102

oppdragsmelding

Ecostrategies for terrestrial CO_2-fixation in Indonesia

Subproject "Scenarios for environmentally sound forest management" Annual report Contribution 1991 and working plan 1992

Arvid Lillethun

NINA

NORSK INSTITUTT FOR NATURFORSKNING

Ecostrategies for terrestrial CO_2-fixation in Indonesia

Subproject "Scenarios for environmentally sound forest management" Annual report Contribution 1991 and working plan 1992

Arvid Lillethun

NORSK INSTITUTT FOR NATURFORSKNING

Lillethun, A. 1991. Ecostrategies for terrestrial CO_2-fixation in Indonesia. Subproject "Scenarios for environmentally sound forest management". Annual report. Contribution 1991 and working plan 1992. - NINA Oppdragsmelding 102: 1-17.

ISSN 0802-413
ISBN 82-426-0185-2

Classification of the publication:
Land use management

Editors:
Eli Fremstad, Synnøve Flø Vanvik

Edition: 40

Adress:
NINA
Tungasletta 2
N-7005 Trondheim, Norway
Tlf.: +47-7-580500
Fax.: +47-7-915433

Abstract

Lillethun, A. 1992. Ecostrategies for terrestrial CO_2-fixation in Indonesia. Subproject "Scenarios for environmentally sound forest management". Annual report. Contribution 1991 and working plan 1992. - NINA Oppdragsmelding 102: 1-17.

The project "Ecostrategies for terrestrial CO_2-fixation in Indonesia" started up in 1991. Several institutions are involved, both in Norway and Indonesia. The report presents work done by NINA in 1991. NINA's contribution is on description and environmental assessment of selected management strategies in rain forest areas and grasslands. The report gives and overview of the initial selection prossess and describes the forest management strategies chosen. The text includes a brief literature review of major environmental problems occuring in rain forests and grasslands in Indonesia. At last, the report presents a framework for how to organize further analyses, to be carried out in 1992.

Key words: Indonesia - tropical rain forest - *Imperata* grassland - climate change - sinks of greenhouse gases - carbon sequestration - environmental assessment.

Arvid Lillethun, Department of Geography, University of Trondheim, N-7055 Dragvoll, Norway.

Referat

Lillethun, A. 1992. Miljøstrategier for terrestrisk binding av CO_2 i Indonesia. Delprosjekt "Scenarier for miljømessig forsvarlig skogforvaltning". Årsrapport. Bidrag i 1991 og arbeidsplan for 1992. - NINA Oppdragsmelding 102: 1-17.

Prosjektet "Miljøstrategier for terrestrisk binding av CO_2 i Indonesia" ble igangsatt i 1991. Flere institusjoner er involvert, både i Norge og i Indonesia. Rapporten presenterer arbeid som har blitt utført av NINA i 1991. Dette inkluderer organisering av arbeid for å beskrive og vurdere ulike typer skjøtsel i regnskog og områder med sekundær grasmark. Rapporten gir en beskrivelse av de valgte formene for skogskjøtsel, samt de kriterier som ligger til grunn for utvalget. Teksten inkluderer en kortfattet oversikt over miljøproblemer forårsaket av skogbruk i Indonesia. Dessuten presenteres en plan for hvordan analysearbeidet bør organiseres i 1992.

Emneord: Indonesia - tropisk regnskog - drivhuseffekten - CO_2-binding - miljø-konsekvenser.

Arvid Lillethun, Geografisk institutt, Universitetet i Trondheim, 7055 Dragvoll.

Contents

1 Introduction

1.1 The project and the sub-projects

The project "Ecostrategies for terrestrial CO_2-fixation in Indonesia" has developed through the official bilateral cooperation between the Republic of Indonesia and the Kingdom of Norway in the field of environmental research and management.

The project's objective is to analyze how different kinds of forest management affect carbon sequestration. Furthermore, it aims at describing both economic and environmental costs and benefits related to each management strategy.

The project is divided into several sub-projects:

a) Scenarios for environmentally sound forest management
b) Vegetation mapping
c) Estimation of CO_2 net fixation
d) Cost analysis

The Norwegian Institute for Nature Research (NINA) is involved in the first of these sub-projects, and Mr. Arvid Lillethun is the project leader. Indonesian researchers primarily attached to the Forestry Research and Development Centre are also involved in this sub-project. The sub-projects are closely interlinked.

1.2 Terms of reference

The terms of reference are presented in the project proposal written by Directorate for Nature Management (DN), dated September 3 1991, and in contract between DN and NINA, dated October 7 1991.

"Main tasks in 1991 for this part of the project is to
- become familiar with eco-strategies concerning land and forest exploitation of Indonesian authorities and international organizations (IUCN, ITTO, FAO, UNEP)
- suggest a technically feasible way of constructing a scenario (by selecting a small heterogenous area, or one type of vegetation of definable extent)
- define scenarios for exploitation of forest and land resources
- participate on a trip to Indonesia, present project proposals, discuss proposal with Indonesian planners and researchers, and establish contact with counterparts
- propose a work plan for 1992."

1.3 Work done by NINA in 1991

The work done by NINA follows the terms of reference. Primarily the work has been to organize the research project to be carried out by other institutions, as it has been DN's aim to give much of the research work to Indonesian counterparts. It seems that the organization of the research project will be working satisfactoriy. In addition, NINA has been involved in compiling a literature review and has contributed to find a suitable framework for the analysis. The work done by NINA can be divided into 5 main parts:
- collection of material on the topic, both through library searching and direct contact with relevant international organizations
- compilation of a literature review/working paper on land use in Indonesia, and common management strategies, first of all in forest areas, but in regarding some agricultural kinds of land use
- participation in meetings in Norway and presentation of possible outlines for the study. A discussion paper on forest management and scenario selection was prepared, dated 8.10.91
- participation on trip to Indonesia with contributions as outlined. This included presentations of possible scenarios, discussions about them with Norwegian and Indonesian counterparts, making agreements upon a selection of the scenarios for further research, and organization of research work to be carried out by Indonesian counterparts
- reporting after end of trip, dated 13.11.91

Time spent on the work has been as expected (9 weeks), and the proposed time schedule has roughly been followed.

2 Collection of material

The collection of material has mainly been done in 3 ways
- search through libraries
- information given by Indonesian institutions
- contact with international institutions

FAO, IUCN and IIED were contacted concerning environmentally sound forest management strategies. In addition were relevant reports from ITTO and TROPENBOS available through other sources.

It was interesting to find that IUCN is involved in a somewhat similar project in Venezuela, where different plantation management systems are being evaluated, concerning both environmental soundness and net biomass fixation rates.

Concerning the other material it mainly presents material on forest management systems, their environmental soundness and their social consequences.

3 Selection of scenarios

Scenarios are here looked upon as future kinds of management techniques, for instance in production forest areas. The idea of presenting scenarios is to describe the future management strategies. Furthermore the scenarios help predicting necessary changes in the broader planning and governmental activities which are preconditions for the adoption of the management techniques.

3.1 Selection of administrative land units

3.1.1 The selected land classes

A high percentage of land in Indonesia is administered by the Ministry of Forestry. A rough administrative classification of this land is shown in Table 1.

Table 1 Classification of land in Indonesia (World Bank 1989).

	Area mill. ha	Forest cover, mill ha
Forest reserve and conservation forest	15	13
Protection forests (Watershed management)	24	20
Limited production forests	23	19
Regular production forests	29	23
Conversion forests/areas open for conversion to other land uses	30	19

Outside the areas administered by Ministry of Forestry we find land categories such as; wetland rice cover about 8 million ha, dryland rice, corn, cassava cover about 1.5 mill ha each, tree crop plantations such as rubber cover 2.6 mill ha, palm oil 0.5 mill ha.

Of the different land categories within land administered by Ministry of Forestry, three were selected for further research, as these are areas in which logging, planting and natural regeneration occur or could occur. Protection forest areas, reserves and conservation areas are not treated in this project. The land units included are:
1 Conversion land
2 Production forest
3 Limited production forest

Conversion land is land which has been designated for agricultural purposes. The areas are being logged before agricultural activities are established. Our interest have been in the **alang alang** grasslands which have been established both due to previous cultivation and forest fires. These occur mainly within the conversion land unit. In addition such grasslands occur in production forest areas, but their distribution has not yet been identified. The grasslands are interesting because establishment of a tree layer rapidly will affect carbon storage. Concerning production forest and limited production forest, these are land units were logging occur. We expect to find that the carbon fixation rates of the different management techniques used and proposed for these land units will vary.

3.1.2 Proposal for further work on administrative land classes

A more detailed description of these administrative units is necessary to compile as this is fundamental for the further classification, selection of scenarios, vegetation mapping and economic cost analysis. NINA has therefore proposed that a brief report should be compiled by the staff at the Forest Research and Development Centre, Bogor, Indonesia. The report should describe all administrative land classes, but emphasis should be given to the classes 1, 2, and 3 presented above, as these are the units selected for further research.

The description of each administrative class should include:

- The criteria for land classification should be presented.
- The description should include material on present and proposed use of the land.
- Main legislation and regulations for each of the classes 1 to 5 should briefly be outlined.

3.2 Selection of vegetation types

Vegetation varies greatly throughout Indonesia. MacKinnon (1991) has presented 10 major classes of original vegetation.

Mangrove
Peat swamp
Freshwater swamp
Montane rainforest
Monsoon forest
Lowland evergreen rainforest
Semi-evergreen rainforest
Forest on limestone
Heath forest
Forest on ultrabasic
Tropical pine forest
Ironwood forest

Within these units, different kinds of anthropogenic vegetation are found:

- secondary forests
- plantations
- fallow grassland
- arable land

It was initially an aim to cover all major vegetation types. This was also expressed by some of the members of the steering committee in Indonesia. It would then be possible to do an assessment of how management of different vegetation types would affect sequestering of carbon.

The detailed work to be done on assessing the environmental soundness of the management strategies and the costs and economic benefits of different alternative pathways make it very complex to handle all these types of vegetation. Even within one unit we have different formations. For example, we have differences from one geographical area to the next, the dipterocarp evergreen rain forests in the western parts of Indonesia, while non-dipterocarp lowland forests on Irian Jaya. Furthermore, there are variations according to location in terrain, from hill dipterocarp to forests on valley bottoms or alluvium. For many of the different formations the options for use varies, and special forestry management systems are needed. In addition to the broad variety of vegetation types also the variations within on unit makes the picture very complex.

Therefore, due to both time limits and availability of production and environmental data, it was agreed upon that only some or one vegetation type should be studied in this project. A guideline for choosing these vegetation units were, of course, their possible importance in fixing carbon, and thus their stabilizing effects on CO_2 levels in the atmosphere.

- lowland evergreen rain forest
- alang-alang (*Imperata cylindrica*) grasslands

3.3 Selection of land and forest management techniques

The selected management systems are partly common practices carried out on land administered by Ministry of Forestry, and partly management systems which are found in trial and research plots. The management practices differ, and include both conservation, natural regeneration, and plantation establishment. Concerning plantations, both mono- and poly-culture systems are to be treated. Management systems and species composition implying both short and longer rotational cycles are included. Furthermore, only management techniques which are relevant to grasslands and lowland evergreen rain forests are included.

1 Conversion land (30.5 mill ha.)

1.1 Grassland (alang-alang)

alt 1 Plantation, *Pinus*, (10 & 25-30 yrs)*
alt 2 Plantation, *Pinus* (30 yrs) & *Acacia*, *Leucaena*, *Eucalyptus* or others (10 yrs)
alt 3 Plantation, longer rotational cycle, monocult. *Shorea* (50 yrs)
alt 4 Clear felling, plantation, long rotational cycle, monocult. Ebony (80 yrs)
alt 5 Secondary forest development on grassland, resulting from management reducing fire frequencies
alt 6 Permanent grassland, present situation continues, no deliberate management carried out

1.2 Other types of conversion land are not treated: secondary forest, rice fields, etc.

2 Production forest (33.9 mill ha)

2.1 Lowland evergreen rain forest with more than 20 m^3/ha commercial trees

alt 1 Selective felling (50 cm), natural regeneration, enrichment planting if needed (35 yrs)
alt 2 Leave forest unlogged

2.2 Lowland evergreen rain forest with less than 20 m^3/ha commercial trees

alt 1 Clear felling, plantation, monocult. *Pinus* (25-30 yrs) (20% of area with other species)
alt 2 Clear felling, plantations, *Pinus* (30 yrs) combined with one of the species *Acacia*, *Leucaena*, *Eucalyptus* or others (10 yrs)
alt 3 Clear felling, plantation, longer rotational cycle, monocult. *Shorea* (50 yrs)
alt 4 Clear felling, plantation, long rotational cycle, monocult. Ebony (80 yrs)
alt 5 Leave forest unlogged

2.3 Other vegetation types within production forest not treated

3 Limited production forest (30.5 mill ha)

3.1 Lowland evergreen rain forest

alt 1 Selective felling (60 yrs), natural regeneration, enrichment planting if necessary (35 yrs)
alt 2 Leave forest unlogged

3.2 Other vegetation types within limited production forest not treated

* (x yrs) = length of rotational cycle

3.4 The criterion of environmental soundness of the scenarios

The selected management techniques should, according to the project proposal prepared by DN (dated 3.9.91), be sustainable. This, however, is not possible to evaluate in the selection phase of the project, due to two main reasons:

- The sustainability criterion has not been defined.
- A sustainability assessment of a management technique have to be carried out by taking into account a series of sub-criteria. To evaluate a whole range of techniques before doing the selection was not possible within the time limits given.

The selection, therefore, was not based on an evaluation of the environmental soundness. It was practical to select forest management techniques which are well known and where quantitative data exist on total biomass, environmental problems etc.

This was also acceptable to the administrative personnel in Indonesia. The term eco-strategy should therefore not be applied to cover all the management systems selected and presented underneath.

There will, however, be carried out an environmental assessment of the management strategies in 1992. Hopefully this work will show that some of the strategies are ecologically sound or even sustainable. NINA has presented a set of sub-criteria to be used in the assessment.

The time of the rotational cycles vary from one scenario to another. Some of the management systems have 80-year cycles, others very short cycles of one or a few years. When assessing the sustainability of the different management systems, a time frame of several rotational cycles would be appropriate. However, empirical material on how the management systems with long rotational periods affect the physical environment and ecological processes only exist for systems which have been practiced for 1 rotational cycle or even less. When examining the sustainability of the different techniques the validity of the empirical material therefore has to be taken into account.

In order to find which management techniques should be studied, it was discussed which administrative areas should be given focus, which vegetation types should be given focus and at last the management techniques and species composition which should be analyzed.

4 Description of common forest management systems

In order to carry out the detailed work on environmental assessment of the management systems, estimation of CO_2 net fixation, and the estimation of cost-effectiveness of the different systems, it is necessary to have a description of the selected management systems.

4.1 Major management systems - a review

Here I will give a brief presentation of some of the major management systems applied in Indonesia, which are of the ones to be given focus in this study.

Natural forest management, according to Buschbacher (1990) has been defined as "controlled and regulated harvesting, combined with silvicultural and protective measures, to sustain or increase the commercial value of subsequent stands, all relying on natural regeneration of native species". Compared to plantations and agroforestry, natural forest management systems are less intensive with relatively low yields, but also demanding smaller capital inputs and requiring less productive land. While any timber harvesting inevitably results in simplification and loss of some biological diversity, natural forest management systems are much more similar to natural forest than either plantations or agroforestry systems.

There has been a great deal of experience with natural forest management systems in Asia. The many management systems that have been tried include shelterwood and other even-aged systems which promote regeneration by partial canopy opening; polycyclic felling systems designed to mimic the age and size distribution of natural forest; and strip clearcutting followed by natural regeneration.

Plantation systems are, on the other hand, relying on the planting of seedlings, rather than on natural regeneration. Not all systems can be put in one of these distinct categories, but combine natural regeneration and replanting. As I understand, the TPTI systems followed in Indonesia are a modified selective felling system with a smaller component of replanting included.

A partial **conservation** of production forest is a recommended management system (TPTI) even today, with conservation criteria such as limit on tree size, limit on slope to be logged, mother trees are to be left, and forest patches to be set aside. However, the regulations are commonly not followed, resulting in a more destructive forestry than planned. Even if they are being followed severe degradation often occur.

International agencies (WB, FAO, IUCN) now advocate that any primary rain forest not already cut should be conserved. This will mean that natural management and plantation establishment should be located within areas already logged. There should be drawn a boundary at the outer limit of already forested areas/secondary forests. Behind the boundary logging should not occur (Poore & Sayer 1991, 13). A modification of such a land use strategy seems likely to develop in the coming years, at least for larger areas than the coverage of conservation areas today.

However, it is not possible, or even desirable, that all tropical forest lands should remain under forest cover. There are certain legitimate demands, such as those of food production, settlement and roads, which can only be fulfilled once the original forest is removed or altered. And with the relatively high economic output from the forests, a conservation future possibly only will cover parts of the production forest. We should, however, have in mind the timescale which economic output refers to, the immediate gains or the poor recovery of forest and poor user potential in the areas after logging. Depending on if we look one ten, hundred or several hundred years ahead the economic gain of logging of primary forest will vary greatly.

Grassland areas occur in logged-over areas where frequent fire result in the development of fire-resistant vegetation cover. The alang-alang grasslands develop in such areas. The causes of fire are not clear, both the logging industry and the shifting cultivators are possibly to blame. The logged forests have more intense fires than primary forest, as they become drier and more open. The waste timber provides fuel, the lack of canopy have dried out leaves accumulated on the ground, and with fewer trees the wind speed increases.

Drought, partly occurring because of deforestation, makes the fires even more frequent and destructive. In drought situations the soil in peat forest dry up to a depth exceeding 0.5. meters.

Due to higher frequencies of forest fires it seems likely that grasslands will form stable ecosystems, not only in conversion forest areas but also in production forest areas. Grassland are interesting when planning increased CO_2-fixation, and different scenarios have therefore been included for this land category.

Rehabilitation of alang-alang land is an issue given priority in Indonesia. The rehabilitation programmes include reclamation for transmigration, expansion of agricultural land and reforestation. Forest rehabilitation may, for instance, be developed through strip or block systems as prescribed by Soerjani et al. (1983). The cleared areas are planted with species such as *Pinus merkusii*, *Eucalyptus* spp., *Albizia* spp. or *Acacia* spp., and with smaller trees and cover crops in between the tree rows. Ruthenberg (1980, 306) describes a strategy where grasslands heavily infested with *Imperata cylindrica* is converted into a plantation of oil-palms without prior ploughing. However, if such a management strategy is followed herbicides often are needed to eliminate undesired weeds.

Wu must, however, be aware that grasslands are in use also today, and that rehabilitation of alang-alang land thus may conflict with other existing and potential uses. Both Blaikie & Brookfield (1987), Conway et al. (1983, 392) and Soerjani et al. (1983) point at different existing uses, such as for roofing and carton making, medicine, fodder and paper pulp, and in addition their ecological functions. Some, therefore, claim that alang-alang should not be perceived as a weed, but as an asset to be preserved.

4.2 Proposed work on describing forest management

A part of this sub-project involves a presentation of the different forest management systems selected. The list below includes a set of aspects which should described for each of the alternatives. Indonesian researchers will carry out most of this work.

1 Brief ecosystem description in which the management system frequently is applied

2 Management practices applied; logging, thinning, poisoning, planting, fertilizer use etc.
3 Proposed rotational cycle
4 Equipment used, such as trucks, caterpillars, cables etc.
5 Percentage of total logged area which is covered non-productive land use, such as roads, storage places for logs etc.
6 Common species utilized and/or managed (main economic species)
7 Common species left (species of less significant or no economic value)

It should be added that not all of these aspects will be relevant to each of the alternative management strategies, some of them will be more relevant when describing a natural management system, others will be relevant when treating plantation establishment on grasslands.

5 General environmental assessment of forest management system

5.1 Forest management in theory - a review of environmental critique

The Indonesian selective logging system (TPTI or sometimes referred to as SLS), permits only the harvest of large trees of the target species, while trees under a certain limit are to be left. The system relies on the growth of residual stock to harvest again in 35 years. Only trees over 50 cm (in diameter) at breast height can be cut. At least 25 trees of 25-49 cm at breast height must be left intact on each hectare logged. If less than 25 trees are left, enrichment planting should take place, otherwise natural regeneration was relied upon. The cutting cycle was stipulated as 35 years, by which time the forest should, in theory, have fully recovered.

The system is applied in different areas and possibly in a variety of vegetation formations. For instance, the concession owned by GPI/Kiani Lestari (Hurst 1990,35) on East Kalimantan has been managed under the theoretically sustainable TPI Select fell system since its inception, according to Hurst. The forest was initially primary hill dipterocarp forest.

The timber extraction and forestry activity in Indonesia has frequently been criticized by environmentalists, usually referring to the destructive **practices** of timber extraction, because the management system is not followed by concession holders, thus resulting in unsustainable forestry.

The selective felling system followed in Indonesia is often claimed, **in theory**, to be sustainable or give sustainable yields. But some researchers claim that even if these **guiding principles** of the TPTI selective felling system are followed, the land use might not be sustainable or environmentally sound;

Dr. Kartawinata, head of the National Biological Institute (Hurst 1990), goes further and argues that in tropical moist forest, "no sound ecological basis for any selection system has yet been established". IIED, who has evaluated the TPTI system, concludes that this system, even if applied, has some basic weaknesses. They state: "There now appears good reason to believe that many of the assumptions

which form the basis of this system may be incorrect, e.g:

- many trees do not continue to grow or become stimulated to enhanced growth as a result of **opening up of the forest canopy** through harvesting
- scientists do not understand fully the role and effectiveness of "**mother trees**" and the need to conserve untouched areas of forest within the production forest
- It also assumes that the **forest physiology** and response to disturbance is similar throughout the forest of Indonesia, whereas, in fact, there are many different forest types. (IIED, in Hurst 1990). The different forest formations (such as peat swamp forest and hill dipterocarp forest) often may require different management systems

I will add:

- The time of the rotational cycle does not seem to be adequate for forest recovery: For instance, it can be seen a reduction in future harvest potential of main economic species. The forest both produce timber and other products. Even if about 4000 species of trees are found within Indonesia, only a few of the timber species are felled at a large scale. These tree species are not recovering sufficiently at **present recommended cycles of time**, thus reducing the future harvest potential of such species.

- **Damage of other trees**: Selective felling inevitably will affect trees surrounding the ones cut. But the damage caused by careless felling makes the selective systems look even worse. It is assumed that careful selective felling could be less destructive than the forestry done today, and thus being at least a better alternative than a continuation of todays management practices.

5.2 Forest management in practice - a review of environmental critique

Turning from the theoretical aspects of the management system, the next section presents some material on environmental problems resulting from the practiced forestry and land use.

Several systems have been presented as sustainable systems. Selective systems have and are the guiding principle in most production forestry. The different systems might be sustainable if followed strictly, but the systems have often failed up to now, due to mismanagement, control functions not operating even though legislation exist, etc. For instance, the regulations on minimum size, and the care taken in order to prevent destruction on trees not cut is often not followed. Thus, logging as currently practiced damages significant amounts of standing timber, due, in part, to the fact that the concessionaire is less interested in future values from the timber left than in immediate gain. Hurst (1990), for instance, report the following evidence that the system is not followed:

- In the early 1980s two scientists for the Weyhauser Corporation studied nine concessions in East Kalimantan and noted that, none was leaving the **required 25 selected crop trees/ha** and indeed, on much of the area there were not sufficient trees at the start to comply with the regulations.

- Of Indonesia's 4000 tree species, just four; Meranti, Ramin, Keruing and Agathis, account for 75% of exports by volume. Pressure on these species is considerable and if a dense stand is found there is a great temptation to **over-cut**. In Sumatra a recent spot survey by WWF on the Padang-Sulihan reserve found that 96% of logs measured outside local timber mills were **smaller than the legal minimum**.

- The damage and waste caused by careless logging has a permanent effect on many areas, as Dr. Kartawinata recorded on one logging site in East Kalimantan: "Even in the selective logged forests, 40 years after logging, the flora still includes a large number of secondary forest species". He also noted that the commercially valuable dipterocarp species **regenerate very poorly**. For instance dipterocarp density was 12/ha in primary forest, only 1 in secondary forest.

- The Forest Research Institute in Java recently reported that on logging sites for Meranti in Sumatra up to 70% of the **non-target trees were damaged** during extraction. They also noted that 52% of those trees damaged were commercials, that is, the next crop.

- Logging in East Kalimantan is even more intense, with up to 20 trees being extracted per ha. SKEPHI report that in this state, where bulldozers are used, 50% of the **forest is totally destroyed** during selective timber extraction. One site had 70% of the forest canopy open 15 years after extraction.

- Even **logs felled are wasted.** The same SKEPHI report estimates that 50% of the logs felled never reach the sawmill. The Forestry Research Institute (FRI) estimate that more than 30% of Meranti logs felled in Sumatra have serious damage' such as cracking or other defects. Despite this 80% of these damaged, logs are dragged to the depots where they were left to rot. They estimate 5.6 million cubic meters of timber were wasted in this fashion each year throughout the 1970s.

- The reason for the little interest shown by timber companies, regarding long-term regeneration of the logged forest and care for the non-target trees, can partly be that the selective cutting policy is based on a 35-year regeneration cycle, while the lease on forest concessions is for only 20 years (Barbier et al. 1991, 57). This is a poor incentive to natural forest regeneration management, as well as for replanting.

Despite the regulations, concession holders were rarely checked to see it they conformed to the regulations. When it became clear that they were not conforming, the authorities established a charge of USD 4. - for each cubic meter of timber extracted, returnable if they stayed within the system. There was a hope that this would attract a more careful logging practice, an thus reinvestment in the industry.

It is now clear that most foreign companies regarded the charge as a direct cost rather than an incentive for reinvestment. The result of this relaxed approach by the government is that approximately 23 million hectares of Indonesian forests have been seriously damaged through timber extraction (Goodland sited in Hurst (1990). Indonesia's largest environmental group, SHEPHI, estimate the area of seriously degraded forest to be nearer to 43 million ha if transmigration sites are included.

The present trend towards plantation forestry in Indonesia has been criticized by environmental organizations. IUCN, for instance, regret that taxes on timber production from natural forests which were applied for the last couple of decades by the Indonesian authorities now are being used to support plantation forestry. The reason for their skepticism is that plantations in many cases are being established on land covered by regenerating logged-over natural forests. IUCN now advocate that any funds available for carbon sequestration should be used to protect these natural forests to allow them to regenerate naturally, rather than to clear them and replace them with plantations, as the plantations only holds few of the environmental and biological values of natural forests (Sayer, pers. comm.).

A more detailed evaluation of the sustainability and ecological soundness of the systems has been proposed.

5.3 Proposed plan for assessment of environmental soundness

For each of the alternative management strategies (listed above), a brief environmental assessment should be carried out, including several aspects outlined underneath. However, biodiversity issues will not be included this part, but defined separately.

The general assessment should include the following environmental factors/values (adapted from Poore & Sayer 1991):

a Maintenance of sustainable harvest and production
- of main economic/commercial trees
- of other trees with economic value
- harvests of fruit, gum, sap and other products
- other biological resources; animals etc.

b Maintenance of essential ecological processes
- flow and recycling of nutrients
- protection function against erosion
- stability of water flow in rivers, groundwater etc.
- effects on local climate

c Satisfaction of basic needs for forest dwellers
- legal property rights to land
- users rights to land and natural resources

6 Biodiversity assessment of forest management system

6.1 Review of some issues on biodiversity in Indonesia

Biological diversity is not only sum of species numbers, it includes the variety, variability and uniqueness of genes, species and the ecosystems where they occur. With its wide range of natural habitats, rich plant and animal resources and high number of island endemics, Indonesia is recognized as a major world centre for biodiversity.

MacKinnon (1991) starts her report on biodiversity as follows: Indonesia covers only 1.3% of the earth's surface, yet it harbours 10% of all flowering plants, 12% of the worlds mammals, 16% of the worlds reptiles and amphibians, 17% or all birds and more than 25% of all marine and freshwater fish species.

In the Indonesia's species-rich forest we find the world's greatest diversity of palms, more than 400 species of dipterocarps (the most valuable commercial timber trees in South-East Asia, and thus this genus has suffered the most amongst the tropical rain forest types) and an estimated 25.000 flowering plants (MacKinnon 1991).

Indonesia has also a rich and diverse fauna. Indonesia ranks first in the world for species richness for mammals, (515 species 36% endemic), third for reptiles (600+ species) fourth for birds (1519 species, 28% endemic), fifth for amphibians (270 species).

Lowland rainforests include some of the most important habitats from a conservation point of view since the greatest richness of species are concentrated in rainforests below 350m. In Borneo, for instance, 78% of all resident birds depend on some form of closed woodland and 244 species (61%) are confined to mixed lowland rainforests. Of these, 146 species (60%) are Sunda endemics (Wells 1985 in MacKinnon 1991). Unfortunately lowland rainforests, together with wetlands and mangroves, are among the most threatened natural habitats throughout Indonesia. All are under-represented in the protected area network (see MacKinnon 1991).

6.2 Proposed work on biodiversity assessment

As already described in section 5.3 the environmental assessment must be linked to **each** of the management strategies outlined in section 3.3. This is also the case for the biodiversity assessment. The work to be done should include an evaluation of how the management strategies:

- maintain, reduce or increase the variety of ecosystems
- affect variety of species and their distribution
- if possible also how they lead to genetic changes; genetic loss, or increased genetic variety following a certain management strategy.

It will also be of interest to get material on the economic value of biodiversity within each of the management strategies. Here we hope to benefit from material presented in the other Norwegian-Indonesian research project administered through the Ministry of Population and Environment in Indonesia.

7 Plans for 1991 and 1992

7.1 The four parts of the sub-project

This sub-project aim at presenting material on the different land categories, vegetation and forest management strategies which will be included in the study, and, furthermore, assess the environmental soundness of the management strategies which are outlined.

During the stay in Indonesia the focus of the study was discussed. Certain land categories within land administered by Ministry of Forestry, certain vegetation types, and certain management systems were selected. The formulation of this work plan is based on the selection agreed upon in Indonesia. Four tasks are to be accomplished:

A Land categories within land under Ministry of Forestry
B Description of forest management systems in question (= scenarios)
C Environmental assessment of specific management systems
D Biodiversity assessment of specific management systems

Proposals for how to organize the work, and how to structure the descriptions and analyses have been presented in the sections 3.1.2, 4.2, 5.3 and 6.2.

7.2 Methods and reporting

This sub-project will rely on secondary sources of data only. It will thus primarily be a literature review. Researchers and other staff in different institutions will be conculted for additional data.

The expected presentation from the Indonesian researchers will be in the form of short reports, written in English. NINA will be involved in commenting upon the papers. A first report will be compiled in Norway in April 1992. NINA will be involved by contributing to this "UNCED-report".

At a later stage (October 1992) a final report will be compiled in Norway, using the separate reports as input, either directly as chapters or in rewritten form, if there is a need to extract only parts of the material from the separate papers. NINA will contribute to this part by commenting upon the papers on forest management systems and environmental assessment, and produce a supplement to the contributions from Indonesia if necessary. Institutions, personnel and time schedule is shown in Appendix.

8 References

Barbier, E.B., Burgass, J.C. & Markandye, A. 1991. The economice of tropical deforestation. - Ambio 20,2: 55-58.

Blaikie, P. & Brookfield, H. 1987. Management, enterprise and politics in the development of the tropical rain forest lands. - In: Blaikie, P. & Brookfield, H. (eds.) Land degradation and society. Meuthen, London.

Buschbacher, R. 1990. Natural forest management in the humid tropics. Ecological, social and economic considerations. - Ambio 19,5: 253-258.

Conway, G.R., Manwan, I. & McCauley, D.S. 1983. The development of marginal lands in the tropics. - Nature 304,4: 392.

Hurst, P. 1990. Rainforest politics. Ecological destruction in South-East Asia. - Zed Books, London.

MacKinnon, C. 1991. Biodiversity action plan for Indonesia. Report-Annexes. - WWF (Draft).

Poore, D. & Sayer, J. 1991. The management of tropical moist forest lands. Ecological guidelines. The IUCN forest conservation programme. Second Edition. - IUCN, Cambridge.

Ruthenberg, H. 1980. The farming systems in the tropics. Third edition. - Oxford University Press, Oxford.

Soerjani, M., Eussen, H.J.J. & Tjitrosudirdjo, S. 1983. *Imperata* research and management in Indonesia. Mountain Research and Development Journal 3,4: 397-404.

World Bank (Davis, G. & Ackerman, R.) 1989. Indonesia. Forest, land and water: Issues in sustainable development. - World Bank Report 7822-IND.

Appendix

Institution, personnel and time schedule in 1992

The plans presented here were partly described in a project plan from NINA dated 13.11.91. Some information on NINA's involvement in the project need to be specified. According to a letter from the Ministry of Population and Environment in Indonesia the work will be delayed by about one month. This means that the work proposed to be done in 1991 possibly not will be prepared before early in 1992.

Indonesian personnel will do most of the work on the sub-project "scenarios". Data will be drawn from existing literature, and consultation with experts on the different topics. The Forestry Research and Development Centre, Bogor will coordinate and do most of the work, partly in 1991 and partly in 1992. However, the part on biodiversity assessment will be coordinated by the Ministry of Population and Environment. The draft reports produced by the Indonesian staff will be used, directly or indirectly, as input to the final report to be produced by the end of 1992. About 14 manweeks will be needed in total.

On the Norwegian side NINA will be responsible for dealing with the issues outlined. The work in 1992 will include follow-up of work to be carried out in Indonesia, for instance, comment upon the reports produced by the Indonesian counterparts (2 weeks). Furthermore, NINA proposes to be involved in the partial preparation of a preliminary report by the end of April 1992 (2 weeks) and of the final report by the end of October 1992 (2 weeks). This makes the total estimate of work in 1992 to 6 manweeks.

If the contributions by the Indonesian staff is seriously delayed, or the contributions do not give the expected output, NINA will be prepared to carry out some more work both on detailed descriptions of land classes and management systems, and/or on the environmental assessment parts. If NINA is to be involved in this work, an agreement should be made between DN and NINA for extending the number of manweeks proposed. Furthermore, if NINA is to be involved in the final editing of the report, it would be as an additional job to those described above. If DN is interested in such work to be done, NINA expect to receive additional funding.

Land categories

This section refers to proposal 3.1.2 above

Institutions and staff involved. The work included in part A is planned to be done by research staff at the Forestry Research and Development Centre, Bogor. The Director of the research centre, Dr. Ombo Satjapradja will decide upon who of his researchers to be involved. NINA have consulted several researchers, and will only comment upon possible cooperating partners: Responsible person part A: Mr. Ngaloken Gintings. Other staff that can be included could be Mr. Yamin Mile.

On the Norwegian side NINA will be responsible for dealing with the issues outlined for Sub-project A: Mr. Arvid Lillethun will we contact person at NINA.

Time schedule, time budget and reporting. The work should be carried out in December 1991. Amount of work: 1 week. Paper produced by the Indonesian staff to be completed by the end of December 1991.

Forest management systems

This section refers to proposal 4.2 above.

Institutions and staff involved. The work included in part B is planned to be done by research staff at the Forestry Research and Development Centre, Bogor. The Director of the research centre, Dr. Ombo Satjapradja will decide upon who of his researchers to be involved. NINA have consulted several researchers, and will only comment upon possible cooperating partners: Responsible person part B: Dr. Komar Sumarna. Other staff possible to involve could be Mr. Harun.

On the Norwegian side NINA will be responsible for dealing with the issues outlined for Sub-project A: Mr. Arvid Lillethun will we contact person at NINA.

Time schedule, time budget and reporting. The work should be carried out in December 1991 and January 1992. Amount of work: 7 weeks. Paper produced by the Indonesian staff to be completed by the end of January 1992.

General environmental assessment

This section refers to proposal 5.3. above.

Institutions and staff involved. The work included in part C is planned to be done by research staff at the Forestry Research and Development Centre, Bogor. The Director of the research centre, Dr. Ombo Satjapradja will decide upon who of his researchers to be involved. NINA have consulted several researchers, and will only comment upon possible cooperating partners: Responsible person part C: Dr. Ngaloken Gintings. Other staff that might be involved Ms. Titiek Setyowati. The staffing on this part has not been discussed in detail.

On the Norwegian side NINA will be responsible for dealing with the issues outlined for Sub-project A: Mr. Arvid Lillethun will we contact person at NINA.

Time schedule, time budget and reporting. The work should be carried out in the period January to March 1992. Amount of work: 4 weeks. Paper produced by the Indonesian staff to be completed by the end of March 1992.

Biodiversity assessment

This section refers to proposal 6.2. above.

Institutions and staff involved. It is suggested that Mr. Bambang Ariaji at the Ministry of Environment and population serves as the main contact person. He will make further contacts with other experts on this part. Researchers already connected to the Norwegian-Indonesian project "Country Study on Biological Diversity" should be involved. Thus no persons from the Forestry Research and Development Centre, Bogor will be involved in part D. It has not been possible up to present to discuss the project plan in detail.

On the Norwegian side NINA will be responsible for dealing with the issues outlined for Sub-project A: Mr. Arvid Lillethun will we contact person at NINA.

Time schedule, time budget and reporting. The work should be carried out in the period January to March 1992. Amount of work: 2 weeks. Paper produced by the Indonesian staff to be completed by the end of March 1992.

102

nina oppdrags-melding

ISSN 0802-4103
ISBN 82-426-0185-2

Norsk institutt for naturforskning
Tungasletta 2
7005 Trondheim
Tel. (07) 58 05 00