ground Group 2: GHG Group 3: Above-ground	Wanagama Group 1: Below-ground Group 2: GHG Group 3: Above-ground	Discussions	All
Sat 14 Aug	Transfer to Padang	-	Stay overnight in Padang	Staff

SCHEDULE (CONTD.)

Date	Morning	Afternoon	Evening	Resp.
Sun 15Aug	Transfer to Bogor	Arrive in Bogor	Stay at Pakuan Hotel	Staff
Mon 16 Aug	Work Plan I	Work Plan II	Closing Session and Farewell Dinner	All
Tue 17 Aug	Departure	Departure	-	Staff

BL: Beta Lusiana
DM: Daniel Murdiyarso
DS: Desi Suyamto
KH: Kurniayun Hairiah
MBM: Mario B Manzano
MvN: Meine van Noordwijk
SMS: S.M. Sitompul
URW: Upik R Wasrin

APPENDIX 2

QUESTIONNAIRES

Dear Participants,
In order to serve you better we would like to know exactly what you are doing in your daily routine and what you are expecting from the training Workshop. These questionnaires are design to probe that. Please take your time and help us to help you by filling out the form. If you think you need extra sheet to further explain your answer, please do so. We would be grateful if you can return the completed form by ***25 July 1999****, electronic version is preferred.*

A. Your Involvement/Interests on Carbon and Greenhouse Gases (GHG) Work

1. Have you been involved in the National GHG Inventory or National Communication report writing?
   Yes No Don't know

2. If your answer is "Yes", please answer the following questions
   a. What is your role and in what sector were you involved?
      .....
      .....
      .....
   b. If you know your National Communication or National GHG Inventory could you figure out how big is the emissions from your country. How are they compared with the rest of the region or global emissions?
      .....
      .....
      .....
   c. Are you willing and prepared to share your data and understanding by presenting them during the Training Workshop?
      Yes No I will prepare it

3. If your answer is "No", please answer the following questions
   a. What is your interest in carbon or GHG related research and analysis?
      .....
      .....
      .....
   b. How is your understanding about global carbon cycle?
      .....
      .....
      .....
   c. Why are you interested in this Training Workshop and how are you going to implement your knowledge afterward?
      .....
      .....
      .....

QUESTIONNAIRES (CONTD.)

B. Computing Skills

4. How is your computing skill in general?
   Excellent Good Fair

5. Have you been exposed to and using any computer modelling tools?
   Yes No Long time ago

6. Can you mention any of those software and indicate how often and fluent do you use them?
   .....
   .....
   .....
   .....

C. Application

7. In what capacity are you going to use the skills obtained in the Training Workshop?
   Researcher Research Manager Analyst Liaison with Policy Maker

8. As research-related type of person, how do you view the implementation of the Kyoto Protocol with regards to your new skills?
   .....
   .....
   .....

9. As management-related person, your view is:
   .....
   .....
   .....

10. Give your general commentson the possibility of improving your National GHG Inventory or national Communication or research activities at project level by indicating your plan in using your new skills.
    .....
    .....
    .....

APPENDIX 3

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APPENDIX 4

PARTICIPANTS' EVALUATION

PART 1 (CLASS WORK)

Suggestions and comments

Presentation of trainers: Clarity
1. Very good

Presentation of Trainers: Usefulness
2. Very useful

Presentation of Trainers: Adequate time
3. Very good

Time allocation for hands-on exercises
4. Not enough

Knowledge gained
5. Very relevant

Course and Reading materials
6. Very good

Workshop Guide
7. Very good

Services and Facilities

1. Very good

General Comments

General

2. Eveything is excellent
3. So far the workshop is well-managed. We do hope this will continue until the end of the workshop
4. Everything is good enough
5. Given the time limitation, the course is organised well.

Time allocation

6. Modelling is one of the major parts. I will appreciate if you could arrange more time period for the practical exercises. It will be useful in remembering all these things.
7. More free time
8. The programme/schedule is very tight so the participants are very tired and do not have time to prepare for the next day's session.
9. Time for sports activities

PARTICIPANTS' EVALUATION (CONTD.)

Programme

10. General discussion on how to apply all methods given
11. More input on global change, carbon trading
12. Give us a real example/case study during computer simulations
13. Workshop schedule and syllabus should be more systematic
14. To improve efficiency in doing exercises on models, it would be better if the course provides a workbook on which to follow the steps needed/to be taken to run the model, enter data, initialise, parameterise, modify, etc.

PARTICIPANTS' EVALUATION RESULTS -PART 2 (FIELD WORK)

Suggestions and comments

Usefulness of the Field Site Visits

1. Very useful

Time Allocation of the Field Site Visits

2. Just enough

Comments on Services and Facilities

3. Excellent.
4. Many mosquitoes in the hotel at Rantau Pandan
5. Lack of bedroom facilities at Pasir Mayang
6. Many mosquitoes at restroom facilities in Swarna Bhumi Hotel, Muara Bungo

Most Interesting Aspects of the Workshop

Modelling

7. The use of models
8. Computer modelling
9. WaNuLCAS + Century (2x)
10. Century model
11. Modelling softwares

Field visits

12. Site visits especially oil palm plantation
13. Working with group of farmers - sisipan system (2x)
14. The field trip which covers various types of land-use in Sumatra
15. Activities at Rantau Pandan

PARTICIPANTS' EVALUATION (CONTD.)

Measurement

16. Digging roots
17. Root biomass (2x)
18. GHG emission measurement (7x)
19. Below ground measurement (2x)
20. Measurement of above ground biomass and below ground (4x)
21. Approach to measure biomass through FBA (2x)
22. Sampling techniques: gas, below ground, above ground

Others

23. Remote sensing and GIS techniques (2x)
24. Allometric methods, these are useful to estimate a large scale of above/below ground biomass
25. Allometric - above ground biomass
26. Discussions/role play
27. Well-managed workshop

Least Interesting Aspects of the Workshop

Field visits

28. Visit to smallholder farm and oil plantation
29. Gathering information from farmers
30. Visiting oil palm plantation
31. Visiting farmers especially in Muara Kuamang Village

Measurements

32. Repetition of field exercises
33. Repetition of similar measurements (biomass) on various sites
34. Above ground measurement (2x)
35. FBA, since it is only applicable mainly to dicotyledoneae plants
36. Above for measuring DBH and height are too early, no chance to apply FBA model to the tree
37. No litter analysis

Others

38. IPCC/OECD methods
39. Remote sensing - no application. Cannot come up with how much biomass can we get from satellite images

PARTICIPANTS' EVALUATION (CONTD.)

Additional Topics to be included

40. Destructive sampling for particular species and make allometric equations
41. Introduction to global C cycle
42. Water content and resource management
43. Measuring some parameters in oil palm plantation
44. Model validation
45. Modelling global change
46. Literature review/related study results related to the course topics
47. Application of software with the real date from the field
48. Sample analysis at the laboratory
49. Discussion on the prospect of Carbon trade
50. Assessment of terrestrial C Stocks on the basis on IPCC method (case study/exercices)
51. Related with global change, GIS is very important tool so it should be discussed in more details
52. Database
53. A discussion with people from the government sector, people who build the protocol (e.g Kyoto protocol) and get them involve in the field work

Topics to be deleted

54. Field visits could be shortened to 3 days instead of 5 days
55. Please only show the models that are related and correlated with the topic
56. IPCC/OECD methodology
57. One demo and practice is enough to take sample gases, above and below ground biomass, tree and micromass
58. Remote sensing/GIS techniques
59. Remote sensing - this subject is interesting and relevant to the workshop but it is not effective to be discussed in the two week-workshop because of time limitation
60. Remote sensing if not come up with biomass

Comment on the implementation of the commissioned studies or field analysis and campaign

61. Techniques learned during the workshop is going to be immensely beneficial to those who are involved in research on terrestrial C-stocks
62. We need the manual of some models and methodology of measurement in the field
63. We need manuals of some models especially Century and WaNuLCAS
64. We got some methodologies for measuring tree parameters, but there was no methodology for measuring oil-palm parameters beside destructive methods. It would be better if there were any equations or modelling on oil palm. We hope that we could develop equation or modelling on oil palm with the assistance of IC-SEA.
65. Carbon can be seen from different ways: farmers, plantation, foresters look at Carbon stock differently. Most of them are interested in economic value. It will be good if IC-SEA can communicate by using language that can be understood by both sides.
66. IC-SEA may assist in laboratory analysis and provide us with up-to-date information regarding global change

PARTICIPANTS' EVALUATION (CONTD.)

Suggestions for improving similar activities/General Comments

Time allocation

67. Use one or two models and give more time to the participants to get training through modelling
68. Include one or two days for data entry and calculations after the field visit. This would enable the participants to understand one concept.
69. Because most of us are not modellers, adequate time for course and exercises on modelling should be longer (4 days)

Field trip

70. Interview with the local people (Muara Kuamang) was very useful in knowing the land use changes in Jambi area, however, good translators are needed.
71. During the field trip, permanent plot must be prepared
72. Participants come from different backgrounds/field of interests. When collecting samples in the field, we should remind participants again and again to handle the samples carefully such as: giving the label clearly, etc. to avoid the waste of time.
73. The field trip could be shortened and arranged in efficient way.
74. In the field, activities were not properly organised as the result, most of the samples were not good as expected.

Analysis

75. It is better if those who collect the sample get involved in doing the analysis and get the satisfaction of getting output/results
76. Participants should be involved in the analysis process from start until the end. Since participants' background are not similar, it is better if the expert could explain/elaborate more on the results, relate to the purpose of this training.

Participants selection

77. Participant selection process should be transparent and clear so you won't get 'keep quiet' participants or 'Mr knows everything' or 'Mr I've done this'

Workshop materials

78. For the participants who are completely new with the topic, it will be a good idea if the training materials are distributed at least before the workshop.

Others

79. Reduce course/workshop fee
80. Indonesian NGOs (especially research-based) involvement will increase capacity building and skills to deal with Carbon stocks

ATTACHMENT 3

SUMMARY REPORT ON

Science-Policy Workshop on Terrestrial Carbon Assessment for Possible Trading under CDM Projects

Bogor, 28-29 February 2000

1. INTRODUCTION

It was generally understood that there is a great deal of uncertainty whether or not sinks or Land-use, Land-use Change and Forestry (LU-LUCF) sector will be included in the Clean Development Mechanism (CDM) under the Kyoto Protocol (KP), that is why the title of the workshop bears the word 'possible'. In a sense it gives a rather pessimistic impression but it turned out that the workshop was highly motivated by positive spirit of individuals involved and it was a forward-looking event. The open mind of the participants has eased the exchange of knowledge and understanding of the issues. In short, the workshop was well accepted.

It was expected that the workshop would meet the following objectives:

- To provide a forum where scientific, policy and business community could interact and share their views and experiences in understanding the issues
- To anticipate the operationalisation of KP especially trading of carbon through CDM Projects in LU-LUCF sector
- To seek the business opportunities and examine the risks while enhancing forest environmental services to meet sustainable development objectives

The preparation of the papers and presentations were based on a number of key questions leading to discussions that clarify and confirm the understanding of the issues. These papers were grouped into science, policy, and business categories. The scientific-related papers were further sub-grouped into general understanding the Kyoto (political) process and the related science that could possibly improve the implementation of the projects. Lessons learnt from the Pilot Phase and direct measurements and modelling were also presented. The policy papers represent government and non-government organisations positions. They range from optimism through warnings of the possible negative impacts of the projects. The business community attitude is very optimistic although the size of the market was considered as small to medium.

The sessions demonstrated that the different 'language' used by different communities may be exchanged to agree (and disagree) upon issues thoroughly discussed, especially in the break-out sessions. Detailed programme of the workshop is shown in Appendix 1. The 2-day workshop which was attended by 41 participants representing scientific, policy, and business communities from Australia, Indonesia, Japan, Philippines, UK, and USA. List of participants is shown in Appendix 2.

2. SCIENTIFIC UNDERSTANDING AND SUPPORT

In order to understand the science behind carbon offset and its roles in the implementation of KP four presenters including a keynote speaker were expected to address issues around KP, CDM and forestry science and practices by raising the following key questions:

- How science can explain the global C-cycles (sources, sinks, and trends) and the significance of GHGs mitigation options through sinks as described in the KP?
- How CDM in forestry projects may be implemented in LU-LUCF related projects to assist the Parties?
- How terrestrial ecosystems serve as sinks? Will they saturate?
- How science can help assess the environmental services and socio-economic values of CDM Projects?
- What lessons we learnt from the pilot phase?

Although Article 12 clearly defines CDM that assists Parties included in Annex 1 in achieving compliance with their quantified emission limitation and reduction commitments under Article 3 and assists parties not included in Annex 1 in achieving sustainable development and in contributing to the ultimate objective of the Convention, it is not clear yet if sinks or LU-LUCF Projects will be included in CDM. The Certified Emission Reductions (CERs) may be benefited by all Parties involved. In the discussion there was a notion that if CDM will be accepted and the accounting rule may follow the rule adopted for Article 3. To this end avoided deforestation will potentially be the major issue. As far as the non-Annex 1 countries are concerned the potential of avoided emissions estimated under human-induced activity (Article 3.3) would be 1500 MT C/year compared with the afforestation and reforestation (also Article 3.3) activities which contribute only 360 Mt C/year, while additional activities under Article 3.4 is 800 Mt C/year. These figures are much bigger than the potentials of Annex 1 countries.

Issues related to on-going liability were discussed in the light of project life-time and accounting procedures on the amount of carbon sequestered. Three options were presented, such as accumulation of long-term average, ton-year concept, and insurance back-up. In this regard saturation issue was clarified by the fact that terrestrial ecosystem, including LU-LUCF sector will saturate in the very long run (100-200 years). During the Pilot Phase 6 Mha of lands have been involved in around 30 projects in the tropics with storing capacity of 4-300 t C/ha.

From the point of view of the traditional forestry practices CDM Projects are expected to create enormous complication since they will bring a lot more actors, different institutions, and new legal aspects. Therefore, KP and CDM in particular should not be viewed as a magic solution of funding in forestry projects. As far as the forestry science is concerned there is a great need for more integrated research and adequate synthesis to be undertaken. Coordinated efforts should be directed towards a more generic in terms of site characteristics and more specific in addressing the issues. Such approach will undoubtedly improve the implementation of the Protocol in terms of project monitoring and verification in an attempt to be accurate in quantifying the baselines and additionality.

Research-based activities coordinated under the APN support presented in this workshop was expected to give the hints related to the robustness of the method, effectiveness in the cost, and accuracy of the results. The assessors as well as managers need such requirements. The presentations demonstrated the

assessment of below and above ground C-stocks using different approaches and methods at various terrestrial ecosystems. In general, they demonstrate a robust academic background to apply the techniques. Although cost-benefit analysis has not been carried out the detailed results and high accuracy may not be able to trade off the costs of assessment.

3. PUBLIC POLICY RESPONSES ON CDM PROJECTS

This session was allotted to present and discuss opinions from government and non-government organisations. It was expected that this session would reveal the following questions:

- What are the main issues around CDM Projects
- How public policy-making may be structured to meet SD objectives?
- How CDM projects in LU-LUCF sector may be implemented?
- What would be the main constraints?
- Do we have sufficient enabling environment to attract CDM investments?
- What are the concerns of civil society regarding the implementation of CDM in LU-LUCF Projects?
- How the local communities may get the benefit to improve their livelihood?
- Are the local institutions strong enough to take part?
- How they may be empowered?

There are three main issues surrounding CDM Projects: that CDM Projects should assist developing countries to achieve sustainable development, that CDM Projects should assist develop countries to achieve compliance with their emission reduction and limitation, and that the institutional arrangement are not certain yet.

It is necessary, therefore, to test the CDM Projects if they meet the sustainable development criteria in terms of enhancing human resources and social capital (such as trust, interaction, cooperation), increasing ecological integrity, and contributing to economic growth. These may be assessed through mechanisms like "Sustainable Development Impacts Assessment" (SDIA) that can follow the pattern of Environmental Impacts Assessment. In addition CDM Projects should not jeopardise the existing efforts towards sustainable development. From the perspectives of developing nations compliance may be achieved if baselines and additionality are determined credibly, while leakage are carefully addressed, especially in the sink projects.

To date there is no generic institutional arrangement to facilitate CDM Projects in forestry sector. They should be tailored based on unique situation of the projects. However, it is the role of government to provide the enabling environment in all components of project implementation that attracts investments. It is always crucial to have a successful project at the first place. It was thought that involving companies that has the least (social) controversy and renders ecolabelling certification would be a good start. It was also anticipated that the main constraints in implementing CDM Projects in forestry sector (in Indonesia) would be the lousy business that is indicated by:

- High demand for logs in plywood and pulp and paper productions that exceed the supply causing rampant illegal logging
- Rent-seeking industry
- Underpriced logs
- Tensions with local community
- Widespread corruption

Knowing the numerous uncertainties around CDM environmental NGOs are apprehensive and felt that it is too early to judge the acceptance of CDM Projects and the overall mechanisms whereby developed industrial nations need not reduce their carbon emissions but rather buy carbon credits from developing countries. Wealthy countries should be able to demonstrate their domestic commitments on reducing emissions before they can use the CER purchased (cheaply) elsewhere.

Within the Indonesian context CDM Projects in forestry sector should aim at protecting natural forests as carbon reservoirs, fulfilling certain basic criteria (revoke concession licences, recognise the rights of local communities and low-income group as primary stakeholders entitled to receive the financial benefits). CDM should not be directed to the development of production forest areas and/or industrial plantations (HTI); instead just follow appropriate national environmental policies that ensure the sustainable management of Indonesia's forests capture and make proper use of forest revenue (*e.g.* reforestation funds).

4. BUSINESS PERSPECTIVES IN CDM PROJECTS

The business session was new for most participants. Contributions from consulting firms and brokers like EcoSecurities, Aon-Lippo, Agricultural Risk Management, and Counterpart International have highlighted issues related to the following questions:

- What would be the likely business prospects and concerns in carbon trading through CDM in forestry?
- Who will be the major source of investment?
- What would be the requirements of the investors and hosts?
- How the assessment and costing of the projects may be made (identification, design, monitoring, certification, and verification)?
- What would be the risks of engaging natural resource-based projects?
- How the risks may be assessed, evaluated, mitigated, and insured?

In Kyoto it was adopted that industrialised countries are to reduce by 5 percent from 1990 emissions, 27 percent from their business-as-usual emissions in 2008 - 2012 amounting in total 5 billion tons of carbon. Assuming the price ranges between $10 and $20 per ton, and 50 percent reduction through CDM, the size of the market is about $50 billion - $100 billion in 2008 - 2012. How can forestry sector absorb this? At annual basis the market would be around 600 Mt C which is distributed in the US (423.9 Mt C), Japan (71.2 Mt C), Canada (29.2 Mt C), and Australia (21.7 Mt C).

The prospect of CDM Projects is bright enough and very attractive if the following would be the case:

- The CDM will not replace ODA
- The major source of investment in CDM will be from mature industries in the private sector
- They meet the requirements of the capital markets as well as those of the host nations

CDM investment is viewed by investors as low cost, high risk, and yet strategic and small scale. Risks are categorised into Project Risk (for those which are not performing, this is usually manageable), Sovereign Risk (associated with investing in a country, this is a major issue in forestry), and Policy Risk (when credits are not being allowed, this is a major disincentive). To date the investment committed in forestry sector amounting US$ 350 million. All of them are AIJ Pilot Phase and not representative of the potential size of the market. The prices range from US$ 0.20 to US$ 12/tC, which is relatively low compared with energy offset prices which ranges between US$ 70 and 200/tC. The transaction costs is considered by investors as 'deal breaker'.

So far the quantification of carbon flows with 5-10% accuracy has currently been done. IPCC report will clarify state of science on this issue. The main difficulty in forestry project is to determine the additionality that is based on behavioural baselines. From business point of view the additionality of energy sector was found to be equally difficult. The difference is that in LU-LUCF sector the leakage e.g., shift of industrial plants to a non-capped country. In addition natural disasters/risks (such as fire) can be very high knowing the long-term nature of forestry. Although energy investments are equally long term, they are usually more capital intensive. It was also perceived that insurers are more prepared and experienced in plantation projects with capital intensive rather than labour intensive.

5. CHALLENGES AND OPPORTUNITIES TO CARRY OUT CDM PROJECTS

The first group of this break-out session was charged to identify type of CDM projects in forestry sector, the institutional arrangement, roles of government, discuss whether project planning should be centralised, and capacity building required to implement CDM projects.

5.1. TYPE OF PROJECTS

The following project types were discussed in the light of CDM criteria. They may be implemented with certain notes identified as issues associated with project implementation that need further elaboration.

Project	Kyoto Criteria				
	Additionality	**Sustainability**	**Benefits**	**GHG**	**Issues**
Mangrove Forests	Yes	Hopefully	Marine, fish, intrusion of salt water, erosion	Yes	Fisheries tourism, tenure, resettlement
Reduced Impact Logging	Yes	Yes	Industry (more profit), ecological	Yes	Technology transfer, partner companies
Sustainable Forest Management	Yes	Yes, by definition	Collateral, community	Yes/No?	Cut or not cut

Project	Kyoto Criteria				
	Additionality	Sustainability	Benefits	GHG	Issues
Community Forestry	Cuts down illegal logging	?	Socio-economic, ecological, Community	Yes/No, depends on type	Investor? Depends on species
Industrial plantation and reforesting degraded lands	Needed to meet demand	If meet criteria of reforestation	Industry, mining, community only with special arrangement, employment	Yes, if meet criteria of reforestation	Depends on species, Definition of Article 3
Value-added Wood Products	?	?	Socioeconomic, industry	Yes, but depends on cycle	Usage of products
Analog Forests / Assisted regeneration/ Enrichment planting/ Improved fallow	Yes	Yes	Community	Yes	Labor intensive, assisted regeneration, new term, whether prod. Forest can be converted to Protection Forest.
Protected Areas	Problematic	Yes	Ecological (*e.g.* biodiversity), community (?)	Yes if under threat	Appropriate for the carbon regime?

It was unanimously agreed that projects with low additionality like man-made plantations of any species planted on converted areas following unsustainable land clearing technique should be ruled out.

5.2. INSTITUTION ARRANGEMENT

The arrangement of institutional set up should be made by the host nations so that they are protected from exploitation and to ensure the full benefits they may get. The institution should be multi-stakeholder at which the benefit and risk sharing may be negotiated. It was confronted that if CDM Projects are categorised as foreign direct investment (FDI), there is still problem as far as Indonesian forestry sector is concerned. It was suggested that forestry department should play roles in the development of CDM guidelines. It is logical that the host countries are to approve the projects. Therefore, a High level Executive order such as Government Regulation is expected to institutionalise CDM projects.

Among other issues regarding the institutional arrangement were:

- *Tenure.* Since the nature of forestry projects are long term, there should be guaranteed investments. The tenure should ideally transferable and governments should be the guarantor of the tenure
- *Contract.* The management of contracts may have options like joint venture, production sharing, or state-run

5.3. GOVERNMENT ROLES

As described in 5.1 with these identified projects by host countries it was strongly felt that government should take the lead in providing enabling environment to the potential investors. The government roles would be:

- Guarantor of tenure (only)
- Creating clear guidelines and building consensus with investors
- Providing political will that builds confidence in policy environment
- Establishing legal framework to facilitate project implementation
- PR and building awareness
- Providing consultancy fora with interdepartmental agencies to set policies
- Approving projects and awarding CERs

5.4. CENTRALISED PROCESSES?

Although the planning phase and policy guidelines are to be done at the central government level, the process should allow consultation with local and regional governments. It should be more practical if the identification and implementation of projects to be done at the regional level, whenever applicable. In the case of Indonesia, there are good arguments on either side, especially with the existing tug-of-war between the Ministry of Forestry and Estate Crops and the Provincial Governments re the existing capacity of the Provincial Governments.

5.5. CAPACITY BUILDING

Although there are several multi-sectoral assessments to compare, CDM is totally new mechanisms. Monitoring, verification, certification are among the weakest area that need to be strengthened. Again, it is government role to attract resources so that the in-house capacity is built. The capacity building should be additional to existing ODA activities and specially designed for:

- The task force to monitor
- The scientific panel to verify
- The independent auditors to certify (possible model: ecolabel certification, FSC)

6. WHO BENEFITS AND WHAT ARE THE COSTS?

This break-out group was charged to discuss how the public and private sectors could get the benefits from CDM Projects and the likely costs they may encounter. It was also a concern if the environmental services would be enhanced by the implementation of such projects. Risks and transaction costs were also elaborated in the small group.

6.1. STAKEHOLDERS' BENEFITS AND COSTS OF CDM PROJECTS

It was believed that the costs and benefit entirely depend on project design as outlined below:

		Benefit	Cost
Host	Local community	• Employment • Education • Enterpreneurship • Infrastructure • Awareness on value of forests • Improved market • Increase control of resources	• Dislocation • Potential disenfranchisement • Not involving local people • Under compensation • Exploitation • Bureaucracy
	Private corporation	• Private capital • Technology transfer • Business opportunity • Community will help • Capacity building	• risk of loss profit, potential financial exposure • unequal agreement • KKN [1]
	National government	• Sustainable development	
	Local government	• Eco-tourism • Potential revenue	
	NGO	• Revenue • Capacity building	
	E public	• Employment	
Investor	Private corporation	• C benefits/credits • Public relations • Financial • Reduce risk	• Unequal agreement
	Government	• C credits • Leverage private investments	

6.2. ENVIRONMENTAL BENEFITS AND COSTS

The environment benefits and cost, on the other hand would depend on the spatial scale. Such locality and size of the domain does matter as identified below:

	Benefits	Costs
Local	• Biodiversity • Better living environment	• Converting natural forests to monoculture • Change in land use • Decline in environmental quality • Heavier fertilisation and mechanisation
Regional	• Reduced haze	
National/Global	• Biodiversity	• Decline in biodiversity

[1] KKN is an Indonesian abbreviation that denotes Corruption, Collusion, and Nepotism widely used to express the major causes of the economic of political chaos around the fall of previous government.

6.3. OPPORTUNITY COSTS AND RISKS

The opportunity costs and risks were grouped by host-investor category as follow:

	Opportunity Costs	Risks
Hosts	• Pursuit of other development paths • Low opp. cost are cherry-picked by developed countries	• Political risk • KKN
Investors	• Capital long-term commitment	• Political risk • Insurers give up • KKN

6.4. TRANSACTION COSTS

There are several options to finance the transaction costs, such as, host country, equity investors, donors/foundations, investor. It would be appropriate, however if the identification and design costs would be the responsibility of the hosts and the rest should be negotiated.

7. RECOMMENDATIONS

At the end of the session the group reached the most important question: "do we recommend CDM in the forestry sector?" The answer was YES, but if it supports sustainable forest management, and the benefit and risk is shared fairly. Therefore, the group strongly felt that the most immediate action to take is that the governments need to discuss the issue more seriously. The following items were then recommended.

7.1. OVERARCHING RECOMMENDATIONS:

- Develop National CDM Guidelines (model contract)
- Promote capacity building (develop/learn from first projects)
- Establish Impact Assessment Committee (including environmental, socio-economic and sustainable development)

7.2. SPECIFIC RECOMMENDATIONS:

- National strategic study on CDM in forestry
- Promote transparency by involving local community and NGOs in all stages especially in the development of assessment tools
- Promote public awareness
- Facilitate the formation of the scientific task force to ensure baselines, CERs, etc.
- Facilitate the formation of multi-stakeholder technical, business, and policy task forces / working groups
- Start the exercise to test the guidelines and criteria for approval by considering:
  - harmonisation and coordination between national and local government
  - risk management standards
  - ensure local community share the benefits
  - make whole certification, verification process simple, yet accurate
  - incorporate sustainable development criteria developed by assessment tool (international standards, probably address only C)
  - international/regional collaborations on CDM project "learning" (e.g at ASEAN level)

APPENDIX 1

PROGRAMME

Day-1: 28 February 2000

Time	Session	Topic and Speaker	Chair
08.00-09.00	*Registration*		
09.00-10.00	Opening Session	• IC-SEA Report • BIOTROP Remarks • Minister of Environment Opening Speech	IC-SEA
10.00-10.30	*Coffee Break*		
10.30-12.00	Session 1: Scientific Under-Standing	**Keynote speaker:** Sinks and the CDM *(Ian Noble, CRC Greenhouse Gas Accounting, Australia)* 1. CDM, Forestry and Science *(Ken MacDicken, CIFOR)* 2. GHG Mitigation Options in Forestry Sector and Their Impact on National Carbon Stock *(Rizaldi Boer, IPB)* 3. The Progress of Establishing Cinnamon and Candlenut Demonstration Plots in Jambi and Their Potential to Absorb Carbon *(A.N. Gintings, FORDA)* • Discussion	Daniel Murdiyarso
12.00-12.30	*Lunch Break*		
13.30-15.00	Session 2: Public Policy Responses	1. Perspective of CDM Projects under The Kyoto Protocol Implementation (*Aca Sugandhy, MoE*) 2. Preventing Perverse Outcomes (Leakage) from CDM Investment in the Forest Sector (*Merrilyn Wasson, ANU*) 3. Issues and Concerns Over Clean Development Mechanism in the Indonesian Forestry Sector (*Agus P Sari, Pelangi*) 4. Walhi's Position towards CDM Projects in Indonesia (*Longena Ginting, WALHI*) • Discussion	Upik R. Wasrin
15.00-15.30	*Coffee Break*		
15.30-17.00	Session 3: Scientific Support	1. Assessment of Above Ground C-Stock Using RS/GIS (*Upik R Wasrin, IPB*) 2. Carbon Stocks Assessment of Philippine Tropical Forest Ecosystems (*Rodel Lasco, UPLB*) 3. Terrestrial Carbon Stock in Oil Palm Plantation (*S. Tjitrosemito, BIOTROP*) 4. Assessment and Simulation of Aboveground and Belowground C-Dynamics (*K. Hairiah and S.M Sitompul, UniBraw*) • Discussion	Ken MacDicken

PROGRAMME (CONTD.)

Day-2: 29 February 2000

Time	Session	Topic and Speaker	Chair
08.30-10.00	Session 4: Business Perspectives	**Keynote speaker:** Capturing the business opportunities presented by the Kyoto Protocol in the Forestry and Land Use Change Sector *(Gerald Kohn, EcoSecurities, Australia)* 1. The Insider's Guide to Protecting CDM Investment and Managing Risk (*Phil Cottle, the Carbon Team Agricultural Risk Management Ltd., UK*) 2. A Sustainable Forest to Accelerate the Carbon Trading: An Insurance Initiative (*Junaedy Ganie, PT Aon Lippo Indonesia*) 3. Experiences from AIJ/CDM Projects (*Anthony A.Dinicola, Counterpart Indon. Ltd.*) • Discussion	Rizaldi Boer
10.00-10.30	*Coffee Break*		
10.30-12.00	Session 5: 2 Parallel Working Groups	**I. Challenges and Opportunities** • Types of CDM Projects • Institution arrangement • Enabling environment • Government 's roles • Capacity building • Planning	Merrilyn Wasson
		II. Who Benefit and What are the costs? • Public and private sectors • Environmental benefits • Opportunity costs • Transaction costs	Rodel Lasco
12.00-13.30	*Lunch Break*		
13.30-15.00	(contd.)	*Ditto*	*Ditto*
15.00-15.30	*Coffee Break*		
15.30-17.00	Session 6: Plennary	• Working Group Report • General Discussion • Closing	Daniel Murdiyarso

APPENDIX 2

LIST OF PARTICIPANTS

No	Name	Institution
1	Dr. Sitanala Arsyad	Director, BIOTROP
2	Dr. Rizaldi Boer	Faculty of Mathematics and Natural Science, IPB
3	Mr. Jim Cannon	Director, Resource Economic Program CI-Washington, USA
4	Mr. Phil Cottle	Senior Consultant, The Carbon Team, Agriculture Risk Management Ltd., UK
5	Mr. Anthony A. DiNicola	Country Director, Counterpart Indonesia Ltd.
6	Mr. Junaedy Ganie	President Director of PT Aon Lippo Indonesia
7	Mr. Longena Ginting	Indonesian Forum for Environment (WALHI)
8	Dr. A. Ngaloken Ginting	Director, Forest Product Research Centre, Bogor
9	Ms. Sri Hadiati	Ministry of Trade & Industry, Indonesia
10	Dr. Kurniatun Hairiah	Brawijaya University, Malang, Indonesia
11	Mr. Dadang Hilman	Ministry of State for Environment
12	Dr. Rod Holesgrove	Intl. Forest Section, Dept. the Environ. and Heritage, Australia
13	Ms. Dana Kenney	USAID
14	Mr. Robianto Koestomo	Association of Forest Concession Holders Indonesia (APHI)
15	Mr. Gerald Kohn	Director, EcoSecurities, Australia
16	Dr. Rodel Lasco	ENFOR UPLB, Philippines
17	Dr. Ken MacDicken	Director of Research, CIFOR
18	Dr. Daniel Murdiyarso	Head, IC-SEA
19	Ms. Ariesta Ningrum	Yayasan Bina Usaha Lingkungan, Jakarta
20	Dr. Ian Noble	Director, CRC Carbon Accounting, Australia
21	Mr. Eko Purnomo	Association of Indonesian Foresters (PERSAKI), Jakarta
22	Dr. Yetti Rusli	Ministry of Forestry and Estate Crops, Indonesia
23	Ms. Wilma A. Sabado	Forest Management Bureau, Philippines
24	Dr. Bambang Hero Saharjo	Faculty of Forestry, IPB, Bogor, Indonesia
25	Mr. Johansyah Salim	Indonesian Chamber of Commerce
26	Dr. Agus P Sari	Senior Researcher, Pelangi Indonesia
27	Dr. SM Sitompul	Brawijaya University, Malang, Indonesia
28	Dr. Imelda Stuckle	Deputy Director, BIOTROP
29	Dr. Shigeto Sudo	National Inst. Agro-environmental Studies, Japan
30	Mr. Aca Sugandhy	Assistant Minister, Ministry of State for Environment
31	Mr. Dodi Supriadi	Biodiversity Foundation (KEHATI)
32	Dr. Jatna Supriatna	CI-Indonesia Programme, Jakarta
33	Mr. Radjab Tampubolon	PT Dalla Billa Sejati, Bogor
34	Mr. Daulat Tarigan	PT. RGM International Corp., Jakarta
35	Mr. Thamrin	Ministry of Trade & Industry, Indonesia
36	Dr. Soekisman Tjitrosemitro	Senior Scientist, BIOTROP

LIST OF PARTICIPANTS (CONTD.)

No	Name	Institution
37	Ms. Corry Triwahyuningsih	Forest Resources Develop. Centre, PERHUTANI
38	Dr. Roberto G. Visco	ENFOR UPLB, Philippines
39	Mr. Warsito	PT Mitra Rimba Lestari, Jakarta
40	Dr. Upik R. Wasrin	Faculty of Forestry, IPB, Bogor, Indonesia
41	Dr. Merrilyn Wasson	Australian National University, Australia