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in Indonesia**

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1. Introduction

A mixture of market and policy failures can be blamed for the excessive exploitation of forest resources currently taking place in most tropical countries. Open access situations in the absence of formal property rights and tenure as well as the existence of public environmental benefits of forest conservation (e.g. watershed protection and nutrient cycling) contribute to market failure (Barbier et al., 1992). Ecologically harmful government activities frequently exacerbate the pressure on tropical forests (Repetto, Gillis, 1988). These policy failures range from subsidized settlement programmes to the protection of domestic wood processing industries. Additionally, macroeconomic policies, such as exchange rate policies or trade policies, may have a significant indirect impact on deforestation (Capistrano, Kiker, 1990; Thiele, Wiebelt, 1994).

The present paper reviews the current policy framework in one particular tropical country, namely Indonesia, concentrating on policies which directly affect the utilization of forest resources. The basic hypothesis is that neither business as usual nor the total preservation of all remaining forest areas is an advisable strategy for the country. While the former would imply a waste of forest resources because of the prevailing market and policy failures, the latter would ignore the opportunity costs. Two examples show that a certain level of forest utilization may be indispensable for Indonesia: First, wood manufacturing as the second-largest source of foreign exchange earnings after oil and natural gas can hardly be substituted. Second, some transmigration to the Outer Islands seems to be the only solution to ease population pressure on the overpopulated Inner Islands. Hence, the policy recommendations outlined in the paper have the objective to reach a compromise between forest exploitation and conservation.

The remainder of the paper proceeds as follows. Section 2 provides a short overview of the extent and the sources of the exploitation of forest resources in Indonesia during the 1980s and deals with the general question how tropical forest areas should be allocated to the various competing uses, which are - broadly speaking - logging, land conversion and conservation. This is followed by an analysis of the specific incentives the Indonesian government provides for these three land use options. Section 3 discusses the influence of forestry policies on logging decisions; Section 4 examines the incentives for agricultural conversion; and Section 5 reviews the management of areas set aside for conservation purposes. The paper closes with a summary of the main conclusions.

2. The Use of Forest Resources in Indonesia

2.1 Deforestation and Forest Degradation

In 1990, 109.5 million hectares or 56 percent of the land area of Indonesia was covered with closed forests (FAO, 1993). This is still a large reserve but the country loses vast areas every year and there are examples, such as Côte d'Ivoire and the Philippines, where the once huge natural forests have virtually been destroyed. According to recent FAO estimates, average annual deforestation in Indonesia during the period 1982-1990 amounted to 1.35 million hectares (Table 1).¹ Forest fires and agricultural conversion are the single-most important sources, whereas other economic activities such as the exploitation of minerals and the generation of energy by hydroelectric powerplants are not significantly contributing to deforestation in Indonesia. The 1982/83 Kalimantan forest fire alone burned an area the size of Belgium (Gillis, 1988, p. 51). Most of the forest conversion to agricultural uses takes place in the form of shifting cultivation and as settlement under the auspices of the Indonesian Transmigration Programme. The establishment of new plantations of permanent crops is a less important but increasing source of deforestation.

In terms of biomass reduction, the forestry sector is almost even up with agriculture.² This is reflected in a relatively high logging intensity (up to 50 m³/ha) - especially in Kalimantan where the natural tree stands are very homogenous - and in the large areas (more than 40 million hectares) which are currently under logging concessions, although not all these areas are actually harvested (FAO, Ministry of Forestry, 1991). Moreover, logging indirectly contributes to deforestation in two further respects. First, logging operations damage the residual stands and the dead wood lying on the ground in logged-over forests facilitates the spreading of forest fires. Second, the forestry sector assists the government as a pacemaker for agricultural conversion by providing the necessary infrastructure. Taking these indirect effects into account, the responsibility of the forestry sector for the destruction of Indonesia's tropical forests is even higher than indicated by its share in biomass reduction.

¹ The recently completed Forest Resources Assessment Project 1990 by the FAO reports a somewhat lower figure of 1.2 million hectares for the period 1981-1990 (FAO, 1993), but this figure is not broken down sectorally.

² Only very few countries, e.g. Malaysia and Gabon, show a similarly high contribution of the forestry sector to the exploitation of forest resources. Summed over all major tropical countries, logging activities come up for merely about 10 percent of the whole biomass reduction (Amelung, Diehl, 1992, p. 42).

Table 1 - Deforestation and Biomass Reduction in Indonesia, 1982-1990

Sources of Deforestation ^a	Average area in ha per year
Development of estate crops such as rubber and palm oil	160 000
Transmigration and related infrastructure	300 000
Shifting cultivation	300 000
Forest fire (normal)	100 000
Influence of the Kalimantan forest fire of 1982-83 on the average of 1982-1990	378 000
Other reasons (such as spontaneous transmigration, illicit logging, mining, urban development, etc.)	77 000
Total	1 315 000
Sectoral share of biomass reduction ^b	Percent
Forestry	44
Agriculture	55
Others	1

^aOnly including the total clearance of wood. No account is taken of the degradation of the rainforest caused by selective logging of trees. - ^bThe biomass destruction by forest fires is not included. The indicator takes into account that logging removes only a part of the forest's biomass, whereas agricultural conversion removes the whole biomass (for the construction of the indicator, see Amelung, Diehl, 1992, p. 43).

Source: Amelung, Diehl (1992), FAO, Ministry of Forestry (1991).

2.2 The Land Allocation Problem

Theoretically, logging or land conversion on a specific forest area should only take place if the net benefits of exploitation outweigh the net benefits of forest conservation, taking into account all relevant costs and benefits of the various land use options. The benefits and costs of land conversion and logging can relatively easily be calculated as production tends to be for commercial markets. The benefits of forest conservation, however, are diverse and, for the most part, difficult to measure so that a bias in favor of forest exploitation is likely (Pearce, 1990). First, the standing forest has *direct use values* in terms of non-timber products³, recreation, human habitat and the habitat of a variety of species, which are a source of genetic and medicinal material. Second, the forest has *ecological values* such as watershed protection,

³ In Indonesia, the value of non-timber exports, particularly rattan, exceeded 10 percent of the value of wood exports in most years during the 1980s.

nutrient cycling and climate stabilization at the local and global level. Finally, there are *option* and *existence values* which reflect the willingness to pay to see species conserved for future use or for their intrinsic worth.⁴

In practice, the measurement problems with most of the non-marketed benefits make an optimal allocation of forest resources almost impossible. Nevertheless, severe misallocations of forest land, such as settlements on areas where the soils cannot support agricultural activities, can be avoided if a careful *land-use-planning* is carried out.⁵ In this respect, the Indonesian government has made some progress by dividing the whole forest area into four categories: forest set aside for conservation and national parks (13 %); forest intended primarily for watershed protection (21 %); production forest in which selective felling is allowed (45 %); and conversion forest (21 %) which can be converted to agriculture and other uses (World Bank, 1990). The classification is based on three criteria: slope, soil erodibility, and rainfall intensity (RePPProT, 1990). Currently, a National Forest Inventory is under way which will improve the informational basis about different wood species. While this will facilitate the identification of areas promising high returns on timber exploitation, a more broadly-based land-use-planning, which should e.g. consider the regional prospects of non-timber products and the regional distribution of biodiversity as additional criteria in order to overcome the bias against forest conservation, is still lacking.

Even if it is based on sound information, a land-use-planning can only provide a rough framework for the management of tropical forests. In order to enforce the land-use-planning and to avoid inefficiencies in the use of forest resources, the government has to rely on complementary economic incentives, which will be discussed in the following.

3. Incentives for Timber Exploitation

In Indonesia's current policy approach towards the forestry sector, the issue of sustainability competes with several other objectives, such as industrial development, generation of additional employment, regional development and foreign exchange earnings. In order to see how the Indonesian production forest can be managed more sustainably without necessarily preventing the achievement of other goals, the main instruments presently used have to be analyzed. These are: the concession policy, the forest-based industrialization policy, and the royalty system.

⁴ Since these values mainly accrue to people in the industrialized world, they have to be treated in an international approach. The same applies for global climate stabilization. This paper, however, concentrates on national policy options.

⁵ While "market-based" policies are superior to "command-and-control" policies for most environmental problems, the management of land use in frontier areas is one example where direct control via zoning regulations seems appropriate to preserve ecologically sensitive habitats from being irreversibly destroyed, because it is ecologically more effective than, for example, a tax solution (World Bank, 1992).

3.1 Concession Policy

Most timber concessions in Indonesia have a duration of 20 years; very few concessions run as long as 25 years (Gillis, 1988). They usually cover large areas, the average concession size being nearly 100,000 ha. The concessionaires have the obligation to harvest logs from tropical forests according to a selective logging system, which stipulates a 35-year harvesting cycle, an annual allowable cut for each concessionaire, and the selection of large stems with diameter of 50 cm or more. At issuance of the licence, the concessionaire has to pay a licence fee which, however, only reflects a very small portion of the value of the concession (Gray, Hadi, 1990).

The introduction of a selective logging requirement, with its underlying assumption that natural regeneration will allow sustained yield of wood products from the forest from one harvesting cycle to another, reveals Indonesia's principle commitment to sustainable forest management practices. Nevertheless, the concession policy contains some serious deficiencies.

The most obvious deficiency is that the duration of concessions falls short of the stipulated harvesting cycle. Hence, concessionaires face very weak incentives to maintain long-term productivity of the forest and to avoid logging damage to the residual stand.⁶ In many instances, they reenter a stand before the concession period ends and thereby irreversibly damage the new growing stock (Gillis, 1988). An increase in the duration of concessions to, say, 70 years (i.e. two harvesting cycles) would provide an incentive for concessionaires to move from the short-run to the long-run privately efficient harvest level by internalizing the *user costs*⁷ of forest exploitation (Barbier et al., 1992). There would be a tendency to manage the forest more carefully, i.e. to minimize logging damage, to apply some silviculture, and to practice sustained yield forestry. This tendency could be reinforced by allowing the transfer of concession rights. Steps taken to maintain the long-term productivity of the concession would then redound to the benefit of the concessionaire in the form of a higher transfer price. Since mismanagement cannot be excluded, it seems preferable to split the long-term contract into short-term contracts of say 5 years, which will automatically be renewed if the concessionaire's performance is in line with certain conditions specified in the contract. This procedure requires, however, that the government is willing and able to monitor the concessionaire's performance and to cancel the arrangement if necessary. Moreover, the criteria for renewal of concessions must be clear and stable over time in order to avoid insecurity of tenure.

⁶ Logging damage can be substantial. Gillis (1988) reports estimates that up to 60 percent of residual stems in Indonesian production forests are liable to logging damage on first entry alone.

⁷ User costs denote the foregone future returns of using a resource today.

Another important issue is the way how concessions are allocated. Currently, the Indonesian government allocates concessions between applicants in an arbitrary fashion and for not much more than a symbolic fee (Gray, Hadi, 1990). The discretionary allocation of concessions invites corruption and sometimes awards logging rights to persons without knowledge of the forest industry. The problem with low concession fees is that they create a strong incentive for loggers to acquire concessions over vast areas, more for insurance purposes or speculation than for timber harvesting. This does not only imply that public resources are lying idle but also that deforestation by shifting cultivators is encouraged, because concessionaires have little incentive to control encroachment if they have excess area (Grut et al., 1991). If adequate competition can be ensured and if the costs of gathering information on stand quality are sufficiently low, concessions should be allocated through bidding. In Indonesia, the first condition is met as there are nearly 600 concessionaires (Ministry of Forestry, 1991), and the second condition will at the latest be met after completion of the National Forest Inventory. Competitive bidding has the advantage that concession areas are allocated to those applicants to whom they are most valuable and that the resulting fees are high enough to avoid speculative land acquisition. It thus reduces the overall area under concessions and leaves land for conservation purposes which would otherwise be at risk of being cleared by shifting cultivators. This does not necessarily reduce the harvested timber volume, because it simply prevents loggers from letting land lying idle. Hence, the objectives of securing employment, regional development and foreign exchange earnings are not hurt.

Even if the concessionaires are provided with secure long-term concessions, it may well turn out that clear-felling of trees or the conversion of forest areas into estate crop plantations is privately more profitable than sustainable timber harvesting. However, such a calculus ignores the *ecological costs* of forest exploitation. If the government wants these costs to be internalized, it has to rely on some sort of regulation. The selective logging regime applied in Indonesia has so far shown a poor record in terms of securing the regeneration of forest areas, particularly because of logging damage and relogging before the end of the harvesting cycle. As argued before, logging damage and premature reentry can substantially be reduced under long-term and transferable logging concessions on a roll-over basis. An additional means of limiting premature reentry is to reform the royalty system in such a way that "high-grading", i.e. harvesting only best species, is minimized (cf. Section 3.3).⁸ Backed up by the right

⁸ The argument is that premature reentry occurs for two main reasons: first, to harvest stems that fall short of minimum diameter at first logging, and second, to harvest stems of lower quality bypassed earlier due to high-grading (Gillis, 1988). Because of low natural growth only a few trees would attain the minimum diameter after say 10 years, i.e. the selective logging requirement alone does not provide a strong incentive for relogging. Hence, discouraging high-grading would make relogging much less attractive.

incentives, which would also include incentives for reforestation and silvicultural treatment, the selective logging system is likely to prove more successful in maintaining at least parts of the environmental services of the forest.

3.2 Forest-based Industrialization Policy

Indonesia is probably the tropical country which has most aggressively promoted the establishment of a domestic forest industry (Arnold, 1990). Starting in 1980, log export quotas were progressively tightened, until an outright ban was introduced in 1985. Likewise, exports of rattan, Indonesia's single-most important non-wood forest product, were gradually banned in 1986 (raw rattan) and 1988 (semi-processed rattan). A nearly prohibitive export tax on rough and semi-processed sawnwood followed in 1989.

By sharply depressing log prices, the log export restrictions provided irresistible signals for investment in sawmills and plywood mills.⁹ As a consequence, Indonesia soon became a major producer of sawnwood and plywood, and the world's largest plywood exporter. However, the rapid development of the forest industry was bought at heavy costs. First, the effective protection granted to the wood processing industry has led to major operational inefficiencies and thus to a loss of potential timber rent.¹⁰ Gillis (1988) has estimated that this loss amounted to US\$ 545 million over 1979-82. Inefficiently operating mills also prevented the creation of substantial additional domestic value added via processing. In sawmilling, domestic value added at world market prices was even negative in some years during the 1980s (*ibid.*). Second, there was a significant cost in terms of foregone export earnings, at least in the short run before exports of processed wood could fully penetrate world markets. For 1981-86, cumulative losses of US\$ 1.9-3.1 billion have been reported (Lindsay, 1989).

Apart from promoting forest-based industrialization, export restrictions were also intended to contribute to the conservation of forest resources (Arnold, 1990). Initially, the shift to processing of timber actually slowed down timber harvesting from a peak of 25 million m³ in 1979 to 14 million m³ in 1982. However, harvests soon recovered to pre-ban levels as milling capacities increased. In the long-term, the inefficiencies and the rapidly expanding capacity of domestic processing are expected to cause more timber extraction than in the no-intervention case (Barbier et al., 1992). Moreover, the provision of cheap log inputs has brought about that Indonesia's average conversion rates for sawnwood (1.8 m³ log input per m³ output) and plywood (2.3 m³ log input per m³ output) are among the lowest in Asia (Repetto, 1988). If the

⁹ In the same vein, the sawnwood export tax and the ban of rattan exports are now causing an expansion of the furniture industry. As this development is not yet completed and as the effects are supposed to be similar to those of the log export ban, it will not be evaluated here.

¹⁰ The timber rent, or stumpage value, of a standing tree is the difference between the market value of timber and all logging, transportation, and processing costs.

Indonesian sawmills and plywood mills operated at the world technological frontier, approximately 10 percent less logs would be needed annually to produce a given level of plywood and sawnwood (Braga, 1992).

In sum, the overly generous incentives for domestic processing have resulted in both economic losses and a waste of forest resources. In order to increase efficiency in the Indonesian forest industry, the trade restrictions have to be relaxed. Some authors (e.g. Grut et al., 1991) argue that an export tax for logs at a moderate rate of say 10 percent can be justified on economic grounds as a second-best solution in view of the tariff escalation prevailing in the industrial world. It has to be noted, however, that an export tax actually serves as a subsidy for the use of raw logs in local processing relative to other inputs and thus is likely to be counter-productive in terms of forest conservation. If any further promotion of wood processing is regarded as necessary at all, a production subsidy or a subsidy for log-saving processing technology are superior instruments.

3.3 Royalty System and Rent Capture

Properly designed forest charges which reflect the values of the forest carry the potential to encourage conservation, efficient utilization of forest resources and forest renewal (Grut et al., 1991). The present revenue system in Indonesia consists of 6 different forest charges (Gray, Hadi, 1990)¹¹:

1. A *forest concession licence fee*, paid only once at issuance of the concession licence.
2. A *land and improvement tax*, applied annually to the area of the concession outside the planned cutting area.
3. A *forest products royalty*, based on the measured volume of processed products (sawnwood, plywood, etc.). The rates, revised every six months, are based on 6 percent of average domestic log prices.
4. *Scaling and grading fees*, charged on the volume of processed wood products. A small part of the fee is paid to the scalers and graders.
5. A *reforestation fee*, charged on the timber cut on concessions, based on scaled log volumes.
6. An *ad valorem sawnwood export tax*, with higher rates for rough than for semi-processed sawnwood.

¹¹ This revenue system only applies to natural forests. For plantation forests there is a separate revenue system which will not be analyzed here.

Currently, the bulk of forest revenues (more than 90 percent) is collected from volume-based charges, i.e. the forest products royalty, the scaling and grading fee, and the reforestation fee. This dominance of volume-based charges is characteristic of the forest revenue system in most tropical countries. By contrast, area-based charges, i.e. the licence fee and the land tax, are no significant revenue sources. In 1989, both together generated just about 3 percent of total revenues (Gray, Hadi, 1990).

Table 2 shows that, added up, the forest charges fall short of capturing the timber rents so that a profit in excess of the normal return on investment remains for the concessionaires.¹² The rent capture differs enormously depending on the quality of the species and the accessibility of the stand, because forest charges are uniform and thus do not correct for the large differences in the value of standing timber. In 1989, logging of high-valued Meranti species on favourable terrain would still have been profitable if royalties and fees were quadrupled, but even in the worst case of logging mixed species in swamps the concessionaire could expect a greater-than-normal profit.

Both the low level and the uneven structure of rent capture constitute a problem for the achievement of sustainable forest management. Low forest fees underprice timber and thus allow inefficient and wasteful logging and processing. Moreover, high potential excess profits encourage "rent seeking" activities in acquiring concessions and open the way for corruption so that the enforcement of concession agreements is endangered. The present uniform structure of forest charges provides a strong incentive to high-grade the stands and thereby increases the probability that concessionaires reenter logged-over stands prematurely.

In a reformed forest revenue system, concession fees based on competitive bidding should play a dominating role (cf. Section 3.1). They have several advantages (Grut et al., 1991). First, concession fees are easy to collect because they do not require extensive measuring of logs. Second, by putting a price on concession area, the acquisition of large unused forest areas will be discouraged. Third, if bidding is introduced, a higher share of the timber rent will be captured. Forth, allocation of concessions by bidding will reduce corruption, because excess profits are lowered and the allocation process becomes less arbitrary. Finally, offers for concessions will at least partly reflect the regional differences in logging and transportation costs as well as in species value so that incentives to high-grade are weakened.

¹² Rent capture was somewhat higher in 1990 than in 1989 because the reforestation fee was raised from US\$ 7 to US\$ 10 per m³.

Table 2 - Estimated Timber Rents and Rent Capture for Different Species and Logging Conditions (US\$/m³)

		Case 1		Case 2	
		Logging Meranti Species on easy to moderately difficult terrain		Swamp logging of mixed species	
		1989	1990	1989	1990
Average log price ¹	(1)	75.00	75.00	50.00	50.00
Total logging costs (including depreciation)	(2)	17.00	17.60	29.70	30.70
Return on investment (20 % profit per year)	(3)	4.45	4.60	2.00	2.10
Timber rent	(1)-(2)-(3)	53.55	52.80	18.30	17.20
Royalties, reforestation fee, licence fee		12.00	15.20	9.60	13.00
Percentage of value captured		22	29	52	75

¹ By taking the domestic log price as a base for the calculation of the timber rent it is implicitly assumed that the log export ban remains in place. If it was removed, international log prices would be the appropriate reference point. As international log prices are considerably higher than Indonesian domestic log prices, timber rents would then be considerably higher.

Source: Gray, Hadi (1990).

If concession fees are set at a substantial level, it is not meaningful to collect them entirely at issuance of the concession as is the current practice in Indonesia. High initial fees would prevent smaller companies from taking part in the bidding process and thus impede competition. By contrast, annual concession fees would spread the burden over time and, in addition, provide incentives for efficient concession management throughout the concession period (Grut et al., 1991). Annual concession fees may be supplemented by low initial fees which cover the governments administrative cost of reviewing and issuing a concession licence.

As a complement to concession fees, a volume-based royalty can be a tool to further discourage high-grading, provided that it is properly differentiated by species. The royalty formula in Sabah, Malaysia, provides an example for the calculation of such a volume-based royalty (Gray, Hadi, 1990). It distinguishes 10 log classes and fixes the royalties as a percentage of the respective timber rents, i.e. fob export values less logging costs and normal profit. It must be noted, however, that it is no easy task to calculate the timber rents. In

particular, logging costs are highly uncertain because of the variability in logging conditions. Moreover, differentiation among species will require sophisticated wood measurement and field supervision. The effectiveness of the royalty thus largely depends on the administrative capacity. If Indonesia retains its volume-based royalty, it should be put back from processed products to logs.¹³ This would raise log prices and thereby exert pressure to utilize logs more efficiently.

More than the concession fees and, eventually, the royalty on harvested logs is not needed to achieve a high and even rent capture as an important condition for sustainable forestry. All other charges, apart from the sawnwood export tax which should be abolished (cf. Section 3.2), could be subsumed under these two items as they are either area-based or volume-based. This simplification would reduce the administrative costs of revenue collection for the government. In order to encourage reforestation, the application of silviculture and careful logging practices, the government could earmark a certain share of the forest revenues for refunding to the concessionaires upon demonstration of satisfactory performance.

4. Incentives for Agricultural Conversion

As shown in Table 1, three kinds of agricultural activities are contributing to deforestation in Indonesia: smallholder settlement under the Transmigration Programme, estate crop development and shifting cultivation. While the government strongly and directly affects the two kinds of permanent agriculture, its impact on shifting cultivation is weaker and more indirect.

4.1 Permanent Agriculture

The major land settlement scheme in Indonesia has been the Transmigration Programme. The main objective of the programme is to move people from overcrowded areas in the Inner Islands to the less populated Outer Islands. Migrants generally receive about 2 ha of land and land titles after 5 years (World Bank, 1990). The government carries all cost of resettlement, namely the cost of transport, land, housing and start-up assistance in terms of food and means of production (Fasbender, Erbe, 1990). The overall cost of the programme is estimated at US\$ 6,000 per family. Between 1980 and 1986, the peak period of transmigration, more than 2 million people were resettled under the sponsored programme (World Bank, 1990). In addition, the infrastructure created by the government attracted spontaneous migrants in the same order of magnitude (Pearce et al., 1990). Agricultural production on transmigration sites has traditionally been dominated by low-input cultivation of food crops, especially rice,

¹³ The base for the royalty was shifted from log volumes to volumes of processed product output in order to assist the forestry industry when the log export ban was introduced in 1985 (Gray, Hadi, 1990).

because the Suharto administration viewed transmigration as a means of achieving self-sufficiency in rice production (Fasbender, Erbe, 1990). Low-input production on 2 ha of land is hardly sufficient to sustain a family. Most transmigrants thus rely on additional off-farm work and some even turn to shifting cultivation. The alternative of increasing productivity is usually too costly because of the high fertilizer requirement on the low-fertility soils (World Bank, 1988). Taking the very limited economic potential of food crop production on converted forest-land on the one hand and the high direct cost of the Transmigration Programme as well as the ecological cost of deforestation on the other hand, the Indonesian government should not continue to sponsor food crop production on transmigration sites.

In mid-1986, the Transmigration Programme was curtailed in response to declining oil revenues. Moreover, the lower than expected agricultural production on transmigration sites convinced the government of the need to use the available funds primarily to upgrade the infrastructure and the production systems on existing sites. As a consequence, the number of sponsored transmigrants fell drastically, but this was accompanied by a significant increase in the number of spontaneous migrants (Fasbender, Erbe, 1990). The special problem with spontaneous migrants is that they have no access to land and thus are forced to encroach upon forested land (World Bank, 1990). There are large areas of underutilized or degraded lands in the Outer Islands, but they are not available for migrants because of traditional land claims by the local population. In order to avoid accelerated clearing of forested areas by spontaneous migrants, some sort of land market has to be developed in the Outer Islands. In this context, it has to be ensured that the migrants either have access to capital for land purchase or can rent land and that purchased or rented land can be registered in order to increase security of tenure.

Since the beginning of the 1980s, the Indonesian government has increasingly sponsored the planting of tree crops like rubber, palm oil and coconuts on the Outer Islands. This initiative is not only aimed at transmigrants but also at local smallholders (World Bank, 1988). The government provides the farmers with planting material, fertilizer and extension, and the cost of these inputs is covered through credit. Recently, private estate development has also been encouraged. Smallholder net income on tree crop schemes is estimated to be twice as high as on food crop schemes (*ibid.*). Compared to food crops, tree crops also cause less soil erosion and provide a habitat for some wildlife, but they certainly support much less biodiversity than natural forests. An option to reduce the conversion of forests without foregoing tree crop production lies in the intensification of areas currently under low-intensity production (World Bank, 1990). The improvement of existing technologies carries a high potential to increase yields per hectare. The government can assist this process by providing research and extension to smallholders. Moreover, the existence of a functioning land market would permit new settlers to purchase underutilized and cleared land (see above). This would not only

reduce pressure on natural forests but also increase the economic returns of tree crop production because the high costs of infrastructure and land clearing could be avoided.

If the two objectives - intensification of tree crop production and drastic reduction of food crop production on transmigration sites - were achieved, this would probably reduce the capability of the Outer Islands to absorb additional agricultural labor from the Inner Islands. If the government nevertheless wants to sustain a high level of transmigration, it has to provide incentives for the creation of additional off-farm employment opportunities in the Outer Islands.

4.2 Shifting Cultivation

One important form of smallholder production is shifting cultivation. It is an evolutionary adaptation to low-fertility soils like those in tropical forests (World Bank, 1990). Under such production systems, forested areas are cleared and burned to take advantage of nutrients in the ash. When soil fertility declines, the area is left fallow and the forest regenerates. As long as land and population balances allow for sufficiently long fallow periods, shifting cultivation is productive and sustainable. In Indonesia, this equilibrium is heavily disturbed, because the number of shifting cultivators has steeply increased which is mainly due to three factors (Amelung, Diehl, 1992). First, some of the farmers resettled within the Transmigration Programme unofficially expand into new areas because of declining productivity on the land provided by the government. Second, spontaneous migrants who rely on agriculture for their livelihood shift from year to year, simply because they cannot obtain secure tenure to the land which they cultivate. Third, the population of indigenous people engaging in shifting cultivation is growing as a result of the increase in life expectancy. The consequence of all these factors is that shifting cultivation has become a main source of deforestation in Indonesia.

The Indonesian government has developed a number of programmes to relocate shifting cultivators from the forest (Weinstock, Sunito, 1989). Virtually all these programmes have been failures, either because the relocated farmers showed little interest in or knowledge of sedentary agriculture, or because insufficient land was provided to maintain productivity on low-fertility soils (World Bank, 1990). Certainly, relocation programmes could be improved, for example by drawing on the farmer's past experience or by demonstrating the benefits to be achieved and the means of realizing them. But the main potential to reduce deforestation by shifting cultivators lies in more indirect measures. Although shifting cultivation in Indonesia is very diverse and not exclusively poverty-related (Pearce et al., 1990), it can be assumed that it does not open up new primary forests. The pace-makers of deforestation are timber exploitation and government-sponsored settlement. Some policy reforms in these two areas,

which were already discussed in previous sections, would also reduce the pressure of shifting cultivation on tropical forests. First, timber concessionaires who are provided with secure long-term licences and who are discouraged to hold excess concession area have an incentive to prevent shifting cultivators from encroaching upon their land. Second, sponsored transmigrants who are enabled to sustain a family on their site by growing tree crops instead of rice have no incentive to turn to shifting cultivation. Third, spontaneous migrants who generally prefer to practice sedentary agriculture, would probably settle if they only had the possibility to purchase land.

5. Management of Conservation Areas

Under the assumption that the Indonesian government allows for a certain level of timber exploitation and agricultural conversion of forest areas, national parks and reserves represent the single most important means of conserving biological diversity. Indonesia is enormously rich in species. While occupying only 1.3 percent of the earth's land surface, the country is estimated to have 10 percent of the world's plant species, 12 percent of the world's mammal species, and 17 percent of the world's bird species (FAO, Ministry of Forestry, 1991). Many of these, such as about 200 of the 500 mammal species, are endemic, that is they can be found nowhere else and thus have a high genetic value.

Indonesia has set aside almost 10 percent of its land area for conservation and protection, a much larger area than so designated in most developed and developing countries (World Bank, 1990). In total, nearly 20 million ha are set aside as reserves and another 30 million ha as permanent protection forest. If policy reforms in the forestry and agricultural sector like those suggested in Sections 3 and 4 are carried out, this area can be further increased, because less production and conversion forest is needed in this case. Among the reserves, different types can be distinguished according to the activities which are allowed within their boundaries. They range from nature reserves which are almost closed to the public to hunting parks in which camping, fishing, hunting and even some growing of tree crops is permitted (FAO, Ministry of Forestry, 1991).

Although the overall size of the protected area is remarkable, there are several shortcomings in Indonesia's efforts to conserve biodiversity. The most fundamental problem is that a complete inventory of biodiversity has not yet been carried out (cf. Section 2). There is thus an insufficient informational base for deciding which particular areas deserve priority for conservation.

Furthermore, in many conservation areas, especially in the nature reserves where no economic activity is allowed for, the incentives for local people to preserve the natural habitat

and to abstain from encroachment are very weak. Illegal logging and agricultural encroachment upon protected areas are widespread phenomena. It is now well established in the literature (e.g. Welts, Brandon, 1992) that the people who are asked to forego gains by setting aside land which was previously used for production must perceive some tangible benefits from doing so. Examples of such benefits are compensation payments in cash or in kind and the provision of alternative income-earning opportunities, either outside the reserve in so-called buffer zones or inside the reserve in the conservation management, for example as rangers or as guides if tourism is permitted.

Even if conservation areas were optimally located and properly managed, there would remain the problem that they usually are too small to sustain populations of wide-ranging mammals like tigers and elephants (FAO, Ministry of Forestry, 1991). For these wide-ranging animals it is of crucial importance to manage land outside reserves in such a way as to allow them to cross between reserves. In this context, incentives for a sustainable management of forest concession areas adjacent to reserves play an important role.

Finally, the management of conservation areas in Indonesia suffers from a severe shortage of funds (World Bank, 1990). In particular, the staffs who manage the reserves are badly paid and trained so that the enforcement of protection is generally low. Since the benefits of biodiversity conservation accrue to a large extent to industrial countries, they should be willing to provide financial and technical assistance in order to support Indonesia's conservation efforts.

6. Concluding Remarks

The present paper has reviewed Indonesia's public policies affecting the rate of deforestation and forest degradation and has suggested some policy reforms for a more sustainable management of the country's tropical forests. It has concentrated on policies with a direct link to the use of forest resources, although general economic measures such as macroeconomic policies may as well have a significant indirect impact on deforestation.

As a first step, a land-use planning can serve as a framework for deciding how to allocate forest areas between different competing uses, which in Indonesia are conservation, timber exploitation and agricultural conversion. The Indonesian government carries out such a land-use planning, but it suffers from the fact that the inventory on which it is based does not cover all the important goods and services provided by the tropical forest.

A land-use planning has to be backed up by proper incentives for the activities to which the land is allocated. In this field, Indonesia can achieve several improvements. Forestry policy reforms should first and foremost guarantee secure and transferable licences for timber

concessionaires. Furthermore, the royalty system should put much more weight on concession fees. They have the advantage of discouraging concessionaires from holding excess area and thereby provide an incentive to prevent shifting cultivators from encroaching upon the concession area. Higher concession fees also lead to higher and more equal rent capture. While the former reduces the incentives for rent-seeking, the latter reduces high-grading and thus the probability of premature reentry into stands. Finally, the heavy export restrictions on logs and semi-processed wood products should be eliminated, because they are likely to cause economic losses as well as a waste of forest resources.

With respect to agricultural settlement in the Outer Islands, the government should discourage the growing of food crops, because the economic returns fall by far short of the ecological costs and the cost of transmigration. The yields of food crops on low-fertility soils are so low that an average transmigrant family can hardly be sustained and thus may be forced to turn to shifting cultivation. Tree crop development promises much higher economic returns and also carries a high potential for intensification so that the pressure on forested areas could be reduced. Spontaneous migrants who are attracted by the infrastructure created through the Transmigration Programme could be prevented from encroaching upon forested areas by establishing a land market for the underutilized and degraded areas in the Outer Islands.

Policy reforms in the forestry and agricultural sector like those suggested here do not necessarily cause economic costs. A shift from food crops to tree crops in development programmes may even have significant benefits. In any case, forest degradation and deforestation is expected to be lowered. Since less production and conversion forest is needed in this scenario, the area available for conservation increases.

A successful management of conservation areas heavily depends on the behaviour of the local people. They must be compensated for losses resulting from set asides in order to avoid encroachment. Another problem is the shortage of funds. Since the industrialized countries have an interest in the conservation of biodiversity, this seems to be an appropriate field for international support.

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