Land Use Change in Indonesia

Stefano Pagiola
Environment Department, World Bank

June 2000

This paper was prepared by as a background paper for *Indonesia: Environment and Natural Resource Management in a Time of Transition* (World Bank, 2001). It is based on an earlier draft by Derek Holmes and comments received from Jean Aden, Stephen Mink, and Jeff Vincent, but does not necessarily represent their opinions, nor those of the World Bank Group.

Tables

Figures

Abbreviations

AMDAL	Environmental Impact Assessment
APKINDO	Indonesian Plywood Association
ASB	Alternatives to Slash and Burn Program
BAPPEDA	Provincial Development Planning Board
BPN	National Land Agency
BPS	Statistics Indonesia (*Badan Pusat Statistik*)
DGEC	Directorate General for Estate Crops
DG INTAG	Directorate-General of Forest Inventory and Land Use Planning (*Direktorat Jenderal Inventorasi Tata Guna Hutan*)
GDP	Gross Domestic Product
ha	hectare
HGU	Estate concession (*hak guna usaha*)
HPH	Forestry concession rights (*hak pengusaha hutan*)
HTI	Industrial tree crop estate (*hutan tanaman industri*)
Kanwil	Provincial office of a central line agency
Kabupaten	District
m^3	cubic metre
MoFEC	Ministry of Forestry and Estate Crops
NFI	National Forest Inventory
PIR	Nucleus plasma estate (*Pola Inti Rakya*t)
RePPProT	Regional Physical Planning Programme for Transmigration
TGHK	Forest land use plan (*Tata Guna Hutan Kesepakatan*)
TPI	Indonesia selective logging system (*Tebang Pilih Tanam Indonesia*)

Land Use Change in Indonesia

1 Introduction

With an estimated loss of up to 20 million ha of forest over the past decade, deforestation in Indonesia has come to the forefront of global environmental concerns. Indonesia is one of the most important areas of tropical forests worldwide. In addition to providing a multitude of benefits locally, including both products and services, these forests are also of global importance because of their biodiversity and the carbon they sequester. Despite the benefits they provide, Indonesia's forests have been under considerable threat in past decades, and the extent of forest cover has declined considerably.

This paper takes advantage of new data on the extent and distribution of forest cover change in Indonesia (Holmes, 2000) to examine its causes and effects. The paper begins by summarizing the long-term trends in land use change in Indonesia, and the new data on loss of forest cover during the period 1985-1997. It then discusses why this land use change is likely to be undesirable in many cases. Land use change can at times be beneficial, but there are good reasons to believe that current patterns of land use change in Indonesia are in fact socially sub-optimal. The paper then reviews the incentives faced by the major actors in land use change—loggers, estate crop producers, and smallholders—and the reasons their decisions concerning land use change, while privately optimal, are likely to be socially sub-optimal. It also briefly examines the effect that the East Asian financial crisis has had on these incentives. Particular attention is paid to mangrove forests, because of their important ecological role.

Definitions. Much of the debate on deforestation has been plagued by varying and often imprecise use of terms. The term 'deforestation', for example, has been used to describe complete loss of forest cover; reduction of forest to below a given (but varying across authors) proportion of land cover; and loss of *primary* forest alone. Plantations and other managed forests may or may not be included in the definition of forest. The term is sometimes used only for permanent loss, and sometimes includes temporary loss as well. As many have noted, what definition is used matters to the results (Dick, 1991; Kummer, 1991; Angelsen, 1995; Sunderlin and Resosudarmo, 1996). Changes in natural forest cover are particularly important for biodiversity, while changes in total forest cover are more important for regulation of hydrological flows. Unfortunately, the weakness of the available data makes it very difficult to use a precise definition.

In keeping with the definitions used in the new forest cover map, the primary focus in this paper is on **changes in natural forest that can be recognized as such on satellite imagery**. As will be discussed below, this focus does entail some limitations. In particular, although the news maps shed important new light on changes in natural forest cover, they say little about the quality of the remaining natural forest and the uses to which converted forest is put, so that several important questions remain unanswered. Other sources often use different definitions, so direct comparisons of results are difficult.

2 Land Use Change in Indonesia: New Evidence

Indonesia has the world's second largest forest area, after Brazil, and accounts for about 10 percent of the world's remaining tropical forest. However, there has been considerable uncertainty about the actual extent and state of most Indonesia's forests. A recent forest map developed by the Ministry of Forestry and Estate Crops (MoFEC) provides new information on the extent of remaining natural forest cover and insights into the process of land use change in Indonesia.

In any discussion of Indonesia, an important distinction must be made between Java and the Outer Islands.[1] Practically all of Indonesia's forests are located in the outer islands. Only vestigial forest

---

[1] The 'outer islands' are generally taken to include all islands except Java, Madura, and Bali, although Nusa Tenggara Barat and Nusa Tenggara Timur are sometimes also considered 'inner islands'.

areas remain on Java and Bali, which have the highest population density in Indonesia. Most remaining forests on Java are located in the uplands and have been designated as protection forests.

2.1 Long-term Trends in Land Use Change

Concern over land use change in Indonesia is relatively recent. Until the transmigration program gained international attention in the 1980s, few were concerned about the rate of forest loss in Indonesia. As late as 1993, Indonesia still claimed a forest cover of 53 percent of land area, compared with only about 25 percent in both Thailand and the Philippines. Complacency has since turned to alarm, however, at what is perceived to be an extremely high rate of forest loss. However, although deforestation has clearly accelerated in recent years, as discussed below, forest conversion has in fact been a long-term process in Indonesia.

Traditional areas of human settlement in Indonesia have been closely related to soil fertility and the ease of producing food. The natural fertility of the volcanic soils on Java and Bali attracted substantial populations, while the lower inherent soil fertility in the 'Outer Islands' meant that population there was more limited and concentrated in areas of fertile soils, such as the central rift valley of the Barisan mountains of Sumatra, the southern and Minahasa peninsulas of Sulawesi, and the 'Spice Islands' of Maluku. These regions had already lost much of their forest cover by the end of the last century. The colonial era saw a substantial expansion of estate crops. The advent of rubber as a major source of revenue saw the process of deforestation begin in the plains of Sumatra and to a lesser extent Kalimantan. At first these developments were concentrated in the relatively more fertile and accessible areas, but they expanded from there, especially as transport links improved.

Forest conversion in recent decades. Recent decades have seen a very substantial increase in pressures on forests, and a consequent increase in the extent of forest conversion. Once limited to agroecologically favored areas, became much more generalized.

(a) **Logging.** Systematic logging of the Outer Islands took off during the 1970s. Logging also provided the access that facilitated spontaneous settlement, and logging roads replaced rivers as the main means of access into the hinterland.

(b) **Transmigration.** Transmigration became the primary engine for the new settlement of the Outer Islands, reaching its peak in the mid-1980s. In addition to its direct impact on forests, transmigration also had substantial secondary impacts through its mechanical block clearance, by additional forest conversion resulting from the failure at most sites to achieve satisfactory production levels or, conversely, by the flush of spontaneous migrants attracted by the more successful sites.

(c) **Spontaneous settlement.** Although transmigration has dominated debate, there has also been substantial amounts of 'spontaneous' settlement into forest areas both by local populations and by migrants from the more heavily populated islands. Many have seen this relentless hectare by hectare encroachment by 'pioneer farmers' along every forest boundary as a more important pressure than formal transmigration programs.

(d) **Estate crops.** The mid-1980s also saw the government commence its policy of promoting the diversification of products outside the oil and gas sector, with a strong focus on the development of tree crop plantations. In the forestry sector, the industrial tree crop estate (*hutan tanaman industri* or HTI) was originally proposed as a model to be established on degraded land, supposedly to reduce the demand for natural timbers. However, there are major establishment problems and fire risks in such terrain, and most timber estates have in fact been developed in forest concessions that have been logged out.[2] The main thrust of development in the tree crop sector, however, has been the rush to develop oil palm estates.

---

[2] Indeed all concession holders (*hak pengusaha hutan* or HPH) were at one time actively required to develop a certain proportion of their area as a fast-growing timber crop.

From around 500,000 ha in 1984, the gross area under oil palm had increased to over 1.0 million ha by 1990, to approximately 2.4 million ha in 1997, and to nearly 3.0 million ha today.

2.2 New Evidence on Forest Cover Loss

There has been considerable controversy over the extent of deforestation in Indonesia, with estimates ranging as high as 1.3 million ha per year (FAO, 1990). A 1990 World Bank study arrived at an estimate of 0.7-1.2 million ha per year (World Bank, 1990), and many have taken the mid-point of this range (about 1 million ha per year) as a reasonable estimate. In a review of the available evidence, Dick (1991), argued that many estimates of deforestation were too high because of double-counting and derived an alternative estimate of 0.6 million ha per year—much of it due to programs sponsored by the Indonesian government, including the transmigration program and forest concessions. Dick's reasoning (but not necessarily his numerical estimate) was endorsed in a later World Bank study (World Bank, 1994) and by others (for example, Angelsen, 1995).

The lack of empirical data, together with abundant local and anecdotal evidence that the rate of forest conversion had increased, led the World Bank to require that the map of nationwide forest cover be updated as a condition to a Policy Reform Structural Loan. Badan Planologi (the former DG INTAG) of the Ministry of Forestry and Estate Crops (MoFEC) has prepared this map for Sumatra, Kalimantan, Sulawesi, and Irian Jaya, while maps for Maluku are nearing completion. The maps are based on Landsat satellite imagery mainly from 1996 or later, at a scale of 1:500,000. The new forest cover map (herein referred to as the MoFEC map) provides a broad overview of the area of forest lost since a similar nationwide survey carried out in the mid-1980s (RePPProT 1990, which was based upon mid-1980s remote sensing data).[3]

In both the RePPProT and MoFEC maps, forest is defined as natural forest that can be recognized as such on satellite imagery. Thus the presence of mapped forest cover is not a statement of the quality of that forest. It often includes heavily logged-out (but not clear-cut) forest and fire-damaged forest, as well as some areas of mature agro-forestry. However, plantation tree crops, including timber estates, would not be mapped as forest.[4]

Natural Forest Loss

Table 1 summarizes the loss of natural forest in Sumatra, Kalimantan, Sulawesi, and Irian Jaya over the twelve years between 1985 and 1997 obtained by comparing the RePPProT map for 1985 and the MoFEC map for 1997.[5] Over 19 million ha of forest have been lost from this region over the period, including 6.7 million ha in Sumatra and 8.5 million ha in Kalimantan. This amounts to an average annual rate in the two islands of 1.26 million ha per year. As would be expected, in view of the province's undeveloped infrastructure and human resources, the rate of deforestation in Irian Jaya is lower. Deforestation has been most extreme in those provinces that still carried extensive forests on the acid

---

3 The Ministry of Forestry also collected data on forest cover in the early 1990s under its National Forest Inventory (NFI) program, with the assistance of FAO. Aside from providing a shorter period for comparison than the RePPProT map, the NFI also used a different definition of forest that incorporates bush and scrub.

4 There are some gray areas, such as areas of extreme logging or serious fire damage, and areas of mature agroforest or older jungle rubber – such as commonly occur in the hills of Sumatra – where arbitrary decisions were necessary. Areas of extreme fire damage were generally mapped as non-forest. Agroforests were classified based on field knowledge. Other gray areas include the teak and mahogany plantations of Java, which in some cases might resemble 'natural' forest on satellite photographs, and the savanna forests of Nusatenggara and East Java, but these cases do not concern us here, as the analysis focuses on forest loss of the Outer Islands.

5 The slight differences in estimated areas for each Province appear to be due to use of different sources for mapped boundaries, and by differences in technology (RePPProT did not have access to digital methods for area measurement, and thus used techniques such as use of planimetres and dot counting).

peneplain soils that were suitable for large-scale conversion to plantation crops: Riau, Jambi, South Sumatra, and West, Central and East Kalimantan. The average annual deforestation rate nationwide over the twelve years is now generally assumed to be about 1.7 million ha.

Table 1. Change in Natural Forest Cover, ca 1985-1997

	RePPProT (1985)			*MoFEC (1997)*				*RePPProT - MoFEC*		
	Total area	*Forest area*		*Total area*	*Forest area*		*No data*	*Forest loss*		*Loss rate*
Province	*('000 ha)*	*('000 ha)*	*%*	*('000 ha)*	*('000 ha)*	*%*	*('000 ha)*	*('000 ha)*	*%*	*'000 ha/yr*
Aceh	5,675	3,882	68	5,669	3,612	64	14	270	7	23
N. Sumatra	7,250	2,812	39	7,113	1,892	27	101	920	33	77
W. Sumatra	4,169	2,590	62	4,154	1,944	47	598	646	25	54
Riau	9,860	5,937	60	9,662	5,072	52	3	865	15	72
Jambi	4,874	2,766	57	4,856	1,603	33	233	1,163	42	97
S. Sumatra	10,226	3,562	35	10,149	1,248	12	914	2,314	65	193
Bengkulu	2,090	1,127	54	2,097	900	43	0	227	20	19
Lampung	3,387	648	19	3,360	361	11	238	286	44	24
Sumatra	**47,531**	**23,324**	**49**	**47,059**	**16,632**	**35**	**2,099**	**6,691**	**29**	**558**
W. Kalimantan	14,753	8,701	59	14,546	6,713	46	244	1,988	23	166
C. Kalimantan	15,360	11,614	76	15,249	*9,900*	*65*	527	*1,714*	*15*	*143*
S. Kalimantan	3,749	1,796	48	3,704	999	27	288	797	44	66
E. Kalimantan	19,721	17,875	91	19,505	*13,900*	*71*	178	*3,975*	*22*	*331*
Kalimantan	**53,583**	**39,986**	**75**	**53,004**	***31,512***	***59***	**1,236**	***8,474***	***21***	***706***
N. Sulawesi	2,656	1,554	59	2,645	*1,300*	*49*	442	*254*	*16*	*21*
C. Sulawesi	6,033	4,359	72	6,001	*3,400*	*57*	645	*959*	*22*	*80*
S. Sulawesi	6,245	2,879	46	6,139	*2,300*	*37*	349	*579*	*20*	*48*
SE. Sulawesi	3,681	2,478	67	3,676	*2,000*	*54*	305	*478*	*19*	*40*
Sulawesi	**18,615**	**11,269**	**61**	**18,462**	***9,000***	***49***	**1,741**	***2,269***	***20***	***189***
3 Islands total	**119,729**	**74,579**	**62**	**118,526**	***57,144***	***48***	**5,076**	***17,435***	***23***	***1,453***
Maluku	7,802	6,348	81	nd	nd	nd	nd	nd	nd	nd
Irian Jaya	41,480	34,958	84	40,871	33,160	81	7,711	1,798	5	150
Java and Bali	13,820	1,346	10	nd	nd	nd	nd	nd	nd	nd
Nusatenggara	8,074	2,469	31	nd	nd	nd	nd	nd	nd	nd
Indonesia	**190,905**	**119,701**	**63**	**189,702**	***100,000***	***50***	**nd**	***19,701***	***17***	***1,642***

Notes: Time frame is approximate; actual dates of imagery used varied in each case over about three years.
Forest loss rate estimate is approximate annual forest loss assuming a 12-year period.
No data: cloud cover on MoFEC map, or no satellite imagery available. Except where mentioned below, the 'no data' area is not included in forest cover totals. In the following provinces, adjustments have been added to the area of forest cover to allow for an estimate of forest within the 'no data' zones: Central Kalimantan, East Kalimantan, North Sulawesi, Central Sulawesi, South Sulawesi, Southeast Sulawesi. *Figures in italics include these adjustments.*

Source: Holmes (2000)

The average figures mask what is believed to have been a sharply increasing rate of forest loss. Scotland, Fraser, and Jewell (1999) estimate that the rate of forest conversion of 800,000 ha/year in the 1980s increased to 1.2 million ha/year over the decade up to 1996, based on a re-analysis of data from the National Forest Inventory (NFI), and suggest that the rate since 1996 may have been over 2.0 million ha/year. If this is correct, the gross area of Indonesian forests may have fallen below 100 million ha by now. Since the 1985 and 1997 remote sensing data are the only reliable available data sources, however, this impression of accelerating deforestation cannot be confirmed at this time.[6]

[6] Forest loss rates in recent years will also have been affected by the massive fires of 1997-98, which are believed to have damaged over 4 million ha of lowland forest, mostly in Kalimantan (Fortech and others, 1999; EUFREG, 1998), and by the impact of the East Asian financial crisis (see below). To the extent that forest fires

Most forest conversion has occurred in lowland forest areas, especially in non-swampy peneplains that generally lie below about 50 masl. Assuming that present trends continue, non-swampy forests of the extreme lowlands will become effectively extinct in Sumatra by about 2005, and in Kalimantan soon after 2010. The small patches that remain will be severely degraded and non-viable both commercially and as wildlife habitat. This forest type is already almost extinct on the rather mountainous island of Sulawesi. The threat to swamp forests is less immediate, although their extinction could also follow about five years later. It is not necessary to assume that all this clearance will be deliberate, because forest fires in the next major drought may become severe in those protected areas and peat swamp forests that are now exposed to heavy logging, both sanctioned and illegal. Consequently the only lowland forests that may survive through the next decade in western Indonesia would be in those areas less susceptible to drought and fires, such as the north-western regions of Sumatra and northernmost regions of Kalimantan.

Uses of Converted Forest

Identifying the uses to which converted forest is put is at least as important as quantifying the extent of conversion. First, because the change in benefits depends on its use, and second, because it can help better identify the driving forces for conversion. Identifying the uses of converted forest is difficult, however. The MoFEC map only shows natural forest cover.[7] As there is no single institution monitoring land use outside forest areas on a systematic basis, available data must be compiled from a variety of sources (for example, MoFEC for tree crop areas, BPS for food production), often with conflicting results.

Table 2 compares the estimated forest loss with data on the development of estate crops. Out of over 17 million ha of natural forest that have been converted since the mid-1980s, it appears that less than 5 million ha have been developed by large tree-crop investors (the majority of these are oil palm estates, while soft-wood timber estates have not been developed as widely as planned). The area under new smallholder tree crops should be treated with caution, because it is not always clear whether the data refer to private smallholders or to the plasma farmers on large estate enterprises.[8] Furthermore, it must not be assumed that all tree crop areas have been developed on land converted from natural forest—some may have been developed from secondary forest, or from land which had previously been used for other forms of cultivations. This is most evident from the minus figures for the balance of cleared land in Aceh and Riau, which demonstrate that at least some land developed to tree crops in those provinces must have come from other sources. Thus, the estimate of 28 percent of 1985-97 natural forest loss being used for large-scale tree crops is an upper bound, as is the estimate of 15 percent being used for smallholder estate crops.

The remaining area, or at least 57 percent of the total area of natural forest converted during 1985-97, must have been used for other purposes, including cultivation. At least some of this land is not under any specific use—that is, areas damaged by forest fires, under secondary forest, or under *alang alang* (*imperata cylindrica*) grasslands.

Holmes (2000) estimates that about 2 million ha, or 10 percent, of deforested land has been used for timber plantations (HTI), and 2.4 million ha, or 12 percent, for estate crops (HGU), and that about 1.2 million ha, or 6 percent, has been cleared by pioneer farmers and another 2.4 million ha, or 12 percent,

---

are cyclical rather than trend phenomena, inclusion of their effect will tend to bias upward estimated deforestation rates.

7 The most recent table of land use in Indonesia based on systematic mapping was produced as part of the RePPProT study, using remote sensing data from the mid-1980s (World Bank, 1994). Efforts to produce a similar table based on data from the MoFEC map and other sources were unsuccessful.

8 ‘Plasma farmers’ are smallholders tied to a nucleus estate, or PIR.

developed by small investors.[9] A further 1.7 million ha, or 9 percent, has been seriously damaged by fire. He concludes, therefore, that as much as half of the cleared forest land is presently lying more or less idle. He stresses, however, that many of these estimates—particularly regarding the area cleared by smallholders—are based on very rough back-of-the-envelope calculations.

Table 2. Forest Conversion and Development of Estate Crops

('000 ha)

				Development of estate crops					
				Large investors					
Province	*Total area*	*Forest (1997)*	*Forest loss, 1985-97*	*HTI*	*Oil palm*	*HTI+HGU*[1]	*Smallholder estate crops*	*Total tree crops*	*Balance of cleared land*
Di Aceh	5,673	3,612	270	82	174	280	154	434	-164
N. Sumatra	7,250	1,892	920	100	225	360	137	497	423
W. Sumatra	4,169	1,944	646	11	133	165	87	252	394
Riau	9,860	5,072	865	292	566	950	442	1,392	-527
Jambi	4,874	1,603	1,163	99	236	360	256	616	547
S. Sumatra	10,226	1,248	2,314	253	303	590	323	913	1,401
Bengkulu	2,090	900	227	2	57	80	68	148	79
Lampung	3,387	361	286	54	57	138	128	266	20
Sumatra	**47,530**	**16,632**	**6,691**	**893**	**1,751**	**2,923**	**1,595**	**4,518**	**2,174**
W. Kalimantan	14,753	6,713	1,988	149	266	470	215	685	1,303
C. Kalimantan	15,360	9,900	1,714	102	110	260	105	365	1,349
S. Kalimantan	3,748	999	797	208	94	330	47	377	420
E. Kalimantan	19,721	13,900	3,975	497	79	610	100	710	3,265
Kalimantan	**53,582**	**31,512**	**8,474**	**956**	**550**	**1,670**	**467**	**2,137**	**6,336**
N. Sulawesi	2,656	1,300	254	9	0	35	48	83	171
C. Sulawesi	6,033	3,400	959	29	18	60	68	128	831
SE. Sulawesi	3,681	2,300	579	28	82	130	207	337	242
S. Sulawesi	6,245	2,000	478	19	0	60	70	130	348
Sulawesi	**18,615**	**9,000**	**2,269**	**85**	**100**	**285**	**634**	**919**	**1,350**
3 Islands Total	**119,727**	**57,144**	**17,435**	**1,935**	**2,401**	**4,878**	**2,696**	**7,574**	**9,860**
% of forest loss				11	14	28	15	43	57

Notes: HTI: *Hutan tanaman industri*, commercial timber plantations; HGU: *Hak guna usaha*, estate concession.
1. This column includes all tree crop plantations, not just oil palm.

Sources: Forest cover and loss from MoFEC forest mapping, other data from DG Estates

Mangrove forest loss

The comprehensive mapping of forest cover at small scale carried out by MoFEC for the Outer Islands does not provide reliable information on conversion of mangroves, especially where the tidal zone is narrow. Various estimates have been made of total mangrove area, but only those made from remote sensing sources are considered reliable. The only such measurement was that made by RePPProT (1990) from mid-1980s sources. Table 3 compares the RePPProT estimates of mangrove area in the mid-1980s to more recent estimates for 1993 (Gieson, 1993), although the source of the latter data is not known.

9 'Small investors' generally are urban-based entrepreneurs seeking to broaden their economic base. They acquire small blocks of forest land, perhaps one or two hectares at a time, and develop them to cash crops such as coffee, rubber, cinnamon, and oil palm using hired rural labor. The land may be acquired informally, and thus may not appear in BPN statistics. Nationwide the total area developed in this way is believed to be substantial.

These data imply that one third of the total area of mangroves in the mid-1980s, or 1.3 million ha, had been cleared by 1993, which would be equivalent to over 160,000 ha per year.

Table 3. Mangrove Forest Area, 1985 and 1993

			Change in Area, 1985-1993	
	ca 1985	*1993*	*(ha)*	*(%)*
Sumatra	681,700	485,025	196,675	29
Kalimantan	1,014,200	393,450	620,750	61
Sulawesi	237,400	84,833	152,567	64
Java and Bali	34,300	19,577	14,723	43
Nusatenggara	27,500	25,300	2,200	8
Maluku	212,100	100,000	112,100	53
Irian Jaya	1,583,300	1,382,000	201,300	13
Total	**3,788,520**	**2,492,178**	**1,296,342**	**34**

Source: Mid-1980s data from RePPProT; 1993 data from Gieson (1993)

The main reason for mangrove clearance is conversion to brackish-water fishponds (*tambaks*). The area of *tambaks* is difficult to determine, because a rather small percentage of them are actually producing, and data sources often do not clearly state whether quoted figures are gross areas, or only productive *tambaks*. Although one estimate places total *tambak* area in the mid-1990s at about 167,000 ha (Wibowo and Suyatno, 1998), this is probably a substantial underestimate. An estimate of 350,000 to 400,000 ha is probably closer to the truth today. For example, East Kalimantan, has seen a massive increase, from 1,733 ha (gross) in 1984 to over 20,000 ha in 1998 (Dinas Perikanan data). Thus the total *tambak* area in East Kalimantan alone in 1998 was already well over the estimate of 9,400 ha for all of Kalimantan given by Wibowo and Suyatno. Mangrove conversion is continuing, probably at an expanding rate. There is anecdotal evidence of widespread conversion to *tambaks* in West Kalimantan during 1998, following the flight of capital out of Jakarta after the May riots of that year.

In comparison to *tambaks*, other uses for converted mangroves (logging, and industrial or urban development) are minor. However, there have been extensive small-scale operations such as harvesting for pulp, firewood, and charcoal which have also damaged mangrove forests. The latter have been particularly important on the east coast of Sumatra, for export to Singapore and Malaysia. The main commercial use for mangroves is for chip and pulp production, although there is now only one wood chip factory that is based solely on a mangrove concession (at Tarakan in East Kalimantan). The major concession granted to a Japanese company to convert the magnificent mangrove forests lining Bintuni Bay in Irian Jaya was cancelled in 1990; this is one of the best developed, most extensive and least disturbed mangrove areas in Asia.

Limitations

These new data provide important new data on deforestation in Indonesia. They are not, however, without problems.

(a) With only two observations of forest cover based on reliable data, perceptions of accelerating rates of forest loss cannot be confirmed.

(b) These new estimates are also based on a narrow definition of forest—natural forest that can be recognized as such on satellite imagery. But many forest benefits are provided—though perhaps at lower levels—by other types of forests as well, including secondary growth and plantations.

(c) The MoFEC map does not provide information on the condition of the remaining natural forest, some of which may be substantially degraded, or on the uses to which converted natural forest is being put. These are both critical points in assessing the costs and benefits of on-going land use change processes.

3 When is Land Use Change Undesirable?

That forest loss has been rapid and extensive does not in and of itself indicate that a problem exists. Forests are valuable, but alternative land uses can also be valuable. Determining whether forest conversion is undesirable thus requires comparing the total benefits provided by forests in their natural state and in their state following conversion.

3.1 Benefits of Forests

Timber. Revenue from production of timber and wood products is the most obvious benefit provided by forests. Timber has been a major driver of economic growth in past decades. In 1997, Indonesia exported about $4.7 billion worth of wood and wood products (including paper products, which have been rising rapidly in the 1990s)—about 19 percent of the total value of merchandise exports, and second only to oil and oil products (EIU, 1998). This contribution has been declining in recent years, partly due to the rapid growth of other sectors, and partly due to the depletion of forest resources. National account figures can be very misleading measures of benefits, however. First, they fail to take into account the depletion of the natural resource base (Hamilton and Clemens, 1999) and therefore overstate benefits.[10] Second, they often do not include production from illegal logging, which is extensive in Indonesia (Brown, 1999). Moreover, a variety of policy distortion have resulted in an economically inefficient timber industry, as discussed below. Unfortunately, the benefits of timber extraction have tended to be so obvious that the many other benefits provided by forests have often been completely ignored.

Non-timber products. Although forests have traditionally been seen solely as a source of timber, it has been increasingly recognized that forests provide a much broader range of benefits. In addition to timber, extractive values can include a wide variety of non-timber products (Lampietti and Dixon, 1995).

Hydrological benefits. Forested watersheds can also provide important hydrological benefits (Chomitz and Kumari, 1998; Cassells and others, 1987; Hamilton and King, 1983). A recent analysis of the value of forests in Indonesia suggests that timber and wood products account for only about one-tenth of the total value of goods and services provided by forests, with other products collected in the forest—especially fuelwood—accounting for another tenth. Of the rest, the bulk consisted of watershed protection services: regulation of streamflows, flood prevention, and prevention of sedimentation damage to downstream infrastructure (Whiteman and Fraser, 1997). Even though such estimates depend on weak data and many assumptions, they do show that timber benefits alone are only part of total benefits.[11]

Biodiversity. Indonesia is more ecologically diverse, complex, and, in some areas, unknown, than perhaps any other nation in the world. Although covering only 1.3 percent of the world's total area, it is home to 10 percent of the flowering plants, 12 percent of the mammals (ranking first in the world), 16 percent of the reptiles and amphibians (ranking third), 17 percent of the birds (fourth), and 35 percent of the fishes of the world. The forests contain an estimated 25,000 flowering plants, more than 400 species of dipterocarps, and the world's greatest diversity of palms. Indonesia also supports the world's largest areas of mangrove forest, and its extensive coral reefs are among the world's richest. This diversity is one of the republic's greatest assets, of global as well as national significance. Indonesia is one of the world's "megadiversity" countries—17 countries that account for some 60-70 percent of total global

---

[10] Estimates based on available data suggest net forest depletion in 1997 (the excess of roundwood harvest over natural growth) amounted to 0.75 percent of GDP in Indonesia (World Bank, 1999). In comparison, net forest depletion was 2.1 percent of GDP in Malaysia, 1.3 percent in the Philippines, and 0 percent in Thailand.

[11] For a state-of-the-art review of forest valuation techniques, see Bishop (1999).

biodiversity—and is included in the list of biodiversity hotspots—threatened areas with very high levels of biodiversity (Mittermeier and others, 1999).[12] Biodiversity provides benefits at many levels, not only to the global community, but also to local communities and Indonesia as a whole (Pagiola and others, 1997).

Carbon sequestration. In addition to the biodiversity they contain, Indonesia's forests are also globally important because of the carbon they sequester.[13] Peat is recognized to be a carbon 'sink' of major importance. While the volume of carbon released to the atmosphere from the burning of fossil fuels worldwide is believed to be around five billion tonnes per year, it is estimated that organic soils store 500 times this amount, with peatlands alone contributing to at least 500 billion tonnes (Maltby, 1986). Indonesia's 17 million ha of peat account for only 4 percent of the world's total peat area, but about 55 percent of tropical peatlands. In view of the great depth of some of Indonesia's peat (up to 20 m has been recorded), this is a carbon sink of global importance. The forest fires in the peat swamps of June 1997 to March 1998 are estimated to have released over 700 million tonnes of carbon dioxide, making Indonesia one of the largest sources of CO_2 emissions that year (Fortech and others, 1999).

Regional impacts. The regional importance of Indonesia's forests was dramatically illustrated by the widespread regional impact of smoke from the 1997-98 forest fires on Borneo and Sumatra (EUFREG, 1998). Much of Indonesia and its neighboring countries were blanketed by thick smoke, with substantial adverse effect for health and economic activity.

Mangroves. The environmental functions performed by mangrove forests and the tidal zones are also wide-ranging and important, like those of the tropical rainforest (Hamilton and others, 1989). A wide range of products is extracted directly from mangrove forests, including charcoal, firewood, poles for foundation piling, scaffolding, and fish traps, tannins, Nipa palm, medicinal products, and honey (Department of Forestry, 1997). More important than these direct benefits from mangrove forests is their indirect contribution to fisheries. The yield of marine shrimp fisheries is directly related to the area of nearby tidal wetlands, which are the nurseries of many species, such as the Tiger Prawn and White Prawn, and the spawning grounds of others, including milkfish, mullet, groupers, and snappers. Freshwater prawns spawn in the mangroves and the larvae then migrate upstream. Mangroves also provide protective shelter-belts against the ravages of storms and high tides.[14]

Wetlands. Wetlands in a near natural state provide many benefits. Water absorption in swamp forests reduces rapid run-off and flooding, while its slow release maintains a useful base flow during the dry season and mitigates against drying up. Backswamps along a river valley form a natural safety valve, protecting riverine settlements downstream from fast moving floods and sedimentation, and maintaining their year-round water supply. Peat can absorb up to 90 percent of its volume in water (a typical peat dome in Riau has a volume of 3-5 billion m^3, of which water would be 3.6 billion m^3). Lakes such as the *lebaks* of South Sumatra and the swamps of the Barito-Negara system of South Kalimantan play a major role in maintaining a stable hydrological balance in the rivers on which their respective provincial capitals

---

12 Following the Earth Summit in Rio de Janeiro in 1992 and the formulation of Agenda 21, the government has made a commitment to protect 10 percent of the land area and 20 million ha of coastal and marine habitats as conservation areas. The Biodiversity Action Plan for Indonesia provides the primary reference point for more detailed strategies and action plans that deal with specific biological resources. It also identifies about 80 priority terrestrial areas for conservation.

13 As an island nation, Indonesia is more vulnerable to some of the effects of global climate change, such as sea level rise, than many other nations. Although emissions from forest conversion in Indonesia contribute to this problem, other causes dominate. The effect of Indonesia's emissions on climate change is thus better understood as part of a global problem rather than a national one. In the case of biodiversity, in contrast, the share of the benefits of biodiversity enjoyed locally is much greater, although here too there is a substantial global component.

14 This function is recognized in regulations against conversion of a strip of mangrove of certain width on the seaward margin, but the regulations are frequently ignored. Generally the required strip is 135 m times the tidal range, which means a strip of at least 400 m in Riau. Mangrove islands smaller than 1,000 ha are not allowed to be cleared.

have grown up. The Danau Sentarum lake complex is able to absorb up to 25 percent of the peak flows of the Kapuas river, while in the dry season up to 50 percent of the river discharge downstream originates from the wetlands (Wibowo and Suyatno, 1998). Swamp forests and natural marshes retain a rainwater lens that acts as a barrier against saline intrusion. Downstream, tidal forests enhance the mixing of salt and river water, preventing the inward progression of saline wedges. The accretion of sediments in the tidal zone is encouraged by the presence of mangroves, which assist in stabilizing coasts against erosion and unwanted siltation in strategic zones such as harbors. The slow flow of water through wetlands allows the removal of sediments from the river as well as the removal of toxins such as heavy metals by the biota, improving the quality of potable water supplies. Wetlands can transform, fix and render harmless viruses, coliform bacteria and suspended solids normally left after secondary sewage treatment. Even the acidic peat swamps maintain clean domestic water supplies to the surrounding inhabitants. Apart from the hydrological and chemical properties of wetlands, there are also secondary products, including those typical of the lowland forests generally, with the addition of fisheries, grazing, and swamp grasses. In addition, with the progressive conversion of dry lowland forests, wetland forests become increasingly important as reserves of biodiversity, although they cannot support the full assemblage of fauna and flora found in the dryland habitats.

3.2 Effects of Forest Conversion

Conversion of natural forests to other uses can have a multitude of effects. A partial list of *possible* effects includes:

(a) Changes in the volume and mix of harvestable products.

(b) Changes in the timing, volume, and quality of run-off, causing significant changes in hydrological patterns (including both surface and groundwater).[15]

(c) Erosion and downstream sedimentation.

(d) Decreasing capacity for carbon sequestration, and direct emissions of carbon dioxide and other greenhouse gases.

(e) Reduction in biodiversity.

(f) Loss of aesthetic values and recreational opportunities.

The extent to which land use change affects the environmental services provided by forests depends on the nature of the forest and on the nature of the change in use. Even monoculture plantations can preserve at least some of the functions of primary forests, such as watershed protection.

Hydrological services. The hydrological effects of forest conversion are extremely hard to pin down. Although conventional wisdom attributes a range of hydrological effects to deforestation, these are often at odds with the results of hydrological research (Bruijnzeel, 1990; Cassells and others, 1987; Chomitz and Kumari, 1998; Hamilton and King, 1983). In particular, the widely-held belief that deforestation reduces baseflow in rivers and lowers groundwater tables appears to have little empirical basis, with the opposite result likely to be true in most cases.[16] Few studies have been carried out in Indonesia to verify or measure these effects. That deforestation can contribute to flooding appears better established.[17] Whiteman and Fraser (1997) use data on flooding in 39 river systems in 11 provinces to find that the extent of flooding increases with the loss of forest cover, once cover falls below a threshold

[15] Loss of forest cover is sometimes also thought to affect the regional climate. If true, this would also have important hydrological effects. However, there is little empirical data to show the impact of deforestation on regional climate in Southeast Asia.

[16] The main exception to this conclusion is when cloud forest is lost (Bruijnzeel, 1990; Cassells and others, 1987; Hamilton and King, 1983). The extent to which changes in forest cover in Indonesia have affected cloud forest, and the relative share of this impact in overall deforestation, remains to be studied.

[17] Most hydrological research indicates that this impact is likely to only be important at the scale of small river basins (Cassells and others, 1987). Many river basins in Indonesia are relatively small, however.

value of about 55 percent, but that both conservation and production forests contribute to reducing downstream flooding, in addition to the protection forests that are designed to do so.

Sedimentation. A standard complaint against logging is that it increases sediment loads downstream. In this case, the cause-and-effect relationships are better established, but empirical evidence on the magnitude of the effect is difficult to obtain. Time series data are rarely available to demonstrate the affect of deforestation.[18] The figure of 30-60 tons/ha/year is a generally accepted range for deforested catchments in Java. Here too, one must be careful before concluding that conversion of *natural* forest will result in high erosion rates. Although the conversion itself, with its disruption to land cover, is likely to cause a short-term spike in erosion rates[19], the long-term effects will depend on land use following conversion. When the new land use incorporates substantial ground cover, erosion rates can be very low. For example, agroforestry areas in West Java were found to have erosion rates as low as those of natural forest (Kusumandari and Mitchell, 1997).[20]

Biodiversity. Biodiversity is generally the most sensitive to forest conversion. Some land uses, such as jungle rubber, can preserve significant parts of the biodiversity of primary forest, for example (Thiollay, 1995; Tomich and others, 1998b). Conversely, sometimes even minor changes can severely disrupt biodiversity even though the forest might remain apparently intact. In addition to the direct impact of loss of habitat on the areas actually converted, there is also an extended impact on remaining adjacent forest because of edge effects and the fragmentation of remaining habitats, which may make them unviable. Because of variations in inherent levels of biodiversity and these indirect effects, the impact of forest conversion on biodiversity will depend on the specific area being converted. Magrath and others (1995), for example, show how biodiversity levels vary in different parts of West Kalimantan.

The complicated effects of land use change on biodiversity and carbon sequestration are illustrated by data collected by the Alternatives to Slash and Burn Program (ASB) in Sumatra. Detailed measurements were made on a range of land uses in a variety of agroecological conditions representative of lowland humid tropical forests (van Noordwijk and others, 1995; Tomich and others, 1998b). Figure 1 summarizes the results of carbon sequestration measurements and an index of biodiversity.[21] In both cases, there is clearly a spectrum of impacts. Variations in below-ground biodiversity were much lower than in above-ground biodiversity; even *imperata* grasslands appear to provide a healthy belowground ecosystem. It should be noted, however, that *between*-plot variation in species composition of natural forests is substantially larger than that for rubber agroforests, even though diversity *within* a given plot was similar.

Unsustainable land use. An important dimension in the costs and benefits of forest conversion concerns the sustainability of the new use. If the new use, however valuable it might be in the short term, rapidly degrades the land and eventually has to be abandoned (forcing a switch to a less desirable use, or to no use at all), then the benefits of this new use clearly have to be seen in a different light. One of the concerns underlying the escalating rates of forest conversion is the ultimate loss of soil resources through

---

18 Erosion estimates based on the widely-used Universal Soil Loss Equation (USLE) method of Wischmeier and Smith (1978) are considered unrealistic in Indonesian conditions. A method devised in Malaysia (Morgan, 1986) may give more realistic estimates. For example, in the Tulang Bawang basin of Lampung, Morgan's method estimates soil loss of around 30-60 tons/ha/year, compared to USLE estimates as high as several thousand tons/ha/year.

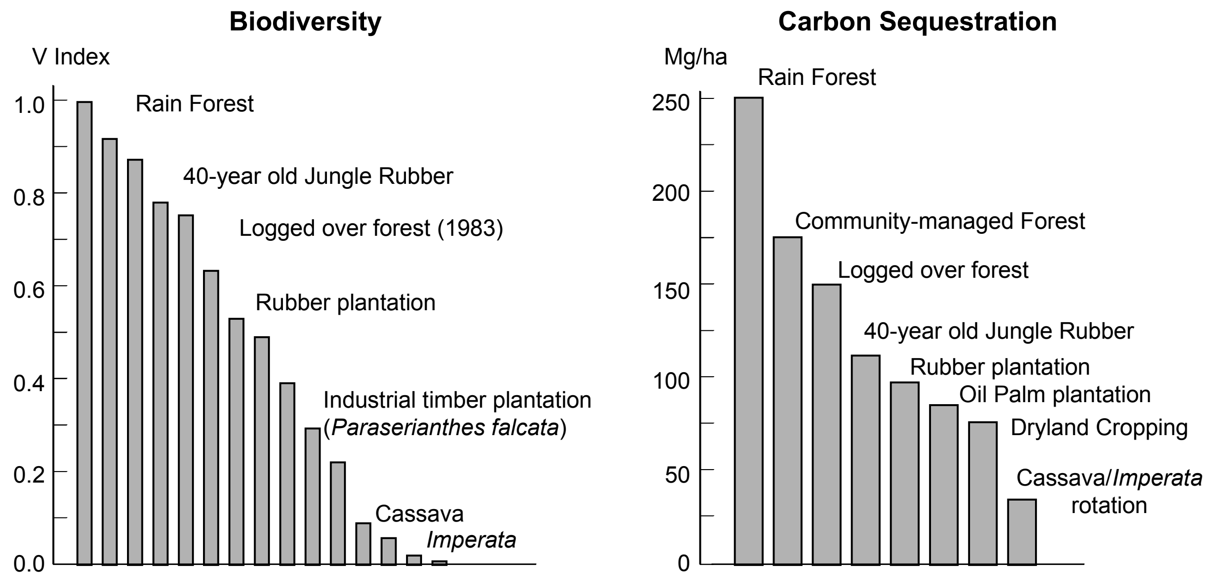
19 The magnitude of this spike will depend on the logging practices employed. With appropriate practices, the erosion resulting from logging can be substantially reduced (Hamilton and King, 1983).

20 Magrath and Arens (1989) estimate that human-induced sedimentation accounts for only a small portion of total sediment delivery, and that the direct impact of erosion on productivity is the main source of concern. See also Barbier (1990) and Nibbering (1991).

21 Measuring biodiversity remains an unsolved, and controversial, problem. The 'V index' used by the ASB is a measure of the diversity of vegetation (hence the 'V'). Other measures might have given different results, both in absolute and relative terms.

land use practices that 'mine' the soil. Most of the nutrients required for plant growth in the tropical forests are retained in circulation within the vegetation and the shallow topsoil, which is the principal basis for traditional practices of shifting cultivation. Smallholders who clear the forest today, however, often have neither the means, the knowledge, nor the incentives to either allow natural regeneration to restore the fertility, or to apply practices of conservation farming.

Figure 1. Biodiversity and carbon sequestration under different land uses in the Sumatran Peneplains



Notes: The V Index is a measure of plant biodiversity and vegetation structure
Source: Tomich and others, 1998b

These data show that conversion of natural forest can have a range of adverse effects. They also shows, however, that the consequences of conversion, although often serious, need not always be as dire as sometimes feared. Much will depend on the what use converted forest land is put to, and how it is managed. Loss of biodiversity is likely to be the most common single problem in most cases, as conversion of natural forest invariably reduces biodiversity—though not always to the same extent. Other problems may also be significant, depending on the specifics of the local situation.[22]

3.3 Net Benefits of Conversion

Deriving a national balance sheet of the benefits and costs of forest conversion is impossible at this point, partly for lack of comprehensive data on the uses to which converted forest is put, and partly for lack of data on the actual benefits of alternative land uses. Some broad conclusions are possible, however.

An important part of the benefits of conversion comes from the timber that is extracted. In some cases, this might be the only benefit. There is substantial evidence that this benefit is lower than it might be:

(a) The benefits of logging depend on the social profitability of the timber and wood products industry. In the past, however, this industry has been distorted by a wide variety of policies which make it likely that social profitability has been lower than it might have been. Barbier and others (1995) estimated that restrictions on exports of raw logs and subsidies to the sawmill industry resulted in a net loss to Indonesia of US$15/$m^3$. The benefits of logging as

[22] Similarly, Vincent and Hadi (1993) find that loss of biodiversity is the biggest cost of forest conversion in a study of deforestation and estate crops in Peninsular Malaysia.

perceived by loggers, therefore, have been much greater than the benefits actually received by society, resulting in excessive logging.

(b) The costs of logging depend in large measure on the manner in which logging is conducted. Use of appropriate logging practices can reduce environmental damage both on-site and off-site. The aim of the Indonesian Selective Logging System (*Tebang Pilih Tanam Indonesia*, or TPI) is precisely to codify such practices. Shortcomings in the rules of the system and in its enforcement mean that environmental damage from logging remains high, however (see section 4.1 below).

The costs of conversion are lower the more profitable the use to which converted land is placed. From this perspective, the estimates that substantial part of the area lost to natural forest has not been put to any productive use is cause for concern, as is the evidence that part of the cleared areas may be put to unsustainable uses.[23] This has been most clearly documented in the case of large-scale resettlement schemes, where it is now widely acknowledged that agricultural production in the cleared areas has not proven sustainable. When the post-forest use is unsustainable, society obtains few if any benefits to counter the various costs of forest conversion, making it less likely that the various environmental costs of conversion will be justified by the timber benefits alone.

Some uses of converted forest can be quite profitable. As discussed below, for example, oil palm production is highly profitable, and has become even more so following the East Asian financial crisis. The benefits of converting natural forest to oil palm, therefore, might well be sufficient, in many cases, to justify the costs of doing so, even after the environmental benefits of forests are taken into consideration. Several caveats need to be borne in mind, however.

(a) Bennett and Reynolds (1993) found that the costs of converting mangroves to oil palm in Sarawak, Malaysia, would substantially outweigh the benefits because of the ensuing damage to fisheries and tourism. In particularly valuable or sensitive areas such as mangroves or protected areas, therefore, even the high benefits of oil palm development may not justify conversion.

(b) In some cases, logging companies appear to have applied for permits for conversion with the purported objective of oil palm development primarily as a way to obtain permission for clearcutting.

(c) There appear to be substantial areas suitable for oil palm development outside the remaining areas of natural forest. By focusing oil palm development of these areas, the same benefits might be obtained at a lower social cost.

Thus, even though oil palm production may well be, in general, more valuable than continued use of a given area as forest, it is quite likely that expansion of oil palm production has been, and will continue to be, inefficient in the sense that it is not undertaken in a way that maximizes social returns and minimizes environmental damage.

That cutting down forests can result in environmental damages does not imply that forests should never be cut down. If the benefits obtained by doing so are high enough, replacing forests with another land use may be socially optimal in particular instances. In practice, however, agents making land use change decisions often do not take into consideration many of the benefits provided by forests—indeed, in many cases they only consider the timber benefits and completely ignore all other benefits. Likewise, agents making land use change decisions seldom take into consideration the costs of conversion. The effects of sedimentation or of any changes in hydrological services will be borne by downstream populations, for example, not by loggers or smallholders clearing land for agricultural use. There are good

---

[23] It should be stressed that the fact that cleared land is 'idle' is not in and of itself a problem—there may not, in fact, be any profitable use for a given area of cleared land, especially if the terrain is unfavorable and access is limited. Moreover, cleared land can still generate a variety of indirect benefits—even *alang alang* can help stabilize soils.

reasons to believe, therefore, that loss of forest is excessive. Had all the benefits provided by forests been taken into account, it is likely that less forest would be cut down. Thus, whatever the actual estimates of deforestation in Indonesia, there is almost universal agreement that current rates of deforestation are excessive, in that many important benefits provided by forests are undervalued.

4 Causes of Inefficient Land Use Change

Agents of deforestation. Deforestation does not just happen. It is individual agents who decide whether and how to change land use in a given area. The primary agents which have been blamed for deforestation[24] in Indonesia are: (i) loggers, which are said to be destructive in themselves because of the way logging is carried out, as well as facilitating the entry of cultivators; (ii) estate crop producers, who are a major user of converted forest land; and (iii) smallholder cultivators, including indigenous groups and new migrants (Sunderlin and Resosudarmo, 1996).[25]

Relative importance. There has been considerable disagreement, however, on the share of deforestation attributable to each of the agents.[26] Conventional wisdom has generally blamed small farmers practicing ‘slash-and-burn’ cultivation for a large share of deforestation. Myers (1994), for example, claims that an influx of small farmers moving into forest areas and practicing slash-and-burn cultivation (whom he calls ‘shifted’ cultivators) “accounted for 61 per cent of all forest destruction, a proportion that since 1989 appears to have been increasing steadily” (pp.32-33). In more recent years, however, the relative importance of smallholders and other causes of deforestation has been re-assessed (Sunderlin and Resosudarmo, 1996). Evidence from a number of detailed case studies tends to indicate that the impact of shifting cultivation may be much smaller than had been thought (Angelsen, 1995). Unfortunately, the MoFEC map does not provide much new evidence in this regard, since it does not show the uses to which converted forest has been put (see above).

Factors affecting agent behavior. As discussed in the previous section, individual decisionmakers generally perceive only a fraction of the benefits of maintaining forest and of the costs of conversion. When market failures are pervasive, as in this case, an important role of government is to attempt to mitigate their effects. And in fact, Indonesia has a relatively elaborate planning and regulatory system one of whose aims is precisely to attempt to offset some of the effects of market failure. As will be seen in this section, this system has largely failed to achieve this aim. Worse, various policies have tended to exacerbate the effects of market failure by further increasing the perceived benefits of forest conversion—policy failure has often compounded market failure.

This section discusses the causes of the pressures that Indonesian forests have experienced. It does so by examining the behavior of the main agents of deforestation—loggers, estate crop producers, and smallholders—and the factors which affect that behavior, with particular attention to the policy framework under which they have operated. The likely effects of the East Asian financial crisis on each group of agents

---

24 In the context of this paragraph, ‘deforestation’ refers to loss of forest cover generally, not to loss of natural forest cover alone, as most of the sources cited do not restrict themselves to the narrower definition.

25 Mining can also be a locally-important cause of deforestation (McMahon, 1999).

26 Here, too, definitions can have an important impact. Definitions of deforestation that focus on loss of natural forest cover will inevitably assign a larger role to logging than definitions which focus on loss of tree cover. Clear-cutting an area of natural forest would always be considered deforestation under the narrower definition, but it would not be considered deforestation under the broader definition if the logged area regenerated as secondary forest or was replanted as a forest plantation. Conversely, smallholder agriculture will get a larger share of the blame for deforestation under a definition that focused on loss of tree cover than under a definition that focused on loss of natural forest alone.

are also briefly examined. Considerable concern has arisen that the East Asian economic crisis would result in a further worsening of the already high pressures experienced by Indonesia's forests.[27]

4.1 Loggers

Logging has been a very important source of pressure on Indonesian forests. In 1995, 585 timber concessions covering 62 million ha (about one-third the total area of Indonesia, and roughly half its forested area, depending on the estimate of the latter) had been issued (Brown, 1999). The profitability of logging has been boosted by the very low stumpage fees charged by the government, thanks to which timber companies have been able to capture a large share of the rents from cutting down forests (Scotland, 1999). The restrictions on log exports might be thought to provide a countervailing factor, by depressing log prices to well below world market levels, but this was not a problem for Indonesia's many vertically-integrated timber companies—additional profits at the processing stage more than compensated for a lower profit in the logging stage. The artificially high profits obtainable from logging have stimulated extremely high demand for logging concessions. Ascher (1993, cited in Sunderlin and Resosudarmo, 1996) further suggests that high rates of timber extraction are partly the result of loggers eager to take advantage of low stumpage fees before they are increased.

Concern over the consequences of logging on forests are threefold:

(a) Logging practices are often thought to cause substantial damage to areas logged, affecting their ability to regenerate even in the absence of cultivators following loggers to use logged areas for cultivation.

(b) Illegal logging occurs in protected areas and/or in watershed areas.

(c) Logging facilitates the permanent conversion of forest areas to agriculture

Logging practices. Logging in Indonesia has often been thought to be inefficient and unsustainable: logging practices often cause substantial damage to areas logged. Logging practices also have a marked effect on the environmental problems associated with logging. Adverse hydrological changes, sedimentation, and nutrient outflows can all be exacerbated by inappropriate logging practices (Hamilton and King, 1983).[28] Logging in drought-prone areas also increases the risk of forest fires.

In principle, logging is supposed to conform to the Indonesian Selective Logging system (TPI), under which only trees with a diameter greater than a specified minimum are harvested. This measure is intended to allow forest regeneration.[29] The TPI also calls for use of reduced-impact logging practices, but

[27] The discussion of the impact of the East Asian financial crisis on deforestation in Indonesia is summarized from Pagiola (1999a). See that report for additional detail, as well as analysis of the crisis on deforestation in other countries in the region.

[28] See Kumari (1995) for a detailed comparison of the effects of different logging practices in peninsular Malaysia. Reduced-impact logging guideline for dipterocarp forests in Indonesia are provided by Sist and others (1998).

[29] Some silviculturalists (for example, at the Forest Research Institute of Malaysia, FRIM) question the suitability of the selective logging system for regenerating desired timber species in tropical rainforests (Jeffrey Vincent, pers. comm.). Seedlings of many of those species (for example, mahogany in the neotropics, shoreas in Southeast Asia) are shade-intolerant and regenerate best in gaps. This ecological characteristic has provided the basis for so-called 'uniform' management systems, which include strip or patch clear-cutting and shelterwood systems (in effect, phased clear-cutting). Under these systems, logging is intensive but is synchronized with trees' fruiting cycles. These systems are generally regarded as being less dysgenic than minimum-diameter systems. They may also be less demanding of forestry departments' monitoring and enforcement capabilities. They entail a focus on the timing of logging and the amount of damage to residual seedlings and saplings, which are the key to forest regeneration. In contrast, by requiring control over the specific trees that are harvested, selective systems are considerably more complicated to administer. Moreover, by leaving a substantial volume of valuable timber in the forest after the initial harvest, selective systems invite secondary, often illegal relogging, which can be devastating to recovering forests.

these are seldom used (Sist and others, 1998). Loggers are also required to reforest logged areas, but again few are believed to do so. As shown in Table 4, Rock (1999) found that most respondents in a survey of forest concessionaires in three provinces off-Java claimed to follow regulations such as selective cutting, use of low-impact logging, and replanting. But the inability of almost all respondents to even describe what these requirements are provides ample grounds for skepticism. Thus, although 84 percent of concessionaires claimed to employ low-impact logging practices, only 11 percent could define what these practices entailed.[30] MoFEC data show that some 9.5 million ha (or 16 percent) of forest concession areas have been so mismanaged as to require rehabilitation. Current logging practices are thought to be harmful even from the narrow perspective of forests as sources of timber. Brown (1999), for example, attributes low timber yields in Riau Province in Sumatra to past logging. Few estimates are available of the impact that reductions in forest areas and changes in forest quality are having on long-term timber production and the environmental services that forests provide. One attempt, by the World Resources Institute, estimated that depreciation of forest stock in Indonesia “amounted to around US$3.1 billion in 1982, or approximately 4 percent of GDP” (Repetto and others, 1989).

Table 4. Compliance with Logging Regulations by Off-Java Forest Concessionaires

Regulations	*Claim to comply with requirements (percent)*	*Able to accurately describe or define requirements (%)*
Selective cutting	81	27
Low-impact logging practices	84	11
Replanting	91	34

Notes: Based on *self-reported* data from a survey of 81 HPH forest concessions in Riau (Sumatra), East Kalimantan, and West Kalimantan

Source: Rock (1999)

A critical question concerning logging is why loggers would undertake logging practices which damage their concessions, and hence jeopardize future logging? Several factors have been identified as resulting in this state of affairs.

(a) The length of concession periods is too short for sustainable logging to be attractive to loggers.

(b) Even if concession periods in a given area were longer, the availability of old-growth forest in other areas may make re-deployment of assets to log those forests more profitable than efforts to sustainably manage the current concession. The low stumpage rates charged by the government magnify this effect.

Logging in sensitive areas. Logging can also cause damage because many of the areas logged are poorly suited to logging. Again, rules are in place to avoid this, but they have largely proved ineffective. Under the forest land-use plan first initiated in 1982 (known by the Indonesian acronym TGHK, *Tata Guna Hutan Kesepakatan*), five categories of forest land are recognized: conservation forest (reserves, national parks), protection forest (mainly for watershed protection), limited production forest (in difficult terrain), production forest, and conversion forest (available for conversion to non-forest use). 142 million ha, or 74 percent of the land area of Indonesia, was classified as forest land, under the jurisdiction of the Ministry of Forestry. However, neither accurate spatial information nor an accurate topographic map base were available at the time, so that much land classified as production forest was in fact unsuited to such

[30] The same survey also showed that concessionaires were more likely to claim to follow regulations if their compliance had been monitored in recent years. Here too, more work is needed to determine whether claims of compliance are matched by actual behavior.

use. A few years later, the RePPProT study found that the forest area was less than 120 million ha (63 percent of the area classified as forest land). This study also determined that according to the Ministry's own criteria, the area of production forest should be reduced by 50 percent and the area of conservation and protection forest should be increased by 25 percent and 55 percent respectively. Efforts have since been made to bring local spatial plans and TGHK forest status boundaries into conformance with each other and with information on actual forest cover, but progress has been uneven. Because of this lack of congruence between land use classifications and actual fragility, even perfectly legal logging operations can cause high levels of damage.

Illegal logging. Legal logging in concessions is supplemented by extensive illegal logging in other areas.[31] Brown (1999) has calculated that the entire legal timber harvest of 1994 would only have been sufficient to provide a little over half the timber necessary to feed all the country's sawmills and plymills, even assuming these were running at their minimum capacity. The balance, plus the feed requirements of the growing pulpmill sector, would have had to come from illegal logging. Growth in the number of mills since 1994 would have further increased demand for illegal timber. Aside from the increased areal impact of logging that illegal logging implies, an important concern is that such illegal logging often occurs in protection or conservation areas, and as such is particularly likely to have adverse effects on hydrological patterns and sedimentation and on biodiversity. There are some 25 sawmills operating in the neighborhood of Bukit Tigapuluh National Park in Sumatra, for example (WWF/DFID, 1998).

Impact of the financial crisis. The impact of the East Asian financial crisis on the logging industry has varied over time, with an initial adverse impact followed by a partial recovery. Devaluation tended to make wood exports more attractive, as did reductions in export barriers: the prohibitive export tax on rough sawnwood were cut to 30 percent and the ban on roundwood exports abolished; there have also been some reductions in forest taxes (Scotland, 1998). The effects of devaluation were not unambiguously favorable, however, since imported equipment became more expensive. Moreover, prices increased much less than initially expected, because of stagnant or declining demand in many of Indonesia's main export markets, which were also affected by the crisis (Flynn, 1999). Domestic demand also declined substantially, as the construction industry came to a near-standstill. Reports indicated that a large stockpile of logs accumulated in the early part of the crisis (Scotland, 1998) and that many mills were laying off employees (Sunderlin, 1998). More recently, however, export prices have recovered, in large part thanks to China's expansion of plywood imports (Sunderlin, 1998). However, exporting logs remains problematic: although the ban on exports has been lifted, new administrative barriers continue to impede log exports (Brown, 1999). Scotland (1998) estimates that financial incentives to loggers fell overall, although logging could remain profitable with appropriate cost reductions—including cuts in activities designed to reduce the environmental damage from logging. Brown (1999) believes that potential rents to timber production have increased overall now that exporting has in principle been liberalized, but that vertically-integrated timber groups have an incentive to allocate profits to their logging operations rather than mills, so as to reduce their tax burden.

Illegal logging has apparently increased in many areas, as a result of the breakdown of the government's enforcement powers. The remaining teak forests in Java appear to have been particularly hard hit. Whether the persistent anecdotal reports of increased illegal logging represent a real increase or a continuation of previous trends is difficult to ascertain without much better data than are currently available. The increased openness resulting from the on-going political changes may also be resulting in a higher level of reporting on illegal logging.

---

31 In the Indonesian context, the term 'illegal logging' is usually taken to include both logging outside concessions and logging practices that violate the terms of the concession, such as harvesting trees that do not meet the requirements of the Selective Logging System. The latter problem has already been discussed above; this paragraph is concerned primarily with logging outside concession areas.

4.2 Estate Crops

As noted in the section 2.2, the development of estate crops has been a major reason for the conversion of natural forest in the past decades, accounting for perhaps as much as a third of land converted from natural forest. Table 5 presents data on forest status and recent conversions. As of 1998, 4.3 million ha of forest land had already been agreed in principle for release. However, additional applications were pending for release of another 15.7 million ha, which would exceed the conversion area by 1 million ha. The deficit is particularly marked in Sumatra (8.5 million ha) and Kalimantan (4 million ha). In practice, however, few applications reach fruition, many being of a speculative nature or having other motives (logging being one of these). The last columns of Table 5 show that actual releases are a relatively small fraction of the area under application.

Table 5. Comparison of Forest Status and Applications for Conversion

('000 ha)

		TGHK Forest Boundaries (a)			*Agreed release of forest land*	*Requested release of forest land*	*Forest land released 1994/95-1997/98*	
Province	*Total area*	*Permanent*	*Conversion*	*Non-forest*	Izin prinsip	Permohonan	*Estates*	*Transmigration*
Aceh	5,539	3,282	848	1,409	316	1,087	151	13
N. Sumatra	7,168	3,526	254	3,387	173	1,072	31	7
W. Sumatra	4,230	2,942	438	849	162	337	57	16
Riau	9,456	4,686	(b)	4,770	1,650	4,246	480	1
Jambi	5,100	2,220	727	2,153	345	685	105	0
S. Sumatra	10,278	3,903	1,112	5,063	128	1,469	17	43
Bengkulu	1,979	978	179	822	48	134	26	15
Lampung	3,302	1,084	153	2,064	91	365	82	8
Sumatra	**47,052**	**22,621**	**2,171**	**20,517**	**2,912**	**9,396**	**949**	**103**
W. Kalimantan	14,681	7,699	1,506	5,476	257	1,265	53	13
C. Kalimantan	15,300	11,018	(b)	4,302	257	1,150	329	17
S. Kalimantan	3,700	2,030	285	1,386	257	525	93	26
E. Kalimantan	21,144	15,952	(b)	5,192	295	1,820	248	26
Kalimantan	**54,825**	**36,699**	**1,791**	**16,356**	**1,067**	**4,760**	**723**	**82**
N. Sulawesi	2,752	1,584	294	874	10	94	7	19
C. Sulawesi	6,369	4,935	242	1,192	83	305	31	18
S.E. Sulawesi	3,814	2,190	699	924	20	75	5	24
S. Sulawesi	6,293	3,356	259	2,681	108	191	41	4
Sulawesi	**19,228**	**12,065**	**1,494**	**5,671**	**220**	**665**	**84**	**65**
Maluku	8,573	5,097	(b)	3,476	26	236	4	10
Irian Jaya	41,066	28,816	11,775	474	126	591	96	41
Other	21,997	6,276	191	14,038	643	1,777	0	1
Indonesia	**192,739**	**111,575**	**18,962**	**60,532**	**4,352**	**15,650**	**1,856**	**304**

Notes: (a) Permanent forest includes TGHK production and protection forest, and conservation areas
(b) Conversion forest has not been delineated in these provinces, and is combined with non-forest land

Sources: Potter and Lee (1998), Forestry and Estate Crop Statistics of Indonesia (MoFEC, 1999)

Oil Palm. Even before the financial crisis, Indonesia had the world's lowest production costs for oil palm, estimated at about 10-25 percent below the costs in neighboring Malaysia, and about 15 percent below the world average (Potter and Lee, 1998; Casson, 1999); the financial crisis has tended to further increase Indonesia's cost advantage (see below). As a result, oil palm production has grown rapidly in recent years, expanding from 0.1 million hectares in 1967 to 2.5 million hectares in 1997 (Casson, 1999). This expansion has come at the expense of forests—although at least some of this area was degraded or logged-over forest.

Industrial timber estates. Industrial timber estates (*hutan tanaman industri* or HTI) are not included in official conversion figures, as they are still considered as forests. The total area claimed to have been developed under HTI between 1989 and 1998 was 2.4 million ha (MoFEC statistics, 1999), although Potter and Lee (1998) consider the figure closer to only 1 million ha. Originally planned to be established on degraded land, most timber plantations lie in land that has production forest status under logging concessions. In addition, many HTIs were formed out of former logging concessions (HPH), where land suitability was of little consequence in the selection (other than the ineffectual forest rating system that was supposed to have been the basis for the TGHK forest classification).

Table 6. Steps Required to Acquire an Estate Crop Concession

Step	*Responsibility*	*Comments*
Provisional reservation (*surat pencadangan prinsip*)	Kanwil	Must accord with spatial plan
Recommendation	Estate Crops Service (Kabupaten)	
Location survey (*informasi lahan*)	Kanwil	
Approval in principle (*izin prinsip*)	MoFEC	Valid one year, extendable to two
Location permit (*izin lokasi*)	BPN (Kabupaten)	Valid one year, extendable to two
Release from forest status (*izin pelapasan hutan*)	MoFEC (Central)	
Permit to harvest the timber (*izin pemanfaatan kayu*)	MoFEC (Central)	
Estate concession (*hak guna usaha*, *HGU*)	BPN (Central)	

Concessions. Acquiring concessions for estate crop development requires a complex series of steps (Table 6). In theory, these complex procedures are designed to supply a series of regulatory controls to ensure sound practice and transparency in land use planning and allocation.[32] As in the case of logging, however, the weakness of the land use planning and investment approval process has allowed estate crop development to occur in environmentally sensitive areas, such as biologically important areas or watershed protection areas—sometimes because these areas are not identified as such, and sometimes because regulatory requirements such as the need for environmental impact assessments (*AMDAL*) have been bypassed. Given the high returns achievable from estate crops such as oil palm, the incentives to bypass the restrictions placed by the regulatory framework have been high.

(a) **Conformity with spatial plans.** Despite considerable investment in developing the capacity of different institutions in land use planning, use of RePPProT maps and provincial spatial plans in evaluating concession applications remains very weak. Too often, the physical planning section of the provincial development planning boards (BAPPEDA), which hold the

[32] Formerly, most decisions were made by the Ministry of Agriculture, with the Ministry of Forestry being involved only when applications concerned land within forest boundaries. In 1998, DG Estate Crops was transferred from the Ministry of Agriculture to the Ministry of Forestry. MoFEC now has responsibility for approving both the agricultural estate and the release of forest land—a change which may well facilitate the process of rapid forest conversions. MoFEC has criteria for release of forest land (Decree 376/Kpts-II/1998), relating to issues such as land suitability and the volume of useful timber, but there are many ways to circumvent these provisions.

maps, play no role in the allocation process, and the boundaries of the estate are straight lines drawn on a map without apparent reference to land suitability nor even present land use or occupation. Numerous examples have been seen of applications that cover either mountains or peat swamp or both, which are blatantly unsuitable for the proposed use. Many other applications are for areas within forest boundaries, even extending into Protection Forest areas of the spatial plan, or on land that is already under intensive use by smallholders.

(b) **Environmental Impact Assessment.** Full environmental impact assessments (*AMDAL*) are required when applications exceed 10,000 ha.[33] Although this provides, in principle, a means to avoid environmentally unsuitable applications, the process has proven susceptible to influence. Hitherto the EIA has been evaluated by the central *AMDAL* commission of the related ministry, and so it failed to provide a genuinely independent assessment.[34] Few officials appear to be clear concerning which stage of an HGU application is contingent upon satisfactory completion of the *AMDAL*.

While the weakness of the planning process can help explain why estate crop development sometimes takes place in environmentally sensitive areas, it provides a less satisfactory explanation of why such development might sometimes not be sustainable. Holmes (2000), for example, cites an example of an oil palm estate in South Aceh where oil palms were planted under slope and soil conditions that make oil palm non-viable. But even if the planning process permitted it, or could be bypassed, why would investors throw away money by planting oil palms on unsuitable land? The technical requirements for successful oil palm production are well-known. If this is not an isolated and unrepresentative example, further study is needed on the factors which might lead to this behavior. Perhaps the extremely rapid growth in oil palm production has brought in new investors unaware of the technical requirements, or has resulted in weak organizations which fails to take such requirements into account. If so, such investors can be expected to be shortlived and to soon pass from the scene—but perhaps not before they have caused substantial damage.[35] Or perhaps the oil palm development in this case was a token effort to appear to be in compliance with the requirements of a conversion permit whose main purpose was really to gain permission to clearcut the land.

The structure of concessions appears to provide little incentives for sustainable long-term management. Investors have complained that the system of acquiring concessions for estate crop development is too complex and have called for simpler procedures. In theory, the complex procedures are designed to supply a series of regulatory controls to ensure sound practice and transparency in land use planning and allocation; in practice, these objectives have often not been achieved.

Impact of the financial crisis. With devaluation increasing the profitability of many estate crops, and in particular of oil palm, it was feared that the East Asian financial crisis would further accelerate the already rapid conversion of forest for estate crops development. Indeed, the structural adjustment program specifically attempted to further encourage production of crops such as oil palm as a way to help Indonesia recover from the crisis. However, although devaluation has made oil palm production even more profitable, the need for large capital investments has proved a major constraint. 90 percent of the 50 foreign investment projects which had planned to establish 900,000ha of oil palm plantation in Indonesia during 1998 were partly or wholly financed by Malaysian companies, but they too were heavily affected by the crisis (Sunderlin, 1998). The uncertainty resulting from the political situation has also made investors wary. Another factor, tied to the breakdown of the traditional power structure, is that some local

33 A lower level of analysis, *UKL/UPL*, is sufficient for smaller areas.

34 See Crooks and Foley (1995), for an assessment of how the *AMDAL* system was applied in the context of several World Bank-financed projects in the early 1990s. They identified numerous problems, including a focus on process rather than results, low quality of technical reports, and limited transparency.

35 The failure of the 'Million Hectare Peat Swamp Project' in Central Kalimantan (Holmes, 2000) is easier to understand, in that government organizations have far weaker incentives to ensure technical requirements are met.

communities which had been displaced by oil palm concessions—often on very unfavorable terms—appear to be seeking to retake their lands. The net result has been a substantial slowdown of the expansion rate of oil palm. Data from the Directorate General for Estate Crops (DGEC) shows continued expansion in the area planted to oil palm, but these data appear to be based on projections of past trends rather than observation. Other data from DGEC is more consistent with a retrenchment of oil palm production: for example, sales of oil palm seed to plantations fell by over one third in 1998, compared to 1997. Some estimates place the area planted in 1998 at 70,000-80,000 hectares, well below the 200,000 hectares per annum average observed in the period 1990-1997 (Casson, 1999). This is likely to prove only a temporary respite, however. As the political situation stabilizes and regional financial markets recover, oil palm can be expected to resume its prior rapid growth.

Forest fires. The 1997 forest fires on Sumatra and Kalimantan and the controversy surrounding them were an important factor in encouraging reform in forest sector. After years of blaming shifting cultivators for burning, the widespread availability of remote sensing images on the internet showing that many fires appeared to coincide with logging and oil palm concessions (EUFREG, 1998; Tomich and others, 1998a) forced an official recognition of the role these firms were playing. The Forestry Ministry released a list of plantation, timber, and construction companies suspected of having participated in large-scale burning. Despite the controversy, no logging companies lost their concession, and few lost their permission to cut wood—and many of these had it restored (Potter and Lee, 1998).

4.3 Smallholders

Discussion of the impact of smallholders is complicated by their great variety.[36] A village-level study of crop choice at the forest frontier (Chomitz and Griffiths, 1996) suggests that tree crops rather than subsistence-oriented shifting cultivation play the largest role in deforestation. Although deforestation is greater in areas where agricultural households are shifting cultivators, the share of households engaged in subsistence agriculture at the forest frontier is surprisingly low. Even in subsistence-oriented areas such as Kalimantan, only 36 percent of agricultural households are subsistence households. Deforestation is associated with a high proportion of tree crop households in total agricultural households. In Kalimantan and Nusa Tengarra almost half of the households in high deforestation areas cultivate tree crops. Of the tree crops, rubber is the dominant smallholder crop with coconuts, coffee and cocoa being important in some parts of the country.

Angelsen (1995) finds that shifting cultivators in Seberida District in Riau Province, on Sumatra, only cleared about 2,400 ha of forest in 1991, which represents only 0.85 percent of the land area in the study area. Moreover, only about 10 percent of the area cleared represented an expansion of the area under cultivation, with the rest consisting of areas that had been used for agriculture in previous years.[37] Moreover, much of the area cleared was used to produce jungle rubber, which tends to preserve at least part of the area's biodiversity (Thiollay, 1995; Tomich and others, 1998b).

As noted in the previous sections, many of the possible agricultural land uses that smallholders might use—especially agroforestry systems such as jungle rubber—can be both sustainable and likely to preserve at least part of the benefits of natural forests. The ASB program has analyzed a number of barriers to the adoption of these more benign land uses (Tomich and others, 2000). The long-term nature of the investment necessary is one constraint. It takes 6-10 years for smallholder rubber to start to generate a positive cash flow, and even longer for the investment to be repaid. Clearly, this has not been an absolute

---

36 It is further complicated by the failure of many previous analysts to distinguish between different types of smallholders. Many have used the catch-all, and often not very accurate, 'shifting cultivator' or 'slash-and-burn cultivator' labels.

37 Whether forest cover cleared temporarily in such a rotational system should be counted as 'deforestation' is one of the many difficult definitional problems encountered in studying deforestation (Sunderlin and Resosudarmo, 1996). Note, moreover, that clearing secondary forest for such use would not be considered deforestation under a definition that focused on loss of natural forest.

constraint, even in the absence of formal credit markets, since over almost 3 million ha of rubber agroforests have been planted by smallholders. Nevertheless, this return profile is likely to tend to discourage this type of land use. Long return profiles also mean that security of tenure is likely to play an important role. Other factors identified by the ASB program as acting barriers to adoption of environmentally-friendlier agroforestry systems include scarcity of appropriate planting materials and price distortions that tend to undervalue products (though recent reforms have tended to reduce the latter problem).

Tenure rights. Weak tenure rights have been a major factor affecting smallholder behavior. The formal legal framework has provided only limited recognition of land rights based traditional (*adat*) law (World Bank, 1994). Incoming pioneer farmers usually hold no rights at all other than weak usufruct rights. Moreover, even this limited recognition could easily be over-ridden by concessionaires. Once a concessionaire received approval in principle (*izin prinsip*), they had an exclusive right to purchase land, leaving smallholders in a weak bargaining position and vulnerable to coercion. The loss (or lack) of tenure security can be a strong disincentive to investing in sustainable cultivation methods. Conversely, some smallholders with weak tenure security have been establishing tree crops such as jungle rubber in part as a means to assert rights over land. Moreover, in the event of expropriation, they would in principle be eligible for compensation, which is only paid for standing crops, not for the land.

Impact of the financial crisis. There has been considerable concern that the East Asian financial crisis would result in a substantial increase in the pressure placed on forests by smallholders, both as a means for coping with the economic and social effects of the crisis and in response to changes in relative prices.

(a) **Coping strategies.** Although the crisis fell short of the devastation initially feared, it did have a substantial impact on household income, with per capita expenditure declining by about 24 percent between 1997 and 1998 (Frankenberg and others, 1999). This impact appears to have been concentrated in urban areas, however (Poppele and others, 1999; Sumarto and others, 1999; Frankenberg and others, 1999). Agriculture did act as a major shock absorber (Poppele and others, 1999). On the other hand, relatively limited return migration was found in the several case studies in the outer islands (Angelsen and Resosudarmo, 1999). A survey undertaken by CIFOR (partly with World Bank financing) found that 36 percent of the 63 percent of households that considered themselves worse off as a result of the crisis (or 23 percent of all households in the survey) had expanded the area they cultivated (Sunderlin and others, 2000). If confirmed, this result would indicate that pressure on the country's forests has increased. A large part of this increase appears to have been for increased production of tree crops, driven in part by their increased profitability as well as by coping strategies.

(b) **Changes in relative prices.** One of the unexpected effects of the crisis is that many smallholders at first actually benefited as devaluation sent the rupiah prices of many export-oriented crops soaring. All crops did not benefit equally, however. Declining world market prices for rubber prices, offset the effects of devaluation, for example. Over time, the initial gains experienced by export crop producers have been eroded by higher production costs due to domestic inflation (although low agricultural wages continue to help) and by the relative strengthening of the Rupiah. In some cases, export crops are now no more profitable, in real terms, than they had been prior to the crisis. In these cases, it is doubtful that any lasting changes in pre-existing trends would be induced. Higher prices for export commodities at market centers will also have little effect on production if they do not manifest themselves in terms of higher prices to producers at the farmgate. Where physical and marketing infrastructure is poor, this may not occur. Thus, although rattan prices have tripled since the onset of the crisis, rattan collection has increased in Central Sulawesi but not in West Kalimantan, where transport is more limited and buyers scarce (Angelsen and Resosudarmo, 1999). Although increases in cash crop prices have been eroded by inflation, they nevertheless remains significant in some cases. The real price of coffee in Sumatra in late 1998 was about 20 percent above its level in early 1997, for example. In these cases, one

> might expect that smallholder tree crop production will expand.[38] Indeed, signs point to increased oil palm production by smallholders. Sales of oil palm seeds to smallholders in 1998 were double the sales in 1997, for example (although this only brings them to about 10 percent of sales to large plantations). Data from the CIFOR survey of rural households in 5 provinces shows that 17 percent of the households that considered themselves better off as a result of the crisis increased the area they cultivate (Sunderlin and others, 2000), presumably to take advantage of the increased profit potential of individual crops.[39]

Pressure on forest resources from smallholders may thus have increased, from both increased collection of products such as fuelwood and from conversion of forest areas to agriculture, as households sought to cope with the social impact of the crisis. The magnitude of this effect is likely to have been limited, however, because the social impacts of the crisis appear to have been greatest in areas in which little forest remains. Devaluation and other consequences of the crisis have tended to increase the profitability of many tree crops, although this increase was not always sustained. Some expansion of smallholder tree crop production is likely as a result of this, although the inherent inertia of tree crop production may limit its extent.

5 Summary and Conclusions

Indonesia's forests are being converted to other uses at an alarming rate. The effects of the East Asian financial crisis may have temporarily alleviated some of the pressures on forests, particularly those coming from the development of large-scale estate crops, but are likely to have worsened others. In any case, any relief is likely to prove temporary.

Costs and benefits of forest conversion. There is a clear need for a balanced and nuanced view of the consequences of forest conversion. Forests provide a multitude of benefits beyond those of timber alone, most of which have until recently been ignored by both analysts and decisionmakers. It is also true, however, that some non-forest uses of the same land can also be quite valuable, sometimes in very different ways (for example, crop production), and sometimes in similar ways (for example, agroforests may provide many of the same environmental benefits as natural forests, albeit at lower levels). The key question is whether, in any given instance, the benefits of conversion outweigh the costs. There is no universal answer to this question—much will depend on site-specific characteristics, on the particular kind of natural forest being converted, and on its use following conversion.

Market failures. There are very strong reasons to believe that, in general, individual land users tend to systematically omit many of the benefits of forests and many of the costs of conversion from their decisionmaking process. They do this not out of malice, nor even of ignorance, but because these benefits and costs accrue to others. As a result of these market failures, Indonesia has suffered from excessive deforestation—the aggregate benefits obtained from forest conversion are less than the aggregate losses resulting from that conversion. If decisionmakers took a more complete view of benefits and costs, Indonesia's deforestation would be lower.

Policy failures. Although Indonesia's high rate of deforestation is rooted in market failures, policy failures have tended to exacerbate the problem. Policy failures have included both failures of omission and of commission. On the one hand, policies such as implicit and explicit subsidies to logging and the Transmigration program have actively encouraged forest clearing. On the other hand, the planning and regulatory apparatus whose purpose was to avoid excessive damage through land use planning and environmental impact assessments has fallen far short of its objectives.

---

[38] Data from the Directorate General for Estate Crops do not show any obvious trend in area planted to coffee on Sumatra in 1998, but these data are based on projections rather than field measurements and so may be misleading.

[39] Because only 31 percent of households considered themselves better off, this only comes to 3 percent of all households, however.

Need for improved data collection. Thanks to the MoFEC map, our knowledge of actual rates of deforestation and of the distribution of remaining forest have improved substantially. Nevertheless, a great many questions remain. Such maps need to be compiled more regularly if the rate of deforestation is to be monitored. More important, land use maps that go beyond simply distinguishing forest from non-forest need to be compiled—assessing the impact of forest conversion requires knowing what uses the converted forest areas are put to. As it stands, current data leaves us unable to account for over half the area of natural forest converted between 1985 and 1997.

Need for policy reform. Several distinct types of reform are needed to alleviate the policy failures that have exacerbated deforestation problems in Indonesia.

(a) **Forest policy reform.** The crisis has already led to a broad range of policy reforms in the forest sector, partly through conditions attached to the emergency loans provided by the IMF and World Bank. Some of the more egregious distortions, such as the log export ban and Indonesian Plywood Association (APKINDO) monopoly over plywood exports, have been abolished. Still, considerable work remains to be done on numerous aspects of forest policy, including stumpage fees and the structure of concession contracts.

(b) **Improved land use planning.** Improved land use planning is one of the major means by which damage to forest areas that are particularly valuable for the biodiversity they contain or for their role in watershed protection can be avoided. Although Indonesia has a long-standing land use planning process, it has largely failed to achieve these aims. Existing maps were often drawn on the basis of inadequate or obsolete information. Moreover, land use planning has hitherto been largely top-down, with little or no consultation with local stakeholders.

(c) **Improved governance.** An important part of the policy failures under the old regime was not so much in the policies and regulations in place as in the ease with which they could be bypassed. Extensive reform of the details of specific policies will be of little use if these policies are not then applied. Likewise, there would be little point in developing improved land use planning maps if their boundaries are routinely ignored. The crisis has also led to a broad range of reforms throughout the country, particularly with regards to governance—a process which continues today. One of the main dimensions of many political changes has been an emphasis on decentralization. This emphasis creates both dangers and opportunities. Although regional governments may be better able to monitor local conditions and more attuned to possible local environmental problems, they may also be more vulnerable to pressure from commercial interests and more dependent on income from timber. For example, the regional government in Kalimantan is allowing oil palm companies to clear logged-over concessions which should in principle be used for plantation forests (Potter and Lee, 1998). The situation is still extremely fluid, however, and it will take time to determine whether this trend is ultimately helpful or harmful; there is also still time to attempt to direct it in a positive direction. Indonesia's forests remain an important source of rents, so the incentives to try to appropriate these rents remain large.

(d) **Other changes.** A variety of other government actions can have an impact on forests, including activities such as road building. Secure tenure rights are also an important part of the recipe for more sustainable land use, though far from sufficient (Pagiola, 1999b).[40]

The old policy regime is widely thought to have played an important part in creating incentives for the unsustainable forest management, but it is still too early to tell how well the new system will work.

Need to address market failures. Even if policy imperfections were to be completely eliminated, however, the fundamental problem that most forest benefits are externalities from the perspective of forest users would remain. In recent years, recognition of this problem and of the failure of previous approaches to dealing with it has led to efforts to develop systems in which land users are

---

40 Secure tenure rights are also important for equity, particularly as it concerns the customary rights of indigenous and small communities.

compensated for the environmental services they generate. In this way, land users would have a direct incentive to include these services in their land use decisions, resulting in more socially-optimal land uses. Small scale examples of this approach can be found all over the world (Richards, 1999; Pagiola, 2000), but the most advanced such effort is that of Costa Rica (Castro and others, 1997; Chomitz and others, forthcoming).

References

Angelsen, A. 1995. "Shifting Cultivation and 'Deforestation': A Study from Indonesia." *World Development*, **23**, pp.1713-1729.

Angelsen, A., and D.P. Resosudarmo. 1999. "*Krismon*, Farmers and Forests: the Effects of the Economic Crisis on Farmers' Livelihoods and Forest Use in the Outer Islands Of Indonesia." Bogor: CIFOR (processed).

Barbier, E.B. 1990. "The Farm-Level Economics of Soil Conservation: The Uplands of Java." *Land Economics*, **66**, pp.199-211.

Barbier, E.B., N. Bockstael, J.C. Burgess, and I. Strand. 1995. "The Linkages Between the Timber Trade and Tropical Deforestation—Indonesia." *World Economy*, **18**, pp.411-442.

Bennett, E.L., and C.J. Reynolds. 1993. "The Value of a Mangrove Area in Sarawak." *Biodiversity and Conservation*, **2**, pp.359-375.

Bishop, J.T., ed. 1999. *Valuing Forests: A Review of Methods and Applications in Developing Countries.* London: International Institute for Environment and Development.

Brown, D.M. 1999. "Addicted to Rent: Corporate and Spatial Distribution of Forest Resources in Indonesia; Implications for Forest Sustainability and Government Policy." Indonesia-UK Tropical Forest Management Programme Report No.PFM/EC/99/06. Jakarta: DFID (processed).

Bruijnzeel, L.A. 1990. *Hydrology of Moist Tropical Forests and Effects of Conservation: A State of Knowledge Review*. UNESCO International Hydrological Programme. Paris: UNESCO.

Cassells, D.S., M. Bonell, L.S. Hamilton, and D.A. Gimour. 1987. "The Protective Role of Tropical Forests: A State-of-Knowledge Review." In N.T. Vergara and N.D. Briones, eds, *Agroforestry in the Humid Tropics*. Honolulu: East-West Center.

Casson, A. 1999. "The Hesitant Boom: Indonesia's Oil Palm Sub-Sector in an Era of Economic Crisis and Political Change." Bogor: CIFOR (processed).

Castro, R., F. Tattenbach, with N. Olson and L. Gamez. 1997. "The Costa Rican Experience with Market Instruments to Mitigate Climate Change and Conserve Biodiversity." Paper presented at the Global Conference on Knowledge for Development in the Information Age, Toronto, Canada, 24 June 1997 (processed).

Chomitz, K.M., and C. Griffiths. 1996. "Deforestation, Shifting Cultivation, and Tree Crops in Indonesia: Nationwide Patterns of Smallholder Agriculture at the Forest Frontier." Research Project on Social and Environmental Consequences of Growth-Oriented Policies. Working Paper No.4. Washington: World Bank.

Chomitz, K.M., and K. Kumari. 1998. "The Domestic Benefits of Tropical Forest Preservation: A Critical Review Emphasizing Hydrological Functions." *World Bank Research Observer* **13**, pp.13-35

Chomitz, K.M., E. Brenes, and L. Constantino. Forthcoming. "Financing Environmental Services: The Costa Rican Experience and its Implications." *Science of the Total Environment.*

Crooks, R., and S. Foley. 1995. "Review of Environmental Assessment and Management Experience in Indonesia." Environment Department Working Paper No.25. Washington: World Bank.

Department of Forestry. 1997. *National Strategy for Mangrove Management in Indonesia*. Jakarta: Department of Forestry.

Dick, J. 1991. "Forest Land Use, Forest Use Zonation, and Deforestation in Indonesia: A Summary and Interpretation of Existing Information." Background Paper to UNCED. Jakarta: EMDI Project (processed).

Economist Intelligence Unit (EIU). 1998. "Country Profile Indonesia." London: EIU.

Economist Intelligence Unit (EIU). Various dates. "Country Report: Indonesia." London: EIU.

European Union Fire Response Group (EUFREG). 1998. "Assessment of the 1997 Fires in Indonesia." Jakarta: EUFREG.

Food and Agriculture Organisation (FAO). 1990. "Situation and Outlook of the Forestry Sector in Indonesia." Jakarta: FAO (processed).

Flynn, B. 1999. "Global Forest Products Trade Trends and their Impact on Asia." Paper presented at the 5th Annual Conference on Asian Timber and Forestry, Kuala Lumpur, March 8-9, 1999 (processed).

Fortech, Margules Pöyry, and Pusat Pengembangan Agribisnis. 1999. "Planning for Fire Prevention and Drought Management Project." ADB TA 2999-INO. Jakarta: Asian Development Bank (processed).

Frankenberg, E., D. Thomas, and K. Beegle. 1999. "The Real Costs of Indonesia's Economic Crisis: Preliminary Findings from the Indonesia Family Life Surveys." Labor and Population Program Working Paper Series 99-04. Santa Monica: RAND (processed).

Gieson, W. 1993. "Indonesian Mangroves: an Update on Remaining Area and Main Management Issues." Paper presented at the International Seminar on Coastal Zone Management of Small Island Ecosystems, Ambon, 7-10 April 1993 (processed).

Hamilton, K., and M. Clemens. 1999. "Genuine Savings Rates in Developing Countries." *World Bank Economic Review*, **13**, pp.333-356.

Hamilton, L.S., J.A. Dixon, and G.O. Miller. 1989. "Mangrove Forests: An Undervalued Resource of the Land and the Sea." In E. Borgese, N. Ginsburg, and J.R. Morgan, eds, *Ocean Yearbook 8*. Chicago: University of Chicago Press.

Hamilton, L.S., and P.N. King. 1983. *Tropical Forest Watersheds: Hydrologic and Soils Response to Major Uses and Conversions*. Boulder: Westview Press.

Holmes, D. 2000. "Deforestation In Indonesia: A Review of the Situation in Sumatra, Kalimantan and Sulawesi." Jakarta: World Bank (processed).

Kummer, D.M. 1991. *Deforestation in the Postwar Philippines*. Chicago: University of Chicago Press.

Kumari, K. 1995. "An Environmental and Economic Assessment of Forest Management Options: A Case Study of Malaysia." Environment Department Working Paper No.26. Washington: World Bank.

Kusumandari, A. and B. Mitchell. 1997. "Soil Erosion and Sediment Yield in Forest and Agroforestry Areas in West Java, Indonesia." *Journal of Soil and Water Conservation*, **52**, pp.376-380.

Lampietti, J., and J.A. Dixon. 1995. "To See the Forest for the Trees: A Guide to Non-Timber Forest Benefits." Environment Department Working Paper No.13. Washington: World Bank.

McMahon, G.J.R. 1999. "**The Environmental Effects of the Economic Crisis in East Asia: The Mining Sector." Washington: World Bank (processed).**

Magrath, W., and P. Arens. 1989. "The Costs of Soil Erosion on Java: A Natural Resource Accounting Approach." Environment Department Working Paper No.18. Washington: World Bank.

Magrath, W., C. Peters, N. Kishor, and P. Kishor. 1995. "The Economic Supply of Biodiversity in West Kalimantan: Preliminary Results." Environmental and Economic Issues in Forestry, Selected Case Studies in Asia, Asia Technical Department Series. Washington: World Bank.

Maltby, E. 1986. *Waterlogged Wealth: Why Waste the World's Wet Places*? London: Earthscan.

Mittermeier, R.A., N. Myers, P. Robles Gil, and C.G. Mittermeier. 1999. *Hotspots: Earth's Biologically Richest and Most Endangered Terrestrial Ecoregions.* Mexico City: CEMEX.

Morgan, R.P.C. 1986. *Soil Erosion and Conservation*. Essex: Longman Group (LE) Ltd.

Myers, N. 1994. "Tropical Deforestation: Rates and Patterns." In K. Brown and D.W. Pearce, eds, *The Causes of Tropical Deforestation*. London: UCL Press.

Nibbering, J.W. 1991. "Crisis and Resilience in Upland Land Use in Java." In J. Hardjono, ed, *Indonesia: Resources, Ecology, and Environment.* Singapore: Oxford University Press.

Pagiola, S. 1999a. "Deforestation and Land Use Changes Induced by the East Asian Financial Crisis." Washington: World Bank (processed).

Pagiola, S. 1999b. "Economic Analysis of Rural Land Administration Projects." Washington: World Bank (processed).

Pagiola, S. 2000. "Payments for Environmental Services." http://www-esd.worldbank.org/eei/.

Pagiola, S., J. Kellenberg, L. Vidaeus, and J. Srivastava. 1997. *Mainstreaming Biodiversity in Agricultural Development: Toward Good Practice.* Environment Paper No.15. Washington: World Bank.

Poppele, J., S. Sumarto, and L. Pritchett. 1999. "Social Impacts of the Indonesia Crisis: New Data and Policy Implications." SMERU Report. Jakarta: World Bank (processed).

Potter, L., and J. Lee. 1998. "Tree Planting in Indonesia: Trends, Impacts and Directions." Bogor: CIFOR (processed).

Repetto, R.C., W. Magrath, M. Wells, C. Beer, and F. Rossini. 1989. *Wasting Assets : Natural Resources in the National Income Accounts*. Washington: World Resources Institute,

Richards, M. 1999. "'Internalizing the Externalities' of Tropical Forestry: A Review of Innovative Financing and Incentive Mechanisms." London: Overseas Development Institute.

Rock, M. 1999. "The Environmental Behavior of Forest Concessionaires Off-Java: What can we Learn from Survey Data?" Washington: World Bank (processed).

Scotland, N. 1998. "The Impact of the Southeast Asian Monetary Crisis on Indonesia Forest Concessions and Implications for the Future." Report SMAT/EC/98/02. Manila: Indonesia-UK Tropical Forest Management Programme (processed).

Scotland, N., A. Fraser, and N. Jewell. 1999. "Roundwood Supply and Demand in The Forest Sector in Indonesia. Indonesia-UK Tropical Forest Management Programme Report No.PFM/EC/99/08. Jakarta: DFID (processed).

Sist, P., D. Dykstra, and R. Fimbel. 1998. "Reduced-Impact Logging Guidelines for Lowland and Hill Dipterocarp Forests in Indonesia." Occasional Paper No.15. Bogor: CIFOR.

Sumarto, S., A. Wetterberg, and L. Pritchett. 1999. "The Social Impact of the Crisis in Indonesia: Results from a Nationwide *Kecamatan* Survey." SMERU Report. Jakarta: World Bank (processed).

Sunderlin, W.D. 1998. "Between Danger and Opportunity: Indonesia's Forests in an Era of Economic Crisis and Political Change." Bogor: CIFOR (processed).

Sunderlin, W.D., and I.A.P. Resosudarmo. 1996. "Rate and Causes of Deforestation in Indonesia: Towards a Resolution of the Ambiguities." Occasional Paper No.9. Bogor: CIFOR (processed).

Sunderlin, W.D., and I.A.P. Resosudarmo, E. Rianto, and A. Angelsen. 2000. "The Effect of Indonesia's Economic Crisis on Small Farmers and Natural Forest Cover in the Outer Islands." Bogor: CIFOR (processed).

Thiollay, J.-M. 1995. "The Role of Traditional Agroforests in the Conservation of Rain Forest Bird Biodiversity in Sumatra." *Conservation Biology*, **9**, pp.335-353.

Tomich, T.P., A.M. Fagi, H. de Foresta, G. Michon, D. Murdiyarso, F. Stolle, and M. Van Noordwijk. 1998a. "Indonesia's Fires: Smoke as a Problem, Smoke as a Symptom." *Agroforestry Today,* January-March: 5-7.

Tomich, T.P., M. Van Noordwijk, A. Budidarsono, A. Gillison, T. Kusumanto, D. Murdiyarso, F. Stolle, and A.M. Fagi, eds. 1998b. *Alternatives to Slash-and-Burn in Indonesia: Summary Report and Synthesis of Phase II*. Bogor: ICRAF.

Tomich, T.P., M. Van Noordwijk, A. Budidarsono, A. Gillison, T. Kusumanto, D. Murdiyarso, F. Stolle, and A.M. Fagi. 2000. "Agricultural Intensification, Deforestation, and the Environment: Assessing Tradeoffs in Sumatra, Indonesia." In D.R. Lee and C.B. Barrett, eds. *Tradeoffs or Synergies? Agricultural Intensification, Economic Development and the Environment*. Oxford: CAB International.

Van Noordwijk, M., T.P. Tomich, R. Winahyu, D. Murdiyarso, Suyanto, S. Partoharjono, and A.M. Fagi, eds. 1995. *Alternatives to Slash-and-Burn in Indonesia: Summary Report of Phase I*. Bogor: ICRAF.

Vincent, J.R., and Y. Hadi. 1993. "Malaysia." In National Research Council, ed. *Sustainable Agriculture and the Environment in the Humid Tropics*. Washington: National Academy Press.

Whiteman, A., and A. Fraser. 1997. "The Value of Forestry in Indonesia." Indonesia-UK Tropical Forest Management Programme Report No.SMAT/EC/97/1. Jakarta: DFID (processed).

Wibowo, P., and N. Suyatno. 1998. "An Overview of Indonesian Wetland Sites—II: An Update Information—Included in The Indonesian Wetland Database." Bogor: Wetlands International Indonesia Program/PHPA.

Wischmeier, W.H., and D.D. Smith. 1978. Predicting Rainfall Erosion Losses: A Guide to Conservation Planning. Agricultural Handbook No. 537. Washington: US Department of Agriculture.

World Bank. 1990. *Indonesia: Sustainable Development of Forests, Land and Water*. New York: Oxford University Press.

World Bank. 1994. *Indonesia: Environment and Development*. Washington: World Bank.

World Bank. 1999. *World Development Indicators 1999*. Washington: World Bank.

World Bank. 2001. *Indonesia: Environment and Natural Resource Management in a Time of Transition*. Washington: World Bank.

World Wildlife Fund/Department for International Development (WWF/DFID). 1998. "Laporan Perkembangan Sawmill di Wilayah Selatan TN. Bukit Tigapuluh & di Sekitar Area KPHP Pasir Mayan." Laporan PFM/KPMP/98/7. Jakarta: WWF/DFID.