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CHAPTER 2
FOREST COVER, CHANGE, AND CONDITION

2.1 Forest Cover and Change

Original Forest Cover: From the Preagricultural Era to 1900

Given current climate and topography, we know that forests would blanket Indonesia today if people did not need to clear trees for agriculture, infrastructure, and settlements. We cannot be sure how much forest covered Indonesia in the distant past but, based on estimates of potential vegetation cover (that is, the areas potentially covered by different forest types, given the appropriate climatic and ecological conditions and no human intervention), we can reasonably conclude that the country was almost completely forested (MacKinnon, 1997). Only narrow coastal strips and the steepest mountain slopes would have been unable to support tree growth.

As late as 1900, Indonesia was still a densely forested country. According to modeled estimates by the World Bank, forest cover in the three major islands of Sumatra, Kalimantan, and Sulawesi at that time still totaled 103 million ha (Holmes, 2000). This represents a reduction of only about 13 percent from their original forest cover, as estimated by MacKinnon.

Indonesia's Forests in 1950

In 1950, what was then called the Indonesian Forest Service produced a vegetation map of the country; it concluded that nearly 84 percent of Indonesia's land area was covered in primary and secondary forest and plantations of such estate crops as tea, coffee, and rubber. *(See Table 2.1.)* The survey aggregated plantations in the "forest" category and thus did not provide an estimate of their extent, but it is clear that plantations and smallholder plantings of tree crops covered only a small area in 1950. Dutch colonial records from 1939 estimated that large-scale plantations included approximately 2.5 million ha "in exploitation," of which only 1.2 million ha were actually planted. The sector stagnated during the 1940s and 1950s and would reach the 1939 level of area planted again only in the 1970s. Smallholder tree crop area was only 4.6 million ha in 1969, and a large part of this area was planted in the 1950s and 1960s (Booth, 1988). In 1950, teak plantations on Java covered an additional 824,000 ha (Peluso, 1992:Annex C). The major cause of forest clearance that had occurred up to 1950 was agriculture, notably rice cultivation.

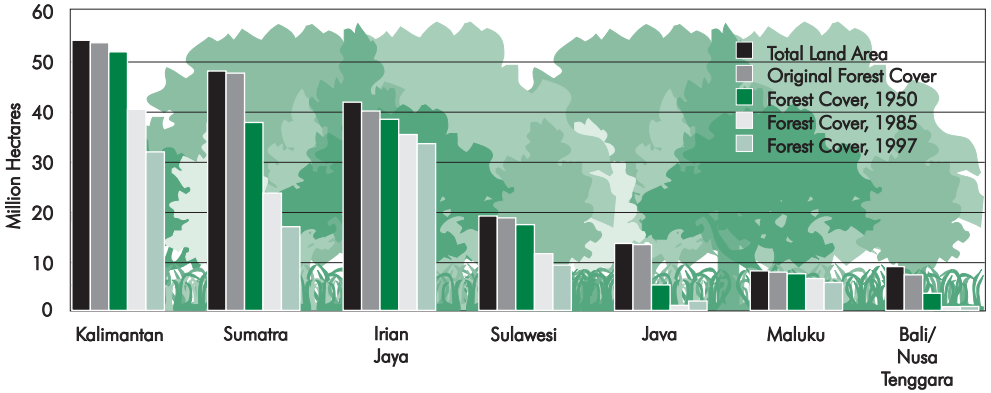
It seems reasonable to conclude that all timber and estate crop plantations covered no more than 4

Table 2.1 Forest Cover in 1950 (Hectares)

Island	Primary Rainforest, Protected Forests, Swamp and Wilderness Forest, Plantations	Tidal Forest	Secondary Forest	Total Forest	Savanna, Grassland, and Nonirrigated Rice Fields	Irrigated Rice Fields	Total Land Area
Sumatra	33,400,000	570,000	3,400,000	37,370,000	8,600,000	900,000	46,900,000
Kalimantan	47,500,000	700,000	3,200,000	51,400,000	3,500,000	—	54,900,000
Sulawesi	14,700,000	50,000	2,300,000	17,050,000	2,600,000	—	19,700,000
Maluku	6,900,000	—	400,000	7,300,000	1,300,000	—	8,600,000
Irian Jaya	38,400,000	2,300,000	—	40,700,000	300,000	—	41,000,000
Java	4,400,000	70,000	600,000	5,070,000	4,100,000	4,100,000	13,300,000
Bali/Nusa Tenggara	3,000,000	—	400,000	3,400,000	5,600,000	300,000	9,300,000
TOTAL	**148,300,000**	**3,600,000**	**10,300,000**	**162,290,000**	**26,000,000**	**5,300,000**	**193,700,000**
Percent of Total Land Area	77%	2%	5.3%	84%	13%	3%	100%

Source: Based on L. W. Hannibal. 1950. Vegetation Map of Indonesia. Planning Department, Forest Service, Jakarta, in: *Forest Policies in Indonesia. The Sustainable Development of Forest Lands.* (Jakarta, Indonesia: International Institute for Environment and Development and Government of Indonesia, 1985). Vol. 3, Ch. 4.
Notes: Numbers may not add due to rounding. — = zero or no data.

Figure 2.1 Deforestation from the Preagricultural Era to 1997



Sources: *Land Area from WCMC, 1996. Original Forest Cover from MacKinnon, 1997. Forest Cover 1950 from Hannibal, 1950. Forest Cover 1985 from RePPProT, 1990. Forest Cover 1997 (Kalimantan, Sumatra, Sulawesi, Maluku and Irian Jaya) from Holmes, 2000. Forest Cover 1997 (Java, Bali/Nusa Tenggara) from GFW calculations based on GOI/World Bank, 2000).*

million ha in 1950, leaving approximately 145 million ha of primary forest and another 14 million ha of secondary and tidal forest.

Deforestation Since 1950

Figure 2.1 summarizes the extent of forest loss from preagricultural times to 1997. Deforestation became a real concern in Indonesia only in the early 1970s, when large-scale commercial logging concessions were established for the first time. Despite the fact that logging concessions were intended to establish a system of long-term timber production, they sometimes led to serious forest degradation followed by clearance and conversion to other forms of land use. (*See Chapter 3.2.*) A picture of the situation in the mid-1980s can be obtained from a nationwide mapping exercise undertaken as part of the government's transmigration program (RePPProT, 1990). According to this survey, forest cover in 1985 was about 119 million ha, representing a decline of about 27 percent from the forested area in 1950. Between the 1970s and the 1990s, the annual deforestation rate was estimated at 0.6-1.2 million ha (Sunderlin and Resosudarmo, 1996).

A more recent forest cover mapping effort carried out in 1999 by the Indonesian government with support from the World Bank (GOI/World Bank, 2000) concluded that the average annual deforestation rate for 1985-1997 was actually about 1.7 million ha. Hardest hit during this period were Sulawesi, Sumatra, and Kalimantan, all of which lost more than 20 percent of their forest cover. If these deforestation trends continue (as they have since 1997), nonswamp lowland forest will disappear in Sumatra by 2005 and in Kalimantan soon after 2010 (Holmes, 2000). A more detailed description of these data sources is provided in Box 2.1.

In total, Indonesia appears to have lost more than 20 million ha of forest cover between 1985 and 1997 – about 17 percent of the forest area existing in 1985. Table 2.2 presents the deforestation estimates developed by Holmes, based on a comparison of RePPProT data with his analysis of satellite imagery from around 1997.

These estimates should be regarded as approximations. The forest cover data for 1997, in particular, suffer from a number of uncertainties. First, they are based entirely on satellite imagery that was not verified by field checks. Analysis by Global Forest Watch indicates that about 6.6 million ha classified in the World Bank study as natural forest might be under timber or estate crop plantations.[4] Second, the images were obscured in many areas by cloud cover or are otherwise unclassified. In the three major islands of Sumatra, Kalimantan, and Sulawesi, "no data" areas cover a total of 5.3 million ha, or 18 percent of the "measured" forest area (Holmes, 2000:Table 1). The World Bank study makes the assumption that, on average, just over half these areas are forested, based on their location and what is known of the terrain and level of development there.

Table 2.3 presents deforestation estimates developed by Global Forest Watch, based on modified versions

of the RePPProT and GOI/World Bank datasets. We chose the World Conservation Monitoring Centre's modification of RePPProT because it represents a consistent digitized spatial dataset that could be used with the GOI/World Bank dataset for the purposes of GIS analysis. We chose to exclude "no data" areas in both datasets in order to compare only areas positively identified as forested in 1985 with areas positively identified as forested in 1997. This estimate is not necessarily more accurate than that developed by Holmes; its purpose is to complete estimates for the missing islands (*see note to Table 2.2*) and provide a form of cross-check.

Map 1 presents the same information visually. It shows the extent and distribution of net changes in natural forest cover between 1985 and 1997. The map highlights the fact that when the two forest cover layers are overlaid, more than 17 million ha must be recorded as "no data," an area equal to nearly 18 percent of that reported as forest in 1997. It also highlights areas of data conflict – those identified in the World Bank study as natural forest but reported to be under plantations by the National Forest Inventory of 1996. The significant extent of "no data" and data conflict areas (nearly 24 million ha) reminds us that current deforestation estimates are uncertain.

A more detailed illustration of forest cover change in Kalimantan is presented in Map 2. Natural forest cover in Kalimantan declined from 40 million to 32 million ha between 1985 and 1997. Clearance for oil palm and timber plantations has been a leading cause of deforestation in the province of West Kalimantan. Central Kalimantan has been hard hit by fires and clearance for the ill-conceived "million hectare rice

Box 2.1 Data Sources and Difficulties

No integrated record of forest area has been kept in Indonesia, so any analysis of current forest cover and recent deforestation must be based on a variety of national and subnational scale sources. The analysis of Indonesian forest cover presented in this report is based primarily on four sources of information.

- The Regional Physical Planning Programme for Transmigration (RePPProT, 1990) included a mapping exercise carried out by the Ministry of Transmigration with funds and technical assistance provided by the British Government. The entire country was surveyed, using existing reports, aerial photographs, and satellite or radar imagery with selective field checking. The areas covered, dates and scales of the hand-colored draft maps, aerial photographs and satellite images varied considerably. Although the main purpose of the exercise was to identify land suitable for transmigration, it provided maps and data on land cover, including different forest types. The data are from various years but are generally taken to describe the situation in 1985.

- The RePPProT dataset was subsequently modified by the World Conservation Monitoring Centre (WCMC, 1996). Land cover classes were reduced in number and harmonized, and various areas of missing or conflicting data were clarified. Complete map coverage for the country was provided at a scale of 1:250,000.

- The National Forest Inventory (NFI) (GOI/FAO, 1996) was undertaken by the Ministry of Forestry with financial support from the World Bank and technical assistance from the Food and Agriculture Organization of the United Nations (FAO). The final report provided a set of forest cover and land use maps at a scale of 1:250,000. They were based on MSS satellite data dating from 1986 to 1991 and supplemented by a field inventory. The inventory was conducted by sampling all forest lands below 1,000 m using a systematic sample design with plot-clusters in a 20 km x 20 km grid. In addition, the study created a Geographic Information Systems (GIS) database utilizing maps from the RePPProT and other surveys as well as NFI data. The data, as with RePPProT, are from various years but are generally taken to describe the situation in the early 1990s.

- A new set of forest cover maps has recently been developed by the Government of Indonesia, working with technical assistance from the World Bank. The mapping was conducted at reconaissance level from Landsat satellite imagery by the Planning Department of the Ministry of Forestry. The resulting dataset (GOI/World Bank, 2000) categorized only forest and nonforest land cover and was not corroborated with field checking. The result may be some misclassifications, notably some identification of plantations as forest. The scale of mapping is 1:500,000. Most of the new imagery dates from 1996 to 1998 but in some areas data from 1994 or 1995 had to be used. An average date of 1997 is assumed for the maps, but some predate the forest fires of 1997 as well as the extensive logging that followed the political crisis of 1998. Thus although the maps provide the most recent national-level information on forest cover available at the time of writing, they are already somewhat outdated. The GOI/

Box 2.1 *(continued)*

World Bank dataset was analyzed by Derek Holmes, a consultant working for the World Bank; his unpublished study (Holmes, 2000) and expert advice proved invaluable in the preparation of this report.

A major problem in dealing with these national datasets is their lack of direct comparability. The RePPProT and NFI surveys provide maps at the same scale, but they use different classification schemes for forest, with the NFI being the less detailed. In addition, the NFI appears to include the category "bush and scrub" among its forest types, which leads to the strange result that Indonesian forest area in the 1990s appears larger than it was in the mid-1980s (Scotland et al., 1999). The GOI/World Bank dataset is mapped at a coarser scale, and the absence of ground truthing means that conclusions must be regarded as provisional. The data provide information on forest/nonforest cover only, but the accompanying World Bank study includes supplementary analysis to estimate loss of forest cover in different forest types. As far as possible, the World Bank study tried to produce results comparable with the RePPProT study so that 12-year trends would become clear.

Such technical difficulties are only the beginning when it comes to understanding Indonesian forest cover and forestry practices. Until recently, researchers had to deal with government secrecy, bureaucratic obfuscation, and industry intimidation. The secrecy is beginning to lift, and official cooperation is more often forthcoming, but access to good information is still hampered by overlapping administrative responsibilities, rapid personnel changes, and a lack of capacity. Often the information simply does not exist. The forestry industry may be less all-powerful than it was, but private citizens who attempt to monitor illegal corporate activity still face considerable risks. (*See Box 3.3.*) Some sense of the challenges and frustrations involved in uncovering statistics is provided by two researchers, unconnected with this report, who have long experience in the field. Their stories can be read in Annex 1.

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Scotland, N., A. Fraser, and N. Jewell. 1999. *Indonesian Forest Inventory Data*. Report No. PFM/EC/99/07. Jakarta: Indonesia-UK Tropical Forest Management Programme.

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project," a failed attempt to establish rice cultivation in former peat swamp forest. In East Kalimantan, forests have been both extensively converted to plantation crops and damaged by fire. South Kalimantan, the most densely populated province, has been developed for oil palm, coconuts, and transmigration settlements. All four provinces are also affected by legal and illegal logging.

Our analyis produces a lower overall estimate of natural forest cover in 1997 than that of Holmes and a slightly higher rate of deforestation, but the differences are minor. However, if we assume that the National Forest Inventory data are reliable and that 6.6 million ha of natural forest identified by Holmes are, in fact, plantations, then total natural forest cover might have fallen as low as 92-93 million ha by 1997. The average annual rate of deforestation between 1985 and 1997 would then amount to 2.2 million ha. In the absence of ground truthing, this higher estimate cannot be substantiated.

Despite these difficulties, the overall trend is clear. If deforestation since 1997 has continued at the same constant rate identified by Holmes, another 7-8 million ha of tropical forest will have been cleared as this report goes to press. In fact, it is likely that deforestation rates have actually increased since 1997, driven by the enormous forest fires of 1997-1998, the economic crisis, and the subsequent breakdown of political authority and law enforcement. According to the World Bank's analysis, deforestation accelerated throughout the 1985-1997 period, with a steep increase to about 2 million ha/year occurring after 1996.

Table 2.2 Forest Area and Deforestation, 1985–1997 (GOI/World Bank Estimates)

	1985			1997				
Island	**Land Area** (Ha)	**Forest Cover** (Ha)	**Forest as % Land Area**	**Land Area** (Ha)	**Forest Cover** (Ha)	**Forest as % Land Area**	**Forest Change 1985–1997** (Ha)	**Forest Change** (%)
Sumatra	47,530,900	23,323,500	49	47,059,414	16,632,143	35	6,691,357	-29
Java and Bali	13,820,400	1,345,900	10	nd	nd	nd	nd	nd
Nusa Tenggara	8,074,000	2,469,400	31	nd	nd		nd	nd
Kalimantan	53,583,400	39,986,000	75	53,004,002	31,512,208	60	8,473,792	-21
Sulawesi	18,614,500	11,269,400	61	18,462,352	9,000,000	49	2,269,400	-20
Maluku	7,801,900	6,348,000	81	nd	*5,543,506*	nd	*804,494*	*-13*
Irian Jaya	41,480,000	34,958,300	84	40,871,146	33,160,231	81	1,798,069	-5
Total	**190,905,100**	**119,700,500**	**63**	**189,702,068**	***100,000,000***	***50***	***20,504,994***	***-17***

Sources: 1985 Land Area and Forest Cover from RePPProT (Regional Physical Planning Programme for Transmigration), "The Land Resources of Indonesia: A National Overview." (Jakarta, Indonesia: Land Resources Department of the Overseas Development Administration, Government of UK, and Ministry of Transmigration, Government of Indonesia, 1990). 1997 Land Area and Forest Cover from D. Holmes, "Deforestation in Indonesia: A Review of the Situation in 1999." (Jakarta, Indonesia: World Bank, 2000).
Notes: nd = no data. Holmes did not live to complete his analysis and did not make estimates of forest cover for the islands of Java, Bali, or Nusa Tenggara. Numbers in italics are Holmes's estimates based on assumptions about areas not mapped in 1997. The total forest area of 100 million ha is Holmes's preliminary estimate based on assumptions about forest loss rates over the study period. It appears to overestimate by about 2 million ha.

Table 2.3 Forest Area and Deforestation, 1985–1997 (GFW Estimates))

	1985			1997				
Island	**Land Area** (Ha)	**Forest Cover** (Ha)	**Forest as % Land Area**	**Land Area** (Ha)	**Forest Cover** (Ha)	**Forest as % Land Area**	**Forest Change 1985–1997** (Ha)	**Forest Change** (%)
Sumatra	47,581,650	22,938,825	48	47,574,550	16,430,300	35	-6,508,525	-28
Java	13,319,975	1,274,600	10	13,315,550	1,869,675	14	595,075	47
Bali	563,750	96,450	17	563,150	76,700	14	-19,750	-20
Nusa Tenggara	6,645,625	686,775	10	6,639,925	450,450	7	-236,325	-34
East Timor	1,498,500	374,400	25	1,497,525	9,850	1	-364,550	-97
Kalimantan	53,721,675	39,644,025	74	53,721,225	29,637,475	55	-10,006,550	-25
Sulawesi	18,757,575	11,192,950	60	18,753,025	7,950,900	42	-3,242,050	-29
Maluku	7,848,175	5,790,800	74	7,846,600	5,820,975	74	30,175	1
Irian Jaya	41,405,500	35,192,725	85	41,403,850	33,382,475	81	-1,810,250	-5
Total	**191,342,425**	**117,191,550**	**61**	**191,315,400**	**95,628,800**	**50**	**21,562,750**	**-18**

Sources: 1985 forest areas are GFW estimates based on UNEP-WCMC, "Tropical Moist Forests and Protected Areas: The Digital Files. Version 1." (Cambridge: World Conservation Monitoring Centre, Center for International Forestry Research, and Overseas Development Administration of the United Kingdom, 1996). 1997 forest areas are GFW estimates based on the digital dataset developed by the Ministry of Forestry, Government of Indonesia and the World Bank. (Jakarta, Indonesia: GOI and World Bank, 2000). CD-ROM.
Notes: The apparent increase in forest area in Java between 1985 and 1997 is probably owing to plantation establishment. The poor quality of the spatial data for plantations in Java did not allow verification of this assumption. For further information on calculation of forest area and problems associated with "no data" areas, see Annex 3: Technical Notes, Table 2.3.

Table 2.4 Loss of Lowland Forest in Sumatra, Kalimatan, and Sulawesi, 1900-1997

Island	Assumed Forest Cover in 1900 (Ha)	Forest Cover in 1985 (Ha)	Forest Cover in 1997 (Ha)	Estimated Loss, 1985–1997 (Ha)	Estimated Loss, 1985–1997 %
Sumatra	16,000,000	5,559,700	2,168,300	3,391,400	61
Kalimantan	17,500,000	11,111,900	4,707,800	6,404,100	58
Sulawesi	2,200,000	546,300	60,000	486,300	89
Total	**35,700,000**	**17,217,900**	**6,936,100**	**10,281,800**	**60**

Source: D. Holmes, "Deforestation in Indonesia: A Review of the Situation in 1999." (Jakarta, Indonesia: World Bank, 2000).
Note: Lowland forest area for the three islands in 1900 is an estimate, based on what is known of human settlements at the time.

Loss of Lowland and Mangrove Forests

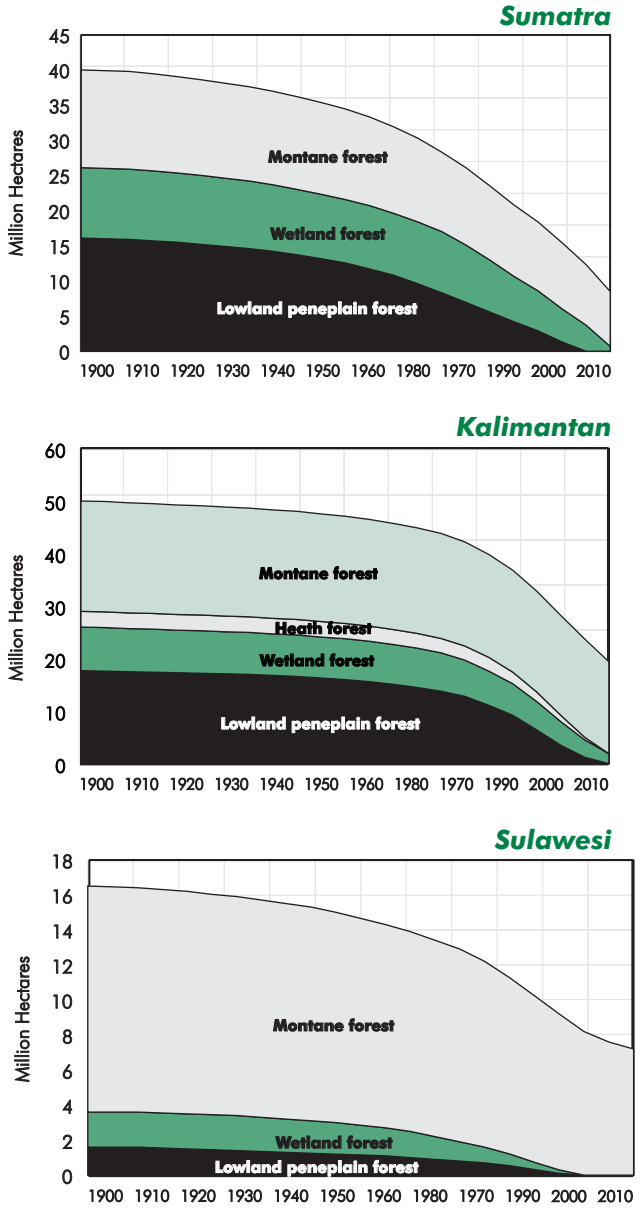
Throughout Indonesia, forest clearance began in the lowland areas, where topography and soil fertility were most favorable to human settlement and agriculture. Clearance for plantation crops in the Colonial era and for transmigration programs in the 1970s and 1980s also occurred largely in lowlands or gently sloping foothills. Commercial logging concentrated first on lowland forests, which are accessible, commercially valuable, and have the greatest potential for large-scale development. Unfortunately, lowland forests are also the most biologically diverse, harboring many of the most prized tree and animal species in Indonesia.

It is difficult to provide good estimates of how much lowland forest has been lost. Vegetation classification types used in the 1985 RePPProT survey and the National Forest Inventory of 1996 are not directly comparable, and the remote sensing survey supported by the World Bank in 1997 did not distinguish among different forest types. However, preliminary estimates by Holmes indicate that, although lowland deforestation was significant even before 1985, losses of this forest type have accelerated sharply since then. (*See Table 2.4.*) Approximately 60 percent of Indonesia's lowland forest in the three major islands was cleared between 1985 and 1997.

Figures 2.2, 2.3, and 2.4 illustrate the estimated loss of lowland and other dominant forest types in the three islands between 1900 and 1997; they also project the forest loss expected by 2010, assuming continuation of current deforestation trends. They indicate that lowland forest area in Sulawesi has already been reduced to statistical insignificance. In Sumatra, it will disappear altogether by about 2005 and in Kalimantan, soon after 2010.

Map 3 illustrates the spatial distribution of losses in lowland, submontane (upland) and montane forests

Figures 2.2, 2.3, 2.4 Changes in Forest Cover



***Source:** Holmes, 2000*

between 1985 and 1997. For purposes of this analysis, Global Forest Watch adopted simple elevation thresholds to define the three forest types: lowland forest below 300 m, submontane or upland forest at 300-1,000 m, and montane forest at above 1,000 m. These thresholds are lower than those adopted in the RePPProT, and are comparable with those used by Holmes in his analysis of lowland forest loss (Holmes, 2000).

Estimates of Indonesia's mangrove forest area are notoriously unreliable and outdated. According to the World Mangrove Atlas, the most reliable estimate dates from 1993, when the country's mangroves are believed to have covered approximately 4.25 million ha (Spalding et al., 1997:54-58). This estimate was based on the 1985 RePPProT survey, updated with maps provided to the World Conservation Monitoring Centre by the Asian Wetlands Bureau. However, other estimates for the mid-1980s are as low as 3.8 million ha or even 2.2 million ha. The Indonesian government reports that some 1 million ha of mangroves were lost between 1969 and 1980 alone, owing primarily to conversion to rice fields, aquaculture, and other agricultural uses (BAPPENAS, 1993). Continuing losses can be attributed to the development of shrimp ponds, logging activities, and local exploitation for fuelwood and building materials. Conversion to shrimp ponds is especially prevalent in East Java, Sulawesi, and Sumatra. Production of woodchips and pulp from mangroves is also increasing; chip mills have been built in Sumatra and Kalimantan, and a major mill has been built in Bintuni Bay, Irian Jaya, formerly one of the largest and most pristine mangrove areas in the world. The National Forest Inventory of 1996 estimates mangrove forest area at 3.5 million ha, implying a loss of 750,000 ha in just 3 years. However, accurate assessment of recent mangrove losses is almost impossible; it can only be stated that their destruction continues.

2.2 Forest Condition Today

Official Forest Function and Use

Virtually all forests in Indonesia are state-owned, and administratively defined forest lands are quite accurately mapped by the government in terms of their intended function and use. The Ministry of Forestry is responsible for land under Permanent Forest Status, that is, land that has been allocated for use as conservation forest, protection forest, limited production forest or production forest. (*See Glossary for explanation of these terms*.) However, these administrative definitions of forest land use do not correspond with actual tree cover. Thus the extent and condition of Indonesia's remaining forests are difficult to establish from official statistics.

The Ministry of Forestry is in the process of preparing updated maps of land under Permanent Forest Status as well as maps of vegetative cover within conservation and protection forests. Officials from the Ministry indicated that this new information would be made available for publication by Forest Watch Indonesia but, unfortunately, the data were not provided. In their absence, the most recent information remains that available from the *Ministry of Forestry Strategic Plan 2001-2005* and the data compiled by the World Bank (Holmes, 2000).

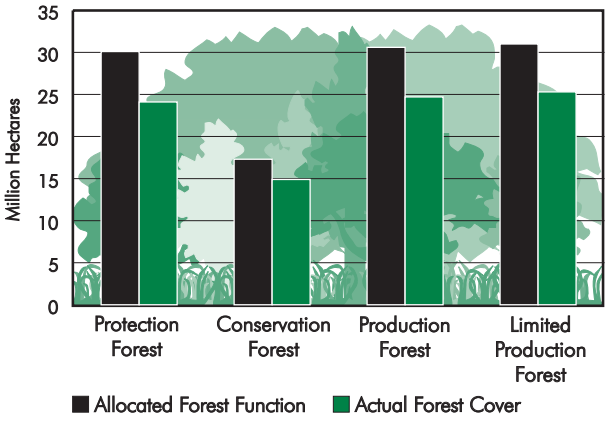
"Official" and "Actual" Forest Cover

Annex 2, Table 1 presents the World Bank's estimate of the area of land officially defined as Permanent Forest Status (114 million ha) and contrasts it with an estimate of land that was actually forested in 1997 (98 million ha). It appears that actual forests cover only 86 percent of the land defined as "forest" in Indonesia.

Another study provides more detail on actual forest cover within the various categories of permanent forest status (Fox, Wasson, and Applegate, 2000). It provides somewhat different estimates of the total area under Permanent Forest Status (109 million ha) and forest cover (89 million ha) but arrives at a comparable estimate of 82 percent for the amount of Permanent Forest Status land actually covered by forest. In every category, actual forest cover is smaller than the area officially allocated to that category, with the greatest shortfall found in protection forest (forest maintained for soil and water protection). (*See Figure 2.5*.)

In 1997, the Ministry of Forestry revised the land area under Permanent Forest Status, with the result that it decreased, possibly by as much as 20 million ha. (*See Table 2.5 and note*.) All categories of forest function were also revised: the areas allocated for protection forest and conservation forest increased, as did the area slated for timber production. The areas allocated for limited production and for conversion to nonforest uses decreased. These changes are not purely administrative; the area of conversion forest decreased in large part because it has already been converted. (Note, however, that the latest unpublished revision of Permanent Forest Status land *increases* the area of forest land allo-

Figure 2.5 Allocated Forest Function and Actual Forest Cover, 1997



Source: J. Fox, M. Wasson and G. Applegate. "Forest Use Policies and Strategies in Indonesia: A Need for Change." *Jakarta. Paper prepared for the World Bank. May, 2000.*

cated for conversion. See p. 45.) According to Holmes's analysis, it is likely that the additional protection forest area has been redesignated from limited production forest on steep slopes, a change that should aid in soil conservation. However, it seems likely that a great deal more land has been moved from limited production forest to production forest status, which may mean that other steeply sloping land will be opened for logging. The increase in conservation forest is probably explained by the establishment of new national parks and other protected areas, although such status is no guarantee of protection from logging and other forms of degradation. In the absence of spatial data, it is not possible to say where these changes in forest land classification occurred.

Table 2.5 Revisions to Permanent Forest Status Between 1986 and 2000

	1986		2000		Change 1986–2000	
Forest Classifications	**Area** (Ha)	**Area as % of Total**	**Area** (Ha)	**Area as % of Total**	**Area** (Ha)	**% Change**
Production	31,850,000	23	35,200,000	29	3,350,000	11
Limited Production	30,520,000	22	21,800,000	18	-8,720,000	-29
Protection	29,680,000	21	31,900,000	27	2,220,000	8
Conservation	18,250,000	13	23,300,000	19	5,050,000	28
Conversion	30,540,000	22	8,200,000	7	- 22,340,000	-73
TOTAL	**140,840,000**	**100%**	**120,400,000**	**100%**	**- 20,440,000**	**-15**

Sources: For 2000: Ministry of Forestry, "Ministry of Forestry Strategic Plan 2001–2005," (Jakarta, Indonesia, 2000). For 1986: RePPProT (Regional Physical Planning Programme for Transmigration), *The Land Resources of Indonesia: A National Overview*. (Jakarta, Indonesia: Land Resources Department of the Overseas Development Administration, Government of UK, and Ministry of Transmigration, Government of Indonesia, 1990).
Note: The total area of land with Permanent Forest Status in 2000, according to the Ministry data cited in this table, is considerably larger than that calculated by Holmes or by Fox, Wasson and Applegate, who also relied on Ministry data. It is possible that the data cited here include aquatic protected areas. The Ministry of Forestry included protected areas of lakes, rivers, and some coastal zones in the recent Permanent Forest Estate revisions. Disaggregated data are being prepared but were not available at the time of writing. Numbers may not add due to rounding.

The reality gap between official forest area and actual forest cover can be dramatic. In South Sumatra and Lampung provinces, for example, only one third of "permanent forest" land is covered with trees. In South Kalimantan, the proportion is less than two thirds. Despite such problems, official forest land use statistics form the basis for resource management decisions and spatial planning.

Forest Degradation

Forest Watch Indonesia analyzed spatial data from the National Forest Inventory in an attempt to determine the level of degradation in major forest types. The analysis concludes that in the mid-1990s, Indonesia had 59 million ha of natural forest unallocated for use as a concession of any kind, 41 million ha of degraded and potentially degraded forest, and 9 million ha

Box 2.2 Impacts of Logging on Dipterocarp Forests

The towering trees that make up the lowland forests of Indonesia are often referred to as "cathedral-like." Canopies in the Indonesian rainforest can reach nearly 50 m into the sky. The stalwarts of these forests are species of the family Dipterocarpaceae. They account for up to 80 percent of the tallest canopy trees, up to 10 percent of all tree species (Ashton et al., 1998:44-66), and constitute as much as 70 percent of the canopy tree biomass in the Indonesian forest (Curran and Leighton, 2000:101-128). Dipterocarps are late-successional trees, invading only forests that already have a closed canopy. They are extremely widespread, growing across lowland and mid-elevation forests in Southeast Asia and the Indian subcontinent. Dipterocarps are also some of the most valuable hardwoods in the world; a single tree may be worth many thousands of dollars. As a result of Indonesia's current economic crisis and decades of corruption, dipterocarp forests are being commercially logged at unprecedented and unsustainable rates.

The direct impact of logging on forests is obviously a net loss of trees. However, the indirect impacts play an important role in the future health of lowland forests. Logging poses real obstacles to seedling survival (Appenah and Mohd. Rasol, 1995). Young plants must not only contend with the trampling, skidding, and disruption caused by logging but also compete with faster growing pioneer species that can outgrow them to reach the precious light in the canopy. One study has shown that cutting back pioneer species and creating gaps in the canopy to generate more light increased survival of dipterocarp regeneration by 30 percent. In unmanaged areas, dipterocarps occupied only 25 percent of the area that they would normally cover (Kuusipalo et al., 1997).

However, the impacts of logging on these forests extend well beyond the boundaries of a logging concession. One of the most remarkable characteristics of dipterocarps is their reproductive pattern. After several years of little to no reproductive activity, nearly all dipterocarps and up to 88 percent of all canopy species may enter into a period of rapid flowering and fruiting. This phenomenon, first described by Dan Janzen, is known as mast fruiting. Janzen theorized that by fruiting synchronously, dipterocarps are able to overwhelm their seed predators with fruit and allow a greater percentage of their seeds to survive (Janzen, 1970; Janzen, 1974). This strategy works only when predators are naturally dispersed over a large geographical area. If predators are concentrated in smaller areas because of forest fragmentation and selective logging, their numbers may be sufficient to consume even a glut of seed production. The impact of a logging road can thus affect forest health several kilometers away.

A recent study has shown that mast fruiting episodes occur almost exclusively during El Niño Southern Oscillations (ENSOs). These events also appear to be critical to regional seed production and recruitment (Curran and Leighton, 2000). Despite the pronounced ENSO episode in 1997-1998, Curran and Leighton have found that since 1991, their study site, Gunung Palung National Park, has had nearly total seedling recruitment failure (Curran et al., 1999). Although Gunung Palung itself contains large areas of nondegraded, intact dipterocarp forest, it is almost completely surrounded by degraded land and logging concessions. The researchers believe that dipterocarp reproductive strategy is particularly vulnerable to disruption because success depends on the ability of predators to range over a large geographic area of forest. These studies underscore the need for effective forest management areas and a reassessment of the area and locations currently designated for logging.

Sources

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deforested by conversion to industrial timber or estate crop plantations or to transmigration sites. (*See Table 2.6.*) For purposes of this analysis, degraded forest is defined as forest area within logging concessions. Concessions that are being actively logged or have been logged in the past (sometimes 2 or 3 times) are invariably degraded. *(See Box 2.2.)* Some inactive or expired concessions may more correctly be described as potentially degraded. In the absence of attribute data regarding the status of concessions, it is not possible to provide separate estimates of degraded and potentially degraded forest. The area defined here as natural forest is characterized only by the fact that it is not under immediate threat of logging or conversion. It should be noted that officials from the Ministry of Forestry who were invited to review this report claimed that these data were no longer valid but they offered no alternative information.

Low Access and Accessed Forest

In an alternative approach to estimating the condition of Indonesia's forests, Global Forest Watch tried to determine how much of Indonesia's remaining forest is still relatively intact (called here "low access" forest) and how much is accessed, that is, disturbed by human activities. Low access forest is defined as forest land not in close proximity to roads, navigable rivers, human settlements, or other forms of development. (*See Glossary and Annex 3 for more detailed definitions of low access and accessed forests.*) Low access forests are the most important for providing habitat to Indonesia's rich biodiversity; their extent, contiguousness, and degree of protection are important indicators of conservation status.

Table 2.6 Natural Forest, Degraded Forest, and Deforested Area, Mid-1990s

Province	Natural Forest Area (Unallocated) (Ha)	Degraded Forest (Ha)	Deforested Area (Ha)
Aceh	2,360,745	1,025,858	362,835
Bengkulu	834,968	171,422	34,771
Jambi	1,197,210	1,071,679	522,858
Riau	1,487,067	2,671,417	1,705,401
West Sumatra	1,784,572	498,107	139,780
North Sumatra	2,183,429	386,006	365,656
Lampung	551,872	6,915	87,423
Total Sumatra	**10,399,863**	**5,831,404**	**3,218,724**
West Kalimantan	3,928,582	2,644,665	545,685
South Kalimantan	667,951	599,666	266,169
Central Kalimantan	536,450	8,447,911	2,089,952
East Kalimantan	5,961,932	8,845,655	1,368,415
Total Kalimantan	**11,094,915**	**20,537,897**	**4,270,221**

Table 2.6 *(cont.)* Natural Forest, Degraded Forest, and Deforested Area, Mid-1990s

Province	Natural Forest Area (Unallocated) (Ha)	Degraded Forest (Ha)	Deforested Area (Ha)
South Sulawesi	2,090,449	558,778	79,184
Central Sulawesi	2,986,684	937,100	75,994
Southeast Sulawesi	2,402,327	0	34,347
North Sulawesi	998,230	510,384	14,145
Total Sulawesi	**8,477,690**	**2,006,262**	**203,670**
Bali	76,417	0	0
East Nusa Tenggara	874,752	0	0
West Nusa Tenggara	629,122	74,188	685
Irian Jaya	23,806,213	10,287,807	1,105,466
Maluku	3,142,390	2,707,486	101,210
TOTAL	**58,501,362**	**41,445,044**	**8,899,976**

Source: Forest Watch Indonesia estimates based on National Forest Inventory, 1996.
Note: For more details on the methodology underlying this table, see Annex 3: Data Sources and Technical Notes.

We did not wish to underestimate the area of low access forest, so for this analysis, we overlaid the GOI/World Bank forest cover dataset with the NFI vegetation cover dataset in order to fill, wherever possible, the "no data" areas in the GOI/World Bank data. *(See p. 9.)* By doing so, we clearly inflated total forest area because the NFI dataset dates from the early 1990s and forest loss since then has been substantial. However, because this analysis is concerned with the area of low access forest – forest that is by definition relatively remote from access routes and development – this methodology was felt to be acceptable.

The analysis indicates that a total of just over 52 million ha may be defined as low access forest. A further 33 million ha meet most of the criteria for low access forests but are within logging concessions. It may be assumed that much of this forest area is far from intact. Map 4 shows the extent and distribution of low access forests, both outside and within concessions. Half of all low access forest outside logging concessions (25.6 million ha) is located in Irian Jaya, 9.2 million ha are in Kalimantan, 7.7 million ha in Sumatra and 6.5 million ha in Sulawesi. Only 2.4 million ha remain in Maluku and in remnant areas in Java, Bali, and Nusa Tenggara.

Fragmentation of Low Access Forests

For many species, the total area of low access forest is less important than the contiguous area of individual forest blocks. When habitat is broken into fragments by roads or other developments, some species populations are reduced to the point at which they are no longer viable. Low access forests, whether formally protected or not, take on the

FWI Sulawesi

character of islands, where wide-ranging species are fated for extinction at the local level. Map 5 depicts the distribution of remaining unfragmented forest in three size categories: 20,000-50,000 ha, 50,001-1 million ha, and over 1 million ha. The size categories reflect the generalized experience that populations tend to decrease in smaller fragments of habitat and that species requiring large home ranges will be absent (Thiollay, 1989; Bierregaard et al., 1992).

Protected Areas

Indonesia was one of the first countries to sign the Convention on Biological Diversity (CBD) and to prepare a National Biodiversity Strategy and Action Plan. During the 1990s, many of the Action Plan priorities were implemented, including expansion of the Protected Area (PA) system and creation of several new conservation areas such as Bukit Tigapuluh National Park in Riau Province, extensions to Gunung Leuser, and two new parks in Nusa Tenggara. Despite this activity, the conservation situation in Indonesia is, in the words of the World Bank, "dire" (World Bank, 2001:32).

The significant loss of natural habitats, especially lowland forests but also coastal, marine, and freshwater ecosystems, means that the country is "almost certainly undergoing a species extinction spasm of planetary proportions" (World Bank, 2001:32). Although habitat loss is probably the main reason for continued biodiversity loss in Indonesia, habitat fragmentation and degradation, hunting, and poaching are also important factors.

To determine how much of Indonesia's low access forest is under some degree of protection, we overlaid the low access forest grid with the most recent spatial data available from the World Conservation Monitoring Centre (UNEP-WCMC). A total of 9.2 million ha of low access forest are protected under World Conservation Union (IUCN) categories I-IV, and a further 2.5 million ha are included in the weaker protection categories V and VI.[5] The distribution of low access forests in all six protection categories is shown in Map 6. Almost half the low access forest protected under categories I-IV is in Irian Jaya; another 2 million ha are in Sumatra, and 1.5 million ha in Kalimantan. To provide a more detailed picture of the protection status of low access forest, Map 7 shows the distribution of protected areas in Kalimantan.

Protected area boundaries are proving a poor defense against the illegal logging, agricultural encroachment, and poaching that afflicts so much of Indonesia's forests. According to our analysis, approximately 1.3 million ha of low access forest are simultaneously protected and within logging concessions. Illegal settlement and logging are rampant even in some of the most well-known protected areas which are sites of important donor programs. According to the World Bank, some 30,000 ha of forests in the northern area of Sumatra's Bukit Barisan Selatan National Park have been lost in the past few years, and major problems with illegal loggers continue in the national parks of Gunung Leuser and Bukit Tigapuluh (Sumatra), and Tanjung Puting and Gunung Palung (Kalimantan) (World Bank, 2001:34). (*See Box 3.3.*) Development of estate crop plantations can also be a problem inside national parks. Box 2.3 illustrates the complexity of the economic, social, cultural, political, and environmental interests that must be reconciled.

Box 2.3 Oil Palm Development in Gunung Leuser National Park

Gunung Leuser National Park is one of Indonesia's oldest and largest national parks, covering nearly 900,000 ha in Aceh and North Sumatra provinces at the northern end of Sumatra. During the Dutch colonial era, much of the area was already gazetted as nature reserve; some areas where people lived within the boundaries were declared as settlement "enclaves" in 1935. One of these areas, covering 4,200 ha, was Sapo Padang, an enclave in the part of the park lying in North Sumatra. By 1953, however, residents abandoned Sapo Padang and the area had reverted to secondary forest by the 1990s.

In November 1995, the regent of Langkat regency proposed to build a road through the national park to the former enclave, and 34 families rapidly relocated to the old Sapo Padang village site, apparently sensing economic opportunity. Some of the families formed a local cooperative (KUD) in March 1996, and in August 1997 made a proposal to develop an oil palm plantation in the enclave. The regent granted their request that October, and the head of the national park agreed to construction of the road.

To implement the oil palm scheme, the Sapo Padang KUD formed a partnership with an oil palm factory called PT Amal Tani, owned by the immediate family of Jamin Ginting, the commander of the nearby Kodam I Bukit Barisan military unit. The director of Amal Tani became an executive of the KUD. The military unit's charitable foundation, Yayasan Kodam I Bukit Barisan, also entered the picture, agreeing to cooperate with the KUD as implementers of the government's Poverty Alleviation Program.

The scheme called for clearance of 4,250 ha of forest and development of oil palm in the area. For the plan to work, the access road was essential. The principal function of the military foundation in the partnership was to organize all "administrative details" related to obtaining permission to build the road, while the Sapo Padang KUD took charge of forest clearance and planting.

The military foundation efficiently discharged its part of the deal, and the then-Forestry Minister granted permission in January 1998 for the 11 km road to be built. In June 1998, the local office of the Forestry Service issued a decree (No. 6201/1/783) stating that the Sapo Padang enclave was no longer legally a part of the national park.

This controversial decision disturbed many stakeholders because building the road would clearly lead to forest destruction in the park. Some local residents are convinced that the decision will invite newcomers and planters who will slash and burn their way ever deeper into park territory. Many people believe, based on prior experience, that oil palm development will not be restricted to the enclave area. But as is often the case in such situations, local opinions vary, with some people eager to profit from the development of hitherto inaccessible national park forest land.

The facts were uncovered and publicized through field investigations carried out by the Leuser Conservation Foundation (YLL), a local NGO, during 1997 and 1998. YLL's reports were taken up by another NGO, the Titian Foundation, which publicized the case to numerous parties and the press. As a result, a consortium of NGOs brought several lawsuits against those involved in the Sapo Padang oil palm scheme.

In 1999, two local university-based NGOs—Generasi Pecinta Kelestarian Alam (Generation of Nature Lovers) and Himpunan Mahasiswa Pecinta Lingkungan Penyayang Alam (Association of Student Nature Lovers)—brought a lawsuit in the Medan State Court, while another group—Forum Komunikasi Pengacara 61 (the Lawyers' Communication Forum 61, or FKP) brought a parallel case in the National Administrative Court. Both suits charged a variety of civilian officials from national, provincial, and local government, the military foundation, the Sapo Padang KUD, and PT Amal Tani (as well as PT Kencana, another partner firm in the scheme), accusing them of violating a number of environmental, forestry, and administrative laws and regulations.

In July 1999, the Administrative Court threw out FKP 61's suit on the grounds that the organization did not have standing to bring suit because it was a lawyers' association rather than an environmental organization. In September 1999, however, the local NGOs won their case in the Medan State Court, which ordered the defendants to pay 300 million rupiah (approximately US$30-35,000 at mid-2001 exchange rates) in compensation for damage to the park caused by the project, and further ordered them to restore the area to its former condition. The defendants appealed to the North Sumatra High Court, which had not ruled on the case by the beginning of 2001. The legal process did not stop the project, however, and the local press continues to report extensive logging and clearing, road-building, and oil palm planting in the project area within the park. By the time the courts ultimately rule on the case, it may be too late to remedy the damage.

Source: Field investigations by the Leuser Conservation Foundation (YLL), and YLL review and monitoring of administrative and court decrees and decisions and local press reports, 1997-2000.