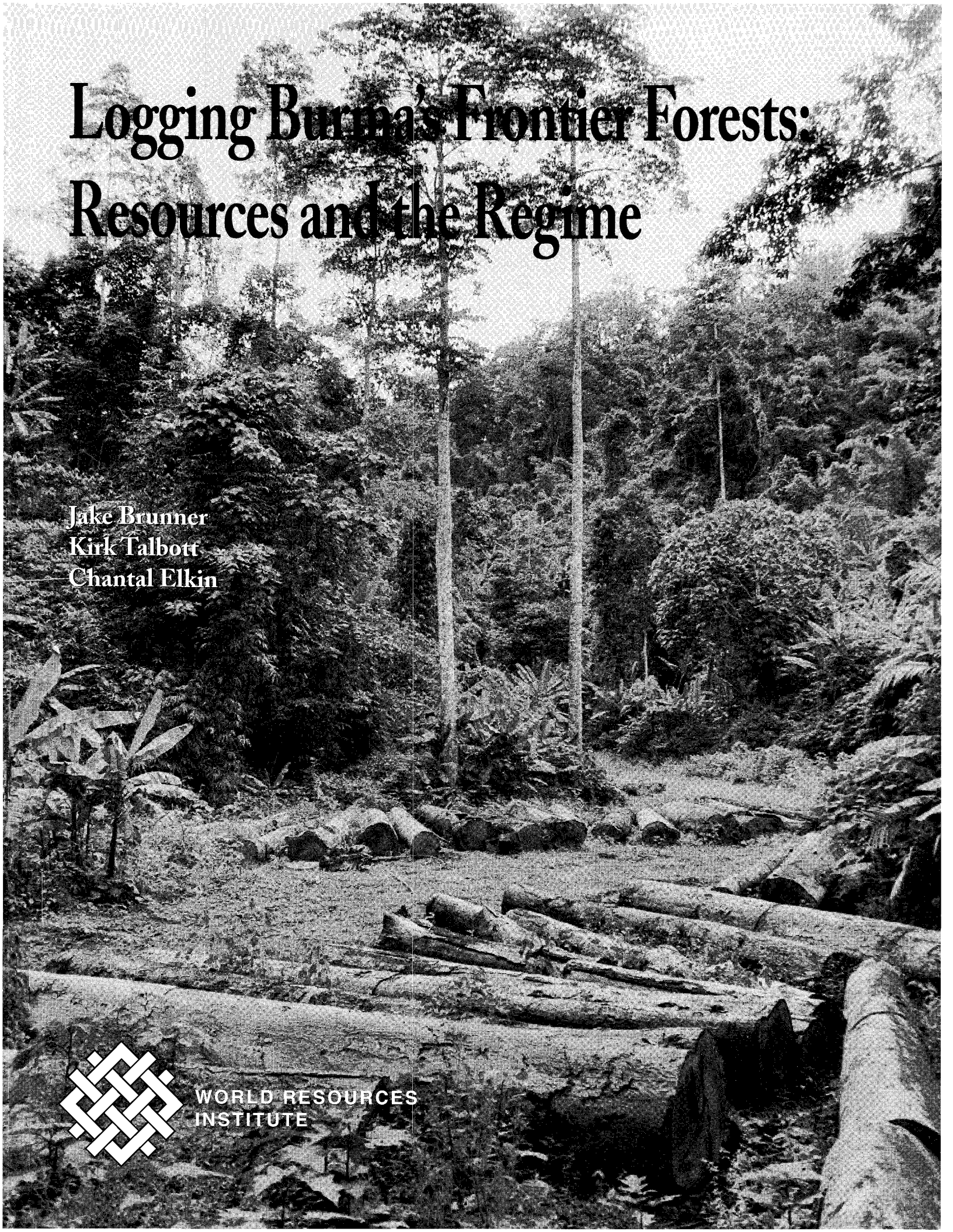
Logging Burma's Frontier Forests: Resources and the Regime



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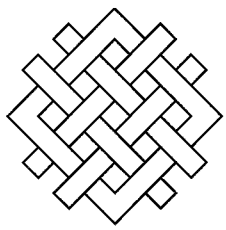

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Contents

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A draft copy of the report was sent to the Forest Department for review, and in October 1997, one of the authors (J.B.) traveled to Rangoon to discuss the draft. None of the major findings of the report was challenged. Department staff were prepared to discuss general issues regarding protected areas management and community forestry but refused to discuss logging in the border areas.

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J.B.
K.T.
C.E.

[1] To subscribe to BurmaNet, send the command "subscribe burmanet-l" to "majordomo@igc.apc.org".

[2] Unlike economic assessments by the World Bank and the International Monetary Fund published in 1995, *Foreign Economic Trends* corrects for the systematic distortions introduced by the dual exchange rate and other errors and omissions that appear in official statistics.

Acronyms

AVHRR	Advanced Very High Resolution Radiometer
CPB	Communist Party of Burma
ERI	EarthRights International
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
HT	Hoppus ton
IMF	International Monetary Fund
ITTA	International Timber Trade Agreement
ITTO	International Tropical Timber Organization
IUCN	World Conservation Union
KIO	Kachin Independence Organization
KNU	Karen National Union
LAC	Local Area Coverage
MSS	Multi-spectral Scanner
MTE	Myanma Timber Enterprise
NCGUB	National Coalition Government for the Union of Burma
NDA	New Democratic Army
NGO	Nongovernmental organization
NLD	National League for Democracy
NMSP	New Mon State Party
SAIN	Southeast Asian Information Network
SLORC	State Law and Order Restoration Council
SPDC	State Peace and Development Council
TM	Thematic Mapper
TREES	Tropical Ecosystem Environment Observations by Satellite
UMEH	Union of Myanmar Economic Holdings
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNICEF	United Nations Children's Fund
WCS	Wildlife Conservation Society
WRI	World Resources Institute
WWF	World Wildlife Fund for Nature

Major Findings

1. Burma holds half of the remaining forest in mainland Southeast Asia. Having lost virtually all of their original forest cover, Burma's neighbors—China, India, and Thailand—rely increasingly on Burma as a source of timber. Most of the regional timber trade is illegal.

2. The rate of deforestation in Burma has more than doubled since the State Law and Order Restoration Council (SLORC), the military regime that rules the country, came to power in 1988.

3. Increased deforestation is primarily due to a rapid growth in logging in Burma's border areas. Timber exports have helped pay for the regime's arms purchases and a doubling in the size of the army.

4. Seventeen of the 20 ethnic minority armies, many of which have been in insurrection since independence in 1948, have negotiated cease-fires with the regime, but not peace agreements. The current situation of "no peace, no war" has encouraged unbridled logging in some of the border areas.

5. Wasteful and destructive logging by the regime, some of the ethinic minorities, and foreign companies along the borders with China and Thailand has resulted in extensive deforestation that has caused massive soil erosion, sedimentation of rivers, increased flooding, and acute dry season water shortages in some areas.

6. Satellite data show that forest clearing in Kachin State more than tripled between 1978–1989 and 1989–1996, and that logging is responsible for almost half the deforestation. Kachin State holds one of the region's last large tracts of relatively undisturbed forest. The rapid fragmentation of this forest, and the biodiversity conservation and watershed protection it provides, is of national and international concern.

7. Opinion is divided on whether the international community should engage the regime to support forest conservation in Burma. Only limited opportunities exist for the international community to provide effective support to local communities or to the Forest Department, or to engage the regime through Burma's signatory status to international agreements.

8. Under current political circumstances, there is no scope for direct engagement by the international community. It is therefore recommended that an independent satellite-based forest monitoring system be established to report on the state of Burma's forests, that environmental issues be included in the international dialogue about how to influence the regime, and that the international community take advantage of international agreements to request information from the regime about forest management and timber production.

1. Introduction

Burma holds more than half of mainland Southeast Asia's closed forests—forests that have caused the country to be called "the last frontier of biodiversity in Asia" (Forest Department, 1997b).[1] Yet these forests are not inexhaustible resources. Deforestation is increasing, and an analysis of current satellite data shows that Burma's remote frontier forests are now threatened. Although agricultural conversion, fuelwood cutting, and charcoal production are the main causes of deforestation in the lowland areas of central and southern Burma, logging appears to be an important factor in the fragmentation of the remaining intact forests that cover Burma's mountainous border areas. This report focuses on the environmental implications of logging in these areas and on the political and economic forces behind this logging.

The report does not argue against logging per se. History shows that countries liquidate a portion of their natural capital to build the roads, schools, hospitals, and other services needed to develop their human resources (World Bank, 1997). The World Bank estimates that human resources form the dominant share of wealth, even in low-income countries, and that failure to invest proceeds from wealth-generating activities (e.g., logging) in a country's human resources leads inexorably to impoverishment. This is the course that Burma appears to be following. According to the U.S. Embassy in Rangoon, defense spending has increased, and health and education spending have decreased, both in real terms and as shares of government disbursements, since the State Law and Order Restoration Council (SLORC) was formed in September 1988. In fact, the ratio of military to social service expenditures is by far the highest in the region.

Instead of arguing against logging itself, the report makes the following points. First, properly managed, Burma's forest resources can make a substantial contribution to the country's development through timber production, tourism, and watershed management. Second, in the past 30 years, Burma's forests have suffered from unsustainable logging—much of it illegal. Since 1988, the trend has accelerated, most sharply in the border areas. Third, the long-term conservation of Burma's extraordinary biodiversity will require a degree of local management to ensure the implementation of policies that will be respected and supported by the population.

The report is divided into seven parts. Chapter 2 presents bibliographic and statistical data describing Burma's forest types, documents the intensification of commercial timber production since 1962, and outlines relevant provisions of the 1995 Forest Policy. Chapter 3 presents evidence that increased timber exports, particularly since 1988, are related to the regime's increasingly desperate search for foreign exchange and growing demands from Thailand and China for wood. Most of these exports are unreported by the regime. Chapters 2 and 3 also provide background information on the declining state of forest management and biodiversity conservation in Burma. Chapters 4 and 5 focus on the border areas. Chapter 4 covers the recent history of logging along the Thai and Chinese borders and describes some of its negative environmental consequences. Chapter 5 provides a detailed analysis of the situation in Kachin State, one of the most remote and densely forested regions in Southeast Asia. Satellite data show that these forests are being fragmented by a combination of shifting cultivation and logging. Logging, according to eyewitness reports, has taken off since cease-fires were signed between Rangoon and the ethnic minority armies in 1989. Chapter 6 deals with the issue of whether the international community should engage the regime to promote forest and wildlife conservation in Burma. Chapter 7 provides conclusions and recommendations. Appendix A describes how the satellite data were processed and interpreted and Appendix B contains maps of the region.

1.1 Physical Geography

Burma has a total area of 676,553 square kilometers (km^2) and is situated in the northern part of mainland Southeast Asia, with an elongated length of 2,100 kilometers (km). High mountain ranges form a continuous barrier along the western border with India and Bangladesh, and extend southward parallel with the coast almost to the Irrawaddy Delta. *(See Figure 1, Appendix B.)* In the northeast, the border with China follows the high crest of the Irrawaddy- Salween divide, then bulges eastward to enclose the mountainous Shan

Plateau that borders Laos and Thailand. West of the Shan Plateau lies the fertile, heavily populated Irrawaddy Valley, with its largest tributary, the Chindwin, joining it from the northwest. The Salween flows south from China, cuts through the Shan Plateau, and empties into the Gulf of Martaban near Moulmein. The west Arakan and southern Tenasserim coasts consist of narrow plains and parallel mountain ranges of moist forest, with an extensive delta and mangrove areas around the mouth of the Irrawaddy.

Burma's climate varies greatly from the temperate north and high-altitude zones to the equatorial regions far south. Annual rainfall ranges from over 5,000 millimeters (mm) along the coast to less than 800 mm in the rain-shadow of the Central Dry Zone where mountains running along the Arakan coast block the heavy monsoon rains. Most of the rainfall arrives between mid-May and October; a cold season occurs from November to January, followed by a hot season from February to mid-May.

1.2 Human Development

In 1993, Burma's population was estimated at 44.6 million, based on the most recent census, which was conducted in 1983. Three quarters of Burma's population live in rural areas, predominantly as subsistence farmers. *(See Figure 2, Appendix B.)* The population comprises about 28 million (60 percent) Burmans from southern and central Burma, and about 17 million (40 percent) members of ethnic groups that inhabit the arc of mountains along Burma's borders. The largest ethnic groups are the Karen (9 percent), Shan (7 percent), Chin and Mon (2 percent each), and Kachin and Wa (1 percent each).

Living standards have deteriorated steadily during the 35 years of military rule. Recent health and education surveys show that the leading indicators of human development—infant mortality (9.4 percent), under-5 mortality (14.7 percent), maternal mortality (14 percent), under-3 malnutrition (32.4 percent), primary school completion (27 percent), and income on a purchasing-power-parity basis (US$700)—are much worse than the regional average and, in some cases, have deteriorated sharply since 1987 (UNICEF, 1995). Conditions are generally worse in the seven states where the majority of the ethnic minorities reside. For example, infant mortality rates in ethnic Karen regions and in eastern Shan State are estimated at 20 percent and 30 percent, respectively (Smith, 1994). There are not sufficient funds for basic health and education services because of a persistent government refusal to allocate any part of its foreign exchange earnings to the nonmilitary sector.[2] Education and health represented 12 percent and 4 percent, respectively, of legal central government expenditures in 1995, or less than one third of defense expenditures (U.S. Embassy, 1996).

Burma's absolute and relative decline is captured by the United Nations Development Programme's (UNDP's) Human Development Index. According to the index, which combines purchasing power, literacy, and life expectancy, Burma is a "low human development" country, ranked 133 out of 174 countries—81 places behind Thailand, 12 places below Vietnam, and just 5 places above Laos (UNDP, 1996). The World Bank, the Asian Development Bank, and the International Monetary Fund are currently prohibited from lending to Burma because of the regime's excessive military expenditures, lack of macroeconomic transparency, and human rights abuses.

1.3 Recent Political and Economic History

After gaining independence from Britain in 1948, the Union of Burma was considered the country in Southeast Asia most likely to succeed economically. Real growth of gross domestic product (GDP) averaged more than 6 percent between 1950 and 1960, and Burma was the world's second largest rice producer, with an abundance of mineral wealth and extensive forest cover. In addition, the country had a high literacy rate, a free press, and an elected parliament. Yet, Burma also contained more than 40 ethnic groups, and problems of cohesion soon surfaced. Within 2 months of independence, the Communist Party of Burma rebelled, and shortly thereafter, the Karen, Burma's largest ethnic minority, began their struggle for independence.

In 1962, the prospect that negotiations underway between Rangoon and leaders of the ethnic minorities might lead to the creation of a federal system, which would have given more power to the ethnic states, triggered a military coup and the installation of General Ne Win as dictator. After ruling by decree for 12 years, General Win promulgated a new constitution in 1974 that provided for a unitary state composed of seven divisions in Burma proper and seven minority states, all of which were to be controlled from Rangoon, the capital city. Yet the failure to allow a meaningful degree of ethnic autonomy led to continued fighting that, until the recent cease-fires, killed about 10,000 people a year, most of whom were civilians, with large fluctuations in the number of deaths depending on the intensity of the fighting. The civil war has also generated more than a million refugees. Another million or so have been forcibly displaced by the regime for security reasons (Smith, 1994).

From 1962 to 1988, the military dictatorship imposed a centrally planned economy aimed at national self-sufficiency, which it styled the Burmese Way to Socialism. Manufacturing and trade were monopolized by the regime, and farmers' surpluses in Burma's largely agricultural economy were purchased and distributed at prices set by the regime. National income stagnated and, in the mid-1980s, started to decline. In 1987, Burma was officially recognized as a "least developed nation" by the United Nations.

In August 1988, following a poor harvest and the third of Ne Win's demonetizations of much of the local currency, antigovernment demonstrations erupted throughout Burma and swiftly developed into a broad-based prodemocracy movement, of which Aung San Suu Kyi, daughter of the leader of Burma's struggle for independence in the 1940s, emerged as one of the central figures. In the face of this movement, Ne Win resigned; in September 1988, however, the military reacted by bloodily suppressing the prodemocracy movement and transferring power to the State Law and Order Restoration Council (SLORC).

The SLORC is a collective decision-making body with 21 members and 3 acknowledged leaders: Army Commander-in-Chief General Than Shwe, Army Deputy Commander-in-Chief General Maung Aye, and Director of Defense Services Intelligence Lieutenant General Khin Nyunt. Little is known about the precise way in which decisions are made within the SLORC, or even the extent to which the top three leaders have absolute vetoes or qualified vetoes.

The SLORC permitted a relatively free election in May 1990 but failed to honor its results—an overwhelming rejection of military rule—or to cede power to the victorious National League for Democracy (NLD) led by Aung San Suu Kyi, who won the Nobel Peace Prize in 1991 for her unflagging efforts to pursue democracy and ethnic reconciliation by peaceful means. Instead, the SLORC attacked the elected NLD representatives through intimidation, detention, and house arrest.

Unfortunately, the SLORC's repression of human rights continues. According to Amnesty International, 1996 was Burma's worst year for human rights.

On November 15, 1997, the SLORC was officially dissolved and renamed the State Peace and Development Council (SPDC), a move apparently designed to win international legitimacy. The council consists of 19 officers, many of whom are regional commanders, rather than the generals that had dominated the SLORC.

2. The State of Burma's Forests

Most of Burma's undisturbed closed-canopy forests are located in the mountains that ring the country. *(See Figure 3, Appendix B.)* The lowlands of central and southern Burma have been largely deforested since the turn of the century as a result of agricultural conversion, firewood cutting, and charcoal production.

Natural vegetation varies with altitude, latitude, and climate. *(See Figure 4, Appendix B.)* The climax vegetation in coastal areas is lowland rainforest with mangroves and freshwater swamp in the Irrawaddy Delta and flood plain. The Irrawaddy Valley includes a Central Dry Zone of open stunted dry deciduous woodland, known as *indaing,* and some thorn scrub. Peripheral to the Central Dry Zone are extensive mixed deciduous forests that are of great economic importance as the source of Burma's teak and other commercial hardwoods. These are, in turn, surrounded by a fringe of moist evergreen forests and evergreen montane forests in the arc of higher hills to the west, north, and east, merging in the far north with temperate oak and subalpine conifer forests and ultimately fir, birch, rhododendron, and other subalpine vegetation.

The rules governing exploitation of Burma's forests are given by the Forest Law that was promulgated in November 1992, superseding the 1902 Forest Act. The law marks a shift away from treating Burma's forests as a purely commercial resource. It emphasizes the importance of forests' contribution "toward the food, clothing, and shelter needs of the public and for perpetual enjoyment of benefits by conservation and protection of forest," the importance of "international agreements relating to conservation of forests and conservation of [the] environment," and the need to "promote the sector of public cooperation in implementing the forest policy of the government" (SLORC, 1992).

A Forest Policy was approved by the Ministry of Forestry in July 1995. It sets specific objectives and policy measures in the areas of environmental protection and management, reforestation, forest industry and trade, forest research, institutional strengthening, and people's participation and public awareness (Ministry of Forestry, 1996). The policy was prepared with the assistance of the Food and Agriculture Organization of the United Nations (FAO). To understand the significance of the new policy, it is necessary to review the historic conditions that have influenced both timber production and biodiversity conservation in Burma.

2.1 Timber Production

Burma hold's 70 percent of the world's remaining teak forests. Teak (*Tectona grandis*) is one of the most valuable tropical timber species and occurs naturally only in India, Burma, northern Thailand, and northwestern Laos.[3] It is extensively used for shipbuilding, furniture, carving, and numerous other purposes. The properties of teak that make it so valuable are "lightness with strength, stability, ease of working without cracking and splitting, resistance to termites, resistance to fungi, resistance to weather, and non-corrosive properties" (Kaosa-ard, 1989). The physical and mechanical properties of teak are superior to other well-known temperate timber species, including ash, beech, oak, pine, and walnut.

The systematic management of Burma's natural teak forests dates back to 1856. It was originally based on an exploitation-cum-cultural system known as *taungya* (shifting cultivation) forestry. Under this system, Karen planted teak alongside crops in their *taungya*; as the cultivators moved to a new area after a couple of years, the process was repeated, and teak plantations were created. The scientific basis of this system was formalized as the Brandis Selection System, later known as the Burma Selection System. The system involves adoption of a 30-year felling cycle, prescription of exploitable sizes of trees, girdling (killing of teak trees in preparation for felling), thinning of congested teak stands, systematic selection of seed trees, removal of other trees interfering with the growth of young and old teak, enumeration of the trees left, carrying out of special sylvicultural operations in bamboo flowering areas, and fixing annual yield based on the Brandis formula. For teak, the exploitable diameter limit varies with the type of forest. In good (moist) forest, the diameter limit at breast height is 73 centimeters (cm), and in poor (dry) forest, it is 63 cm. At the time of selection, teak trees down to a 29-cm diameter are recorded to serve as the basis for calculating future yields. Properly implemented, the Burma Selection

System has proved successful at maintaining a high yield of top-quality timber with minimum environmental impacts in the mixed deciduous forests of central and northern Burma.

Responsibility for the commercial exploitation of Burma's forests is vested in the Myanma Timber Enterprise (MTE), formerly the State Timber Corporation. The Forest Policy "assigns the MTE an autonomous status so that it runs on a business enterprise basis with capability to make on-the-spot decisions" and "entrusts to the MTE the responsibility for only harvesting, marketing, and trade of forest products on [a] commission basis." The policy establishes the MTE as an enterprise wholly owned by, and financially accountable to, the SLORC and independent of the Forest Department. The MTE enjoys a monopoly on the production and trade of teak and other hardwoods.

The MTE sells sawn teak at fixed prices (MTE, 1995), whereas teak logs are sold at monthly auctions, a system that allows the MTE to maximize its revenues. About 6,500 Hoppus tons (HT)[4] are sold at each auction, yielding the MTE a gross income of more than US$230 million a year. The MTE sells eight grades of teak. The top four grades are trimmed and inspected to ensure a straight grain, an absence of defects, and an even color and texture; they are used to produce veneer.[5] According to a teak trade specialist, logs of this quality have become quite rare because of a drastically shortened cutting cycle. Under the Burma Selection System, the forest was closed for 30 years. Today the loggers return in "a few years."

Traditionally, logging in Burma has been carried out using elephants for both economic and practical reasons. Using elephants also minimizes environmental damage on steep slopes and erosion-prone terrain. However, external assistance provided to the forestry sector in the 1980s tended toward more intensive forms of forest exploitation, with heavy investments in mechanized logging equipment and, consequently, increased environmental damage. In 1989, the World Conservation Union (IUCN, 1989) concluded that "should this trend continue, it will constitute a major threat to the survival of Burma's forest ecosystems and their irreplaceable genetic resources, including wildlife. At the same time the preponderance of aid channeled to the State Timber Corporation for logging operations has drawn national personnel and material resources away from the Forest Department, and thereby greatly reduced its capacity for effective forest management."

The balance of power between the MTE and the 15,000-strong Forest Department has shifted dramatically since the military coup in 1962. Under Ne Win, the timber industry was nationalized, taken over by the military, and run by officers with no training in forest management. Logging became a significant factor in Rangoon's effort to reassert control over the national territory (Bryant, 1994) and an important source of revenue. Foreign exchange earnings from timber exceeded those from agriculture for the first time in the 1980s. The Forest Department is technically responsible for selecting, girdling, and felling the trees, and for postharvest inspection. The MTE is responsible for shipping the logs to port and for marketing them. In practice, however, the MTE operates independently of the department and determines its own cutting cycle and harvesting volume.

Teak production expanded significantly after the military coup in 1962. *(See Table 1.)* Since 1971, the annual allowable cut has been set at 609,500 cubic meters (m^3) for teak and 2,463,600 m^3 for other hardwoods (Forest Department, 1996). As Table 1 shows, teak production exceeded that limit by an average of 15 percent between 1970 and 1990. Some reports indicate that timber production in many areas exceeded the limit by as much as 26 percent during the 1980s (Marchak, 1995). The department's own figures also show that teak production exceeded the annual allowable cut in three of the four years between 1989 and 1992 (Saw Han, 1995). Although occasionally exceeding the allowable cut is no cause for concern, 30 years of cumulative overextraction, with no sign of a letup, is indeed alarming.

Another concern is that the annual allowable cut is based on timber-working plans that are almost 30 years old. The difference between actual production and a sustainable annual limit may, therefore, be even greater than the figures indicate. Moreover, the annual allowable cut is calculated on the basis of the entire national teak forest, including forest that is off-limits because of insurgent activity, but is applied without modification

Table 1. Average Annual Timber Production, 1950–1990 (cubic meters)

	Timber Production	
Year	Teak	Other Hardwoods
1950–1960	331,095	1,085,759
1960–1970	603,209	1,196,442
1970–1980	651,578	918,267
1980–1990	736,771	990,641

Source: Forest Department, Rangoon, 1996.

to the accessible areas. Inevitably, this has led to serious overcutting of teak in the accessible forest (Bryant, 1998).

The Forest Department is currently preparing a new working plan to meet the criteria and indicators for sustainable forest management set by the International Tropical Timber Organization, which Burma joined in 1993. However, a source close to the department doubts whether the working plan will ever be seriously implemented given the department's lack of political influence and financial resources. Foreign exchange earnings from the MTE's auctions go directly to the central coffers. Even the derisory export tax of 1,000 Kyat per HT payable by the MTE on every tree felled—less than 1/1,000th of its market value—does not accrue to the department.

Because of insufficient government funding, the department can afford to pay laborers only one-fifth of a living wage. As a result, few of the labor-intensive tasks prescribed by the Burma Selection System are carried out, leading to inadequate forest management and no improvement in the genetic material. Extremely low wages for forestry workers also lead to rampant corruption, further undermining the department's ability to enforce its own policies. The department is therefore trapped between two forces: a growing demand from the regime to log for export, and a declining capacity to implement the Burma Selection System. In the long term, unsustainable logging will lead to the liquidation of Burma's teak stocks. In the short term, the need to gain control of teak-rich forests has contributed to Rangoon's policy of aggression toward the Karen and other ethnic minorities that inhabit the Thai-Burmese border.

The impact of unsustainable logging is shown by the Forest Department's 1994–1995 National Forest Survey and Inventory in Bago Yoma, the mountain chain running north of Rangoon where Burma's finest teak stands are found. The results show a severe shortage of trees smaller than 2.5 m in diameter, equivalent to about 20 years' growth. The deficit is greatest for trees between 0.6 and 0.9 m in diameter, for which just one eighth of the expected number were observed. This is the result of insufficient replanting and thinning, and a shorter felling cycle since 1962. The same survey shows that teak densities have fallen from 50 HT per 100 hectares to 6 today, a 90-percent reduction. In the words of one specialist, the Burma Selection System has "totally broken down." Even the department concedes that "existing institutional capacity is unable to enforce scientific logging or to control heavy logging waste and loss of timber in transit" (Forest Department, 1997b).

The private sector is only allowed to participate in value-added timber processing such as the production of sawnwood, plywood, and veneer. According to the Minister of Forestry: "Our policy today is to grant harvest quotas to Singapore, Hong Kong, and Taiwanese companies. Never again will we give concessions" (Asia Inc., 1996). But according to a report prepared as part of an overview of transnational logging companies, Idris Hydraulic, a Malaysian logging company with major real estate interests in Rangoon, entered into an agreement with the MTE in January 1995 to jointly develop a concession of 1.2 million hectares (ha) (Ferrari, 1997). Given the ban on foreign concessions, this is likely to involve the MTE managing the concession and Idris Hydraulic providing capital and expertise. If, as is stipulated in the Forest Policy, such foreign investment is confined to timber transformation and other value-added activities, this agreement would be an encouraging development given the inefficiency of the MTE-owned saw mills and the large volume of timber required per unit output. However, if the investment is in machinery and heavy equipment to speed up logging, a move that would be consistent with a 35-year trend toward higher volume harvesting, forest degradation would be accelerated.

2.2 Protected Area Management

As a result of an extremely wide range of physical conditions, Burma is rich in biological diversity, containing 251 known mammal species, 867 breeding bird species, 203 types of reptiles, 75 types of amphibians, and 7,000 different flowering plants (WCMC, 1994 and unpublished data on rare and endangered species, 1997). According to a recent study by the World Wildlife Fund and the Wildlife Conservation Society, 40 percent of Southeast Asia's highest priority tiger habitat areas lie in Burma, all of them in border regions.

Between 1981 and 1984, FAO and the United Nations Development Programme (UNDP) supported the Nature Conservation and National Parks Project, which was concerned with undertaking field surveys and identifying areas suitable as national parks or nature reserves. Although some of the most promising sites, located in northern Burma, were inaccessible for security reasons, several potentially valuable conservation areas were proposed (Blower, 1985). Yet an implementation phase was never initiated because the government insisted that a large part of the budget be used for road construction, whereas FAO/UNDP would only support training and other critical needs. As a result, Burma still has barely more than 1 percent of its land area under protection in three national parks and 18 wildlife sanctu-

aries. Wildlife is protected within these areas, but not its habitat.

A review by the World Conservation Union in 1989 showed that Burma remains one of the few countries in Southeast Asia without an effective system of protected areas: "The present coverage of protected areas in Burma is by far the lowest in Southeast Asia and is totally inadequate for the purposes of biological conservation. The wildlife sanctuaries are ineffective, being, with a few exceptions, much too small, while most have suffered serious damage through logging or agricultural encroachment." The vast majority of protected areas are understaffed and poorly managed, and many have suffered years of agricultural encroachment and settlement. Hunting with the aim of selling wildlife parts to China is particularly severe. For example, the rhinoceros population of Tamanthi, Burma's largest national park, has been almost completely wiped out since the park was gazetted (officially introduced or listed) in 1974. *(See Figure 3, Appendix B.)* Tiger poaching has been intense, with Kyat 100 being offered by organized poachers to anyone reporting a pug mark. All indications point to the tiger population being very thin throughout much of its native habitat. Community relations with Forest Department staff are also poor. During the anti-government demonstrations in 1988, government-managed eucalyptus fuelwood plantations were almost completely destroyed. There are also cases of the military appropriating land in protected areas in violation of existing law.

A stated goal of the 1995 Forest Policy is to "strengthen wildlife management through the establishment of a network of national parks, wildlife reserves, and sanctuaries." The policy includes provisions to expand the protected area system first to 5 percent, and ultimately to 10 percent, of the land area, although no time frame is provided. Given that large areas in the north of the country are well forested and sparsely populated, this target is not unrealistic, in theory. Two foreign conservation organizations, the Wildlife Conservation Society and the Smithsonian Institution, have signed agreements with the Ministry of Forestry with a view to evaluating and implementing the recommendations of the Nature Conservation and National Parks Project. Many protected areas have suffered significant damage since the project ended, and, according to one foreign source, some may not be worth preserving. The Wildlife Conservation Society is training department staff in wildlife survey methods and is helping develop management plans for a number of new protected areas. These include the Lambi Marine National Park in the Mergui Archipelago off the coast of the southern Tenasserim Division (gazetted in 1996) and Khakaborazi in the foothills of the Himalayas in northern Kachin State (gazetted in 1995). *(See Figure 3, Appendix B.)*

However, the decision to gazette the Myinmoletkat Nature Reserve in the central Tenasserim Division has raised concerns about the extent to which the regime's renewed interest in environmental protection is being driven by its desire to relocate populations that might pose a security risk to key infrastructure projects (ERI/SAIN, 1996). An international consortium, comprising Unocal of the United States, Total of France, and the government, is developing the offshore Yadana natural gas field. This field is expected to earn the regime $150 million annually when it comes fully on-line in 2000. According to a reliable source, the decision to gazette Myinmoletkat was originally proposed by Unocal. The limits of the proposed protected area were apparently enlarged by Rangoon to include the onshore segment of the pipeline 666 km long that will ship gas to Thailand starting in July 1998. Protecting the pipeline, which runs to the south of Mon State, through villages inhabited by ethnic Mon and Karen, is thus of strategic importance to the regime. Myinmoletkat also covers a planned highway linking Thailand with a deep-sea port in Tavoy. In July 1996, the U.S. Embassy in Rangoon observed that the consortium had been criticized for forced relocations of populations along the planned pipeline route and for using forced labor provided by the army in its surveying and construction. The consortium has denied these allegations, but serious human rights abuses were reported by *The Observer* (1997).

Rangoon's recent conservation initiatives also ignore the fact that the Karen and other ethnic minorities have long pursued environmental protection. In 1982, the Karen National Union (KNU) established 11 wildlife sanctuaries within its territory, including the 460-km^2 Kaserdoh Wildlife Sanctuary in the Mergui-Tavoy District. *(See Box 1.)* Kaserdoh is 20 km from Kaeng Khra Chan, Thailand's largest national park. *(See Figure 3, Appendix B.)* Uniting Kaserdoh and Kaeng Khra Chan would have created a major transboundary reserve, and the KNU requested international assistance to upgrade and manage the Sanctuary. Yet the Karen's efforts to conserve Kaserdoh and other ecologically sensitive areas have been undermined by years of fighting and, more recently, by logging carried out by Thai companies. In September 1996, villages to the west of Kaserdoh were relocated to the Mergui-Tavoy Road by the Burmese army under the pretext that they could no longer inhabit the newly established Myinmoletkat Nature Reserve. In February 1997, peace talks between the KNU and Rangoon broke down, leading to fresh military offensives in

Box 1. Kaserdoh Wildlife Sanctuary

The Kaserdoh (Big Mountain) Wildlife Sanctuary, "a unique combination of riparian forest, extensive mineral springs, and high-altitude montane forest" and "one of the greatest natural areas left in Indochina," was designated to protect the habitat of the Sumatran rhinoceros (a species declared "almost certainly extinct" by the World Conservation Union in 1982), the tiger, tapir, clouded leopard, and other vulnerable or endangered species, as well as the headwaters of three large tributaries of the Tenasserim. Kaserdoh forms part of the "Kayah-Karen/Tenasserim Moist Forest" habitat that the World Wildlife Federation considers to be one of the world's 136 most threatened terrestrial ecosystems.

The proposed Myinmoletkat Nature Reserve covers Kaserdoh. According to a declaration by the Karen National Union (KNU) in January 1997: "the KNU does not recognize the superimposition of biosphere reserves or wildlife sanctuaries by the SLORC [State Law and Order Restoration Council] or foreign companies whose intentions are questionable, dishonest, and only face-saving, and whose actions are devious and oppressive toward the Karen people and the proper aims and methods of ecosystem management."

Source: Latimer et al., 1992; Olson and Dinerstein, 1997.

which 20,000 new refugees were forced into Thailand, swelling the number of refugees in camps along the Thai-Burmese border to more than 115,000. Kaserdoh is now under the control of the Burmese army.

The uniqueness of the Karen's efforts in Kaserdoh was that not only were on-the-ground activities being implemented (including environmental education, village meetings, and patrols of the Sanctuary), they were also being implemented with the full and willing participation of the local population. This stands in stark contrast to the dire situation prevailing in most of the officially protected areas. Indeed, it is no coincidence that Burma's most biologically diverse and intact habitats are found in the areas inhabited by the ethnic minorities. In the eyes of the KNU (1996):

> As the SLORC military government continues to polish its environmental image through its protected areas program and attendance at international conservation conferences, the people in the country suffer from forced relocations out of forest areas and very restrictive use of local resources after protected area declaration. The local people are forced to porter for foreign scientists and military personnel on survey and patrol trips. The SLORC may be interested in this international wildlife Sanctuary, but with their own different purposes.

In the case of Kaserdoh, Rangoon's efforts to present an environment-friendly image to the international community have gone hand in hand with a policy of unrelenting aggression against the Karen, the very people with the most to gain from, and the most to contribute to, forest conservation.

2.3 Deforestation Rates

A combination of officially sanctioned logging in the reserved forests, an unknown level of logging in the public forests (suspected to be extensive), and weak to nonexistent environmental protection has caused a marked increase in deforestation since the early 1970s. Forest area estimates over time have been published by the following organizations: the Landsat Pathfinder, the Forest Department in Rangoon, the United Nations Environment Programme (UNEP) in Bangkok, and the FAO in Rome. Table 2 shows the average annual rate of deforestation for four periods using these sources.

Although differences in data sources and interpretation methods preclude a precise estimation of deforestation trends *(see "Data Parameters" in Table 2)*, the table indicates a doubling in the deforestation rate beginning in the late 1980s. The figures are also consistent with reports of a trebling in the deforestation rate between 1975 and the mid-1980s (Blower, 1985), a trend associated with the intensification of timber production in both government and ethnic minority-controlled areas.

Table 3 gives the results of an analysis of deforestation by forest type based on a comparison of original and remaining habitats (MacKinnon, 1996). The remaining habitat is shown in Figure 4.

Table 3 shows that the montane forests (59 percent remaining) are better preserved than the lowland forests (48 percent remaining) because of their remote location, sparse population, and low levels of economic development. The most rapid deforestation has taken place in the Irrawaddy Delta, where mangrove forests have been cleared for charcoal production and shrimp production. Satellite image analysis carried out by the Forest Department shows that one third of the forest cover in the delta was lost between 1974 and 1994 (Myint Swe, 1996).

Table 2. Average Annual Deforestation Rates and Forest Loss in Burma

Year	Deforestation Rate (percent)	Forest Loss (square kilometers)	Data Source	Data Parameters
1973–1985	0.69	3,234	Pathfinder	Pathfinder figures are based on automatic classification, combined with visual verification, of Landsat MSS data captured from 1972–1979 and 1985–1986. Based on validation exercises in northern Thailand in environments similar to Burma, forest (including seasonal forest) is defined as land with a tree canopy cover of at least 40 percent.
1975–1989	0.71	2,139	Forest Department	The department carried out two assessments considered to be consistent and comparable (Tint and Hla, 1991). The 1980 assessment was based on the visual interpretation of 1:1 million Landsat MSS prints taken from 1972–1979. The 1990 assessment was based on the visual interpretation of 1:500,000 Landsat TM prints taken in 1989. The department uses the same definition of forest as Pathfinder.
1986–1993	1.84	5,706	UNEP	UNEP's figures are based on the automatic classification of coarse resolution AVHRR LAC (1-km pixel) data acquired from 1985–1986 and 1992–1993. Forest is defined as evergreen, deciduous, or mangrove forest.
1990–1995	1.38	3,874	FAO	FAO's figures come from its *State of the World's Forests 1997*. Forest cover figures are based on high-resolution satellite data acquired on a 10-percent sample basis; national forest cover assessments; and a deforestation model that correlates forest cover over time with population density and growth, initial forest extent, and ecological zone. FAO revised the 1990 figures that appeared in its *1990 Forest Resources Assessment* based on updated world population figures and new national forest inventories available in 1996. Forest is defined as land with a tree canopy cover of at least 10 percent and includes both natural forest and plantations.

However, the single most degraded habitat, in absolute terms, is the teak-rich mixed deciduous forest, the result of ill-managed logging, agricultural encroachment, and fuelwood cutting.

2.4 Community Forestry

There have been some remarkable changes in recent years in Asia in formal policies and programs supporting greater engagement of rural people in the management of public forests (Lynch and Talbott, 1995). Nepal and the Philippines began exploring community forest management policies nearly 20 years ago. By the late 1980s, India began implementing joint forest management. Now Cambodia, China, Indonesia, Thailand, and Vietnam are experimenting with policies that involve communities in public forest management. The emergence of community forest management is a significant step in reversing a century-old trend of forest land nationalization and growing government dominance. There is an increasing recognition of the need for a greater formal role for communities, often in partnership with the state (Asia Forest Network, 1997).

Burma's Forest Policy "gazettes 30 percent of the total land area of the country as reserved forest." In theory, this is to be accomplished by reforesting degraded public forests through a large number of community

Table 3. Loss of Major Forest Types in Burma (square kilometers)

Forest Type	Original	Remaining	Difference	Percent Remaining
Swamps	32,692	4,791	27,901	15
Mangrove	16,616	4,219	12,397	25
Freshwater swamp	16,076	572	15,504	4
Lowland evergreen	261,655	142,104	119,551	54
Semi-evergreen rainforest	151,003	88,545	62,458	59
Tropical moist evergreen	75,543	22,171	53,372	29
Subtropical lowland	35,109	31,388	3,721	89
Lowland deciduous	172,484	74,926	97,558	43
Mixed deciduous (teak)	141,096	69,519	71,577	49
Dry dipterocarp	31,388	5,407	25,981	17
Montane evergreen	95,888	59,236	36,652	62
Subtropical montane	53,090	25,196	27,894	47
Montane wet temperate	27,984	26,819	1,165	96
Montane evergreen	14,814	7,221	7,593	49
Montane deciduous	81,970	42,044	39,926	51
Montane deciduous	52,821	41,389	11,432	78
Submontane dry evergreen	29,149	655	28,494	2
Subalpine conifer	12,239	11,670	569	95

Source: MacKinnon, 1996.

forestry projects. The policy includes provisions to "create an awareness of community forestry and [of the] significance of the problem it seeks to address" and to "demonstrate the cost-benefit of community development programs as also the mechanism for distribution of benefits to facilitate adoption of the program by the people."

These provisions were elaborated in the Community Forestry Instructions published in December 1995 (Forest Department, 1995). The instructions give broad discretion to the Forest Department to establish community forests on government, village, or private land. To request the establishment of a community forest, households must form a user's group and submit an application to one of the department's 315 Township Forest Offices. The lease is set initially at 30 years, with the possibility of renewal depending on the performance and desire of the group. The group is allowed to sell surplus forest products to other villages at market prices.

Community forestry in Burma is currently targeted at the Central Dry Zone, where deforestation has been severe. Nine projects are underway, three with the support of FAO/UNDP.[6] However, there are strong grounds for questioning the likely success of community forestry in Burma. Since 1962, successive military regimes have exploited the rural population as a source of foreign exchange and unpaid labor. According to the U.S. Embassy: "Half of Burma's farmland continues to be used as a government laboratory for experiments in centrally planned agriculture evidently conducted with a view to maximizing the regime's foreign currency receipts from its rice export monopoly; the freedom of farm households to make their own production choices continue[s] to be highly constrained." The amount of uncompensated labor "contributions" has also increased sharply. Under these conditions, villages are unlikely to have the means or motivation to engage in community forestry. Anecdotal evidence also suggests that villages have great difficulty in acquiring usufruct rights from the department. It appears that the idea that villagers have rights, guaranteed by law, to control and benefit from their forests is not fundamentally understandable to the present regime, to the extent that it is in many other countries in the region. In Burma, promoting the kinds of political change needed to secure a shift in power away from the state is regarded as tantamount to sedition.

3. Burma's Timber: Supply and Demand

The rate of deforestation in Burma has more than doubled since the SLORC came to power. Satellite and economic data, as well as eyewitness reports, indicate that increased deforestation is principally caused by logging in Burma's border regions. This expansion results from a combination of domestic and international factors that have arisen out of the political turmoil of the past few years. Two factors, however, have played a particularly important role in maintaining both a supply of, and demand for, Burma's timber: the regime's economic and security policies and the regional timber trade.

3.1 The SLORC's Economic and Security Policies

An analysis of Burma's economy by the U.S. Embassy shows that the SLORC has pursued three basic policies since coming to power.

First, the SLORC has liberalized the economy and reduced obstacles to foreign trade and investment, as well as to inflows of funds from the illegal economy (opium exports alone are worth as much as all legal exports), thereby increasing the regime's foreign exchange earnings, which now constitute 50 percent of its receipts, and stimulating a renewal of positive, albeit highly skewed, real per capita economic growth.

Second, the SLORC has greatly increased defense spending to at least 50 percent of government expenditures, while substantially reducing expenditures for health and education. The Burmese army has grown from 175,000 soldiers in 1989 to 325,000 in 1995, and the regime's stated intent is to expand the army to 475,000. Military imports have also soared.

Third, the SLORC has forcibly suppressed the democracy movement of 1988, refused to implement the results of the 1990 election, and conducted military offensives against the armed ethnic groups.

As a result of increased defense spending, offensive military activity, and the cessation of most development assistance and concessional lending in 1988, Burma's external debt grew steadily between 1989 and 1995 to $5.5 billion (equivalent to about 112 percent of its legal GDP). To service this debt, the regime has tried to attract export-related foreign investment. However, foreign investment (chiefly in oil and gas) peaked in 1992 and has since declined sharply, a decline accelerated by trade sanctions imposed by the United States and the European Union and by the current financial crisis in Southeast Asia. The collapse of regional currencies has provoked a capital flight to which the regime has responded by printing money. As a result, inflation has soared. The Kyat, worth 250 to the dollar on the black market in October, fell to 310 to the dollar in December 1997.

Facing regular brushes with bankruptcy since 1988, the regime's response has been twofold. First, it has supplemented declining sources of investment with uncompensated "people's contributions," chiefly of labor, to build or maintain irrigation, transportation, and tourism infrastructure projects. Second, it has increased exports of teak, rice, and other natural resources.

Timber exports in 1995 are shown by species in Table 4. As shown in the table, teak, worth $\$750/m^3$, made up 60 percent of the volume and 80 percent of the value of Burma's timber exports in 1995. Declared teak sales raised more than $150 million, close to 10 percent of the country's GDP, making teak the single largest foreign exchange earner.

3.2 Regional Timber Trade

Until recently, Southeast Asia had the world's fastest growing economies: the economies of China, Malaysia, Thailand, and Vietnam all grew at more than 9 percent in 1995. Historically, economic growth in these countries has depended on the extraction of natural resources, principally timber and water, from their own upland areas and those of neighboring countries. Timber production has been falling in Indonesia, the Philippines, and Thailand since the 1980s and is starting to fall in Malaysia. Timber production is increasing in the next tier of countries: Burma, Cambodia, and Laos.

Burma hold's almost half of the region's forest cover and experienced the lowest rate of deforestation between 1973 and 1985. *(See Table 5.)* Based on forest cover per capita, Burma and Laos are by far the most richly endowed countries in the region.

Table 4. Tropical Log Species and Sawnwood Exported from Burma, 1995

Species	Logs			Sawnwood		
	Volume (000 cubic meters)	Price (dollars per cubic meter)	Income (000 dollars)	Volume (000 cubic meters)	Price (dollars per cubic meter)	Income (000 dollars)
Teak (*Tectona grandis*)	175	756	132,300	28	763	21,364
Pyinkado (*Xylia dolabriformis*)	49	265	12,985	N/A	N/A	N/A
Dipterocarpus spp.	43	133	5,719	7	237	1,659
Padauk (*Pterocarpus macrocarpus*)	37	429	15,873	1	237	237
Other	7	83	581	N/A	N/A	N/A
Total	311	N/A	167,458	36	N/A	23,260

Source: ITTO, 1996.

This unequal forest cover distribution is related to the original forest endowment and to regional patterns of economic growth and natural resource extraction. Timber production in Thailand rose steadily during the 1980s. In November 1988, however, floods and landslides killed more than 350 people; the principal cause of this devastation was attributed to land denudation and soil erosion resulting from large-scale felling of Thailand's forests. This disaster led to a complete logging ban, effective January 1, 1989, and to the cancellation of 300 logging concessions. As a result, domestic timber production fell from 4.5 million m^3 in 1988 to 2.7 million m^3 in 1992.

To meet the country's growing demand for timber, both in the construction sector and in the downstream timber processing industry, many Thai companies crossed borders to cut forests in neighboring countries, and timber imports increased sevenfold between 1988 and 1989. Mainland Southeast Asia's share of Thailand's legal imports increased from 43 percent in 1988 to 67 percent in 1992, of which Burma's share increased from 26 percent to 41 percent during that period. These figures indicate a relatively modest increase in the regional timber trade. However, a World Bank study (Brandon and Kishor, 1994) indicates that:

- The total volume of timber available for processing in Thailand more than doubles when the illegal harvest in Thailand and the illegal inflows from the surrounding countries are added to the official production figures.

Table 5. State of Forests in Southeast Asia, 1973–1985

	Forest Cover (square kilometers)		Percentage of Regional Forest Cover (percent)		Forest Per Capita, 1985 (hectares)	Average Annual Deforestation, 1973–1985 (percent)	Forest Loss, 1973–1985 (square kilometers)
	1973	1985	1973	1985			
Burma	487,050	448,238	42	46	1.19	0.69	3,234
Cambodia	52,452	39,785	5	4	0.54	2.31	1,056
Laos	182,764	165,192	16	17	4.60	0.84	1,464
Thailand	225,567	167,425	20	17	0.33	2.48	4,845
Vietnam	199,154	161,463	17	16	0.27	1.75	3,141
Total	1,146,987	982,103	100	100	0.62	1.29	13,740

Source: Landsat Pathfinder, University of New Hampshire.

- Burma is the single largest supplier of illegal timber into Thailand, supplying 1.6 million to 1.7 million m^3 in 1992, or 70 percent of total illegal imports.

- There are also reports of large-scale illegal exports of timber from Burma to China (which in 1996 imported more than 80 percent of the logs it consumed), but no statistics are available.

These estimates have been updated by the International Tropical Timber Organization (ITTO). The organization crosschecks national figures with independent estimates to monitor both declared and undeclared trade.

According to the ITTO, there has been a steady decline in declared timber exports, from 1,550 m^3 in 1992 to 447 m^3 in 1996. *(See Table 6.)* While there was a well-documented decline between 1993 and 1994 in export volume following the termination of logging contracts along the border with Thailand, the table highlights an important discrepancy. In 1994, Burma declared a smaller volume of logs exported than the volume reported by importers (570,000 m^3 versus 602,000 m^3). Yet in 1995, the situation was reversed: 276,000 more cubic meters of logs were reported by importers than Burma declared as exported. If we assume that the undeclared exports comprised logs with a unit value of \$312/m^3 (ITTO, 1996), this represents an income differential of \$86 million, or 48 percent of Burma's official timber export revenue in 1995. If the undeclared exports included sawnwood, which has a unit price of \$496/m^3, the differential would be far higher.

These findings are consistent with an analysis of Burma's balance of payments, which shows \$400 million in unexplained foreign financial inflows in 1995, up from \$79 million in 1994 (Lintner, 1997). Most of this income is believed to come from drug sales, but illegal timber exports may contribute tens of millions of dollars to the amount of money in circulation that cannot be explained in terms of official trade.

As well as deliberately concealed exports, another explanation for the export-import discrepancies shown in Table 6 is that substantial timber exports are taking place from territories outside the control of the Forest Department. Both explanations are probably valid.

Burma's biggest customers (China, India, and Thailand) are not only its neighbors, thus facilitating unofficial cross-border trade, but also report the greatest differences between their imports and Burma's declared exports. *(See Table 7.)*

Thailand reported more than four times Burma's declared exports in 1994 and double the declared exports in 1995; India did not provide any statistics for 1994, but in 1995, its declared imports were 30 times greater than

Table 6. Timber Production, Exports, and Export Income in Burma, 1992–1996

	1992	1993	1994	1995	1996
Production (000 cubic meters)					
Logs	2,791	2,004	1,200	1,100	1,200
Sawnwood	625	470	309	329	331
Plywood	7	6	5	4	9
Total	3,423	2,480	1,514	1,433	1,540
Exports (000 cubic meters)					
Logs	1,500	1,029	602	500	415
Sawnwood	50	38	36	44	31
Plywood	0	14	1	0	1
Total (declared by Burma)	1,550	1,081	639	544	447
Total logs (declared by importers)	N/A	N/A	570	776	N/A
Income (000 dollars)					
Logs, sawnwood, and plywood	\$157,000	\$203,000	\$191,597	\$178,936	N/A

Source: ITTO, 1996; income estimates for 1992 and 1993 are from U.S. Embassy, 1996.

Table 7. Declared Exports of Logs to Thailand, India, and China, 1994–1995 (000 cubic meters)

	1994	1995
Exports to Thailand		
Reported by Thailand	486	212
Reported by Burma	114	116
Exports to India		
Reported by India	N/A	69
Reported by Burma	50	2
Exports to China		
Reported by China	23	511
Reported by Burma	7	N/A

Source: ITTO, 1996.

Burma's declared exports. Burma reported no exports to China in 1995, but China declared imports of more than 500,000 m^3. There can be some legitimate reasons for mismatched export-import figures, but when these discrepancies persist for several years in the same direction, they point to a systematic attempt by Rangoon to conceal timber exports and the illegal income it generates, a pattern that has been well documented elsewhere in the region. *(See Box 2).*

Box 2. Illegal Logging in Cambodia

Cambodia offers an interesting parallel to the situation in Burma. Forest cover in Cambodia has fallen from 75 percent in the early 1970s to less than 35 percent today. Most of this forest loss is due to illegal, but officially sanctioned, logging by the Royal Cambodian Armed Forces and the Khmer Rouge. After Burma, Cambodia is the second-largest exporter of illegal logs to Thailand. These timber revenues have been used to finance arms procurement by both the Cambodian Armed Forces and the Khmer Rouge forces based along the Thai border. The illegal timber trade with Thailand earned the Khmer Rouge an estimated $10 million a month in 1992.

In November 1995, Cambodia's two prime ministers secretly granted concessions covering 6.3 million hectares of forest—three times the area that can support commercial logging—to 30, mainly foreign, logging companies. Seven of the companies received tax breaks for exports and profits. The revenues from these operations almost entirely bypass the national budget and represent an absolute loss to the country of at least $117 million for the period January 1996 to March 1997. Following the collapse of the Khmer Rouge in 1996, and until the coup d'état in July 1997, these revenues helped finance the campaigns of the co-prime ministers for the elections scheduled in November 1998. The coup was provoked in part by the import of weapons purchased using illegal timber revenues.

Source: Global Witness, 1997; Brandon and Kishor, 1994; Talbott, 1998.

4. Logging Burma's Borders

Heavy logging, by both the regime and by ethnic minorities, is a major cause of deforestation in Burma's border areas. The first timber concessions were granted by Rangoon along the Thai-Burmese border in 1989.

4.1 Thai-Burmese Border

The border between Thailand and Burma stretches for 1,930 km. For years, the Mon, Karen, and Karenni ethnic minorities controlled the timber trade along the Thai border and used low impact harvesting methods that protected the forest. This situation changed in December 1988 when the Ministry of Forestry granted contracts to foreign logging companies, a move that was triggered by an acute shortage of foreign exchange following the end of official development assistance and concessional lending in September 1988.

Within months, 42 five-year logging concessions were granted to 36 Thai companies, many of them linked to Thai military interests rather than specialist forestry firms. The contracts covered up to 18,800 km^2, tripled the area being exploited, and were worth $112 million a year, doubling the government's timber income. Many of the Thai logging concessions were deliberately located in rebel-controlled territory. In addition to generating revenue, logging along the Thai border coincided with Rangoon's desire to control rebel-held territory. The most important strategic consideration was the construction of logging roads. The regime had been unable to bring the full weight of its military superiority to bear against the ethnic armies because there were few roads in these areas. Once the logging roads were bulldozed, however, the Burmese army was able to advance rapidly. There is a close correlation between the granting of a concession and the initiation of military offensives against the ethnic minorities.

In July 1992, the government announced the cancellation of all Thai logging concessions, effective December 31, 1993. There are a number of explanations for this abrupt and surprising change of policy. Officially, the decision was precipitated by the discovery that some of the regime's Thai partners were violating the terms of their contracts by clear-cutting and exporting more timber than was specified. The Ministry of Forestry was apparently stung by international criticism and embarrassed by the scale of the logging by Thai companies, over whom it had little control. In an interview in 1996, Minister of Forestry Lieutenant General Chit Swe called this attempt to attract foreign investment "a foolish mistake" that "produced no tangible benefit to the government" (Asia Inc., 1996).

Another explanation was Rangoon's desire to stop the flow of money from the Thai logging companies to the KNU. Many of the concessions were located in the Maneplaw and Three Pagodas Pass border areas held by the KNU. Taxation of the border trade, particularly in teak, from which the KNU earned $60/$m^3$ (and from which the regime earned $80/$m^3$), was the economic basis of the Karen resistance (Bryant, 1997). Indeed, between 1989 and 1993, the KNU permitted overcutting in a desperate attempt to maintain forest-based revenue. Unable to cut the KNU out of this activity, the Minister canceled the Thai concessions.

As a result of this change in policy, Burma's legal teak exports fell by more than 40 percent from 1994 to 1995, while other hardwood exports fell by more than 90 percent. Although other hardwood receipts fell from $82 million to $19 million, teak receipts actually increased because of Burma's near-monopoly position on the world's market. To compensate for reduced timber revenues, the regime quadrupled rice exports during this period from $44 million to $197 million. This dramatic increase proved unsustainable, however, and rice production fell by 40 percent in 1996. Lower revenues from legal hardwood exports were also compensated for by a 25-fold increase in illegal log exports to China between 1994 and 1995. *(See Table 7.)*

Overcutting resulted in widespread deforestation in the logging concessions as Thai loggers extracted more timber than was allowed under the terms of their contracts. Furthermore, cutting also took place outside designated areas as loggers took advantage of the lack of government control to extract timber free of charge. Some indication of the intensity of logging is given by the fact that in April 1993, 500,000 m^3 of cut logs were ready for shipment (equivalent to 80 percent of Burma's declared log exports in 1993; *see Table 7*), and that logs

felled prior to 1994 continue to be extracted, thanks to the network of logging roads built between 1989 and 1993. As a result, the border forests on which the KNU relied have been largely depleted, undermining a key element in the Karen resource base (Bryant, 1997).

Traditional practices for removing trees without causing collateral damage include girdling the tree, whereby a band of bark is removed from around the trunk so that the branches die and do not damage other trees on felling. Elephants were used to move logs to feeder streams, and monsoon floods transported the timber to downstream depots. This was an environmentally benign system, but it took several years between girdling and arrival of the teak at the sawmill. Thai loggers speeded up this process by using heavy machinery to cut and grade new roads so that trucks could haul out timber all year round. The width of the roads was greater than needed, and large areas of bare soil were exposed to erosion. The roads also often ran beside streams, causing rapid siltation. Uncontrolled road construction and clear-cutting, combined with heavy rainfall and steep slopes, caused rapid soil erosion, reduced dry season flow, and increased flooding of the Salween, the river most affected by logging (Manila Observatory, 1990).

4.2 Chinese-Burmese Border

Large-scale logging along the Thai-Burmese border has been widely reported. Yet a much less well-understood story has been unfolding along the Chinese-Burmese border. Logging along Burma's 1,780-km border with China is best understood in relation to the collapse of the Communist Party of Burma (CPB), the largest and best armed of the opposition groups.

On April 19, 1989, the CPB's 15,000 troops mutinied and split along ethnic lines into five regional resistance armies, four in Shan State and one in Kachin State. The regime, concerned that the thousands of political activists who fled Rangoon in August 1988 would be armed by the insurgents, reacted quickly. Rangoon took advantage of the CPB's collapse to negotiate a deal whereby in exchange for promises not to arm the activists and not to attack government forces, the CPB mutineers were granted unofficial permission to engage in any kind of business deal needed to sustain themselves. As part of the cease-fire agreements, the leaders of the ethnic armies were awarded logging concessions and received saws and milling machinery. The regime also promised development assistance and initiated a Border Areas Development scheme under the Ministry of Border Areas and National Races in 1993. Although the immediate military threat from the rebel armies was neutralized, the environmental consequences have been severe as timber and opium production, especially in Shan State, has expanded.

Extensive environmental damage, as a result of both logging and forced relocation, has been observed in Shan State. A member of Green November-32, a Thai NGO, who traveled throughout the Shan plateau and Chinese border region in 1993 reported that (Green November-32, 1996):

> . . . there were no forested hilltops left in the region. Every vantage point had been cleared for occupation by troops. Logging [serves] as an effective means of strategic defoliation in areas controlled by ethnic armies. Logging companies are usually also asked to build roads to their sites which are subsequently used in military operations. All these activities again result in both the relocation of ethnic communities and disruption of natural habitats.

It is paradoxical that the regime should support the logging and other commercial activities of some of the ethnic groups. However, the U.S. Embassy reports that much of the revenue from the timber, gem, and opium trade is invested in the Union of Myanmar Economic Holdings. This organization is controlled and wholly owned by the Defense Ministry's Directorate of Defense Procurement and by military officers, including SLORC members. The union, which is a popular joint-venture partner for foreign investors, serves two purposes. It allows revenue from drug exports to be laundered (and taxed) in foreign-funded projects (particularly real estate, hotels, and tourism) and provides a long-term source of revenue for the military. In the words of Martin Smith (1994):

> The Burma logging trade has become a desperate business in which few parties emerge with their reputations intact. Though on a lesser scale, many of the country's armed opposition groups have also become increasingly active in logging deals since 1988 as one of their major sources of revenue to buy arms and ammunition. The most serious cases of overfelling have reportedly taken place in areas where insurgent armies have signed cease-fires with the SLORC.

The opportunities for personal enrichment, the absence of alternative income generating activities, and de facto collusion between some of the ethnic minorities and Rangoon suggest that the current "free for all" in natural resource exploitation in the border areas will

continue. Efforts to document the rapidly changing economic, security, and environmental conditions in these areas are seriously hampered by the limited amount of information available. Information about conditions along the Indian border is even more fragmentary. *(See Box 3).*

Box 3. The Indian-Burmese Border

Little is known about logging along Burma's 1,320-km border with India. A poor transport infrastructure and decades of tribal warfare in the Indian States of Manipur and Mizoram and the Chittagong Hills in Bangladesh have made large-scale logging difficult. However, economic relations between India and Burma have recently improved, and there are both published (ITTO, 1996) and anecdotal reports of increased timber exports to India.

In April 1995, India and Burma signed their first cross-border trade agreement; this agreement does not include timber. Officially, all timber exports have to pass via Rangoon (which explains the very low level of declared timber exports). *(See Table 7.)* In reality, an illegal timber trade is flourishing between Manipur State in India and Kachin State and Sagaing Division in Burma. The 1995 trade agreement includes provisions to upgrade roads connecting major trading towns in Burma to the Indian border. Once these roads are improved, cross-border trade could expand significantly given India's growing demand for timber.

5. Kachin State: A Frontier Forest

Kachin State is one of the most sparsely populated, densely forested, and inaccessible parts of mainland Southeast Asia. A study of the world's frontier forests by the World Resources Institute shows that Kachin State contains one of the region's last remaining areas of "large, intact natural forest ecosystems that are relatively undisturbed and large enough to maintain all their biodiversity" (Bryant et al., 1997).

By virtue of its remote location, Kachin State suffered little deforestation in the 1970s and 1980s. However, high-resolution satellite data show that this frontier is now being threatened by logging. Evidence elsewhere in the region suggests that Kachin State may be in the early stages of a period of intense deforestation that could culminate in the clearing of all accessible timber, leaving just a patchwork of severely degraded forest fragments.

Deforestation is of particular concern in Kachin State because of its high level of biodiversity and because its forests protect the local watershed. Habitats and wildlife in northeastern Burma and adjacent areas of China have been assessed, respectively, as being "vulnerable" and "critical or endangered" by the World Wildlife Fund (Olson and Dinerstein, 1997). One of the priority recommendations of the FAO/UNDP Nature Conservation and National Parks Project that ended in 1984 was the establishment of a protected area in northern Kachin State that would protect Himalayan fauna—the takin, musk deer, red panda, and wolf (Blower, 1985)—and the upper catchments of the Irrawaddy River.

The only protected area in Kachin State, the once renowned 200,000-ha Pindaung Wildlife Sanctuary, has been severely degraded. Pindaung was established in 1918 as Burma's first wildlife sanctuary. Until the 1950s it was a carefully managed home for a variety of wildlife, including rhinoceroses and up to 800 elephants (Smith, 1994). The rhinoceroses and most of the elephants are now gone, along with more than half the forest cover. A 2-km-wide strip on either side of a railway line that traverses the Sanctuary has been cleared as a counterinsurgency measure, and a growing number of villagers dislocated from other parts of Kachin State have moved in to illegally cut timber and settle on the land. Today, Pindaung has effectively ceased to exist.

5.1 Analysis of Satellite Data

Because most of Kachin State is off-limits to independent field investigation, WRI contracted with the University of New Hampshire to acquire and interpret current and historic satellite data for a study area covering south and central Kachin State, where extensive logging is believed to be taking place. Two Landsat Thematic Mapper (TM) images taken in December 1996 were acquired, each 180 by 180 km, covering about 10 percent of the country. *(See Figure 3, Appendix B.)* These images, together with images of the same area taken in 1989 and 1993, were processed to show forest cover at each date. This period covers the signing of cease-fires between the Burmese and resistance armies since 1989. The results were compared with the Pathfinder analysis for 1978 which used lower resolution Landsat Multi-spectral Scanner (MSS) data. Figure 5 shows the extent of the satellite coverage, national and state boundaries, major roads, railways, mines, rivers, lakes, towns, and the approximate locations of the Burmese and ethnic armies.

Two analyses were performed. The first measured the total area in forest for each year and, through a comparison, the *net* forest loss over time. The total forest area for each year includes forests that may have regrown after having previously been cleared. (This is the standard approach for calculating deforestation and was used to generate the figures shown in Table 2.) The second analysis measured the *gross* forest loss over time, which excludes secondary forest that may have regrown between the years the images were taken. Gross forest loss therefore gives the actual clearing rate, which is a more accurate measure of human disturbance than net deforestation.

Table 8 summarizes the results of the two analyses. Because the calculation of gross forest loss was only possible using Landsat TM data, no gross forest loss figures are given for 1978–1989. Only pixels that were cloud-free on all four dates are included in the analysis. Details of the image acquisition and processing are given in Appendix A: Technical Notes. Table 8 shows that:

Table 8. Forest Loss in the Kachin State Study Area

	Annual Net Forest Loss (hectares)	Rate of Net Forest Loss (percent)	Annual Gross Forest Loss (hectares)	Rate of Gross Forest Loss (percent)
1978–1989	15,545	0.37	N/A	N/A
1989–1996	23,500	0.58	48,529	1.23
1989–1993	31,000	0.76	44,143	1.09
1993–1996	16,000	0.40	52,914	1.37

Source: Landsat Pathfinder, University of New Hampshire.

- The rate of net forest loss for 1989–1996 is 50 percent higher than for 1978–1989, but still lower than the FAO estimate of 1.38 percent per year for the whole country for 1990–1995. *(See Table 3.)*

- The rates of gross forest loss (actual clearing rates) are much higher than are those based on net forest loss (actual clearing minus regrowth) because of rapid regrowth in the study area. Moreover, the rate increases over the study period, from 1.09 percent for 1989–1993 to 1.37 percent for 1993–1996.

- Because the rate of gross forest loss is both high and increasing, this suggests that the frontier forest is "opening up." The abundance of regrowth and the spatial pattern of forest clearing, suggest that deforestation is primarily the result of exploitative logging and shifting cultivation, not permanent agriculture or plantations.

5.2 Patterns of Forest Clearing

Figure 6 shows the cumulative extent of forest clearing over the study period. White denotes areas that remained forested throughout the study period, red denotes areas that were cleared before 1989, green denotes areas that were cleared from 1989 to 1993, and blue denotes areas that were cleared from 1993 to 1996. Areas that were covered by clouds or water on one or more of the three dates appear in grey. Most of the urban areas and transport corridors located along the river valleys have been cleared. Sharp forest to nonforest discontinuities along the valleys are the result of abrupt changes in elevation caused by faulting.

Figure 7 shows enlargements of three basic types of clearing that appear in Figure 6:

Large-scale clearings that have expanded radially around towns. (Figure 7-A.) Deforestation around Bhamo, Myitkyina, Hpakant, and other towns, and along the lowland transport corridors, appears over time as a series of concentric circles that are distinct from the diffuse fragmentation patterns evident in the uplands. According to sources familiar with conditions on the ground, over the past 20 years, there has been intense clearing of the most accessible forests in the region. These include areas bordering the Irrawaddy in southern Kachin State and the Sagaing Division; areas all along the railway lines connecting Mandalay and Myitkyina (the railhead); the jade mining area around Hpakant (where the world's only commercial deposits of imperial jade are found); and around Myitkyina and Bhamo.

Rapid deforestation is also the result of Rangoon's forced relocation policy and a tripling in its military presence in Kachin State since 1992. When the Kachin insurgency began in the early 1960s, large portions of Kachin State fell into the hands of the Kachin Independence Organization (KIO). Central government control was limited to the large towns and main roads. To regain control after the 1962 military coup, Rangoon developed a new strategy known as the "four cuts." Similar to the "strategic hamlet" policy pursued by the U.S. Army in Vietnam, Rangoon sought to block the insurgents' food, funds, recruits, and intelligence—the four cuts. In practice, this required the wholesale removal of the civilian population from the uplands where the KIO has its bases to lowland transport corridors controlled by the Burmese army. The poorly paid Burmese troops in Kachin State engage in logging, brick-making, and other timber-consuming activities to sustain themselves. As a result of large-scale migration to the jade mines, the influx of Burmese troops, and the forced relocations, the major towns in Kachin State

grew rapidly. For example, Hpakant's population grew from 10,000 in 1970 to 500,000 today; such growth has caused rapid forest clearing, which appears on the satellite images as a series of expanding "halos" around each town.

Small clearings to the west of Nmai Hka and Mali Hka rivers (Figure 7B). A map produced by the Forest Department (Tint and Hla, 1991) shows this area as either closed or degraded forest affected by shifting cultivation. Shifting cultivation is a form of agriculture adapted to upland areas where slopes are steep and soils poor; in such areas, the forest is cut to release nutrients from the resulting biomass to the soil and enhance crop growth. Within a few seasons, this temporary fertility is exhausted and new fields are cut. This process causes a type of deforestation in which natural forest is removed and progressively replaced by secondary forest. When population density is low and the area of forest is relatively large, this process may not be of ecological concern. Yet, as the population grows and expands, and the available forest area shrinks, shifting cultivation can lead to a high level of habitat fragmentation, the complete removal of natural forest, and insufficient time for cleared fields to recover before being cut again; all of these factors lead to a gradual impoverishment of the ecosystem and declining per capita yields (Dearden et al., 1996).

Shifting cultivation is carried out to grow maize and rice for subsistence, and, in isolated areas, opium to generate income to pay for food. Despite the reported increase in poppy cultivation, it is probably not a direct cause of deforestation. *(See Box 4.)* Given the large labor input required, farmers are more likely to reallocate some of their fields used in subsistence agriculture to grow poppies than to clear new forest areas. This is the case in Shan State, where farmers stop growing upland rice and maize in their less productive fields and use them instead for poppy production. In Kachin State, another factor that mitigates against clearing forests exclusively to grow poppies is a significant reduction in the number of active males in the population due to decades of civil war, and, more recently, the HIV epidemic among drug users.

There is no reliable information on the total area of fields under shifting cultivation in Kachin State. However, in a 24,000-ha area in the Mae Samoeng watershed near Chiang Mai, northern Thailand, a Pathfinder study showed that almost all of the fields are smaller than 10 ha. The vast majority (82 percent) of fields under shifting cultivation are smaller than 5 ha, and half are smaller than 2 ha. *(See Table 9.)*

Box 4. Opium Cultivation in Kachin State

According to the U.S. Embassy, the area under poppy cultivation in Burma increased by about two thirds between 1987 and 1990, but has remained in the 150,000-ha to 166,000-ha range since then. Most of this expansion has taken place in Shan State, which forms part of the "Golden Triangle" where the borders of Burma, Laos, and Thailand intersect. In the early 1990s, Kachin State was declared an "opium-free zone" by the Kachin Independence Organization (KIO), the only organization with such a policy. American satellites subsequently recorded a decline in poppy production. Yet the *Far East Economic Review* (February 20, 1997) has reported that "the anti-opium scheme seems to have fallen apart after the KIO signed a cease-fire agreement with the [Rangoon] junta. The regime appears to have encouraged local farmers to grow poppies in the areas it controls, and the Kachin rebels have been unable to sustain their anti-drug campaign. Increased production has been observed in the northern and western parts of Kachin State."

However, the KIO has publicly reaffirmed its "no opium" policy, despite the fact that policing against poppy growing has become much more difficult because of the interweaving of KIO and Burmese-controlled areas. According to the KIO, the areas where increased opium production has been reported lie outside its control. Apparently, while it is not directly involved in poppy cultivation (most of the heroin refineries are owned and operated by ethnic Chinese), the Burmese army permits it around the towns it controls, provided that the opium is refined at its factories, and that taxes are paid at every stage in the production cycle.

A similar analysis was conducted on 623 clearings to the west of the Nmai Hka. To exclude spurious "clearings" caused by noise in the satellite data and image-to-image registration errors, only clearings greater than or equal to 0.4 ha (5 pixels) were considered. *(See Appendix A: Technical Notes.)* Clearings that were obviously caused by roads or rivers were also excluded, as was a large (1,287 ha) cleared area located on high ground 25 km to the east of the Mali Hka for which there is no obvious explanation. *(See Figure 6, Appendix B.)* Pixels connected diagonally were treated as contiguous and part of the same clearing. The results are shown in Table 10.

Table 9. Size Distribution of Fields Under Shifting Cultivation in Northern Thailand

	Size of Cleared Fields Under Shifting Cultivation (hectares)								
	<2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	>9
Percentage of all clearings	50	10	11	11	3	3	2	2	8

Source: Landsat Pathfinder, University of New Hampshire.

These results are similar to the size distribution observed in Mae Samoeng, with 95 percent of the clearings smaller than 4 ha. The clearings are therefore presumed to be fields under shifting cultivation.

Large clearings, interspersed with many small clearings (Figure 7-C). Because of a low population density, the large clearings are unlikely to have been cleared for settlement or agriculture. They are presumed to be clear-cuts,[7] given their size, shape, and reports of logging in this area. Large and small clearings are interspersed, indicating that logging and shifting cultivation coexist.

The relative importance of shifting cultivation and logging as agents of deforestation was estimated based on a size-distribution analysis of the clearings. *(See Appendix A: Technical Notes.)* The analysis was performed on a 1.1 million-ha window in the northeast of the study area. *(See Figure 6, Appendix B.)* The window covers a rugged and sparsely populated area where forest loss is presumed to be related to either shifting cultivation or logging. The 1993 image was used because it is virtually cloud-free. The results show that shifting cultivation accounts for twice as much deforestation as logging in the window.

However, this analysis may underestimate the impact of logging and overestimate the impact of shifting cultivation. First, the 30-m resolution of Landsat TM does not allow the identification of selective logging. Second, shifting cultivation in Kachin State is typically rotational rather than pioneer. Whereas pioneer cultivation involves clearing primary forest, rotational cultivation uses the same designated land area over a long cycle. In other words, although shifting cultivation may cause high levels of *net* deforestation, it causes only low levels of *gross* deforestation because cultivated fields revert to forest fallow after 2 to 3 years.

5.3 Environmental Impacts

After the mutiny and subsequent break-up of the Communist Party of Burma (CPB) in April 1989, the 101 War Zone that ran along the China-Burma border *(see Figure 5, Appendix B)* came under the control of the New Democratic Army (NDA) led by two former CPB officers, Ting Ying and Ze Lum. Rather than force an unconditional surrender, which would have risked the armed opposition of elements of the NDA (which held large stockpiles of arms and ammunition), the government agreed to a cease-fire to "freeze" the situation. In return for ending all military activity, Ting Ying and Ze Lum were allowed to run logging concessions and jade mines that generated enormous wealth for the NDA. In February 1994, after 4 years of difficult negotiation, the KIO, in a search for peace after 34 years of fighting that had produced no real change in the political situation, agreed to a cease-fire with Rangoon. *(See Box 5.)*

Before 1989, the sparsely populated 101 War Zone was one of the most densely forested areas in Burma. Because the CPB was well supplied with guns and rice from the Chinese military base at Tengchong, it never turned to logging to finance its military operations. However, with the KIO cease-fire and the end of Chinese support to the NDA, the political struggle in Kachin State died and large-scale logging, primarily for export to China, took off.

Between 1984 and 1994, cross-border trade between China's Yunnan Province and Burma increased from $15 million to about $800 million a year, a boom driven by China's rapid economic growth, by the decision in 1992 to list Ruili and Wanding as two of 13 Chinese "border cities" dotted along the frontier from Siberia to Vietnam that are able to offer special privileges to investors, and by the fact that Yunnan has a developed industrial base because of China's Cold War policy of locating industry as far as possible from the reach of the U.S. Pacific Fleet (Lintner, 1994). Over the past decade, Yunnan's economy has grown at close to 10 percent a year, exerting a high and growing demand for timber and other forest products. The Burma Road, connecting Ruili to Lashio, has become the main route for timber leaving southern Kachin State and Shan State bound for Yunnan.

Table 10. Size Distribution of Fields Under Shifting Cultivation in Kachin State

	Size of Cleared Fields Under Shifting Cultivation (hectares)									
	<1	1–2	2–3	3–4	4–5	5–6	6–7	7–8	8–9	>9
Percentage of all clearings	60	23	8	4	2	1	0	0	1	1

Source: Landsat Pathfinder, University of New Hampshire

Timber from northern Kachin State is exported to China via the Kambaiti Pass. Logs are carried to the border by mule train (which explains the absence of visible tracks on the Burmese side of the border) and then by truck into China. In 1990, within months of the NDA cease-fire, eyewitnesses reported as many as 200 logging trucks a day arriving in Baoshan, equivalent to an annual timber production of about 200,000 m^3. This figure is similar to an estimate by a researcher from the Kunming Institute of Botany that 300,000 m^3 of logs a year come from the area between Bhamo and Myitkyina. Reports also indicate that while mature firs, pines, and other temperate species originally made up the bulk of timber exports, bamboo and rattan are now common, which indicates a harvesting rate far higher than the sustainable yield. Martin Smith has described the effects of logging in this region: "Most of the Kambaiti Pass area in northern Kachin State has been stripped of its original forest cover with the logs carted across to China by the NDA, the former communist force with strong ties to China. It was deforestation on this scale that inhabitants blamed for flooding in 1991 in which 100 villagers died" (Smith, 1994). Of particular concern for the coming years is the fact that the government is building a bridge across the Irrawaddy just north of Myitkyina, which will greatly increase access to China via the Kambaiti Pass. The government has also decided to rebuild the Myitkyina-Putao Road. These developments will open up large, previously inaccessible areas of intact forest to logging.[8]

Logging is mostly carried out by Chinese contractors employing Kachins under a profit-sharing agreement between the KIO and the SLORC. Because the objective is to extract as much timber as quickly as possible, logging tends to be wasteful and destructive. Chinese traders have also been organizing villagers to harvest rattan, and their methods are equally unsustainable. Thus, while shifting cultivation may be the major cause of deforestation in the Kachin State's frontier forests, the environmental impacts of logging are much more severe. Evidence about the impact on wildlife and on other nontimber forest products of the "opening up" of the forest frontier is fragmentary. No systematic surveys have been carried out. However, fieldnotes by Kachin observers near Bhamo suggest high levels of logging and hunting. *(See Box 6.)*

Box 5. The KIO and Environmental Protection

Satellite image analysis indicates rapid degradation of the forest frontier in Kachin State. The SLORC, the KIO, and the NDA are all implicated on the surface, and it is necessary to sort out each organization's involvement. The environmental management records of the SLORC and the NDA are woeful. The SLORC is considered an alien occupation army by the vast majority of Kachin, and it routinely clear-cuts around military bases and along transport corridors. The NDA is a small local militia that is notorious for its destructive logging.

The KIO, which received no economic concessions as part of its cease-fire agreement, has also permitted heavy logging in some areas. In recognition of the damage caused, the KIO is using its own funds to initiate Burma's largest reforestation scheme using a native fir species, *Cunninghamia lanceolata*, and has established more than 40 village nurseries. The seedlings are either given away or sold quite cheaply to local villagers. More than 180,000 firs were planted along the Chinese border in 1996 and over 1 million in 1997. The trees can be harvested for timber in 7 to 10 years. The KIO has also initiated negotiations with the SLORC to protect the headwaters of the Nmai Hka and other rivers from deforestation.

Source: Policy advisors to the KIO, July 1997 (personal communication).

Box 6. Deforestation and Wildlife Trade in Bhamo District

Timber. Logging of various kinds of wood, including teak, is rampant in the northern and eastern parts of Bhamo District adjacent to the Chinese border. Logging is carried out by local traders working with Chinese merchants. The trees are cut into logs of different lengths or sawn into rough planks that are carried to the Chinese border by mules. Large areas that were previously thickly forested have been cleared.

Flora. Chinese merchants are buying every variety of wild orchid found in these areas. People cut whole trees to get a few orchid plants, which contributes to further deforestation.

Rattan. Various species of wild rattan are extracted in this area. The rattan is transported by truck and mule to China, and by truck and train to Mandalay and Rangoon. Because of the economic dislocation and unemployment caused by many years of civil war, these natural resources are widely used as cash crops.

Wildlife. Tortoises and turtles, monkeys, various types of birds, otters, bears, snakes, tigers, deer, antelope, and other species are shipped to China from Shan State and Kachin State along the Mandalay-Lashio Road. According to eyewitness reports, three trucks, each loaded with rattan hiding 800 to 900 tortoises and turtles, crossed the border into China in November 1996. Apes are captured and shipped to China (where a young ape sells for Kyat 500) in quantities so large that no one keeps records. Elephants have also been captured or found shot.

Source: Unpublished report by independent Kachin sources, 1997.

6. The Role of the International Community

6.1 Conflicting Views of International Engagement

The National Coalition Government for the Union of Burma (NCGUB)—the provisional government in exile, composed of some of the members of parliament elected in 1990—has called on "international agencies and NGOs not to increase humanitarian assistance to Burma until substantial progress is made toward a transition to democracy. Under the SLORC's current restrictions on NGOs and international agencies, no assistance to the people of Burma can be delivered without indirectly supporting the SLORC's repressive policies.

Aung San Suu Kyi, leader of the National League for Democracy, has clearly stated her opposition to foreign involvement in conservation work in Burma under current political conditions (NCGUB, 1997a):

> I doubt under the present circumstances you can do anything very effectively in the way of conservation for two reasons. One is that under the kind of military regime that we have here you would not be allowed free access to all the people with whom you wish to work. The second is that the people of Burma are very poor and when people are poor they are not primarily concerned with conservation unless you can make them understand that it is in their own economic interests. You have to make people understand that conservation is not just for the purpose of creating a beautiful scenery for rich tourists to look at. It's about peoples' everyday lives in a country in which 80 percent of the population are rural.
>
> I doubt whether any project which is implemented through the SLORC is done with the consent of the people involved, the people who live on the land. Unless the people on the land are involved and unless they understand and are enthusiastic about the conservation project, I think it could lead to a lot of bitter feelings and misunderstanding.

These views are shared by the vast majority of the international community. Although FAO and UNDP support a few community forestry projects, there is currently no official bilateral assistance for forest or wildlife conservation in Burma. The New York-based Wildlife Conservation Society (WCS) is the only environmental NGO active in Burma. WCS has had to face the issue of the terms and conditions under which environmental NGOs operate, and the extent to which they share information with the democratic opposition and other stakeholders. After being accused of "turning a blind eye to atrocities committed against an irksome ethnic minority" (*The Observer*, 1997), WCS has adopted the practice of sharing its reports with representatives of the opposition.

Most environmental NGOs refuse to deal with the regime, and many work actively against foreign engagement. However, a few observers have argued that principled disengagement may not be in Burma's best interest in the long term. According to John MacKinnon of the Hong Kong-based Asian Bureau of Conservation: "International donor agencies should be more positive in assisting the government of Burma to undertake essential environmental programs rather than refrain because of political stances. Environmental boycott is not valid" (MacKinnon, 1996).

6.2 Limited Opportunities for International Engagement

In theory, opportunities for the international community to support forest management and biodiversity conservation in Burma exist at three levels: with communities at the local level, with the Forest Department at the national level, and through agreements to which Burma is a signatory at the international level.

Local Communities

A few humanitarian NGOs, such as World Vision, World Concern, and CARE, work directly with local communities in Burma. According to a staff member of one NGO that was considering (but decided against) extending its work to Burma:

> At the local level (villages and townships) the SLORC organizations may be long-standing and hold fairly legitimate leadership. After 1988 existing leadership at all administrative levels was given the title "Law and Order Restoration Council," but de-

pending on the local area they may or may not be SLORC-related. The same holds true for individuals in the professional departments of government offices. The trick is to determine which individual relationships are ethically healthy for the program to pursue.

In practice, NGO engagement at the community level has to be approved by the regional military commander. Provided this engagement is perceived by the military as nonpolitical, approval may be granted.

Similar opportunities may exist for environmental NGOs to engage local communities directly in conservation efforts. However, even if foreign support was approved by the military, and localized success achieved, there would be few opportunities for sharing results or broadening their impact because of the lack of government commitment for community-based forest management and the very small number of NGOs prepared to work in Burma.

Forest Department

Some foreign observers have been impressed by the sincerity and competence of the Forest Department staff. One way to engage the department, without channeling money through the regime, would be to support study tours and training abroad for professional staff to Laos or the Philippines, for example, where the governments have gone a long way toward encouraging community-based forest management. The Regional Community Forestry Training Center at Kasetsart University in Bangkok also offers training courses in participatory rural appraisal and other participatory methods. This would expose department staff, most of whom have been isolated from the international community for their entire professional careers, to new approaches to forest management. However, even if such training were offered, the department enjoys neither the funding nor political will to implement these approaches on a large scale.

International Agreements

The government is signatory to several binding international agreements including the Convention on Biological Diversity and the International Tropical Timber Agreement instituted by the ITTO. Signatories to the Convention on Biological Diversity commit to conservation and to the sustainable use of biological diversity; specifically they commit themselves to establishing national biodiversity strategies and integrating the sustainable use of biodiversity into other national sectoral policies through a participatory process to achieve conservation and biodiversity objectives. The International Tropical Timber Agreement was the first commodity agreement to include a conservation mandate. It also includes a nonbinding commitment for member countries to produce timber from sustainable sources by the year 2000.

Burma's signatory status to these agreements lends unearned legitimacy to the regime, without any evidence that it is adhering to the agreements. The human rights abuses allegedly associated with the creation of the Myinmoletkat Nature Reserve violate the Convention's commitment to participatory processes, while the export-import discrepancies documented by the ITTO suggest that even the basic requirement to report accurately on timber exports is not being respected. The international community could use these agreements to press for fundamental changes in the way the regime manages its forest resources.

7. Conclusions and Recommendations

A convergence of evidence suggests that a combination of logging and shifting cultivation is opening up large areas of intact forest along Burma's borders, with potentially quite damaging environmental consequences. Evidence from Thailand, Vietnam, and the Thai-Burmese border shows that extensive deforestation can result in massive soil erosion, reduced soil fertility and agricultural productivity, sedimentation of river channels, siltation of dams, catastrophic floods, and acute water shortages during the dry season.

The regime and the ethnic minorities that oppose it are currently locked in a "zero sum" game whereby the timber and other natural resources that are not extracted by one side may well be captured and exploited by the other. Distrust, rivalries, and jealousies among the various ethnic minorities continue to play into the SLORC's unwillingness to negotiate an end to Burma's historic internal conflicts. Yet it is ultimately the military regime's refusal to enter into meaningful peace negotiations that is the root cause of the uncontrolled logging, particularly in the border areas.

Unsustainable logging, as practiced by the regime and by some of the opposition ethnic groups, will not end until Burma's political and military conflicts are resolved. Such resolution is unlikely in the absence of a government that can attract broad popular support. Even if peace prevails, there is no guarantee that it will lead to improved environmental management. In fact, the arrival of predatory logging companies, combined with weak government enforcement, could trigger increased deforestation, as happened in Cambodia after the 1993 peace agreement. Nevertheless, most observers see the transition to a more participatory, accountable form of government as a necessary first step toward the effective conservation of Burma's forest resources. Such a move would also open the door to the international financial assistance that Burma needs to improve the human and physical infrastructure required to manage its extensive forests.

Under different political circumstances, our overriding recommendation to the international community would be that it should support the Ministry of Forestry to implement its own Forest Policy. Specific recommendations might include establishment of a national land-use advisory board to promote the careful consideration of short- and long-term forest land-use planning issues; improved management of logging concessions including the preparation of concession management plans that are specific and legally binding with respect to reporting on timber inventory, stocking, and volumes; and strengthening the Forest Department's capacity to implement the policy's community forestry provisions. The policy includes specific measures that could be used to track its implementation. International support could be tied to the satisfactory completion of these tasks.

In practice, however, this recommendation is meaningless because none of the preconditions for more rational forest management exists in Burma. The need to log at unsustainable levels, grossly inadequate human resources, high levels of corruption, and pervasive fear and intimidation severely limit the scope of meaningful foreign engagement. Indeed, the NLD and others have argued that under present conditions, engagement only legitimizes the regime.

Moreover, the situation remains volatile. Neither the absence of any evident external military threat, nor the signing of cease-fires with 17 of the 20 largest ethnic armies, many of which are just "gentlemen's agreements" with no provisions for political negotiations,[9] appear to presage any slowing of Rangoon's military build-up. According to the U.S. Department of Commerce, which advises U.S. companies on overseas investment: "The current high level of repression leaves no outlet for the widespread resentment among the populace against the military regime. Although tight repression means that immediate prospects for political disturbances appear low, the situation is inherently unstable and impossible to predict."

Even within the regime, uncertainty pervades. In November 1997, confronted by a growing economic crisis, the SLORC turned against itself. At least four generals were accused of corruption and imprisoned, including Minister of Forestry Chit Swe. All personal aides and senior staff members of the imprisoned generals are being questioned. These include the director generals of the departments that the former ministers were in charge of (NCGUB, 1997b).

In view of the lack of an opportunity for the international community to effectively engage the regime directly, we recommend that the international community support the measures that follow.

- *The international community should support projects and programs that shed light on what is happening on the ground.* Every year, the ITTO provides data on legal and illegal timber trade flows. There is, however, no systematic monitoring of Burma's forest cover. An independent, satellite-based forest monitoring system should be established to provide regular coverage of Burma's frontier forests. The system could build on the technical and scientific expertise, as well as the installed infrastructure, of existing programs such as the Landsat Pathfinder. A priority area for investigation is the Indian-Burmese border, where increased log exports have been reported. The timely completion of the Pathfinder analysis for 1993 would also help to substantiate the deforestation trends identified in this report.

- *Forest and other environmental issues should be included in the international dialogue about how to influence the regime and the course of events in Burma.* This report has shown that there are clear links between the political situation in Burma and unsustainable logging, particularly in the border areas. More consistent monitoring, as recommended above, will improve our understanding of how politics and logging are related. The international community should use the results of such a monitoring program to increase international pressure on the regime to move toward a more open and accountable political system.

- *The international community should take advantage of the Convention on Biological Diversity, the International Tropical Timber Agreement, and other intergovernmental processes to provide both information to, and to request information from, the regime about forest management and timber production in Burma.* The fact that Burma has signed these agreements provides a yardstick against which the regime's policies and practices can be judged. By the same token, the 1995 Forest Policy provides clear goals and guidelines to which the regime can, and should, be held accountable.

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Endnotes

1. This paper does not use the adopted name, "Myanmar," given to Burma by the State Law and Order Restoration Council in 1988. The name Burma is used in accordance with the Burmese National League for Democracy, the United States Government and many other countries, and leading publications including the *Washington Post, Bangkok Post, The Nation,* and *The Far Eastern Economic Review.*

2. For an in-depth analysis of the impact of SLORC policies on the health of the Burmese people, see Beyrer, Chris. 1998. *War in the Blood: Sex, Politics, and AIDS in Southeast Asia,* Zed Books, London.

3. Teak grows over a wide range of climatic conditions, but it grows best and reaches its largest dimensions in a tropical climate with a mean monthly maximum temperature of 40°C, a mean monthly minimum temperature of 13°C, rainfall between 900 and 1,300 mm per year, and a 3–5 month dry period (Kaosa-ard, 1989).

4. One Hoppus ton is equal to 50 cubic feet or 1.416 cubic meters.

5. Grades 1–4 sell for $15,000, $10,000, $4,000, and $3,000 per HT, respectively. Grades 5–8 are not trimmed and are used to produce sawnwood; they sell for between $2,000 and $800 per HT.

6. Following a Governing Council ruling in 1993, UNDP is only permitted to implement community-based projects in Burma. It is not permitted to fund large-scale infrastructure projects because these could potentially enhance the regime's legitimacy. This ruling was passed to protest the regime's human rights abuses.

7. Clear-cut is used here to indicate very high-volume logging, rather than complete deforestation.

8. Although Figure 6 only covers a sliver of Yunnan Province, the area shown indicates much greater deforestation at all three dates than in adjacent areas on the Burmese side of the border.

9. See, for example, a statement by the Mon National Council regarding the cease-fire agreement between the New Mon State Party (NMSP) and the SLORC: "After the cease-fire is in effect, the NMSP is not allowed to discuss nor even present political issues to the SLORC. Instead, the NMSP is allowed to present [only] business and border development projects."

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Appendix A. Technical Notes

A.1 Objectives of the Study

Pathfinder has been analyzing Landsat data from Southeast Asia to determine the rate of forest loss for the period from 1973 to 1993. Techniques have been developed that are generally applicable to the analysis of forest conversion and reforestation using Landsat data. In addition, Pathfinder has considerable experience on the ground in the region and has established several case study sites in various countries.

These techniques were applied to the analysis of deforestation in a study area covering south and central Kachin State from 1989 to 1996. These results were compared with the Pathfinder results for the same area using Landsat Multi-spectral Scanner (MSS) data for 1977 and 1979 (referred to here as 1978). This analysis provides a quantitative assessment of forest cover changes in the study area and a foundation for further research into the causes and dynamics of forest conversion in the region.

A.2 Image Acquisition

Landsat Thematic Mapper (TM) provides routine, high-resolution (30-m) coverage for the analysis of land cover change. These data can only be acquired from ground stations around the world because Landsat's onboard recording devices have not functioned for several years. Pathfinder acquires data routinely from the satellite receiving station in Bangkok under a special agreement with the National Research Council of Thailand. In January 1997, Pathfinder staff visited Bangkok to evaluate the images available for the study area. The best quality images for the most recent dry season (December 1996) were acquired. These were used in conjunction with images that Pathfinder already held for 1989 and 1992/1993 (referred to here as 1993). Table A.1 identifies the images used in the study.

A. 3 Geometric Rectification

The Landsat images were rectified to UTM coordinates and projection and coregistered using image-to-image rectification techniques. The rectification was performed until a minimum root mean squared error (RMSE) was obtained. Table A.2 provides the statistics on the RMSE associated with each image rectification. The average RMSE was less than one pixel. The output pixel size was 28.5 m.

Table A.1 Images Selected for This Study

Scene ID	Path/Row	Date Acquired
133042011689	133/42	January 16, 1989
133043011689	133/43	January 16, 1989
133042030893	133/42	March 8, 1993
133043040692	133/43	April 6, 1992
133042121396	133/42	December 13, 1996
133043121396	133/43	December 13, 1996

A.4 Image Classification

The images were classified using Erdas ISODATA, an iterative self-organizing, unsupervised classification routine. Four output classes were used: forest, nonforest, water, and clouds. ISODATA was run using Band 3 (red) and a new band: the ratio of Band 4 (near-infrared) to Band 3. Forty-five output clusters were specified. These clusters were then recoded into the four output classes. The results were visually inspected using vellum overlays on 1:250,000-scale photographic output to check for date-to-date consistency in phenology. The final classified images were then overlaid digitally, and image-to-image change detection was performed to calculate forest cover change throughout the study period. A cloud and water mask was applied to all images to eliminate areas in which clouds or water appear on any of the four dates.

A.5 Net vs. Gross Deforestation

Both net and gross forest loss were calculated.

Net Forest Loss (Including Regrowth)

Table A.3 shows net forest loss for 1978–1989, 1989–1993, and 1993–1996. These figures count as forest areas of secondary vegetation that regrew after being cleared at an earlier date. The average annual net forest

Table A.2 Image Coregistration Statistics

Scene ID	Rectified to:	Residuals, X/Y	RMSE[a]
133042011689	Data description record	0.000/0.000	0.000
133043011689	Data description record	0.000/0.000	0.000
133042030893	133042011689	0.748/0.507	0.904
133043040692	133043011689	0.466/0.772	0.902
133042121396	133042011689	0.424/0.417	0.595
133043121396	133043011689	0.520/0.565	0.768

Note: a. RMSE is root mean squared error.

loss for 1989–1993 is 30,987 ha per year, while the average loss for 1993–1996 is lower at 16,006 ha per year. However, the average net forest loss for 1978–1989 is significantly lower at 15,541 ha per year. Therefore, average annual net forest loss almost doubles between the 1980s and 1990s.

Gross Forest Loss (Excluding Regrowth)

Table A.4 shows gross forest loss for 1989–1993 and 1993–1996. These figures do *not* count as "forest" areas of regrowth that were classified as forest in the analysis of net change. Because original and secondary forests cannot be reliably discriminated by Landsat, the calculation of gross forest loss requires precise pixel-to-pixel registration to track changes between forest and nonforest over time. Because pixel-to-pixel registration was only possible using Landsat TM data, not the lower resolution Landsat MSS data, no gross forest loss figures are provided for 1978 to 1989.

The average annual gross forest loss for 1989–1993 is 44,146 ha per year and 52,902 ha per year for 1993–1996. These results are much higher than those based on net change because of significant regrowth in the study area. Moreover, the rate increases over the study period.

A.6 Logging vs. Shifting Cultivation

Fifty-seven of the large clearings in the 1.1 million-ha window shown in Figure 6 were inspected. Based on ancillary information, these are presumed to be caused by logging, not shifting cultivation or settlement. These clearings range in size from 17 ha to 128 ha, with an average of 38 ha, a median of 30 ha, and a standard deviation of 22 ha. Of the 57 clearings, 48 are between 17 ha and 50 ha. Small linear clearings associated with rivers and tracks were excluded from the analysis.

The total area cleared was then calculated for three size classes: 0.4 ha to 4 ha, 17 ha to 50 ha, and 50 ha to 128 ha. The 0.4-to-4-ha range captures 95 percent of the shifting cultivation fields observed to the west of the Nmai Hka. The 17-to-50-ha range captures 84 percent of the logged clearings, and the 50-to-128-ha range accounts for the remaining 16 percent. The results are shown in Table A.5.

Table A.3 Net Forest Loss

Forest and Nonforest Area (hectares)			Net Forest Loss (hectares per year)		
Forest Area	Nonforest Area	Year	Net Forest Loss	Average Annual Net Forest Loss	Period
4,294,165	432,810	1978	170,951	15,541	1978–89
4,123,214	602,434	1989	N/A	N/A	
4,014,758	710,890	1993	108,456	30,987	1989–93
3,958,736	766,911	1996	56,022	16,006	1993–96
			164,478	23,496	1989–96

Table A.4 Gross Forest Loss

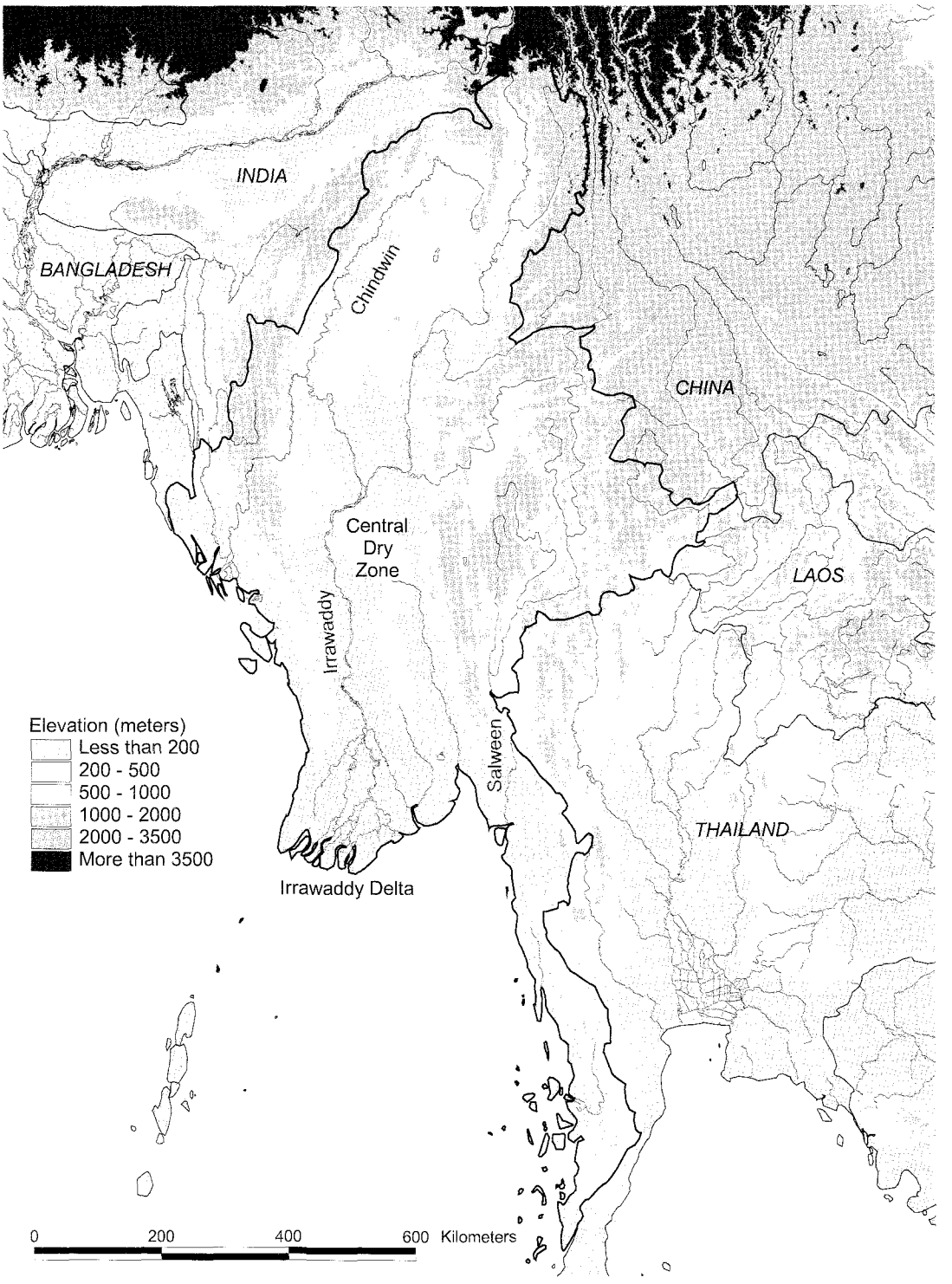
Forest and Nonforest Area (hectares)			Gross Forest Loss (hectares per year)		
Forest Area	Nonforest Area	Year	Gross Forest Loss	Average Annual Gross Forest Loss	Period
4,123,214	602,434	1989	N/A	N/A	
4,014,758	710,890	1993	154,510	44,146	1989–1993
3,958,736	766,911	1996	185,157	52,902	1993–1996
			339,667	48,524	1989–1996

Table A.5 Total Cleared Area by Size Class and Probable Cause

Total Cleared Area		Size Class	
(hectares)	(percent)	(hectares)	Probable Cause
6,668	66	0.4–4	Shifting cultivation
2,262	22	17–50	Logging (probable)
1,245	12	50–128	Logging (possible)

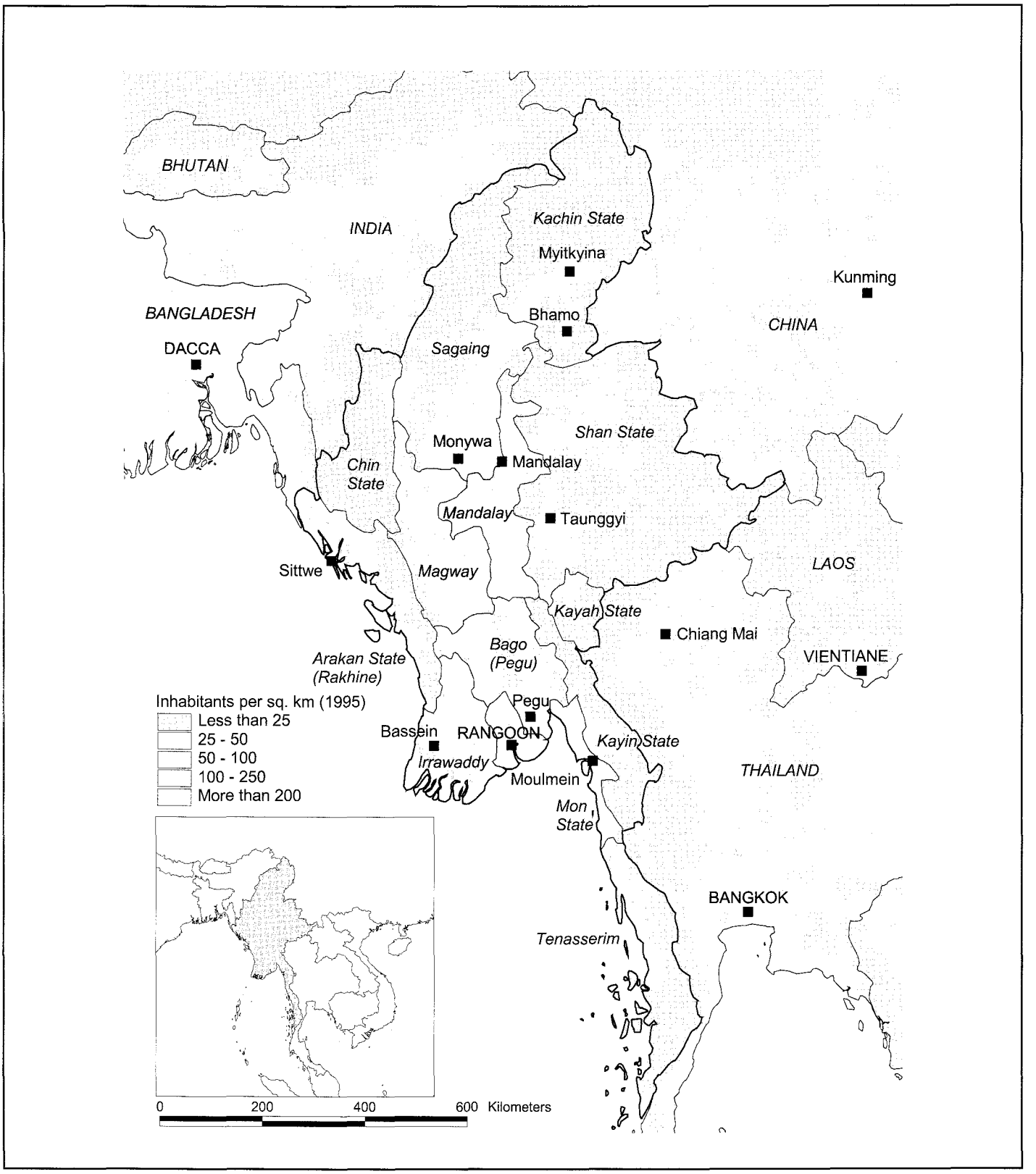
Appendix B. Maps

Figure 1. Physical Geography of Burma



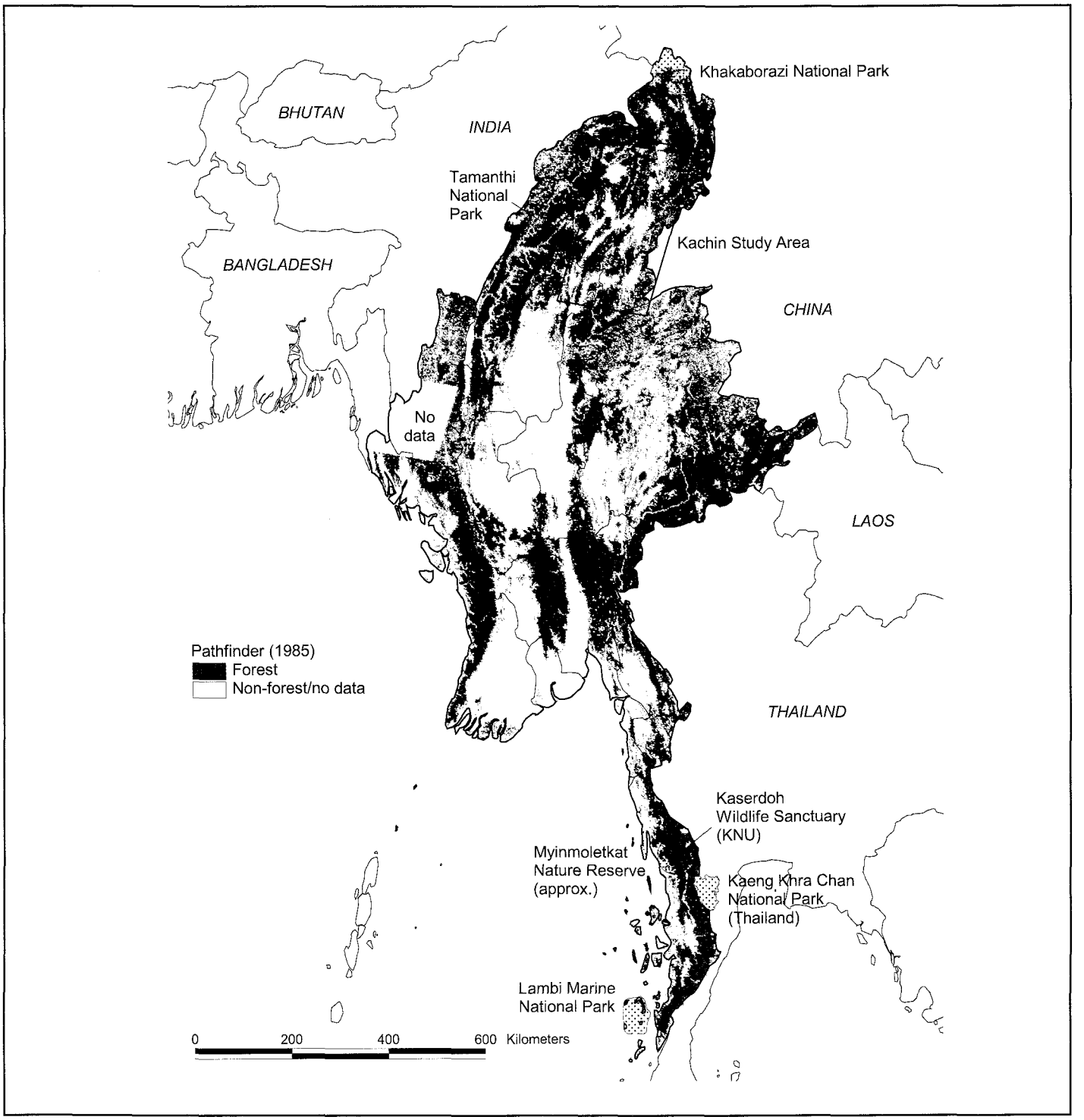
Source: United States Geological Survey/EROS Data Center. Evaluation data. Available online at http://grid2.cr.usgs.gov/dem/.

Figure 2. Population Distribution of Burma



Source: UNEP/GRID—Sioux Falls. Population data. Available online at http://grid2.cr.usgs.gov/globalpop/asia/.

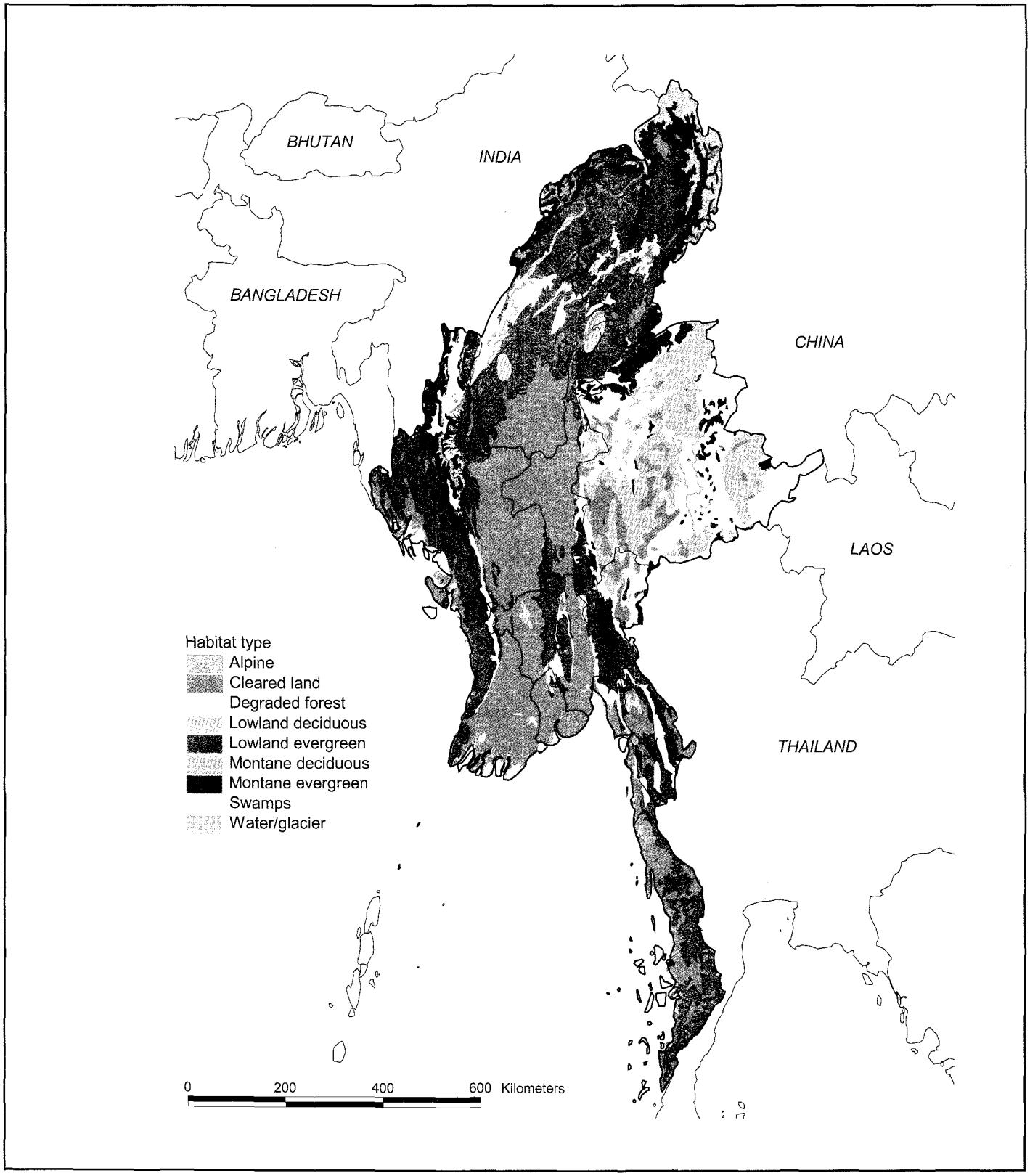
Figure 3. Forest Cover in Burma, 1985



Source: Landsat Pathfinder, University of New Hampshire.

Note: Pathfinder is a U.S. multiagency project that uses high-resolution Landsat data to map the world's tropical forests at three dates: 1973, 1985, and 1993. The 1973 and 1985 assessments used 57-m pixel Landsat Multi-spectral Scanner data. The 1993 assessment, which uses 30-m pixel Landsat Thematic Mapper data, is not complete. Further information is available online at http://www.pathfinder.sr.unh.edu.

Figure 4. Burma's Major Habitats



Source: Asian Bureau of Conservation in collaboration with the World Conservation Monitoring Centre (MacKinnon, 1996).

Figure 5. Kachin State Study Area

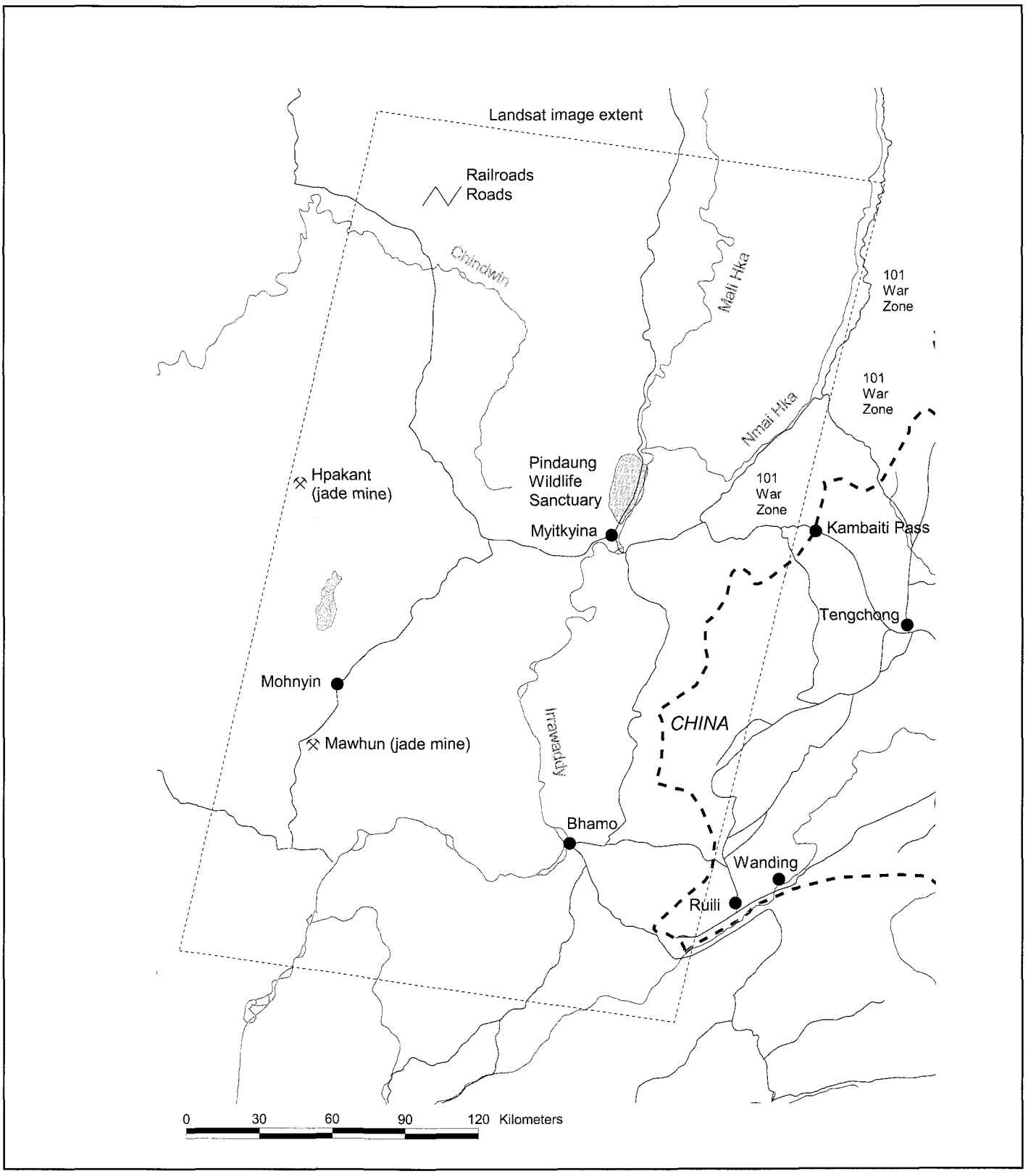
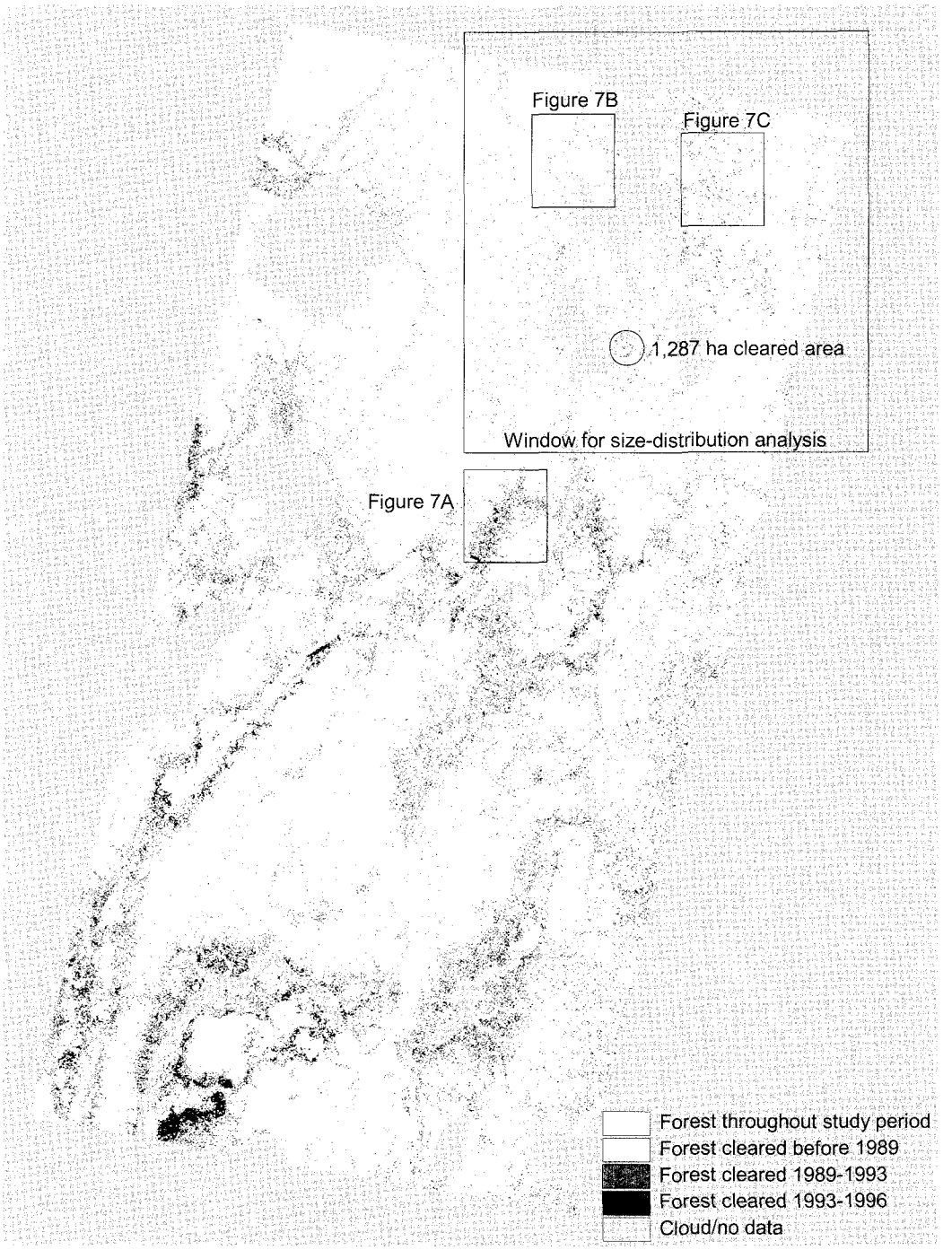
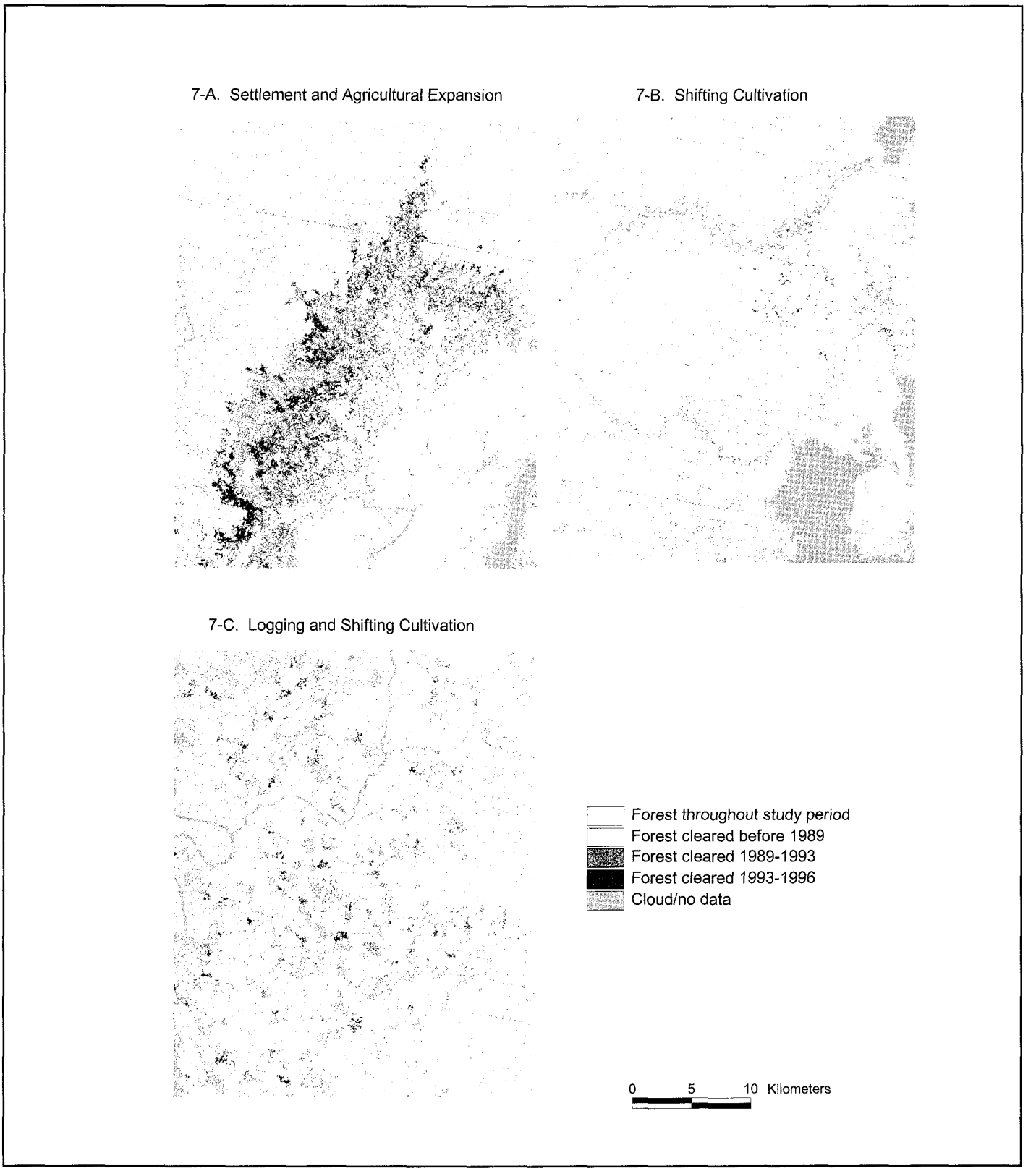


Figure 6. Cumulative Forest Clearing, Kachin State Study Area, 1989–1996



Source: Landsat Pathfinder, University of New Hampshire.

Figure 7. Patterns of Forest Clearing, Kachin State Study Area, 1989–1996



Source: Landsat Pathfinder, University of New Hampshire.

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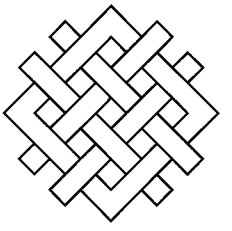

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